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SECTION 011000
SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work under separate contracts.
4. Access to site.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and drawing conventions.
8. Miscellaneous provisions.

B. Related Requirements:

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

1.3 PROJECT INFORMATION

A. Project Identification: Secure Entrance Renovation Project at Various Schools – Phase 2:

1. Ellis Elementary School, 222 South Central Avenue, Rockford, IL 61102.
2. Lewis Lemon Elementary School, 1993 Mulberry Street, Rockford, IL 61101.
3. RESA Middle School, 1800 Ogliby Road, Rockford, IL 61102.
4. Thurgood Marshall Middle School, 4664 North Rockton, Rockford, IL 61103.

B. Owner: Board of Education of Rockford School District No. 205, 501 Seventh Street, Rockford, Illinois 61104.

C. Architect: Richard L Johnson Associates, Inc., 4703 Charles Street, Rockford, IL 61108.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of the Project is defined by the Contract Documents and consists of Secure Entrance Renovation Work at Various Schools – Phase 2 for the Rockford Public School District #205.

B. Contractor is responsible for construction means, methods and sequencing. Architect will not have control over, be in charge of, or be responsible for construction means, methods, techniques, sequences, procedures or safety precautions and programs in connection with the Work, as these are solely within the responsibility of the Contractor. Architect shall not be responsible for the Contractor's failure to carry out the Work in accordance with the Contract Documents.

1.5 ACCESS TO SITE

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

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 storage of materials.

a. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

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

1.6 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.

1.7 WORK RESTRICTIONS

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

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

B. On-Site Work Hours: Normal business working hours will be 7:00 a.m. to 3:30 p.m., Monday through Friday. However, Contractor can work weekends and nights with prior notification to the Owner.

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

1. Notify Architect and Owner not less than two days in advance of proposed disruptive operations.

D. Nonsmoking Building: Smoking is not permitted within the building or anywhere on the site.

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

1.8 SPECIFICATION AND DRAWING CONVENTIONS

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

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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

C. Drawing Coordination: Requirements for materials and products identified on 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 published as part of the U.S. National CAD Standard and scheduled on Drawings.
3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

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

END OF SECTION 011000

SECTION 012500
SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

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

1.3 DEFINITIONS

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

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

1.4 ACTION SUBMITTALS

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

1. Substitution Request Form: Provide on Contractor’s letterhead.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

   a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
   b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.

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

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

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

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately 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.

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 MINOR CHANGES IN THE WORK

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

1.4 PROPOSAL REQUESTS

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

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request or 10 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

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

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

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule.

1.5 CHANGE ORDER PROCEDURES

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

B. The combined overhead and profit included in the total cost to the Owner for a change in the Work shall be based on the following schedule:

1. For the Contractor, for Work performed by the Contractor's own forces, twelve percent of the cost.
2. For the Contractor, for Work performed by the Subcontractor's, five percent of the amount due the Subcontractors.
3. For each Subcontractor involved, for Work performed by the Subcontractor's own forces, five percent of the cost.
4. For each Subcontractor involved, for Work performed by the Subcontractor's Sub-subcontractors, five percent of the amount due the Sub-subcontractor.
5. In order to facilitate checking of quotations for extras and credits, all proposals, except those so minor that their propriety can be seen by inspection, shall be accompanied by a complete itemization of costs including labor, materials and Subcontracts. Labor and materials shall be itemized in the manner prescribed above. Where major cost items are Subcontracts, they shall be itemized also.

1.6 CONSTRUCTION CHANGE DIRECTIVE

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

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

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

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

END OF SECTION 012600

SECTION 012900
PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

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

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

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

2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.

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

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

   a. Project name and location.
   b. Name of Architect.
   c. Architect's project number.
   d. Contractor's name and address.
   e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

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

6. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

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

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

1.5 APPLICATIONS FOR PAYMENT

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

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

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

C. Payment Application Times: Submit Application for Payment to Architect by the 10th of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

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

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

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

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

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

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

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

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

1. List of subcontractors.
2. Schedule of values.
3. Contractor's construction schedule (preliminary if not final).
4. Submittal schedule (preliminary if not final).
5. List of Contractor's staff assignments.
6. List of Contractor's principal consultants.
7. Copies of building permits.
8. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
9. Initial progress report.
10. Certificates of insurance and insurance policies.
11. Performance and payment bonds.

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

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

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

1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
4. AIA Document G706-1994, "Contractor's Affidavit of Payment of Debts and Claims."
5. AIA Document G706A-1994, "Contractor's Affidavit of Release of Liens."
6. AIA Document G707-1994, "Consent of Surety to Final Payment."

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

END OF SECTION 012900

SECTION 013100
PROJECT MANAGEMENT & COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Coordination drawings.
2. Requests for Information (RFIs).
3. Project meetings.

B. Related Requirements:

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

1.3 DEFINITIONS

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

1.4 INFORMATIONAL SUBMITTALS

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

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

1.5 GENERAL COORDINATION PROCEDURES

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

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

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

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

1.6 COORDINATION DRAWINGS

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

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

a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
b. Coordinate the addition of trade-specific information to the coordination drawings by multiple contractors in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.

1.7 REQUESTS FOR INFORMATION (RFIs)

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

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

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

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

C. RFI Forms: AIA Document G716.

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

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

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

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

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

1.8 PROJECT MEETINGS

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

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.

2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, and Architect, within three days of the meeting.

B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect.

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

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

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

C. Progress Meetings: General Contractor to conduct progress meetings at weekly intervals.

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

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

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

      1) Review schedule for next period.

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

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

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

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

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

END OF SECTION 013100

SECTION 013300
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

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."

1.4 ACTION SUBMITTALS

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

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

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

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

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

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

1. Initial Review: Allow 5 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
3. Resubmittal Review: Allow 15 days for review of each resubmittal.

C. Paper Submittals: Place a permanent label or title block on each submittal item for identification.

1. Indicate name of firm or entity that prepared each submittal on label or title block.
2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
3. Include the following information for processing and recording action taken:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Name of subcontractor.
    f. Name of supplier.
    g. Name of manufacturer.
    h. Submittal number or other unique identifier, including revision identifier.

        1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

    i. Number and title of appropriate Specification Section.
    j. Drawing number and detail references, as appropriate.
    k. Location(s) where product is to be installed, as appropriate.
    l. Other necessary identification.

4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.

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

5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return without review submittals received from sources other than Contractor.

   a. Transmittal Form for Paper Submittals: Provide locations on form for the following information:

      1) Project name.
      2) Date.
      3) Destination (To:).
      4) Source (From:).
      5) Name and address of Architect.
      6) Name of Contractor.
      7) Name of firm or entity that prepared submittal.
      8) Names of subcontractor, manufacturer, and supplier.
      9) Category and type of submittal.
      10) Submittal purpose and description.
      11) Specification Section number and title.
      12) Specification paragraph number or drawing designation and generic name for each of multiple items.
      13) Drawing number and detail references, as appropriate.
      14) Indication of full or partial submittal.
      15) Transmittal number, numbered consecutively.
      16) Submittal and transmittal distribution record.
      17) Remarks.
      18) Signature of transmitter.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

   1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

A. General Submittal Procedure Requirements:

   1. Submit electronic submittals via email as PDF electronic files.

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

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

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

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

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

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

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

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

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

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

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

2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm), but no larger than 30 by 42 inches (750 by 1067 mm).
3. Submit Shop Drawings in the following format:

a. PDF electronic file.
b. Two opaque (bond) copies of each submittal. Architect will return one copy.

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

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

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

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

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

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

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

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

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

1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

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

1. Submit product schedule in the following format:

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

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

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

H. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

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

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

K. 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.

L. 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.

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

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

O. Schedule of Test and Inspections: Comply with requirements specified in Section 014000 “Quality Requirements”.

P. 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.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

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

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

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

3.2 ARCHITECT'S ACTION

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

B. Action Submittals: Architect’s review is performed to determine general conformance with the design concept set forth in the Contract Documents. Review does not relieve Contractor of sole responsibility for means, methods, sequencing, scheduling of work, verification of quantities and dimensions or the performance of the work in a safe manner. No comments on the shop drawings will relieve the Contractor from performing the work in a manner consistent with the Contract Documents. Architect’s review will indicate action mark as follows:

1. Reviewed.
2. Note Comments.
3. Rejected.
4. Not reviewed/Outside scope of Services.
5. Resubmit After Required General Contractor Review.
6. Revise.
7. Resubmit.

C. Subcontractors are not to use shop drawings and submittals to ask questions or request information. All questions must be asked through the RFI.

D. Architect is not responsible for correcting errors in the shop drawings or submittals.

E. 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.

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

G. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 013300

SECTION 014200
REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

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

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 the following list:

1. AA – Aluminum Association (The).
2. AIA - American Institute of Architects (The); www.aia.org.
3. AISC - American Institute of Steel Construction; www.aisc.org.
4. AISI - American Iron and Steel Institute; www.steel.org.
5. ANSI - American National Standards Institute; www.ansi.org.
6. ASTM - ASTM International; www.astm.org.
7. AWPA - American Wood Protection Association; www.awpa.com.
8. CSI - Construction Specifications Institute (The); www.csinet.org.
9. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
10. DHI - Door and Hardware Institute; www.dhi.org.
11. GANA - Glass Association of North America; www.glasswebsite.com.
12. ICBO - International Conference of Building Officials; (See ICC).
13. ICC - International Code Council; www.iccsafe.org.
14. IGMA - Insulating Glass Manufacturers Alliance; www.igmaonline.org.
15. NFPA - National Fire Protection Association; www.nfpa.org.
16. NFPA - NFPA International; (See NFPA).
17. NFRC - National Fenestration Rating Council; www.nfrc.org.
18. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
19. SPIB - Southern Pine Inspection Bureau; www.spib.org.
20. UL - Underwriters Laboratories Inc.; www.ul.com.
21. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
22. WDMA - Window & Door Manufacturers Association; www.wdma.com.
23. WWPA - Western Wood Products Association; www.wwpa.org.

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

1. ICC - International Code Council; www.iccsafe.org.
2. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

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

1. CPSC - Consumer Product Safety Commission; www.cpsc.gov.
2. DOC - Department of Commerce; National Institute of Standards and Technology; www.nist.gov.
3. DOE - Department of Energy; www.energy.gov.
4. EPA - Environmental Protection Agency; www.epa.gov.
5. FG - Federal Government Publications; www.gpo.gov.
6. LBL - Lawrence Berkeley National Laboratory; Environmental Energy Technologies Division; www.eetd.lbl.gov.
7. OSHA - Occupational Safety & Health Administration; www.osha.gov.

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

1. FED-STD - Federal Standard; (See FS).

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

END OF SECTION 014200

SECTION 015000
TEMPORARY FACILITIES & CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

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

1.3 USE CHARGES

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

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

1.4 INFORMATIONAL SUBMITTALS

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

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

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

1. Store combustible materials apart from building.

B. Portable Toilet Facilities - All Contractors can use the existing toilet rooms in the building except for at Ellis Elementary School. Contractor shall provide a portable toilet facility at this school.

C. Contractor to provide proper temporary dust barriers between the construction area and the rest of the school.

D. For Ellis, provide chain link construction fencing around construction area.

2.2 EQUIPMENT

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

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

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

3.2 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

1. Provide sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.

B. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

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

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

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

E. Temporary Elevator Use if Available: Use of existing elevators is permitted.

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

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

3.3 SECURITY AND PROTECTION FACILITIES INSTALLATION

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

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

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

END OF SECTION 015000

SECTION 016000
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Related Requirements:

1. Section 014200 "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

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

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

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

1.4 ACTION SUBMITTALS

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

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

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

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

1.5 QUALITY ASSURANCE

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

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

B. Delivery and Handling:

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

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.

3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.

1.7 PRODUCT WARRANTIES

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

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

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

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

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

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

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

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

6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

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

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

4. Manufacturers:

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

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

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

2.2 COMPARABLE PRODUCTS

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

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

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300
EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

B. Related Requirements:

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

1.3 DEFINITIONS

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

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

1.4 QUALITY ASSURANCE

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

1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection

   a. Refer to Unit Specifications.

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

PART 2 - PRODUCTS

2.1 MATERIALS

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

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. 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 walls for suitable conditions where products and systems are to be installed.
2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

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

3.2 PREPARATION

A. 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.

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

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

3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

3.4 INSTALLATION

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

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.

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

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

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

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

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

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

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

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages.

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

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

3.5 CUTTING AND PATCHING

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

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

B. 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 according to requirements in Section 011000 "Summary."

E. 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. Proceed with patching after construction operations requiring cutting are complete.

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

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
3. Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

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

4. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

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

3.6 PROGRESS AND FINAL CLEANING

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

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
3. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
4. Contractor shall provide final cleaning of all new glass and aluminum window frames.

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

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

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

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

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

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

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

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

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

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

K. Provide final cleaning of all disturbed areas. Clean all glass and frames.

3.7 STARTING AND ADJUSTING

A. Confirm proper operation of components. Remove malfunctioning units, replace with new units and retest.

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

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

3.8 PROTECTION OF INSTALLED CONSTRUCTION

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

END OF SECTION 017300

SECTION 017419
CONSTRUCTION WASTE MANAGEMENT & DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Disposing of nonhazardous construction waste.

1.3 DEFINITIONS

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

B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
2. Provide plywood under the wheels of the dumpsters.

B. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

3.2 DISPOSAL OF WASTE

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

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

B. Burning: Do not burn waste materials.

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

END OF SECTION 017419

SECTION 017700
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

B. Related Requirements:

1. Section 017300 "Execution" for progress cleaning of Project site.
2. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.

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

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

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 SUBSTANTIAL COMPLETION PROCEDURES

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

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

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

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. Perform preventive maintenance on equipment used prior to Substantial Completion.
3. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
4. Participate with Owner in conducting inspection and walkthrough.
5. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
6. Complete final cleaning requirements, including touchup painting.
7. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

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

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

1.7 FINAL COMPLETION PROCEDURES

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

1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.

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

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

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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

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

   a. MS Excel electronic file. Architect, will return annotated file.
   b. Three paper copies. Architect will return two copies.

1.9 SUBMITTAL OF PROJECT WARRANTIES

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

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

1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch (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.
4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1.10 ELECTRONIC CLOSEOUT DOCUMENTATION

A. General: Provide a complete project Closeout Documentation Package in electronic format. This package shall include:

1. Project Record Documents.
2. Approved submittals.
3. Operation and Maintenance Manuals.
4. Warranties.
5. Project Contact Directory.

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, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
b. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.

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.
f. Sweep concrete floors broom clean in unoccupied spaces.
g. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
h. Clean transparent materials, including and in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish glass, taking care not to scratch surfaces.
i. Remove labels that are not permanent.
j. Leave Project clean and ready for occupancy.

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

3.2 REPAIR OF THE WORK

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

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

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

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

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

END OF SECTION 017700

SECTION 017839
PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

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

B. Related Requirements:

1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set of marked-up record prints.
2. Number of Copies: Submit copies of record Drawings as follows:

a. Initial Submittal:

1) Submit one paper-copy set(s) of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and one of file prints.
3) Submit record digital data files and one set of plots.
4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit three paper-copy sets of marked-up record prints.
2) Submit PDF electronic files of scanned record prints and three sets of prints.
3) Print each drawing, whether or not changes and additional information were recorded.

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

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

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

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

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

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

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.

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

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

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

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

2.2 RECORD SPECIFICATIONS

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

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.

2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as scanned PDF electronic file(s) of marked-up paper copy of Specifications.

2.3 RECORD PRODUCT DATA

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

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

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

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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

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

END OF SECTION 017839

DIVISION 02 – SITE CONSTRUCTION

SECTION 024119
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.

B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 017300 "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

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

B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse or store as instructed by Architect.

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.

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

1.4 MATERIALS OWNERSHIP

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

1.5 FIELD CONDITIONS

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

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

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

D. Hazardous Materials:

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

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

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

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

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

B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. 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.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

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

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. Owner will arrange to shut off indicated services/systems when requested by Contractor.
2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

3.3 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. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
3. Cover and protect furniture, furnishings, and equipment that have not been removed.

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.

3.4 SELECTIVE DEMOLITION, GENERAL

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

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. 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 2 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 in Section 017419 "Construction Waste Management and Disposal."

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

C. Removed and Salvaged Items (When requested by Architect):

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area on-site designated by Owner.
5. Protect items from damage during transport and storage.

D. Removed and Reinstalled Items (When requested by Architect):

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, cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. 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.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and dispose of them according to Section 017419 "Construction Waste Management and Disposal."

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

B. Burning: Do not burn demolished materials.

3.7 CLEANING

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

END OF SECTION 024119

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Cast-in-place concrete slab-on-grade including formwork, reinforcement, concrete materials, mixture design, placement procedures and finishes.
2. Concrete stoops.
3. Concrete foundations.
4. Concrete sidewalks.

B. Related Requirements:

1. Section 024119 "Selective Demolition" for removal of existing floor materials.
2. Section 096813 "Carpet Tile" for carpet floor covering.

1.3 DEFINITIONS

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

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

1.4 SUBMITTALS

A. Process all submittals per requirements in Section 013300 – Submittal Procedures.

B. Shop Drawings: Submit Shop Drawings pertaining to fabrication, bending and placement of concrete reinforcements.

1. Comply with the ACI 315 “Manual of Standard Practice for Detailing Reinforced Concrete Structures.”
2. Show bar schedules, diagrams of bent bars, and arrangements of concrete reinforcement. Include special reinforcement required at openings through concrete structures.

C. Test Reports: Submit 3 copies of laboratory test reports for concrete materials and mix design tests including potential for alkali-silica reaction (ASR).

D. Product Data: Submit manufacturer's data on fiber reinforcement, additives, curing agents, sealers, grouts, joint materials and similar pre-manufactured products.

E. Certificates: Submit purchase receipt verifying grade and quantity of under-slab vapor barrier.

F. Concrete Truck Delivery Tickets: Submit delivery tickets indicating:

1. Delivery date and time dispatched.
2. Name and location of project.
3. Name of Contractor.
4. Name of ready-mixed concrete producer.
5. Truck number.
6. Number of cubic yards of concrete in load.
7. Class of concrete.
8. Cement content in bags per cubic yard of concrete.
9. Type and brand name of cement.
10. Names and quantities of admixtures used.
11. Maximum size of aggregate.
12. Amount of water added at job, if any, and who authorized the addition.

1.5 QUALITY ASSURANCE

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

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

C. Cooperate with other trades regarding installation of embedded items. Obtain templates, dimension, instructions, etc., from other trades or other contractors as required for setting items in concrete work.

D. Comply with the latest edition of each of the following:

1. "Building Code Requirements for Reinforced Concrete" (ACI 318).
2. "Specifications for Ready Mixed Concrete" (ASTM C 94).
3. "Guide to Concrete Floor and Slab Construction" (ACI 302.1).
4. "Recommended Practice for Hot Weather Concreting" (ACI 305).
5. "Recommended Practice for Winter Concreting" (ACI 306).
6. "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete" (ACI 304).
7. "Specifications for Structural Concrete for Buildings" (ACI 301).

E. Inform personnel that may be working with concrete as to requirements and the availability of ACI 301.

F. Provide protection during the construction period for concrete pad, from oil, grease, stains, discoloration and other physical damage.

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

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

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

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

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

1. ACI 301.
2. ACI 117.

2.2 FORM MATERIALS

A. Form Facings for Unexposed Concrete: Plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

B. Form Coatings: Commercial formulation intended for form coating which will not bond with, stain, or adversely affect concrete surfaces, and which will not impair bond or adhesion of subsequent treatments nor impede wetting of surfaces to be cured with water or curing compound.

C. Form Ties:

1. 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.

2. Configured so as to leave no metal closer than 1" to the surface of the concrete.

2.3 STEEL REINFORCEMENT

A. Materials

1. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
2. Tie Wire: Cold drawn steel wire meeting ASTM A 82.
3. Welded Wire Fabric: Per ASTM A 185.
4. Reinforcing Bar Holders: Galvanized or plastic coated when within 3/4" of exposed concrete surface.

B. Fabrication:

1. No lapped splices for tension and compression bars unless noted on the Drawings or approved. Locate splices in temperature bars so that no more than half the bars are spliced at any point. Lap splices 36 diameters.
2. Label bars to identify grade of steel and to facilitate placing.

C. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.

2.4 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I for normal and Type III for high-early-strength.

B. Mixing Water: Fresh, free of oil, acid, alkalis, salts, organic matter and potable.

C. Aggregates: Per ASTM C 33, including freedom from potentially reactive constituents, as well as soft, thin elongated or laminated pieces, disintegrated stone, plant matter, trash and lumps of frozen or partly cemented material.

1. ASR Tested: Per ASTM C 1260. Submit test results.
2. Fine Aggregate: Natural hard, clean sand.
3. Coarse Aggregate: Gravel or crushed rock.

   a. Size 57 (1-1/2" top size) for structural elements 6" or more in thickness.
   b. Size 67 (3/4" top size) for slabs.

4. Furnish 3 copies of testing laboratory reports showing sieve analysis.

D. Admixtures:

1. Air-Entraining Admixture: Per ASTM C 260. Use one of the following:

   a. “Darex AEA” by W.R. Grace.
   b. “Sika AER” by Sika Chemical Corp.
   c. “MB-VR” by Master Builders Co.

2. Water-Reducing Admixtures: Per ASTM C 494; one of the following:

   a. “Pozzolith” by Master Builders Company.
   b. “Plast-o-Crete” by Sika Chemical Co.
   c. “WRDA” by W.R. Grace.

3. Calcium Chloride: Shall NOT be used. Neither calcium chloride nor admixtures containing chloride salts shall be added to concrete.

2.5 ACCESSORY MATERIALS

A. Curing Materials:

1. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., conforming to AASHO M 182, Class 3.
2. Moisture-Retaining Cover: Waterproof paper, polyethylene film or polyethylene coated burlap conforming to ASTM C 171.
3. Curing Compound: Liquid, membrane forming compound conforming to ASTM C 309, Type 1, with fugitive dye, and guaranteed to not affect the bond, adhesion or effectiveness of floor hardeners or other applied finishes or surface treatments. Product shall be one of the following:

   a. “Masterseal” by Master Builder’s Co.
   b. “Kure-N-Seal” by Sonneborn.
   c. “Sika-Gard C/H” by Sika Chemical Co.
   d. “CS-309” by W.R. Meadows.
   e. “Clearbond” by Guardian Chemical Co.
   f. “Resi Chem Clear Cure” by Symons Corp.

B. Dovetail Inserts: Sheet metal inserts conforming to ASTM A1008 and galvanized per ASTM A653 Class G60 (0.6oz/ft2):

1. “Dovetail Anchor Slots: Hot dipped galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.6 PROPORTIONING AND DESIGN OF MIXES

A. Use an independent testing facility experienced in concrete mix design and acceptable to Owner for preparation of proposed mix designs. The testing facility shall not be the same used for field quality control testing unless otherwise acceptable to Owner.

B. Allow a minimum of 14 days prior to placing concrete for testing laboratory to design the mix for each type of concrete required.

C. The adequacy of the design mix shall be verified by tests on a minimum of 6 cylinders; 3 tested at least 7 days and 3 at 28 days in accordance with ASTM C 192 and C 39 and by slump tests in accordance with ASTM C 143.

D. Submit 3 copies of the mix design and test results to Owner's Representative for review before any concrete is placed.

E. Concrete for interior concrete pad shall have a maximum water-cement ratio of 6-1/2 gallons per bag and shall maintain a slump no greater than 4". Refer to drawings for compressive strength.

F. Calcium chloride or admixtures containing chloride salts shall not be used.

G. All concrete to be 4,000 psi.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Mix and transport in accordance with ASTM C 94, “Specification for Ready-Mixed Concrete” and the established mix design.

B. Batch mixing at the site will not be allowed except on prior approval

C. Use admixtures only as specified in the established mix design.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347.

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

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

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

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

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

3.2 REMOVING AND REUSING FORMS

A. General: Formwork for sides of concrete work, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

3.3 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

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

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

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

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

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

3.4 JOINTS

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

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

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

3.5 CONCRETE PLACEMENT

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

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

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

D. Deposit concrete continuously in one layer of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layer of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

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

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

3.6 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

3.7 FINISHING CONCRETE WORK

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

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish.

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

1. Apply a trowel finish to surfaces exposed to view.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
3. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft. long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch.

3.8 CONCRETE PROTECTING AND CURING

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

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

C. Formed Surfaces: Cure formed concrete surface. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed pad surface.

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

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

a. Water.

b. Continuous water-fog spray.

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

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.9 JOINT FILLING

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

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

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

3.10 FIELD QUALITY CONTROL

A. Cooperate with the laboratory in every respect by arranging material for sampling and supplying necessary facilities at the job site for making the field tests and storing specimens.

B. Tests shall be made for each 50 cubic yards of concrete or fraction thereof, but not less than 2 for each day’s pour. Perform the following tests:

1. Compression Test: Make a minimum of 3 standard 6"x12" cylinders for testing, one at the age of 7 days, and one for testing at 28 days, unless otherwise directed. If compression tests are to be used for determining when forms may be removed, make at least 2 additional cylinders and cure on job site in accordance with ASTM C 31.
2. Tests for Air-Entrainment: Per ASTM C 231, on a random basis, as determined by the Owner's Representative.
3. Slump Test: Per ASTM C 143. Contractor shall provide cone and make tests whenever requested by Owner's Representative. Test each and every truckload. 1/2" tolerance allowed each way.
4. Additional Tests: If, in the opinion of the Owner's Representative there is any question as to the quality of the concrete already placed, make additional tests as directed. Tests may be either compression tests on cored cylinders, per ASTM C 42; or load tests as outlined in ACI 318; or as directed. These tests shall be paid for by the Contractor.

C. Evaluation of Tests: In accordance with ACI 214-83.

D. Test Reports: Furnish for all tests. Report must show exact location of work represented by samples and tests.

END OF SECTION 033000

SECTION 051200
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. SUMMARY

1. Structural steel.
2. Field-installed shear connectors.
3. Grout.

C. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
3. Section 099113 "Painting" for surface-preparation and priming requirements.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Mill test reports for structural steel, including chemical and physical properties.

C. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

D. Survey of existing conditions.

E. Source quality-control reports.

F. Field quality-control reports.

1.6 QUALITY ASSURANCE

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

B. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 360.
3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

B. Moment Connections: Type PR, partially restrained.

C. Construction: Moment frame.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50 (345).

E. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.

F. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.

G. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.

1. Weight Class: As noted on drawings.
2. Finish: Black except where indicated to be galvanized.

H. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.

I. Steel Forgings: ASTM A 668/A 668M.

J. Welding Electrodes: As noted on drawings.

K. Where fire proofing is called for on the drawings, omit the prime painting of the steel.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 490 (ASTM A 490M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH, (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers with plain finish.

C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip or mechanically deposited zinc coating.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

F. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Straight and Hooked.
2. Nuts: ASTM A 563 (ASTM A 563M) -]hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
5. Finish: Plain .

G. Headed Anchor Rods: ASTM F 1554, Grade 36.

1. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436 (ASTM F 436M), Type 1, hardened carbon steel.
4. Finish: Plain.

H. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 (ASTM A 563M) hex carbon steel.
2. Washers: ASTM A 36/A 36M carbon steel.
3. Finish: Plain .

I. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

J. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.4 PRIMER

A. Primer: Comply with Section 099113 "Painting"

B. Primer: SSPC-Paint 25, Type I, zinc oxide, alkyd, linseed oil primer.

C. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

D. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.5 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches (50 mm).
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Surfaces enclosed in interior construction.
7. Surfaces to receive fireproofing. See code plan on architectural drawings for locations.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

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

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

END OF SECTION 051200

SECTION 053100
STEEL DECKING

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 roof deck.
2. Accessories and closures.
3. Fabrication of openings in metal deck not shown on Drawings but required by other trades.
4. Reinforcement of small openings in metal deck

B. Related Requirements:

1. Section 051200 "Structural Steel Framing" for deck bearing.
2. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

B. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.2 ROOF DECK

A. Acceptable Manufacturers:

1. Bowman/E.G. Smith, Div. Cyclops Corp.
2. Epic Metals Corp.
3. Roll Form Products, Inc.
4. United Steel Decking, Inc.
5. Vulcraft/Div. Nucor Corp.
6. Cordeck

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Steel for Galvanized Metal Deck Units: ASTM A653/A653M, Structural Quality Grade SS33. Galvanizing shall conform to ASTM A924/A924M with a minimum coating class of G30 (Z090) as defined in ASTM A6563/A653M.
2. Deck Profile: As indicated on drawings.
3. Profile Depth: As indicated on drawings.
4. Design Uncoated-Steel Thickness: As indicated on drawings.
5. Span Condition: Three span, u.n.o. on drawings.
6. Side Laps: Overlapped or interlocking seam at Contractor's option.

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch minimum thick, with factory-punched hole of 3/8-inch minimum diameter.

G. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions 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, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 12 inches apart in the field of roof and 6 inches apart in roof corners and perimeter, and as indicated on drawings, based on roof-area definitions in FMG Loss Prevention Data Sheet 1-28.
3. Weld Washers: Install weld washers at each weld location.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 18 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

D. Miscellaneous Roof-Deck Accessories: Install finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.5 PROTECTION

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

PART 4 - END OF SECTION 053100

SECTION 054000
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 Division 01 Specification Sections, apply to this Section.

B. SUMMARY

1. Cold formed metal framing and accessories.

C. Related Requirements:

1. Section 051200 "Structural Steel Framing" for structural steel framing.
2. Section 061000 "Carpentry Work" for plywood sheathing and weather barrier.
3. Section 074213 "Formed Metal Wall Panel" for metal fascia.
4. Section 076200 "Sheet Metal Work" for metal coping.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

1.3 SUBMITTALS

A. Product Data: Provide shop drawings prepared by cold-formed metal framing manufacturer. Submit manufacturer's data for all steel stud framing items required, showing pertinent features.

B. Shop Drawings: Submit details of construction for Architect's review. Include design assumptions and calculations for loads and stresses.

C. Shop drawings shall be sealed by a Licensed Structural Engineer in the State of Illinois.

1.4 QUALITY ASSURANCE

A. Fabricator's Qualifications: Minimum of 5 years' satisfactory experience producing items of like quality and type.

B. Component and System Design:

1. Design wall framing to the requirements of 2015 IBC, based on a uniformly distributed wind load of 30 psf, positive and negative pressure, with maximum allowable deflection of 1/600 span. When heads of studs will not be completely restrained, as at some deflection heads, do not use manufacturer's load tables but select stud size and gauge based on calculation of actual deflection resulting from the less-than-ideal stability of the top of the stud. Include for concentrated axial loads created by window weights.
2. Compute structural properties of studs in accordance with AISI "Specifications for the Design of Cold-Form Steel Structural Members" and AWCI (Association of Wall and Ceiling Industries) requirements, the more stringent requirement governing in case of differences.
3. Design the wall system to accommodate seasonal or cyclical day/night temperature variations without noise, damage, failure of joint seals, undue stress on fasteners, or other detrimental effects.
4. Design the system to accommodate construction tolerances and deflection of building structures.

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

1. Qualify welding processes and welding operators in accordance with the AWS "Standard Qualifications Procedure."
2. Submit to the Architect, upon request, current certifications that welders employed on the site have passed all required AWS qualification tests within the previous 12 months.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect and store metal framing units from rusting and damage in accordance with A.I.S.I.'s "Code of Standard Practice".

PART 2 - PRODUCTS

2.1 MATERIALS

A. Acceptable Manufacturer: One of the following:

1. Aegis Metal Framing.
2. ClarkDietrich Industries, Inc.
3. MarinoWare.
4. MRI Steel Framing.

2.2 Studs: Sheet Steel per ASTM A 653, and A 1003/A 1003M gauges as shown on Drawings but not less than 18-gauge, galvanized finish minimum G-60 coating.

1. Steel Grade:

a. 33-ksi minimum for 18 ga. and lighted members.
b. 50-ksi for 16 ga and heavier members.

2. Minimum uncoated steel thicknesses:

   a. 18-gauge .0428" (yellow)
   b. 16-gauge .0538" (green)
   c. 14-gauge .0677" (orange)
   d. 12-gauge .0966" (red)

B. Track and Accessories: Include all track and sheet metal accessories required, fabricated from matching metal.

C. Screw Fasteners: Cadmium coated.

PART 3 - EXECUTION

3.1 FRAMING

A. General: Erect metal framing per the requirements of ASTM C 1007.

B. Studs, track, bracing, etc. shall be used and erected as recommended by manufacturers. Connections shall not induce distortions into the framing.

C. Runner Tracks: Install continuous tracks, straight and true, accurately aligned to the layout at base and at tops of studs. Anchor track at corners and ends.

D. Set studs plumb, except as indicated otherwise, not more than 16" o.c. and not more than 2" from abutting walls. In each line of studs, face flanges all in the same direction. Erect studs one-piece full length; splicing not permitted.

E. Secure studs to runners, top and bottom, at both inside and outside flanges, by either welding or screwing with the equivalent of 2 Type “S” screws.

F. Bridging: Install between studs as required to prevent stud rotation.

G. Supplementary Framing: Install blocking and bracing to support other work requiring attachment to the framing system. Where type of supplementary support is not otherwise indicated, comply with the stud manufacturer’s recommendations and industry standards, considering the weight or loading resulting from the item supported.

H. Junctures With Masonry Structures: Provide compressible filler strip at least 1/2" thick between top runners and structure above. Where studs abut masonry or concrete, install 1/2" thick compressible filler strip full height of stud.

I. Welding: Perform welding, including tack welds, in accordance with ANSI/AWS D1.1 and AWS D1.3.

   1. Protect members from damage caused by welding. Provide non-combustible shield during welding operations.
   2. Touch-up welds on hot-dip galvanized items with zinc-rich paint after cleaning joint of welding residues.

END OF SECTION 054000

SECTION 061000
CARPENTRY WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Wood blocking and nailers.
2. Installation of wood doors and door hardware.
3. ¾" fire rated plywood.
4. 1 ½" Insulated plywood sheathing (Composite sheathing consisting of fire rated plywood bonded to polyisocyanurate).
5. Provide and install new plastic laminate cabinets and countertops.

B. Related Requirements:

1. Section 072726 " Fluid Applied Membrane Air Barrier" for application on weather resistant barrier
2. Section 081416 "Flush Wood Doors" for wood door to be installed.
3. Section 087110 "Door Hardware" for finish hardware to be installed in wood door installation.
4. Section 092900 "Gypsum Board System" for gypsum board to be installed.

1.3 SUBMITTALS

A. Product Data:

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. Submit manufacturer's product data for premanufactured items.

B. Shop Drawings: Include all shop fabricated items.

1. Show location and quantity of each item, dimensioned plans and elevations, large scale details, anchors, hardware and other components. Show cabinets in relation to adjacent work. Where required, show electrical service runs.
2. Highlight any field dimensions required to be maintained by other trades.
3. Indicate compliance with AWI Quality Grade, and other specified requirements for materials and workmanship.

C. Samples: Upon Architect's request, submit Samples of each of the following items:

1. Exposed Cabinet Hardware: 1 unit of each type and finish.
2. Plastic Laminates.

D. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

E. Evaluation Reports: For Wood-preservative-treated wood, from ICC-ES.

1.4 QUALITY ASSURANCE

A. Quality Standards: Except as otherwise approved, comply with "Custom Grade" provisions of Architectural Woodwork Institute's (AWI) "Architectural Woodwork Quality Standards."

B. Americans with Disabilities Act (ADA) Requirements: Cabinetry, where specifically indicated on Drawings as "ADA," shall comply with Federal Register Volume 56, No. 144, Rules and Regulations.

C. Measurements: Before proceeding with millwork to be fitted to other construction, obtain field measurements and verify dimensions and Shop Drawing details as required for accurate fit.

D. Workmen: Use only tradesmen experienced in the fabrication and installation of millwork.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MILLWORK SUPPLIERS

A. Grommes Millwork

B. The Horizon Group, Davenport, Iowa

C. Pierce Laminated Products, Rockford, Illinois.

D. TMI Systems, Inc.

E. Or approved equal.

1. Must be submitted 10 days prior to bid opening. On supplier letterhead, a list of any specific variances to our specifications, confirmation that supplier will provide both premanufactured and millwork items as applicable, comply with AWI standards or provide certification of AWI, a list of at least 6 recent public educational/municipal project references and a statement clarifying that supplier will meet or exceed these specifications, for Architects full review.

2.2 WOOD BASED MATERIALS

A. GENERAL

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Dress lumber, S4S, unless otherwise indicated.
3. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.
4. Cabinet Materials:
   a. Wood shall be AWI Custom Grade, unless otherwise indicated, of an average moisture content within 5% to 10% ranges.
   b. Cabinetwork Materials: As listed under Fabrication
5. Fire Rated Plywood Sheathing: Plywood, DOC PS 1, Exposure 1, C-D Plugged, 3/4-inch nominal thickness, fire rated.
6. Insulated fire-rated plywood sheathing: Hunter Panels Xci Ply by Hunter Panels or comparable products of other manufacturers as approved by Architect.
   a. Composition: Closed cell foam bonded to coated glass facer on one side and 5/8” fire rated plywood.
   b. Thickness: As noted on drawings.

2.3 PLASTIC LAMINATE

A. Approved Manufacturers: Wilsonart Premium AEON or equal by Formica.

B. Plastic Laminate: NEMA type Ld3:

1. Countertops: .048" thick Post Form Grade GP50 grade, general-purpose type.
2. Exposed Cabinetwork and Panels: .028" thick (+ .004") vertical-surface, high pressure type (GP28 Grade).
3. Cabinet Interiors: Melamine interior sheets (CL20 Grade). Or thermally fused melamine laminate in situations that meet standards of AWI Custom Grade. Interior color of open cabinets shall be GP28 to match exterior surfaces.
4. Totally Concealed Faces: .020" thick, BK20 or CL20 grade, back-up sheets.
5. Panels: .028" thick, GP28 grade, vertical-surface type.
6. Edging: 3mm PVC at door and drawer edges and of solid, color-through, high-impact vinyl, 3mm thickness, machine applied with hot melt adhesive. color and gloss as selected by Architect from full line of manufacturer’s standard colors and finishes. Color/Pattern shall directly match adjacent drawer/door laminate.

Countertop Laminate: To be determined. Match to existing. Provide physical samples of closest match to architect/owner for review and approval.

Laminate for Exposed Exteriors of Base Cabinets and Front Desk, including door and drawer fronts: To be determined. Match to existing on site. Provide physical samples of closest match to architect/owner for review and approval.

Grommets, see drawings. Color: Charcoal. Location as required/determined by owner.

2.4 CABINET HARDWARE

A. Pulls: Brass wire pull with satin chrome finish.

B. Hinges: Concealed, self-closing type of heavy gauge metal construction, 165° swing, passing 200,000 open/close cycle test; and backed by hinge manufacturer's standard material replacement guarantee.

1. Adjustability: Fully adjustable for clockwise, counter-clockwise, toe-in and toe-out door alignment. Provide base plates to maintain 1/8" reveals between door/drawers within the same cabinet, and between doors of adjoining cabinets.
2. Finish: Hinge manufacturer's standard corrosion resistant finish. Colored finishes shall be subject to Architect's approval for color compatibility with cabinet finish selected.

C. Magnetic Cabinet Door Catches: Knape & Vogt 916, Stanley 46 ALD, Hager 1437 and 1438, or Engineered Products 590 and 591.

D. Drawer Slides: 1 pair per drawer.

1. Standard Drawers: Self-closing design with positive in-stop, out-stop and out-keeper to maintain drawer in 80% open position; captive nylon rollers, front and rear; minimum 100 lb. dynamic load rating at 50,000 cycles and 150 lb. static load rating at full extension; epoxy coated, bottom corner mounted.
2. Guarantee: All drawer slides shall be furnished with manufacturer's lifetime warranty.

2.5 FASTENERS/SUPPORT FRAMING

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 pressure-preservative treated provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

1. Nails: Ring-shank or rough coated finish, size and type to suit application.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws: Plain steel; wood or sheet metal shank; flat, countersunk Phillips or square drive head.

E. Bolts, Nuts, Washers: Size and type to suit application; unfinished in concealed location.

F. Interlocking Mechanical Fasteners: Conforming to 400B-S-8.A or 1600B-S-4.A or to Sections 14 and 25 of the Woodwork Institute of California's manual of millwork; corrosion resistant finish.

G. Panel Clips: 2 ½" pairs steel, pre-punched, 2 hole "Panelclips" as supplied by Brooklyn Hardware or comparable clips recommended by millwork supplier and as approved by Architect.

H. Millwork Fabrications Attachment Hardware & Support Framing: Exposed metal shall be stainless steel of shapes and sizes as noted on drawings.

2.6 SHOP FABRICATION

A. General:

1. Adhesives: Use waterproof, resorcinol-formaldehyde type adhesive. Products made with urea-formaldehyde or melamine-formaldehyde must comply with HPMA Standard FTM 2 for emissions.
2. Loose Joints: Locate loose joints so as to render them as inconspicuous as possible in the finished work.

B. Countertops: Comply with AWI Section 400, Custom Grade except as specified otherwise.

1. Cores: Plywood cores or particleboard cores. Thickness not to be less than 1."
2. Apply plastic laminate finish in full, uninterrupted sheets consistent with manufactured sizes. Make corners and joints hairline. Front edges including applied back splashes, Self edge of finished laminate. See drawings.
3. Back the tops with a minimum .020" backer sheet.
4. Backssplashes and side splashes to be fit to wall with location of splash marked on countertop. Between the splash and countertop a bead of clear silicone is to be applied and the splash is to be fastened to the top with screws from below: Include 4" high x 1" thick backsplashes and endsplashes wherever countertops abut vertical surface.
5. Splice Joints: Continuous countertops requiring splice joints shall be aligned with dowels and splines and shall be joined with Tite-Joint type fasteners and wood glue to make a uniform and gapless joint. Provide structural framing under countertops within 8" of each side of joint. Locate countertop joints at least 15" from sink cutouts.
6. Cutouts: Cut openings for, inserts, and fitments to be installed under other Sections of the Specifications. Verify locations of cutouts from site measured dimensions. Verify size of opening with actual size of equipment to be used, prior to making openings. Form inside corners to a radius of not less than 1/8". After sawing, smooth the edges of cutouts to ensure crack-free openings.

C. Cabinets:

1. General: Comply with AWI Section 400, Custom Grade. Shop fabricate items in sizes to ensure passage through the building without the necessity to modify any building openings. Form joints to conceal shrinkage.
2. Face Style: Flush overlay.
3. Frame Fabrication: Fabricate members that mate to walls with undercut to allow scribing in the field.
4. Cabinetwork for Plastic Laminate Finish: Plastic laminate on all exposed and semi-exposed surfaces.

    a. Balanced construction as defined by AWI custom grade shall be utilized.
    b. Panel Cores: 3/4" particleboard for doors, 1" plywood for shelves and 1/2" plywood or ¼" MDF for backs, unless otherwise detailed.
    c. Edges: Edge-band doors, drawer fronts and other exposed edges, including shelves, with machine applied 3mm PVC.

5. Drawers:

    a. Sides, back and sub front: Minimum 1.2" thick particleboard, laminated with Thermally Fused Melamine doweled and glued into sides. Top edge banded with 1mm PVC.
    b. Drawer bottom: Minimum ½" thick particle board laminate with Thermally Fused Melamine, screwed directly to the bottom edges of drawer box.

c. Drawer fronts. 3/4” thick particle board. VGS laminate exterior, balanced with high pressure cabinet liner CLS.

6. Cabinet Shelves: Design for load of 15 psf with deflection limited to l/180.
7. Shelf Supports: Provide holes for shelf cleats to be adjusted up or down 3" from indicated elevation, in 1-1/2” increments, using metal shelf cleats.
8. Loose Joints: Make with rail bolts that can be pulled up tight to form perfectly flush joints.

2.7 WOOD BLOCKING AND NAILERS

A. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

B. 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

2.8 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction. Use Category UC3b for exterior construction.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. 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.
3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
4. Application: Treat all rough carpentry unless otherwise indicated**.**

B. Fire-Retardant Treatment: Furnish fire-retardant treated wood (FRTW) framing, blocking, nailers and plywood where indicated on Drawings and where wood is required in fire-rated assemblies including roof assemblies. Treat with Koppers’ “Non-Com Fireprotective,” Hickson Corp’s “Dricon,” or equal chemicals bearing a National Evaluation Services Report. The treatment shall provide a UL fire hazard classification of 25 or less for both flame spread and fuel contributed:

1. Treat lumber with non-corrosive AWPA C20 type free of halogens, sulfates and ammonium phosphate per FR-1 of AWPA Standard P17
2. Treat plywood with non-corrosive AWPA C27 type free of halogens, sulfates and ammonium phosphate per FR-1 of AWPA Standard P17
3. After pressure treatment, kiln dry the treated lumber to a maximum moisture content of 19%. Plywood shall be kiln dried to a maximum moisture content of 15%.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Wood Blocking/Nailer:

1. 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.
2. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
3. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

B. Flush Wood Door and Finish Hardware:

1. Install flush wood door on hollow metal door frame.
2. Install finish hardware on flush wood door and attach to hollow metal door frame.

C. General:

1. Setting: Secure work to grounds and blocking as required, holding to correct surfaces, lines and levels. Make finished work flat, plumb, and true. Install items tight to adjoining surfaces except as approved otherwise. Cope and scribe for tight fits.
2. Fastening: Conceal fastenings; where not possible, locate them in inconspicuous places. Where nailing is permitted through woodwork face, conceal nail heads. Do not nail adjacent woodwork to paneling.
3. Loose Joints: Locate loose joints to render them as inconspicuous as possible in finish work. Make joints in interior work with rail bolts that can be pulled up tight to form perfectly flush joints.
4. Expansion Joints: Install joints to permit sections to expand and contract without buckling, warping or causing other conditions that will detract from appearance and durability.
5. Miter external corner of flat horizontal members; house internal corners. Miter external corners of molded members; cope internal corners. Glue mitered corners; secure with corrugated metal fasteners.
6. At substrate irregularities apply colored sealant at such spaces and tool sealant to a straight line along millwork edge.
7. Thoroughly sand finished wood items smooth. Touch up edges and make smooth.
8. Coat cut surfaces of preservative treated wood after cutting, with a heavy brush coating of the same preservative

D. Cabinetwork:

1. Install cabinetwork in a manner consistent with the specified quality grade, plumb, level, true and straight with no distortions.
2. Secure wall cabinets only to masonry or solid wood blocking. Anchor with concealed fasteners of the kinds recommended by the cabinet manufacturer to accommodate maximum loads; place anchors in the cabinet manufacturer's recommended locations/patterns.

3. Scribe and cut for accurate fit to other finished work. Permanently fix cabinet and counter bases to floor using appropriate concealed angles and anchorages.
4. Carefully scribe cabinetwork set against other building materials, leaving gaps of 1/32" maximum.
5. Install and adjust cabinet hardware to correct operation.
6. Cutouts: Provide cutouts for conduits and other fixtures and fitments. Verify locations, shapes and sizes of cutouts from site measured dimensions.
7. Coordinate installation of cabinetwork with other cabinetwork furnished and installed under other Sections of the Specifications.

3.2 HARDWARE FOR DOORS

A. Receive, store, protect and install finish hardware for wood and hollow metal doors on entire project as furnished by finish hardware supplier under Section 087100 - Finish Hardware. Install according to requirements specified in Section 087100.

B. Adjust, and protect from injury all installed hardware. Cover door knobs and levers with heavy cloth until project acceptance.

C. Deliver keys to Owner at completion and acceptance of work.

3.3 ADJUST AND CLEAN

A. Repair damaged or defective work to the satisfaction of the Architect.

B. Adjust and lubricate hardware for proper operation.

C. Clean exposed interior surfaces

3.4 PROTECTION

A. Protect installed finish carpentry from damage by other trades until Owner’s acceptance of the work.

END OF SECTION 061000

SECTION 072100
BUILDING 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. Batt wall insulation.

B. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete" for perimeter insulation.
2. Section 092900 "Gypsum Board System" for metal framing.

1.3 SUBMITTALS

A. Process all submittals per requirements in Section 013300 “Submittal Procedures”.

B. Manufacturer’s Data: Submit 2 copies of manufacturer’s specifications and installation instructions for each type of insulation required.

1.4 QUALITY ASSURANCE

A. The application of all insulations shall be in strict accordance with the directions and specifications of the manufacturer and shall be performed by an Installer approved by the manufacturer.

B. Thermal Factors:

1. Thermal Conductivity (k), Thermal Conductance (C) and Thermal Resistance (R) factors used in these specifications shall be for aged insulation effectiveness as listed in the latest edition of ASHRAE’s Handbook of Fundamentals, and the Annual Book of ASTM Standards.
2. Installed insulation thickness shall be adjusted to meet these minimum requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Batt Insulation:

1. Acceptable Manufacturers:

   a. Owens-Corning.
   b. Guardian Fiberglass.
   c. CertainTeed.
   d. USG.
   e. Johns Manville.

2. Glass or other inorganic fibers and resinous binders formed into unfaced flexible blankets of thicknesses indicated conforming to ASTM C 665, Type I, with density not less than 0.5 pcf. Thickness as noted on drawings.

2.2 MISCELLANEOUS MATERIALS

A. Mechanical Anchors: Type and size shown or, if not shown, as recommended by the insulation manufacturer for the type of application shown and condition of substrate including insulation batt supports.

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer shall examine the areas and conditions under which the work is to be installed. Notify the Contractor in writing of conditions detrimental to the proper and timely completion of the work.

B. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's instructions for the particular conditions of installation in each case. If printed instructions are not available or do not apply to the project conditions, consult the manufacturer's technical representative for specific recommendations before proceeding with the work.
2. Extend insulation full thickness shown over entire surface to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation.
3. Apply a single layer of insulation of the required thickness unless otherwise shown or required to make up the total thickness.

B. Batt Insulation.

1. Do not obstruct ventilation spaces. Provide batts of appropriate width to fit in spaces tightly.
2. Insulation shall fill all voids as shown on drawings.
3. Penetrations where ducts or structural framing cut insulation shall be stuffed all around with insulation

3.3 CLEANUP

A. Remove all scraps of insulation and dispose of properly.

END OF SECTION 072100

SECTION 072726
FLUID APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Fluid-applied, vapor-retarding membrane air barriers.

B. Related Requirements:

1. Section 061000 "Carpentry Work" for fire rated plywood.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that form part of air barrier.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by the Installer, who work on Project.

B. Product Certificates: From air-barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

C. Product Test Reports: For each air-barrier assembly, for tests performed by a qualified testing agency.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly as shown on Drawings, incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.

   a. Coordinate construction of mockups to permit inspection by Owner's testing agency of air barrier before external insulation and cladding are installed.
   b. Include junction with roofing membrane**,** building corner condition, and foundation wall intersection.
   c. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.2 L/s x sq. m of surface area at 75 Pa), when tested according to ASTM E 283 or ASTM E 2357.

2.3 VAPOR-RETARDING MEMBRANE AIR BARRIER

A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Elastomeric, modified bituminous membrane.

1. Elastomeric, Modified Bituminous Membrane:

a. Barriseal S by Carlisle Coatings & Waterproofing Inc.
b. Air-Bloc 06 WB by Henry Company.
c. Textroflash Liquid by Holmann & Barnard, Inc.
d. Air-Shield LM by W.R. Meadows.
e. ExoAir 120SP/R by Tremco Inc.

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
b. Vapor Permeance: Maximum 0.1 perm (5.8 ng/Pa x s x sq. m); ASTM E 96/E 96M.
c. Ultimate Elongation: Minimum 500 percent; ASTM D 412, Die C.

2.4 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

C. Counterflashing Strip: Modified bituminous, 40-mil- (1.0-mm-) thick, self-adhering sheet consisting of 32 mils (0.8 mm) of rubberized asphalt laminated to an 8-mil- (0.2-mm-) thick, cross-laminated polyethylene film with release liner backing.

D. Butyl Strip: Vapor retarding, 30 to 40 mils (0.76 to 1.0 mm) thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.

E. Modified Bituminous Strip: Vapor retarding, 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.

F. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.

G. Substrate-Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

H. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

I. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch (0.5 mm) thick, and Series 300 stainless-steel fasteners.

J. Modified Bituminous Transition Strip: Vapor retarding, 40 mils (1.0 mm) thick, smooth surfaced, self-adhering; consisting of 36 mils (0.9 mm) of rubberized asphalt laminated to a 4-mil- (0.1-mm-) thick polyethylene film with release liner backing.

K. Adhesive-Coated Transition Strip: Vapor-permeable, 17-mil- (0.43-mm-) thick, self-adhering strip consisting of an adhesive coating over a permeable laminate with a permeance value of 37 perms (2145 ng/Pa x s x sq. m).

L. Elastomeric Flashing Sheet: ASTM D 2000, minimum 50- to 65-mil- (1.3- to 1.6-mm-) thick, cured sheet neoprene with manufacturer-recommended contact adhesives and lap sealant with stainless-steel termination bars and fasteners.

M. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.

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

a. 123 Silicone Seal by Dow Corning Corp.
b. US11000 UltraSpan by Momentive Performance Materials.
c. Sil-Span by Pecora Corp.
d. Spectrem Simple Seal by Tremco Inc.

N. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Section 079200 "Joint Sealants."

O. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.

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

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

D. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

A. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches (75 mm) along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.

3.4 TRANSITION STRIP INSTALLATION

A. General: Install strips, transition strips, and accessory materials in accordance with air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.

C. Connect and seal exterior wall air-barrier material continuously to other construction used in exterior wall surfaces, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Seal top of through-wall flashings to air barrier with an additional 6-inch- (150-mm-) wide, modified bituminous or counterflashing strip.

G. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

H. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches (150 mm) beyond repaired areas in strip direction.

3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION

A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.

1. Apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.

1. Vapor-Retarding Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil (1.0-mm) dry film thickness, applied in two equal coats.

C. Apply strip and transition strip a minimum of 1 inch (25 mm) onto cured air-barrier material] or strip and transition strip over cured air-barrier material overlapping 3 inches (75 mm) onto each surface according to air-barrier manufacturer's written instructions.

D. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

F. Remove masking materials after installation.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections if they require.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests: As determined by Owner's testing agency.

D. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 072726

SECTION 074213
FORMED METAL WALL PANELS

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 metal wall panel system for canopies.

B. Related Requirements:

1. Section 051200 "Structural steel Framing" for structural framing.
2. Section 054000 “Cold Formed Metal Framing" for metal stud framing.
3. Section 061000 "Carpentry Work” for Canopy/Fascia sheathing and weather barrier.

1.3 SYSTEM DESCRIPTION

A. Panel's exposed finishes shall perform according to AAMA 2605-98; exposed anodized aluminum according to AAMA 611-98.

B. Panel composite assembly shall conform to ASTM E84, Flame Spread Resistance, Class A.

C. Panel composite assembly shall pass Modified ASTM E108, External Flame Resistance.

D. Panel composite assembly shall pass UBC 26-3, Fire Standard For Interior Applications.

E. Panel bond integrity shall have a minimum peel strength of 34.5 in-lbs/in when tested according to ASTM D1781.

F. Design wall system to withstand a positive and negative windload pressure acting inward and outward normal to the plane of the wall to meet the requirements of the 2015 International Building Code.

G. Make adequate provisions in the wall system for thermal expansion and contraction of the component parts and fastening of the system to prevent harmful damage caused by buckling, opening of joints, contraction and expansion due to accumulation of dead loads and variations of live loads, in accordance with ASTM E72, Strength Tests For Panels For Building Construction.

H. Water Leakage: No water infiltration into the panel system under static pressure when tested in accordance with ASTM E331 at a differential of 10% of inward acting design load, 6.24 psf (.299 kPa) minimum, after 15 minutes.

I. Air Leakage: Not more than 0.06 (cfm)/sf of wall area (.003 (L/s) m^2), when tested at 1.57 psf (.075 kPa) in accordance with ASTM E283.

1.4 QUALITY ASSURANCE

A. Take field measurements prior to preparation of shop drawings and fabrication, where possible. Take measurements in time, so as to avoid delaying job progress. Allow for trimming and fitting.

B. Panel Manufacturer: Manufacturer shall have a minimum of ten (10) years experience in the manufacture of ACM/MCM and have ISO 9001:2000 Certification.

C. Panel Installers: Installer shall be experienced in performing work of this section and be specialized in the installation of similar work required on this project.

D. Field Measurements: When possible, measurements should be taken prior to the completion of shop manufacturing and assembly.

E. Pre-Installation Meetings: Conduct pre-installation meetings to verify project requirements, substrate condition, installation instructions and warranty requirements.

F. Mock Ups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mock up of typical metal composite material panel assembly as shown on Drawings, including corner, soffits, supports, attachments and accessories.

G. Source Limitations:

1. Obtain each type of wall panel from single source from single manufacture.
2. Installer: Pre-Qualified Company specializing in performing the work of this Section shall install the system in strict compliance with the written manufacturer's instruction.

H. References:

1. American Society for Testing and Materials (ASTM):

a. ASTM E84: Surface Burning Characteristics.
b. ASTM D1781: Climbing Drum Peel for Adhesives.
c. ASTM E108 (Modified): Standard Test Methods for Fire Tests of Roof Coverings.
d. ASTM E72: Strength Tests for Panels for Building Construction.
e. ASTM E331: Test for Water Penetration of Exterior Walls by Uniform Static Air Pressure Difference.
f. ASTM E283: Test Method for Rate of Air Leakage through Exterior Walls

2. Architectural Aluminum Manufacturers' Association (AAMA):

   a. AAMA 2605-98: Voluntary Specification, Performance Requirements and Test Producedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
   b. AAMA 611-98: Voluntary Specification for Anodized Architectural Aluminum.

3. UBC26-3: Room Fire Test Standard for Interior of Foam Plastic Systems.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal wall panel and accessory.

B. Shop Drawings:

1. Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, corners, and accessories; and special details. Distinguish among factory, shop, and field-assembled work.
2. Coordination Drawings: Elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

   a. Metal wall panels.
   b. Wall-mounted items.
   c. Penetrations of wall by utilities.

C. Samples: Samples for Verification: For type of exposed finish required, prepared on 6” x 6” sample of actual material.

D. Maintenance Data: For metal wall panels to include in maintenance manuals.

E. Preconstruction field adhesion test reports.

F. Warranties: Sample of Manufacturers standard warranty.

1.6 WARRANTY

A. Manufacturer's Warranty: Furnish panel manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not a limitation of other rights Owner may have under the Contract Documents.

B. Panel Lamination Warranty: Five (5) years commencing on Date of Substantial Completion.

C. Installing Contractor shall warranty the system for 2 years from substantial completion.

D. Finish Warranty: Kynar 500®: Twenty (20) years.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package panels for protection during transportation and handling.

B. Store and handle in strict compliance with manufacturers instructions and recommendations. Protect from damage from weather, excessive temperatures and construction operations.

C. Store covered with suitable weather tight and ventilated covering. Store panels to ensure dryness, with positive slope for drainage of water. Do not store panels in contact with other materials that might cause staining, denting, or other surface damage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE TYPES & MANUFACTURERS

A. Metal Composite Material Wall Panel Systems: Provide factory-formed and assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoset Phenolic Resin core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners and accessories required for a watertight condition. Basis of Design - "Envelope 2000 Reveal (RV) System" by Citadel or equal by Alucobond, Reynobond, or Formabond Wall System. Alucoil, and Vitrabond Composite Panel are acceptable manufacturers as long as they are installed with the same type of extrusions and installation methods as the Basis of Design.

1. Materials:

a. Panel Composition:

1) Face Skin: .024" (minimum) prefinished smooth aluminum.
2) Core: .105" thermoset phenolic resin.
3) Back Skin: .010" primed smooth aluminum backer.
4) Panel thickness: 1/8"

b. Panel Tolerances:

1) Thickness: ±1/32".
2) Length and Width: +0, -1/16".
3) Squareness: 1/64" per lineal foot.

c. Attachment System: R System.

d. Finish: Exposed finish of Kynar 500 for panels, trims and reveals.

1) Color: Clear anodized.

e. Accessories:

1) Fasteners and moldings as required for panel system's design by panel system manufacturer. Fasteners shall be coated or stainless steel.
2) Weather Seals: Shall be Tremco® Spectrem® 2 or Dow Corning 795™, applied per the sealant manufacturer's instructions.

2.2 FABRICATION

A. Panels shall be factory fabricated and finished by manufacturer. Comply with indicated profiles and with dimensions as detailed and noted on drawings.

B. Form exposed work true to line and level, with accurate angles and surfaces and straight, sharp smooth edges.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine and verify substrate surfaces to receive composite metal panel system and associated work and condition which work will be installed.

B. Maximum deviation from vertical and horizontal alignment of substrate shall be no more than 1/4" in 20'-0".

C. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to installer. Starting work within a particular area will be construed as installer's acceptance of surface conditions.

3.2 COORDINATION

A. Coordinate with other trades for any items which may be attached to or require penetrations to the panel.

3.3 INSTALLATION

A. Erect panels level and true to intended plane.

B. Anchor panels securely in place in accordance with manufacturer's/fabricator's approved Shop Drawings.

C. Maximum deviation from vertical and horizontal alignment of erected panels shall be no more than 1/4" in 20'-0".

D. Maximum deviation in panel flatness shall be 0.6% of the assembled units.

E. Conform to panel manufacturer's instructions for attachment systems.

F. Weather seal all joints as required using methods and materials as recommended by the panel manufacturer/fabricator.

3.4 CLEANING/REPAIR/REPLACEMENTS AND PROTECTION

A. Weather seal all joints as required using methods and materials as recommended by the panel manufacturer/fabricator.

B. Repair or replace damaged installed products.

C. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

D. Remove and legally dispose of construction debris from project site.

END OF SECTION 079200

SECTION 075320
ADHERED TPO ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fully adhered TPO sheet roofing systems.
2. Board insulation.
3. Cover Board.
4. Membrane roof flashings, base flashings and parapet flashings.
5. Fasteners and adhesives.
6. Sealants.

B. Related Work Specified In Other Sections:

1. Section 013300 “Submittal Procedures” for submittal of required items.
2. Section 053000 “Steel Decking” for metal roof decking.
3. Section 061000 “Rough Carpentry” for plywood sheathing and wood blocking, nailers and studs.
4. Section 076200 “Sheet Metal Work” for new sheet metal work and roof trim.

1.3 QUALITY ASSURANCE

A. Roofing Contractor: Illinois licensed, specializing for at least 5 years in the type of membrane system involved, who is approved by Architect and is certified/licensed by new roofing membrane system producer and who can furnish for this installation a foreman factory trained by the roof membrane system producer.

B. Source of Supply: Membrane system materials shall be obtained from a single source of supply except as authorized otherwise by membrane producer.

C. Standards of Installation: All components of roof system shall be furnished and installed to meet the wind 72 mph wind warranty.

D. Scheduling and Coordination:

1. Coordinate roofing installation with mechanical and electrical work associated with roof penetrations.
2. No phased construction will be considered or approved.

E. Wet and Damaged Materials: Shall not be installed.

1.4 SUBMITTALS

A. Process all submittals as required in Section 01300 – Submittals.

B. Product Data: Submit 3 copies of roofing materials producer's specifications, material characteristics and installation instructions for each product required including fasteners.

C. Shop Drawings: Indicate:

1. Outline of roof and dimensions.
2. Typical and special details for flashings, roof curbs, penetrations, perimeter conditions, termination details, etc. Reference the locations of details on the roof outline.
3. Number and mark of each factory prepared roofing sheet and flashing.
4. Layout of tapered insulation saddle areas.
5. Provide fastener locations and spacing for insulation installation.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Packaging: Deliver materials to the job site in their original containers or packages, sealed, with legible labels intact, brand name, lot number, warning labels and reference standards clearly shown.

B. Temperatures Prior to Use: Store materials in the dry and in accordance with membrane producer's instructions. Other than roof membrane, all materials furnished by membrane producer shall be stored between 60°F and 80°F. If exposed to lower temperatures, restore to 60 - 80°F prior to use.

C. Warped or Broken Insulation Boards: Shall be removed from site.

1.6 JOB CONDITIONS

A. Ambient Conditions: Do not apply adhesives below adhesive manufacturers' recommended ambient temperature ranges.

B. Cold Weather: Follow membrane producer's special recommendations when cold weather retards free flow of adhesives and sealants. Do not apply adhesives below adhesive manufacturers' recommended ambient temperature ranges.

C. Electrical Power: Furnish power for heat welders by way of portable generator(s) producing at least 30 amps per welder supplied or furnish power to 220V heat welders by way of #10 x 3 or greater power cords and boost the power with a step-up transformer when cord length exceeds 150 feet.

D. Fire Prevention: Take every precaution to prevent fire.

1. Maintain at least 2 portable fire extinguishers, rated 10-B:C-20 pounds, near area where adhesives are being used and train applicators in their proper use.
2. Do not use open flames to heat adhesives. Allow solvents to air-dry.
3. Use only grounded spray equipment.

E. Coordinate with Owner to shut off or block vents which may allow solvents or adhesives vapors to be drawn inside the building.

1.7 WARRANTIES

A. New Roofing: Shall be provided with a non-prorated, No-Dollar-Limit, full system warranty to Owner, including tapered insulation saddles, against leaks or defects of any kind due to faulty materials or workmanship, and to sustain a 72 mph maximum wind speed as follows:

1. Roofing membrane system producer's 20 year warranty for materials and workmanship.
2. Roofing Contractor's 2 year warranty for workmanship.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. System Fire Rating: Provide a fire-resistant membrane and insulation assembly which has been tested and listed by Underwriter's Laboratories, Inc. (UL) as Class A, for the roof deck and slopes to be used on this project.

B. System Wind Rating: Roof to be warranted for a 72 mph maximum wind speed.

C. System Types: Reinforced TPO membrane fully adhered to the top layer of insulation units.

D. Membrane Joint System: Membrane system producer's splice tape system.

E. Approved Products: Use one of the following systems:

1. TPO Membrane System:

   a. Carlisle **"**Sure-Weld**"**
   b. Firestone "Ultra Ply TPO".
   c. Versico "VersiWeld."

F. Membrane Joint System: Membrane system producer's splice tape system.

2.2 MATERIALS

A. Membrane: TPO Roof Membrane: Gray or Tan as selected bu Architect, Thermoplastic Polyolefin, .060" (60 mil) thick, reinforced.

B. Roof Insulation: High Density Rigid board insulation of foamed isocyanurate core with manufacturer's standard glass fiber reinforced mat facers or organic/inorganic facers integrally laminated to both sides; minimum R=5.7 per 1" of thickness: All insulation to be 25psi: Insulation furnished shall be as approved by membrane manufacturer.

1. Thickness: As shown on the drawings.
2. Tapered Insulation for Saddle & and Crickets: Isocyanurate units by same manufacturer as typical roof insulation; taper as required to achieve slopes indicated, or, if not indicated, not less than 1/4" per foot after roof deflection under full design load.

C. Cover Board: ½" water-resistant gypsum substrate, 1/2 inch thick, DensDeck Prime or approved equal during bidding. The cover board can be adhered with a low rise foam applied in a ribbon format as recommended by the manufacturer. The contractor has the option to install the cover board using hot asphalt. However, this method can only be used during the summer months when students and staff are not in the school.

D. Mechanical Anchors: Types recommended by roof system manufacturer including compression plates, for the kind of deck indicated and for wood nailers, featuring anti-corrosive materials and anti-blackout design. Anti-corrosion coating shall pass 30 cycles in Kesternich Cabinet DIN #50018 - 2 liter.

E. Base and Parapet Flashing: Same material as used for roof membrane.

F. Flashing To Cover Corners In Substrates: Same material as roof membrane; or roof membrane producer's unreinforced ethylene propylene-based flashing strips, .055" (55 mil) thick, of matching color.

G. Temporary Protection: Sheet polyethylene or fiber reinforced plastic. Provide weights to retain sheeting in position.

H. Auxiliary Materials: Prefabricated flashing units, bonding adhesives, sealants, splicing cements, mastics and other accessory materials shall be recommended by producer of roof membrane for the system installed.

I. Roof Expansion Joints: 2" to 3" diameter closed cell foam tube, laid over the expansion joint opening. In addition, the joint shall be filled with one of the following:

1. Non-rigid closed cell plastic foam batts or tubes to a depth of 10".
2. 3–1/2" thick glass fiber batts cut to nominal 10" width and suspended on a 10 mil polyethylene sheet, all covered with roof membrane.

J. Termination Bars: One Piece Surface mounted, .063" thick mill finish aluminum, "Flat Bar" 1" x 1/8" thickness as manufactured by W.P. Hickman, or Architect approved equal co. Furnish aluminum in lengths not more than 4 ft long. All exposed fasteners shall be installed with neoprene washers.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install roofing membrane and flashing system in accordance with details, specifications and best practices recommended by membrane manufacturer.

1. Follow all recommendations and adhere to all precautions specified by roofing manufacturer except that where conflict occurs between manufacturer's recommendations and these specifications, the more stringent requirement shall prevail.
2. No wet or damaged materials shall be installed.

B. Refer to drawings for "Renovation General Notes," "Demolition Box Notes," General Notes." and "Renovation Key Notes." for description of Work.

3.2 TEMPORARY PROTECTION

A. Temporary Protective Sheeting: Provide over uncovered deck surfaces whenever precipitation is forecast.

1. Retain sheeting in position with weights or temporary fasteners.
2. Provide for surface drainage from sheeting to existing drainage facilities.

B. Traffic: Do not permit traffic over unprotected or repaired deck surface.

3.3 PREPARATION

A. Surfaces to Receive Roofing System: Prepare so that they will be clean**,** dry**,** and free of fins**,** sharp edges**,** loose**,** damaged and foreign materials**,** oil and grease.

B. Cleaning: Sweep roof surface clean of loose matter.

3.4 INSPECTION FOR ROOFING

A. Acceptance of Conditions Affecting Application: Proceeding with roof system application shall designate acceptance of conditions.

3,5 INSULATION INSTALLATION

A. Roof Insulation Installation: (Verify installation with drawings)

1. Install first layer and mechanically fasten to metal deck.
2. Install and adhere second layer of rigid insulation to the first layer of insulation.

C. Crickets and Saddles: Slopes shall be of 1/2 per foot. Assure positive drainage flow by installing crickets and saddles wherever flow to roof drain is obstructed, is inadequate or must be positively encouraged during storms to counter the forces of excessive runoff speeds or high winds. Take special care to correct flow patterns at rooftop equipment and where roofs have been modified. Fully adhere to insulation using adhesive as recommended by manufacturer.

3.6 ROOF MEMBRANE INSTALLATION

A. General: Install roofing membrane and flashings in accordance with details**,** specifications and best practices recommended by membrane producer. Follow all recommendations and comply with all precautions specified by roofing producer except that where conflict occurs between producer**'**s recommendations and these specifications**,** the more stringent requirement shall prevail.

1. Direction of Membrane Placement: Orient the membrane so that rainwater runs over rather than along lap joints.
2. Whole Sheets: Use whole, single sheets to the extent practicable.

B. Membrane Installation: Lay membrane in full bed of contact adhesive for 100% adhesion.

1. Relaxing: Roof membrane shall be set in place over substrate without stretching and allowed to relax 30 minutes before bonding.

2. Placement: Set sheets in final position, free of wrinkles and folds, overlapping adjacent sheets, with up-hill sheet on top of joint. Make overlap 5" on EPDM membranes. Then roll sheet back evenly onto itself. Sweep away bonding contaminants from mating surfaces using a stiff bristled broom.
3. Bonding Adhesive Application: Apply evenly to underside of sheet and to insulation at about the same time so as to allow matching drying times. Smooth out adhesive with nap roller. Hold bonding adhesive well back from edges to be spliced over other membrane.
4. Bonding to Insulation: When bonding adhesive is tacky and does not stick or string to touch of a dry finger, roll membrane into the coated substrate slowly and evenly so as not to cause wrinkles. Compress the bond with an approved roller. Do not bond surfaces before adhesive becomes tacky. Should adhesive loose its tackiness, reapply adhesive. Set the pace of work accordingly. When first half of a sheet is fully adhered, complete other half in same manner.
5. Contaminated Adhesive: Should adhesive become contaminated by dust, moisture, walking etc., re-apply adhesive, but only after contaminated adhesive is thoroughly dry, even if redoing entire field of adhesive is required. Remove contaminated adhesives when so recommended by membrane producer.

C. Lap Splices:

1. Cleaning: Sweep away excess talc and other bonding contaminants from mating surfaces using a stiff bristled broom.
2. Adhesive Application: Scrub on bonding adhesive to each surface to be mated, extending adhesive 1/2" to 3/4" beyond edge of the sheet that will be layed on top. Scrub harder where there is excess dusting agent or contamination. Time the application of adhesive to each surface so as to allow matching drying times when each side of splice tape is pressed into the adhesive.
3. Rolling: Roll the splice tape into the adhesive applied onto bottom sheet, leaving no edge of tape un-wet by the adhesive.
4. Trimming: Trim the top sheet as required to allow splice tape to be exposed 1/8" to 1/2" after top sheet is fixed.
5. Bonding: Fix the top sheet in place by allowing the sheet to carefully fall on to the freshly exposed top surface of the splice tape, making a joint free of wrinkles and fishmouths. Broom the entire length of the splice as the splice is made and then roll the splice tight with a silicone wheeled hand roller, working across the joint and then along its length.
6. Splices between Lengths of Splice Tape: Lap the splices at least 1" and cover such joints with a 6" x 6" patch of uncured membrane, sealed all around with lap edge sealant.
7. Sealing Exposed Scrim: Wherever the membrane reinforcement scrim is exposed, cover with continuous bead of lap edge sealant.
8. Sealant Application: Prime the surfaces before applying sealant and tool the sealant bead, as required by membrane manufacturer. Take caution to not disturb fresh lap sealant.

D. Edge Attachment: Mechanically attach edges of membrane all around roof edges and roof openings, anchoring into parapets and edge blocking, according to membrane producer's recommendations and approved details.

E. Flashing: Bond only to clean surfaces. Contour the membrane to fit substrate to which it is bonded so as not to allow bridging or gapping effect.

1. Roof Interruptions, Curbs and Edges: Flash with longest pieces practicable. Include intersections with other roofs. Terminate flashings a minimum of 8" above adjacent roof surface unless indicated otherwise.
2. Pipe Penetrations: Flash with prefabricated rubber boots. Seal the top of boots with stainless steel strap clamps and continuous bed of mastic sealant. Form all surfaces so as to provide positive drainage.
3. Base Flashings: Membrane flashings applied over upright surfaces shall be fully adhered to substrate, all across contact area, using techniques similar to those used to bond main roof membrane.
4. Joints In Membrane Flashings: Provide a minimum lap of 3" at joints and compress the bond with an approved roller. Round off membrane corners. Apply additional patches of flashing membrane over joints and seal all around edges, according to roof membrane system producer's recommendations.
5. Flashing Over Fasteners: Cover the fasteners with flashing membrane, providing a minimum lap of 3" beyond washers.

F. Termination Bars: Apply where required. Anchor with approved fasteners and neoprene washers not more than 12" o.c. and within 2" of ends of units. Leave expansion space between units of 3/16" when metal temperature is 70°F or below and 1/8" when above 70°F.

G. Expansion Joints:

1. Fill expansion voids with expansion joint insulation down to the level of the roof deck. Fill voids completely. Do not use any rigid materials.
    a. Wrap a vapor barrier membrane around fibrous insulations and seal joints between vapor membrane sections with vapor resistant construction tape and then seal the joint between vapor barrier and curb with approved mastic.
2. Top the expansion joint with an approved foam tube and secure the tube against dislodgement with strips of flashing membrane or as otherwise approved.

H. Temporary Closures: Install as needed to prevent water from flowing beneath roof system during inclement weather.

1. Extent: The roof membrane shall be extended at least 2 feet past edge of roof insulation and a continuous layer of sealer applied onto substrate 12" wide along the membrane edge.
2. Sealing Edge: Firmly embed roof membrane into sealer and provide continuous pressure over the length of the cut-off, using lumber and other ballast, so as to prevent blow-off.

I. Repairs:

1. Wrinkles: When within 18" of a splice or running towards a splice or positioned to interrupt proper drainage, cut out the wrinkle and repair with unspliced roof membrane to at least 3" beyond the wrinkle.
2. Cuts and Punctures: Patch over with roof membrane to at least 3" beyond the break.

3.7 INSTALLATION OF SHEET METAL WORK

A. Coordinate membrane installation with Section 076200 – Sheet Metal Work Contractor.

3.8 CLEAN UP

A. Smears and Droppings: Clean from all non-roofing surfaces.

B. Rubble, Debris, and Excess Materials: Remove roof construction rubble, debris, and excess roofing materials and containers.

END OF SECTION 075323

SECTION 076200
SHEET METAL WORK

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. Flashings and sheet metal work.
2. Coping.
3. Scupper opening, conductor box and downspout.

B. Related Requirements:

1. Section 062000 "Carpentry Work" for treated blocking, nailers and plywood backer panels.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

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 for each manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.

8. Include details of special conditions.
9. Include details of connections to adjoining work.
10. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.
3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.

E. Certifications: Submit roof membrane producer's certification that metal items to be furnished for roofing are acceptable for inclusion in roof system producer's warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing panels and trim, and its accessories, to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Applicator: A company specializing in sheet metal flashing work and approved by membrane roofing subcontractor; having 10 years' minimum experience.

C. Provide water and weather-tight work, with surfaces free from waves and buckles, and seams avoided as much as possible.

D. Comply with applicable recommendations and details of the latest editions of the SMACNA Architectural Sheet Metal Manual and the NRCA Roofing & Waterproofing Manual, including workmanship and installation.

E. Coordination:

1. Coordinate fabrication and installation of metal roof flashings with roof membrane system installers so as to meet requirements of roof warranty (specified in roofing specifications Section).
2. Coordinate metal flashings work with adjoining work for proper sequencing of each installation to ensure the best possible weather resistance and the protection of materials and finishes from damage.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver prefinished sheet metal components free of surface blemishes.

B. Do not store sheet metal flashing, panels and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

C. Protect strippable protective covering on sheet metal flashing, panels and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.8 WARRANTY

A. Sheet metal flashings incorporated into membrane roofing shall be compatible with the requirements of the roof system producer for inclusion into the roofing warranty.

B. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing, panels and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing, panels and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing, and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

2.2 FABRICATED SHEET METAL COMPONENTS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Counterflashings: Made from 0.050" aluminum, with 3" end laps. Corners to be mitered and solder sealed. Fabricate with punched nail hole slots 12" o.c. to allow for expansion.

C. Coping Metal Edge: Made from 0.050" aluminum, with corners formed by butting adjacent fascia pieces over backer splice unit that has been mitered and welded.

D. Flow Thru Scuppers and Conductor Box: Made from .050” aluminum with Kynar coating; color as selected by Architect from manufacturer's standard range of colors. Include all accessories required.

E. Downspouts: 0.050" aluminum, having smooth surface and rectangular profile, size shown on the drawings, with transition thru concrete sidewalk into storm sewer piping. Finish to match overflows and conductor box.

F. Finish: All fabricated sheet metal components shall have factory applied fluoropolymer coating containing a minimum of 70%, by weight, Kynar 500, Kynar 500 VLD or Hylar 5000 resin; Color as selected by Architect.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Flashing Cement: Asphalt mastic cement formulated for weathering and flow resistance, meeting requirements of Fed. Spec. SS-C-153.

C. Adhesives for sheet metal flashings in contact with EPDM roofing shall be type recommended by flashing sheet manufacturer and approved by roofing system manufacturer to provide a waterproof/weather-resistant seaming and adhesive application compatible with roofing system materials.

D. Dissimilar Metal Protection: Bituminous coating conforming to Fed. Spec. TT-C-494 or SSPC-Paint 12, or plastic separators, or insulating tape, subject to Architect’s approval.

1. For metal flashing in contact with roofing, use separation materials or methods compatible with roofing system materials as approved by roofing system manufacturer.

E. Sealant Tape for Surface Mounted Flashings: Protective Treatments, Inc., “Product #606 Architectural Sealant Tape,” 3/16" x 3/4" minimum size.

F. Sealant for Metal Flashing Joints: Use one of the following, color as best blends with color of flashing material:

1. Dap, Inc. “Butyl - Flex”.
2. Pecora Corp. “BC 158”.
3. Protective Treatments, Inc. (PTI) “757 Butyl Sealant”.
4. Tremco “Butyl Sealant”.
5. Sonneborn Bldg. Products “Butakauk”.

G. Fasteners: Fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. For Fastening Aluminum Flashings: Aluminum or stainless steel nails with annular threads, of sufficient length to penetrate wood blocking at least 7/8".
2. For Cleats to Nailers: Use ring-shank or screw-shank nails long enough to penetrate the wood nailer at least 1-3/4" or use #8 screws long enough to penetrate the wood nailer 3/4".

3. For Exposed Fastening: Fasteners as specified above or screws, with soft neoprene washers.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

F. Drip Edges: All exposed edges of flashing shall have 1/2" projecting hemmed edge.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

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

3.2 PREPARATION

A. Coordinate with other trades to provide flashings, etc., to secure their work.

B. Clean surfaces to be covered, removing dirt and other foreign matter.

C. Flashings shall be installed to prevent galvanic action with dissimilar metals by priming with heavy coat of bituminous paint (min. 7.5 mil DFT).

D. Prepare all surfaces where dissimilar metals meet, using dissimilar metal protection materials hereinbefore specified.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Cleats For Edgings: Install over a continuous bead of butyl sealant applied to the bottom of the vertical flange of the cleat. Install with annular threaded or ring-shank nails 16" o.c. When within 8 ft of outside corners, double the fasteners. Double-nail at ends of runs.

D. Metal Coping:

1. Install in coordination with roofing, as required to maintain roofing warranties.

E. Conductor Box & Downspout: Install in accordance with manufacturer’s instructions:

1. Keep metal downspouts separated from walls to avoid staining and corrosion.

2. Install downspouts visually plumb and anchor to building at top and bottom and at 4 ft (maximum) intervals in between. Extend into storm sewer piping. Protect building surfaces from damage from hanger and strap connectors.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

G. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

H. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

I. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 CLEANING AND PROTECTION

A. Clean off excess sealants.

B. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

C. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 078400
FIRESTOPPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Firestopping systems for the firestopping of top and ends of fire rated partitions and where elsewhere designated on drawings.

B. Sealing of **ALL** sleeved and un-sleeved pipe, conduit, cable, cable tray, duct and similar penetrations through **ALL** rated walls and partitions.

C. Related Requirements:

1. Section 079200 "Joint Sealants" for miscellaneous sealant work.

D. With respect to fire stopping of pipe, pipe sleeves and conduit penetrations, the requirements of this Section apply and are to cover fire stopping requirements specified in Mechanical and Electrical Divisions. Work of this Section shall be coordinated with Mechanical and Electrical contractors as required to assure compliance with the fire stopping requirements specified in Mechanical and Electrical Divisions.

1.3 SUBMITTALS

A. Schedule of Applications: Submit 6 copies of a usage schedule showing what products will be used for which situations.

1. Submit detailed drawings of all firestopping systems to be used, giving names of materials and means of installation. Indicate the appropriate UL or FM approval number with each drawing.
2. On a plan drawing of the project, reduced in scale as convenient, indicate where each kind of firestopping system submitted will be located.

B. Product Data: Provide data on characteristics, performance and limitation criteria of products.

1. Include manufacturer's material safety data sheets (MSDS).
2. Manufacturer's Installation Instructions: Include preparation and installation procedures required.

C. Certificates.

1. Manufacturer's Certification: Submit manufacturers' letters of certification verifying acceptability of proposed Fireproofing Installer.
2. Verification of Installation: Contractor shall submit letter certifying that fire stopping has been installed complete and in accordance with all specifications.

D. Sample Warranties: For manufacturer's warranties.

1.4 QUALITY ASSURANCE

A. Installer: Firestopping Installer shall complete the installations as specified and to the satisfaction of all authorized inspectors.

B. Manufacturer's Representative: Each manufacturer furnishing materials for the work shall have an on-site representative to perform the following:

1. Assist Installer with selection of correct products for the various conditions of installation.
2. Train Installer's personnel in proper installation procedures, including quantities of materials necessary to meet the fire resistance ratings required.
3. Verify throughout the course of the work that correct installation procedures are being used.

C. Firestopping Systems' Performance Requirements:

1. Fireproofing Resistance: As appropriate to the fire rating(s) noted on the Drawings, per ASTM E 814.

   a. Flame and Temperature Ratings: As required by the pertinent building codes, according to test results produced in nationally accepted test agencies from tests conducted per ASTM E 814 or UL 1479. Flame (F) rating must be no less than the fire resistance rating of the assembly through which it is applied. Temperature (T) rating, when required by code authority, shall be measured under a positive pressure differential of at least .01" of water column.

2. Expansion Joint Materials: Tested for F, T and L ratings per UL 2079 at full extension after 500 expansion/contraction cycles.

D. Product Compatibility: In each type of firestopping system used, each component shall have been tested and approved for use with the other components installed.

E. Verification of Compliance: The Contractor shall provide to the Architect, prior to final payment, a letter of certification verifying that all perimeters of fire resistance rated constructions as well as penetrations through fire resistance rated constructions were completed as required by Code and the requirements of this Section

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in manufacturer's original, unopened packaging with intact labels identifying product, UL labels, lot number and use-by date.

B. Store materials at site in one location, in original containers, under conditions recommended by manufacturer.

C. No material shall be used which has exceeded its shelf life.

1.6 PROJECT CONDITIONS

A. Install materials only under the conditions of temperature and humidity recommended by manufacturer of product to be installed.

B. Coordinate with other trades as required to assure proper installation of their work and the firestopping work. Install firestopping at drywall penetrations before finishing is started on drywall joints.

PART 2 - PRODUCTS

2.1 ACCEPTABLE PRODUCTS

A. Acceptable Manufacturers: Products shall be produced by one or more of the following manufacturers:

1. Sonneborn Div. of ChemRex Inc.
2. Hilti.
3. 3M Brand Products.
4. RectorSeal Metacaulk.
5. Tremco.

B. Acceptable Products: Use one of the following or similar produced by a manufacturer listed above:

1. Hilti "FS-One" sealant with matching backer, and Hilti "FS-Fire Block."
2. Sonneborn "NP2" sealant with BackerRod Mfg's "Ultra Block" fire blocking mat.

2.2 MATERIALS

A. General: Use only UL listed materials complying with ASTM E 814 (UL 1479) or ASTM E 119 (UL 263) and appropriate to the kind of opening and kind of item penetrating the opening, as required to maintain the indicated fire rating of the construction assembly penetrated:

1. Materials shall be VOC compliant.
2. Materials shall be free of materials requiring hazardous waste disposal, including PCBs, lead and asbestos.
3. For each kind of firestopping situation, use materials from only one manufacturer.

B. Safing Insulation: Either unfaced mineral fiber OR ceramic fiber insulation, as required by system manufacturer

C. Accessories: Furnish sleeves, confinement collars, dam material, primers, sealants and other placement and attachment accessories as recommended by manufacturer and as necessary to establish the required fire ratings

D. Identification Labels: Plastic or plastic shielded paper, configured for permanent attachment and bearing the following information:

1. FIRESTOP SYSTEM - DO NOT DISTURB.
2. (Manufacturer's Name).
3. System Number _____.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify that openings are ready to receive the work of this Section and that elements penetrating the floors, walls and partitions have been permanently affixed. All penetrations are to have sleeves, except as approved otherwise by Architect.

B. Verify that pipe sleeves have been properly installed.

1. Pipes and conduits shall be sleeved with un-split Schedule 40 pipe solidly joined to masonry with mortar, to drywall with joint compound and to concrete with mortar.
2. Pipe sleeves shall be sized to maintain a minimum gap of 1" all around the pipe or conduit (including any insulation on the pipe), irrespective of whether the pipe or conduit is aligned with the center of the sleeve or is off-center.
3. The pipe sleeve's length shall be 1" longer than the thickness of the wall assembly, so that it shall extend out from each face of the wall or partition by 1/2".
4. The pipe sleeve's length at floors shall be 2 1/2" longer than the thickness of the floor assembly, so that it shall extend 2" above the rough floor elevation and 1/2" below the bottom of the floor assembly.

C. Verify that pipes are not insulated with any materials inappropriate to the rated fire stopping system.

D. Should an area requiring firestopping be covered up with other construction or should other conditions unsatisfactory for a proper installation be found, such as lack of sleeves, report the conditions to Contractor for rectification, and send copy of report to Architect. Do not proceed with installation until unsatisfactory conditions have been corrected.

E. Clean substrate surfaces of dirt, dust, grease, oil, loose material and other matter that might affect bond of firestopping material.

F. Protect adjacent surfaces from damage due to material installation.

3.2 APPLICATION

A. General:

1. Apply materials in accordance with manufacturer's instructions, in the same manner as was used to achieve the UL design listing.
2. Apply firestopping materials to uniform densities and texture, in sufficient quantities to achieve required fire resistance rating. Keep exposed work neat.
3. Where additional layers of construction create voids in addition to the primary floor or partition, treat the extra voids the same as primary voids, assuring that fire, smoke and gases are restricted from flowing in any voids.
4. Install retention dams as required. After curing of firestop materials, incombustible dams may be left in place; combustible dams shall be removed.

B. Penetrations Through Fire Rated and Smoke Rated Interior Walls And Partitions:

1. Apply firestopping wherever a void has been made in a wall or partition for the penetration of pipes, conduit, wire, cables, ducts, sleeves, or other items which could allow passage of flame, smoke or gases in the event of a fire —whether that wall or partition is rated or not rated.
2. Ensure that any voids between the sleeve and the surrounding construction are filled and firestopped to the same degree as voids within the sleeve.

C. Tops Of Interior Walls And Partitions: At tops of masonry partitions and gypsum partitions, which are fire rated or smoke rated, create a fire and smoke barrier by installing firestopping between the top of the wall or partition and the deck above.

D. Permanently affix adjacent to each installation in a fire-rated wall the label specified above, properly identifying the firestopping system installed.

E. Correct any firestops that do not conform to the requirements specified, at no additional charge to the Owner

3.3 CLEANING, AND PROTECTION

A. Clean firestopping materials from adjacent surfaces.

B. General Contractor shall protect work of this Section from damage by other trades.

END OF SECTION 078400

SECTION 079200
JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes joint sealants for exterior and interior applications:

B. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete" for perimeter sealing of concrete floor slab joints
2. Section 081113 "Hollow Metal Doors & Frames" for perimeter sealing of hollow metal door frame to gypsum board wall.
3. Section 084113 "Aluminum Framed Entrances" for perimeter sealing of door frame to masonry wall.
4. Section 084113 "Aluminum Storefront Windows" for perimeter sealing of window frame to masonry wall.

1.3 PERFORMANCE REQUIREMENTS

A. Provide joint sealants for exterior and interior applications that establish watertight and airtight continuous seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each type of joint sealant product.

B. Samples: For each kind and color of joint sealant required.

C. Joint Sealant Schedule: Include the following information:

1. Joint sealant application, joint location and designation.
2. Joint sealant manufacture and product line.
3. Joint sealant formulation.
4. Joint sealant color.

D. Product Test Reports.

E. Preconstruction compatibility and adhesive test reports.

F. Preconstruction field adhesion test reports.

G. Field adhesion test reports.

H. Warranties.

1.5 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

1.6 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MAUFACTURERS

A. Products: Subject to compliance with requirements, provide one of, the products listed herein.

2.2 JOINT SEALANTS

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated in accordance with 40 CFR 59, Part 59, Subpart D (EPA Method 24):

1. Architectural sealants shall have a VOC content of 250 g/L or less.
2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
3. Sealants and sealant primers for porous substrates shall have a VOC content of 775 g/L or less.

C. Liquid Applied Sealants: Sealants and sealant primers shall comply with ASTM C 920 and other requirements for each liquid applied joint sealant specified including those referencing ASTM C 920 classifications for type, grade, class and uses related to exposure and joint substrates.

1. Suitability for Immersion in Liquids: Where sealants are indicated of Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing in accordance with ASTM C 1247. Liquid used for testing is deionized water unless otherwise indicated.

D. Stain Test Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing in accordance with ASTM C 1248 and have not stained porous joint substrates indicated for the project.

E. Colors of Exposed Joint Sealants: As selected from standard colors.

2.3 SEALANT TYPES

A. Sealant for Exterior and Interior Side of Aluminum Windows and Entrance Frames: A single component, chemical curing Silicone having Shore A hardness between 15 and 50; non-staining; non-bleeding:

1. Sonneborn **"**Sonolastic 150**"**.
2. Pecora **"**890 Architectural Silicone Sealant**"**
3. Dow Corning **"**791 Building Sealant**"**
4. Tremco **"**Spectrem 1**"**
5. Dow 795

B. Sealant for Interior Control Joints and Door frame Seals:

1. Pecora "Dynaflex"
2. Sika Chemical Co. "Sikaflex-1a"
3. Sonneborn Div. of ChemRex Inc. "Sonolastic Ultra"
4. Tremco "Vulkem 617"

C. Sealant for Joints in Floors: Polyurethane base, multi-component, chemical curing, self-leveling, Shore A hardness between 15 and 50; non-staining; non-bleeding:

1. Sonneborn Div. of ChemRex Inc. "Sonolastic SL1" and "Sonolastic SL2"
2. Tremco "Vulkem 45" or "245/255"
3. H.S. Peterson "Isoflex"

D. Sealant for Other Interior Uses: Acrylic base, single component, chemical curing, paintable, Shore A hardness of 55, maximum; non-staining; non-bleeding:

1. Pecora Corp. "AC-20 + Silicone"
2. Sonneborn Div. of ChemRex Inc. "Sonolastic Sonolac"
3. Tremco "Tremflex 834"JOINT FILLER

E. Joint Filler: Backer rod for elastomeric sealants. Extruded closed cell polyethylene foam or polyethylene jacketed polyurethane foam, non-bleeding, non-staining, oversized 30 to 50 percent; provide one of the following:

1. Dow: Ethafoam.
2. Meadows: backer Rod.
3. Sonneborn: Sonofoam backer Rod.

2.4 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Non-staining; 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 C 1330, Type C (closed-cell material with a surface skin**)**, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas and capable of remaining resilient at temperatures down to minum26 deg. F (minimum 32 deg. C). Provide product with low compression set of size and shape to provide a secondary seal, to control sealant depth and otherwise contribute to optimum sealant performance.

D. 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.

2.5 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: Non-staining, 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.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

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 C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.4 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.

END OF SECTION 079200

SECTION 081113
HOLLOW METAL DOORS & FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. New interior fire rated hollow metal door, frames and borrowed lite.

B. Related Requirements:

1. Section 081416 "Flush Wood Doors" for new wood doors set in new hollow metal frames.
2. Section 088000 “Glazing” for glazing of hollow metal door and frames.
3. Section 092900 "Gypsum Board Systems" for installing new hollow metal frames in gypsum board partitions.
4. Section 099000 "Painting" for finish painting of new hollow metal door and frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and finishes.

B. Shop Drawings: Include the following:

1. Elevation of door and frame.
2. Details of door, including vertical and horizontal edge details and metal thickness.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.

1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For hollow metal door frame assembly, for tests performed by a qualified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frame with two removable spreader bars across bottom of frames, tack welded to jambs.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each unit to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturers:

1. Hollow metal door frame shall be manufactured by one of the following:

a. Ceco.
b. Curries.
c. Mesker.
d. Precision Metals.
e. Philipp.
f. Steelcraft.
g. Security Metal Products Corp.
h. Republic.

2.2 INTERIOR HOLLOW METAL DOOR AND FRAME

A. Construct interior doors and frame to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Commercial Doors and Frames: NAAMM-HMMA 861

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches (44.5 mm.)
c. Face: 18 ga steel.
d. Edge Construction: Continuously welded with no visible seam.
e. Core: fire rated.

3. Interior Frame:

   a. Form frames from 16-gauge sheet steel**,** with machine-mitered corners of interlock construction having faces only welded.
   b. Fire-Rated Frame: Construct frames occurring in fire rated openings to meet and receive fire resistant ratings scheduled.

4. Exposed Finish: Prime.

C. Removable Glazing Stops:

1. Rolled 20-gauge steel ch`annels formed to finish slightly recessed frame face.
2. Corners: Mitered.
3. Attachment: Prepare for countersunk screws at minimum 12" o.c. Furnish Phillips type screws..

D. Frame Anchors

1. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows.

E. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), clip-type anchors, with two holes to receive fasteners.

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

F. Materials:

1. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
2. Frame Anchors: Steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
3. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/ A 153M.
4. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated

2.3 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Door:

1. Steel-Stiffened Door Cores: Provide minimum thickness 0.026 inch (0.66 mm), steel vertical stiffeners of same material as face sheets extending full-door height, with vertical webs spaced not more than 6 inches (152 mm) apart. Spot weld to face sheets no more than 5 inches (127 mm) o.c. Fill spaces between stiffeners with glass or mineral-fiber insulation.

2. Vertical Edges for Single-Acting Door: Provide beveled or square edges at manufacturer's discretion.
3. Top Edge Closures: Close top edges of door with flush closures of same material as face sheets.
4. Bottom Edge Closures: Close bottom edges of door where required for attachment of weather stripping with end closures or channels of same material as face sheets.

C. Hollow-Metal Frame: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
2. Grout Guards: Weld guards to frame at back of hardware mortises in frame to be grouted.
3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
4. Head Anchors When recommended by Manufacturer): Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
6. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick
7. Glazing Stops: Fasten them loosely in place with required fasteners**,** leaving glazing rabbets ready for installation of glass by glazers.

D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce hollow metal frame to receive nontemplated, mortised, and surface-mounted hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.4 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 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 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap frames to receive nontemplated, mortised, and surface-mounted hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frame: Install hollow-metal frames for doors, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frame accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. Where frame is fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    b. Install door silencers in frames before grouting.
    c. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    d. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    e. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb that extends to floor, and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. In-Place Concrete Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

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

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

END OF SECTION 081113

SECTION 081416
FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Solid-core fire-rated pre-finished doors with wood-veneer faces.
2. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 061000 "Carpentry Work" for finish hardware installation.
2. Section 081113 "Hollow Metal Door Frames" for hollow metal door frames.
3. Section 087100 "Finish Hardware" for wood door finish hardware.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction. Include factory-finishing specifications.

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

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Undercuts.

C. Samples for Verification:

1. Provide Samples for species of veneer and solid lumber required.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

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

1.5 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.

1.6 WARRANTY

A. A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 TYPE AND MANUFACTURERS

A. Construction: Solid core**,** flush**,** wood veneer faced door of 5-ply hot press or 7-ply cold press construction**,** 1-3/4" thick. Factory finish stain color and sheen shall be as selected by Architect.

B. Acceptable Manufacturers: One of the following:

1. Algoma Hardwoods**,** Inc.
2. Eggers Hardwood Products Corp.
3. Oshkosh Architectural Door.
4. V.T. Industries, Inc.
5. Graham Manufacturing Corp.

2.2 MATERIALS AND CONSTRUCTION

A. Face Panels:

1. Construction for Factory Finish: 2-ply face panels. Manufacturer's standard 3-ply face veneers will be accepted in lieu of 2-ply.
2. Face Veneer Species**,** Grade and Cut: Plain sliced Red Oak, slip matched**,** Type I**,** Grade A**,** per AWI **"**Quality Standards**"** Section 01300 and C.S. 171-64. (No rotary or half round sliced veneers accepted.).

B. Crossbands (5/7-Ply Construction): Hardwood or natural/engineered fiberboard**,** minimum 1/16" thick**,** tapeless spliced**,** no voids.

C. Cores: Thickness: Matched to face veneer and crossband thicknesses so as to produce a door 1-3/4" thick.

D. Stiles & Rails: Solid**,** sound wood or structural composite lumber (SCL)**,** 1-3/8" minimum total width for stiles**,** 1-1/8" for rails**,** securely bonded to the core and then abrasively planed before application of face veneers to ensure minimal telegraphing of core parts through veneers.

1. Finish the vertical edges of door with hardwood of same species and grade as door veneers.

2. Stile Edge Split Resistance: Minimum of 750 lbs when tested per ASTM D 143-52/78 Modified.
3. Screw Withdrawal Resistance: Minimum of 740 lbs when tested per ASTM D 1037-78.

2.3 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

2.4 FINISH

A. Faces and edges as well as door frames and trim shall be factory finished with one of the following systems meeting or exceeding the performance standards of TR/OP 6**,** catalyzed polyurethane:

1. TR/OP 6 catalyzed polyurethane.
2. AWI 1500 Finish System #3 (conversion alkyd-urea varnish) or System #5 (catalyzed polyurethane)**,** Premium Grade.
3. AWI Division 1500 Finish System S-4.
4. NWWDA G-17 Finish System.

B. Factory finished - Stain color and sheen shall be as selected by Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.

1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

3.3 ADJUSTING

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

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

END OF SECTION 081416

SECTION 084113
ALUMINUM FRAMED ENTRANCES

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. Aluminum entrance doors and vestibule doors and frames.
2. Seals around frame perimeters.
3. Weatherstripping.
4. Installation of hardware furnished for aluminum entrances by hardware supplier as specified in Section 087100 - Finish Hardware.
5. Perimeter sealant installation in accordance with requirements of Section 079200 - Joint Sealants.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for sealing at aluminum door frames
2. Section 087100 "Finish Hardware" for new aluminum doors and frames finish hardware.
3. Section 088000 "Glazing" for new glass.

1.3 QUALITY ASSURANCE

A. Installer's Qualifications: Company specializing in installation of systems of the type specified for 5 years, and approved by system manufacturer.

B. Fabrication Tolerances: Fabricate aluminum storefront in accordance with framing manufacturer's prescribed tolerances.

C. Thermal Break Components: Manufactured to meet the following standards:

1. AAMA QAG 1–98**, "**Quality Assurance Processing Guide for Poured and Debridged Polyurethane Thermal Barriers.**"**
2. AAMA TIR A8–90**, "**Structural Performance of Poured and Debridged Framing Systems.**"**
3. AAMA 505-98**, "**Dry Shrinkage and Composite Performance Thermal Cycling Test Procedure.**"**

D. Coordination:

1. Installer of aluminum entrance doors and frames shall be responsible for installing each complete with glass and perimeter sealant.
2. Coordinate with Finish Hardware Supplier as required to assure proper fitting of hardware items furnished under Section 087100.

    a. Hardware Installation: According to templates approved by hardware item manufacturers.
    b. Hardware Templates: Report to Architect in writing should templates not be delivered by Hardware Supplier in sufficient time to meet construction schedules.

3. Glazing: Installer of aluminum entrance doors shall be responsible for installing them complete with glass.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and finishes.

B. Shop Drawings: Show elevations and details, including gaskets, weatherstripping, methods of anchoring, type of alloy, finishes; size and thickness of individual parts, dissimilar metal protection.

1. Shop drawings for the window systems shall bear the seal and signature of a Structural Engineer licensed in the State of Illinois and contain:

    a. Anchor locations - If anchors other than thru-jamb type are used, contractor to provide required interior trim as required to conceal fasteners whether shown on the drawings or not.
    b. Structural integrity.
    c. Wind loading.
    d. Structural loading.
    e. All installations shall be based on the 2015 IBC.

C. Samples: Submit for Architect's review:

1. 2 samples 6" long of each color available for each type of glazing sealant and gasket exposed to view.
2. Full size samples of each framing system.

D. Certificates: Submit manufacturer's certification that Installer is approved by manufacturer.

1.5 PRODUCT STORAGE, AND HANDLING

A. Uncrate doors, frames and related accessories and store in strict compliance with the manufacturer's instructions. Remove all padding and packing in contact with aluminum immediately upon arrival in order to prevent staining.

1.6 WARRANTIES

A. Manufacturer shall agree to repair or replace units whose components fail due to inferior materials or workmanship within 10 years of installation. Failures shall include but are not be limited to:

1. Structural failures including excessive deflection**,** leakage or air infiltration.
2. Failure of insulating glass, including interpane dusting or misting and internal dew point rising above -50°F.

B. Warranty Period:

1. Manufacturer: 10 years from date of Substantial Completion.
2. Installer: 5 years from date of Substantial Completion
3. Finish: Manufacturer's standard warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURER AND TYPE

A. Acceptable Products:

1. Exterior Entrance Doors and Frames:

   a. Thermally Broke Aluminum Door Frame: TriFab "VG 451T" as manufactured by Kawneer as the Basis-of-Design or comparable products by Efco, Tubelite, Manko or YKK AP or Owner Approved Equal.

      1) Frames shall have with a nominal profile of 2" x 4 1/2".

   b. Non-Thermally Broke Aluminum Entrance Doors: Doors shall be heavy duty swing type, "Standard 500" (2" deep) as manufactured by Kawneer as the Basis-of-Design or comparable products by Efco, Tubelite, Manko or YKK AP.

   c. Hardware and Lock Cylinders: As furnished under Section 087100 – Finish Hardware.

2. Interior Vestibule Doors and Frames:

   a. Aluminum Door Frame: TriFab "VG 451" as manufactured by Kawneer as the Basis-of-Design or comparable products by Efco, Tubelite, Manko or YKK AP or Owner Approved Equal.

      1) Frames shall have with a nominal profile of 1 3/4" x 4 1/2".

   b. Aluminum Entrance Doors: Doors shall be heavy duty swing type, "Standard 500" (2" deep) as manufactured by Kawneer as the Basis-of-Design or comparable products by Efco, Tubelite, Manko or YKK AP.

      1) Door thickness of 2".

   c. Hardware and Lock Cylinders: As furnished under Section 087100 – Finish Hardware.

2.2 MATERIALS AND CONSTRUCTION

A. Aluminum (Framing and Components):

1. Material Standard: ASTM B 221; 6063-T6 alloy and temper.
2. Wall Thickness: minimum wall thickness of 3/16."
3. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.
4. Thermal Breaks: Manufacturer's standard type. Poured-in-place polyurethane type shall have maximum tensile strength of 4,300 psi.

B. Accessories:

1. Fasteners: Where exposed, shall be Stainless Steel.
2. Gaskets: Glazing gaskets shall be extruded EPDM rubber.
3. Perimeter Anchors: Aluminum. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.
4. Dissimilar Metal Protection: Alkali resistant bituminous paint conforming to AN-P 31**,** plastic separators**,** insulating tapes or manufacturer**'**s standard**,** subject to Architect**'**s approval.

C. Weatherstripping: Thermoplastic elastomer weatherstrip system on all sides of exterior doors and/or frames**,** meeting AAMA 702 requirements. Provide surface applied bottom weatherstrip with flexible blade gasket at bottoms of doors.

D. Internal Joint Sealant: Polyisobutylene non-hardening thin-joint sealant **"**Presstite #579**"** or equal.

E. Sealants: See Section 079200 - Joint Sealants.

F. Glass: See Section 088000 - Glazing.

G. Material Separation: Provide a coating or material between dissimilar materials as recommended by aluminum door manufacturer to protect against corrosion of aluminum materials.

2.3 FABRICATIONS

A. Fabricate components per manufacturer's installation instructions and with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Arrange fasteners and attachments to conceal from view.

2.4 FINISH

A. Finishs: Provide the following finishes as noted on drawings:

1. Natural Anodized Aluminum, AA-C22A41, Class I (min. 0.7 mils thickness and sealed), clear natural aluminum color for Ellis Elementary School, RESA Middle School and Thurgood Marshall Middle School.
2. Baked-on fluoropolymer coating having 70% Kynar 500 or Hylar 5000 resin, in custom color selected by Architect for Lewis Lemon Elementary School.
3. Unexposed metal surfaces may remain uncoated.

2.5 FABRICATION

A. General: Fabricate and assemble in as large sections in shop as consistent with shipping and field requirements.

B. Joints: Shall be flush, hairline. Field splices and joints between sections shall produce strength to resist misalignment and deformations imposed by handling and live loads. Keep fasteners concealed.

C. Doors: Corners: Dual moment construction consisting of mechanical fastening using extruded aluminum channel clips and bolt fasteners and SIGMA deep penetration plug welds and fillet welds.

D. Reinforce doors and frames for hardware with backing plates of non-magnetic steel or hot-dip galvanized steel complying with ASTM A 36.

1. Reinforce for butt hinges with 1/4" steel plates 10" long welded to aluminum with 6 welds, each 1/2" long.
2. Reinforce for closers with 10-gauge plate, 12-gauge plate for other hardware.
3. Reinforce for all other cutouts and mortises similarly.

E. Provide positive means to drain to the outside any water entering the system.

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 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap frames to receive nontemplated, mortised, and surface-mounted hardware.

C. All surfaces that may contact steel**,** concrete or masonry construction shall be prepared with dissimilar protection materials hereinbefore specified. Aluminum surfaces to remain exposed shall be protected from bituminous paint application.

3.3 INSTALLATION

A. Set frames in locations shown, level, plumb and in line. Seal joints between framing members and mullions. Where moldings are jointed, accurately cut and fit members to result in tightly closed joints.

B. Do not use exposed fasteners except as approved by Architect.

C. Internal Drainage: Cut, join and seal members to form positive paths of drainage within the framing in order to prevent any water that may enter the system from leaking through to interior of building.

D. Frame Anchors: Unless indicated or approved otherwise, space anchors all around opening at not more than 24" o.c. Powder-actuated fasteners will not be allowed.

E. Glazing Application:

1. Center plane.
2. Outside glazed.

F. Glazing Beads: Make corners square, butted and tightly fit.

G. Glazing Seals: Furnish seals to glass installer, ready for installation of glazing.

H. Apply sealant to both sides of perimeter of frames, using materials and methods specified in Section 079200 - Joint Sealants, including submissions.

I. Install Material Separation: Provide a coating or material between dissimilar materials as recommended by aluminum door system's manufacturer to protect against corrosion of aluminum materials.

J. Contractor is allowed to install head receptors. No jamb receptors will be allowed.

K. Finish Hardware: Install finish hardware as specified in Section 087100.

3.4 ADJUSTING, CLEANING AND PROTECTION

A. Hardware Adjustment: Adjust and check each operating item, to ensure proper operation and function.

B. Hardware Lubrication: Lubricate moving parts with lubricant recommended by manufacturer. Use graphite-type lubricant if none other recommended.

C. Hardware Replacement: Replace units that cannot be adjusted and lubricated to operate freely and smoothly as intended.

D. Cleaning: Clean aluminum surfaces promptly after installation of frames and doors, exercising care to clean corners and to avoid damage of the protective coating (if any). Remove excess glazing and sealant compounds, dirt and other substances. Final cleaning will be done by General Contractor just prior to time of acceptance.

E. Touch-Up: Scratches and abrasions shall be touched-up with finish manufacturer's recommended coating, to satisfaction of Architect.

F. Protection:

1. General Contractor shall provide protective measures and other precautions as required through remainder of construction period**,** according to recommendations of Installer**,** to ensure that doors and frames will be without damage or deterioration (other than normal weathering) at time of acceptance.
2. Plastic films applied for protection during shipment shall not be used for protection after installation of aluminum.

END OF SECTION 084113

SECTION 085113
ALUMINUM STOREFRONT WINDOWS

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. Fixed aluminum storefront windows.

B. Related Requirements:

1. Section 079200 "Joint Sealants" for perimeter sealing of aluminum windows to exterior walls.
2. Section 088000 "Glazing" for glass and metal panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Washington Academy.

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review, discuss, and coordinate the interrelationship of aluminum windows with other exterior wall components. Include provisions for anchorage, flashing, sealing perimeters, and protecting finishes.
3. Review and discuss the sequence of work required to construct a watertight and weathertight exterior building envelope.
4. Inspect and discuss the condition of substrate and other preparatory work performed by other trades.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for aluminum windows.

B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

1. Submit shop drawings by date shown on drawings.
    a. Shop drawings must be prepared wholly by the window manufacturer, or a qualified engineering services firm under the direction of the manufacturer.
    b. After mockups are field tested and approved, window manufacturer shall complete the shop drawings for the remaining windows.
2. Shop drawings for the window systems shall bear the seal and signature of a Structural Engineer licensed in the State of Illinois and contain:
    a. Anchor locations - If anchors other than thru-jamb type are used, contractor to provide required interior trim as required to conceal fasteners whether shown on the drawings or not.
    b. Structural integrity.
    c. Wind loading.
    d. Structural loading.
    e. All window installations shall be based on the 2015 IBC.

C. Samples: For each exposed product and for each color specified, 2 by 4 inches (50 by 100 mm) in size.

D. Samples for Initial Selection: For units with factory-applied color finishes.
1. Include similar Samples of hardware and accessories involving color selection.

E. Samples for Verification: For aluminum windows and components required, showing full range of color variations for finishes, and prepared on Samples of size indicated below:
1. Exposed Finishes: 2 by 4 inches (50 by 100 mm).
2. Exposed Hardware: Full-size units.

F. Product Schedule: For aluminum windows. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Test Reports: For each type of aluminum window, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For manufacturer's warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating aluminum windows that meet or exceed performance requirements indicated and of documenting this performance by test reports, and calculations.

B. Installer Qualifications: An installer acceptable to aluminum window manufacturer for installation of units required for this Project, who has a minimum of 5 years experience in similar window installation projects.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace aluminum windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Failure to meet performance requirements.
   b. Structural failures including excessive deflection, water leakage, condensation, and air infiltration.
   c. Faulty operation of movable sash and hardware.
   d. Deterioration of materials and finishes beyond normal weathering.

2. Warranty Period:

   a. Window Manufacturer: 10 years from date of Substantial Completion.
   b. Window Installer: 5 years from date of Substantial Completion.
   c. Finish: 20 year Manufacturer’s standard warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable Products:

1. Basis-of-Design is Kawneer Window System or comparable products by Efco, Tubelite, Manko or YKK AP or Owner Approved Equal:

   a. Fixed: 451 TVG, 2” x 4 ½”.

B. Source Limitations: Obtain aluminum windows from single source from single manufacturer.

2.2 MATERIALS

A. All aluminum members**,** frames**,** sash bars**,** glazing beads**,** muntins and mullions shall be extruded from 6063T alloy of suitable temper and have a minimum tensile strength of 28**,**000 psi.

1. No main member shall have a wall thickness less than .070"
2. Aluminum glazing beads shall be snap-in type with a minimum wall thickness of .050".
3. Sills/subsills shall have a minimum wall thickness of .090".

B. Aluminum Glazing Beads: Extruded snap-in type with glazing legs no less than 3/4".

C. Thermal Barrier: Poured in place polyurethane with max. tensile strength of 4300 psi.

1. Thermally Improved Construction: Fabricate frames, sashes, and muntins with an integral, concealed, low-conductance thermal barrier located between exterior materials and window members exposed on interior side in a manner that eliminates direct metal-to-metal contact.

D. Weatherstripping: Two rows of jacketed foam or neoprene fin gaskets or polypropylene pile installed in dovetailed grooves extruded in sash members and secured to prevent movement, shrinkage or loss. Jacketed type shall conform to AAMA 701.2.

E. Glazing Seals: As furnished by window manufacturer; color as selected by Architect from manufacturer's standard color options. Any of the following types may be used:

1. Extruded EPDM dry gasket seals with impervious skins.
2. Extruded vinyl dry gasket seals with impervious skins, meeting ASTM D 2287.
3. Extruded neoprene dry gasket seals with impervious skins, meeting ASTM D 2000, type 2BC415 to 3BC415.
4. Extruded silicone dry gasket seals with impervious skins.
5. Expanded neoprene gaskets with impervious skins meeting ASTM C 509, Grade 4.
6. Butyl tape and silicone wet seals as standard to window manufacturer.

F. Anchors: Aluminum or steel. When anchors are steel they must be primed with shop coat of approved zinc chromate primer and insulated from the aluminum members or must be cadmium or zinc plated to meet ASTM A 165 or A 164 requirements.

G. Fasteners:

1. Frame Assembly Fasteners: Non-magnetic stainless steel.
2. Miscellaneous Fasteners: Aluminum or non-magnetic stainless steel, with finish color to match frames where exposed to view.
3. Frame Anchor Clip Fasteners: Expansion bolts, toggle bolts or lag screws, as required by building construction material, not less than 1/4" dia., cadmium or zinc plated steel in accordance with ASTM A 164 and A 165.
4. No plastic expansion anchors allowed.

H. Sills/Subsills:

1. Extruded aluminum sections shall assure that any water entering the glazing channels will be positively weeped to the exterior. Furnish sills with sub-structural components, such as legs and/or blocking, so as to assure complete support of the sill across the window opening.
2. Subsills: Thermally broken, extruded-aluminum subsills in configurations indicated on Drawings.

I. Receptors: Head and Jamb receptors are not allowed.

J. Dissimilar Metal Protection: Alkali resistant bituminous paint conforming to AN-P 31, plastic separators, insulating tapes or manufacturer's standard, subject to Architect's approval.

2.3 COMPONENTS

A. Hardware:

1. All steel components including attachment fasteners to be stainless steel except as otherwise noted.
2. Extruded aluminum components 6063-T5 or T6.
3. Locking handles, bases and strikes to be die cast, white bronze or stainless steel.

B. Sealants:

1. All sealants shall comply with applicable provisions of AAMA 800 and/or Federal Specifications FS-TT-001 and 002 Series.
2. Frame joinery sealants shall be suitable for application specified and as tested and approved by window manufacturer.

2.4 WINDOW PERFORMANCE REQUIREMENTS

A. Design Wind Loads:

1. The design wind pressure for the project shall be per the IBC 2015 code and should be determined by the Structural Engineer licensed in the State of Illinois obtained by the manufacturer.
2. All structural components, including meeting rails, mullions, anchors and added reinforcing shall be designed accordingly, by a Structural Engineer licensed in the State of Illinois, complying with deflection and stress requirements as listed herein.

B. Air Test: Air infiltration maximum 0.1 cfm per square foot at 6.24 psf pressure differential when tested in accord with ASTM E283.

C. Water Test: No uncontrolled water leakage at 12.00 psf static pressure differential, with Water application rate of 5 gallons/hr/sq ft when tested in accord with SASTM E331 and ASTM E547.

2.5 GLAZING

A. See Specification Section 088000 "Glazing".

2.6 HARDWARE

A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

B. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range of colors.

C. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners and Anchors: Do not use exposed fasteners or anchors to the greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.
2. Exposed fasteners or anchors shall be covered by trim which matches the finish and colors of the window frame.

2.7 FABRICATION

A. Fabricate aluminum windows in sizes indicated. Include a complete system for assembling components and anchoring windows.

B. Weather strip each operable sash to provide weathertight installation.

C. Weep Holes: Provide weep holes and internal passages to conduct infiltrating water to exterior.

2.8 ALUMINUM FINISHES

A. Finishs: Provide the following finishes as noted on drawings:

1. Natural Anodized Aluminum, AA-C22A41, Class I (min. 0.7 mils thickness and sealed), clear natural aluminum color for Ellis Elementary School, RESA Middle School and Thurgood Marshall Middle School.
2. Baked-on fluoropolymer coating having 70% Kynar 500 or Hylar 5000 resin, in custom color selected by Architect for Lewies Lemon Elementary School.
3. Unexposed metal surfaces may remain uncoated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.

B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

E. Glazing Application:

1. Center plane.
2. Outside glazed except where otherwise noted on drawings.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 085113

SECTION 087100
FINISH 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. Mechanical door hardware for interior and exterior swinging doors.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames" for new hollow doors set in new hollow metal frames.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

   a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
   b. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.

c. Content: Include the following information:

1) Identification number, location, hand, size, and material of each door and frame.
2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
4) Fastenings and other pertinent information.
5) Explanation of abbreviations, symbols, and codes contained in schedule.
6) Mounting locations for door hardware.
7) List of related door devices specified in other Sections for each door and frame.

2. Keying: Provide Sargent LA 6 pin at Ellis and Marshall MS, Sargent LG 6 pin at Lewis Lemon and Schlage E 6 pin at RESA. Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents. Coordinate all keying with the Owner.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.

B. Source Limitations: Obtain each type of door hardware from a single manufacturer.

C. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

D. Accessibility Requirements: Comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and ICC A117.1.

1. 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 (22.2 N).
2. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
3. Closers: Adjust door and gate closer sweep periods so that, from an open position of 90 degrees, the time required to move the door to a position of 12 degrees from the latch is 5 seconds minimum.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.7 COORDINATION

A. 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.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

C. 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.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including excessive deflection, cracking, or breakage.
    b. Faulty operation of doors and door hardware.
    c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Two years from date of Substantial Completion, unless otherwise indicated.

    a. Exit Devices: 3 years from date of Substantial Completion.
    b. Manual Closers: 10 years from date of Substantial Completion.
    c. Bored Locksets: 3 years from date of Substantial Completion.
    d. Hinges: Life of Building from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section as follows:

1. Continuous Hinges: Roton, No substitutions.
2. Locks: Sargent, No substitutions.
3. Closers: Norton, No substitutions.
4. All Other Hardware: As specified or Owner approved equal.

2.2 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Spacers or Sex Bolts: For through bolting of hollow-metal doors and wood doors.
3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.3 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other 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 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.

B. 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.

3.3 INSTALLATION

A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.

B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install type quantities indicated in door hardware schedule.

D. Thresholds: Set threshold in full bed of sealant.

E. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

F. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

G. Closers: Sex-bolt all closers on wood doors. Provide drop plates where required.

3.4 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DOOR HARDWARE SCHEDULE

Hardware Group No. 01

E101B R104B T103B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ROTON HINGE	780-112HD-EPT10	CLR	ROT
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELECTRIFIED EXIT DEVICE	56-8810	626	SAR
1	EA	90 DEG OFFSET PULL	8190HD 10" STD	630	IVE
1	EA	OH STOP	100S	630	GLY
1	EA	CLOSER	PR7500	689	NOR
1	EA	BLADE STOP SPACER	6891	689	NOR
1	EA	PA DROP PLATE	7788	689	NOR
1	EA	WEATHER STRIPPING	BY DOOR/FRAME MANUFACTURER		B/O
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-V3-223	A	ZER
1	EA	AXIS SYSTEM	SUPPLIED BY ELECTRICAL		AXS
1	EA	DOOR CONTACT	SUPPLIED BY ELECTRICAL		TBD
1	EA	POWER SUPPLY	3500 AS REQ.		SAR

AXIS SYSTEM IS TO RETRACT LATCH AND SHUNT ANY ALARM ASSOCIATED WITH THE DOOR CONTACT ALLOWING THE DOOR TO BE OPENED. FREE EGRESS IS ALWAYS AVAILABLE.

ITEMS TO BE PROVIDED BY DIVISION 28 SUPPLIER:
AXIS SYSTEM.
DOOR CONTACT.
REQUIRED WIRING FROM POWER SUPPLY TO ELECTRIFIED EXIT DEVICE.
REQUIRED POWER AND WIRING TO THE AXIS SYSTEM AND THE DOOR CONTACT.

Hardware Group No. 02

R102B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ROTON HINGE	780-112HD	CLR	ROT
1	EA	EXIT DEVICE	8810	626	SAR
1	EA	90 DEG OFFSET PULL	8190HD 10" STD	630	IVE
1	EA	OH STOP	100S	630	GLY
1	EA	CLOSER	PR7500	689	NOR
1	EA	BLADE STOP SPACER	6891	689	NOR
1	EA	PA DROP PLATE	7788	689	NOR
1	EA	WEATHER STRIPPING	BY DOOR/FRAME MANUFACTURER		B/O
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-V3-223	A	ZER
1	EA	DOOR CONTACT	SUPPLIED BY ELECTRICAL		TBD

MONITOR ONLY.

ITEMS TO BE PROVIDED BY DIVISION 28 SUPPLIER:
DOOR CONTACT.
REQUIRED POWER AND WIRING TO THE DOOR CONTACT.

Hardware Group No. 03

E101A R104A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ROTON HINGE	780-112HD-EPT10	CLR	ROT
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELECTRIFIED EXIT DEVICE	56-8810	626	SAR
1	EA	90 DEG OFFSET PULL	8190HD 10" STD	630	IVE
1	EA	OH STOP	100S	630	GLY
1	EA	CLOSER	PR7500	689	NOR
1	EA	BLADE STOP SPACER	6891	689	NOR
1	EA	PA DROP PLATE	7788	689	NOR
1	EA	AXIS SYSTEM	SUPPLIED BY ELECTRICAL		AXS
1	EA	POWER SUPPLY	3500 AS REQ.		SAR

AXIS SYSTEM IS TO RETRACT LATCH ALLOWING THE DOOR TO BE OPENED. FREE EGRESS IS ALWAYS AVAILABLE.

ITEMS TO BE PROVIDED BY DIVISION 28 SUPPLIER:
AXIS SYSTEM.
REQUIRED WIRING FROM POWER SUPPLY TO ELECTRIFIED EXIT DEVICE.
REQUIRED POWER AND WIRING TO THE AXIS SYSTEM.

Hardware Group No. 04

L101A T103A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ROTON HINGE	780-224HD-EPT10	CLR	ROT
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	FIRE RATED ELECTRIFIED EXIT DEVICE	12-56-8810	626	SAR
1	EA	90 DEG OFFSET PULL	8190HD 10" STD	630	IVE
1	EA	CLOSER	CPS7500	689	NOR
1	EA	KICK PLATE	8402 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
1	EA	AXIS SYSTEM	SUPPLIED BY ELECTRICAL		AXS
1	EA	POWER SUPPLY	3500 AS REQ.		SAR

AXIS SYSTEM IS TO RETRACT LATCH ALLOWING THE DOOR TO BE OPENED. FREE EGRESS IS ALWAYS AVAILABLE.

ITEMS TO BE PROVIDED BY DIVISION 28 SUPPLIER:
AXIS SYSTEM.
REQUIRED WIRING FROM POWER SUPPLY TO ELECTRIFIED EXIT DEVICE.
REQUIRED POWER AND WIRING TO THE AXIS SYSTEM.

Hardware Group No. 05

R103

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ROTON HINGE	780-112HD	CLR	ROT
1	EA	ASYLUM LOCK	28-10G17 LL	626	SAR
1	EA	ELECTRIC STRIKE	1006 FSE 12/24 VAC/VDC FACE PLATE AS REQ.	630	HES
1	EA	OH STOP	100S	630	GLY
1	EA	CLOSER	PR7500	689	NOR
1	EA	BLADE STOP SPACER	6891	689	NOR
1	EA	PA DROP PLATE	7788	689	NOR
1	EA	AXIS SYSTEM	SUPPLIED BY ELECTRICAL		AXS

AXIS SYSTEM IS TO RELEASE ELECTRIC STRIKE ALLOWING THE DOOR TO BE OPENED. KEYED INGRESS IS ALSO AVAILABLE. KEYED EGRESS IS ALSO AVAILABLE.

ITEMS TO BE PROVIDED BY DIVISION 28 SUPPLIER:
AXIS SYSTEM.
REQUIRED POWER AND WIRING TO THE AXIS SYSTEM AND ELECTRIC STRIKE.

Hardware Group No. 06

E102 L101B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ASYLUM LOCK	28-10G17 LL	626	SAR
1	EA	ELECTRIC STRIKE	1006 FSE 12/24 VAC/VDC FACE PLATE AS REQ.	630	HES
1	EA	AXIS SYSTEM	SUPPLIED BY ELECTRICAL		AXS
2	EA	CREDENTIAL READER	SUPPLIED BY ELECTRICAL		TBD

NOTE: PROVIDE RIV-NUT TYPE FASTENERS WHERE PROPER REINFORCEMENT IN THE FRAME IS NOT PRESENT. FIELD VERIFY ALL EXISTING OPENINGS TO CONFIRM FUNCTIONALITY OF NEW HARDWARE ITEMS.
NOTE: PROVIDE ANY AND ALL PLATES REQUIRED TO COVER EXISTING UNUSED PREPS IN THE DOOR SLAB. FIELD VERIFY ALL EXISTING OPENINGS TO CONFIRM FUNCTIONALITY OF NEW HARDWARE ITEMS.
NOTE: BALANCE OF HARDWARE THAT IS EXISTING TO REMAIN IS HINGES, CLOSER, SILENCERS/GASKETING, KICKPLATE AND WALL STOP.

AXIS SYSTEM OR EITHER CREDENTIAL READER RELEASES ELECTRIC STRIKE ALLOWING THE DOOR TO BE OPENED. KEYED INGRESS IS ALSO AVAILABLE. KEYED EGRESS IS ALSO AVAILABLE.

ITEMS TO BE PROVIDED BY DIVISION 28 SUPPLIER:
CREDENTIAL READER DEVICES.
AXIS SYSTEM.
REQUIRED POWER AND WIRING TO THE ELECTRIC STRIKE.

Hardware Group No. 07

E104

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ASYLUM LOCK	28-10G17 LL	626	SAR
1	EA	ELECTRIC STRIKE	1006 FSE 12/24 VAC/VDC FACE PLATE AS REQ.	630	HES
2	EA	CREDENTIAL READER	SUPPLIED BY ELECTRICAL		TBD

NOTE: PROVIDE RIV-NUT TYPE FASTENERS WHERE PROPER REINFORCEMENT IN THE FRAME IS NOT PRESENT. FIELD VERIFY ALL EXISTING OPENINGS TO CONFIRM FUNCTIONALITY OF NEW HARDWARE ITEMS.
NOTE: PROVIDE ANY AND ALL PLATES REQUIRED TO COVER EXISTING UNUSED PREPS IN THE DOOR SLAB. FIELD VERIFY ALL EXISTING OPENINGS TO CONFIRM FUNCTIONALITY OF NEW HARDWARE ITEMS.
NOTE: BALANCE OF HARDWARE THAT IS EXISTING TO REMAIN IS HINGES, CLOSER, SILENCERS/GASKETING, KICKPLATE AND WALL STOP.

EITHER CREDENTIAL READER RELEASES ELECTRIC STRIKE ALLOWING THE DOOR TO BE OPENED. KEYED INGRESS IS ALSO AVAILABLE. KEYED EGRESS IS ALSO AVAILABLE.

ITEMS TO BE PROVIDED BY DIVISION 28 SUPPLIER:
CREDENTIAL READER DEVICES.
REQUIRED POWER AND WIRING TO THE ELECTRIC STRIKE.

Hardware Group No. 08

T101 T102

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ASYLUM LOCK	28-10G17 LL	626	SAR
1	EA	ELECTRIC STRIKE	1006 FSE 12/24 VAC/VDC FACE PLATE AS REQ.	630	HES
1	EA	CLOSER	CPS7500	689	NOR
1	EA	KICK PLATE	8402 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188SBK PSA	BK	ZER
2	EA	CREDENTIAL READER	SUPPLIED BY ELECTRICAL		TBD

EITHER CREDENTIAL READER RELEASES ELECTRIC STRIKE ALLOWING THE DOOR TO BE OPENED. KEYED INGRESS IS ALSO AVAILABLE. KEYED EGRESS IS ALSO AVAILABLE.

ITEMS TO BE PROVIDED BY DIVISION 28 SUPPLIER:
CREDENTIAL READER DEVICES.
REQUIRED POWER AND WIRING TO THE ELECTRIC STRIKE.

Hardware Group No. 09

L101C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ASYLUM LOCK	28-10G17 LL	626	SAR
1	EA	ELECTRIC STRIKE	1006 FSE 12/24 VAC/VDC FACE PLATE AS REQ.	630	HES
1	EA	CLOSER	PR7500	689	NOR
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
2	EA	CREDENTIAL READER	SUPPLIED BY ELECTRICAL		TBD

EITHER CREDENTIAL READER RELEASES ELECTRIC STRIKE ALLOWING THE DOOR TO BE OPENED. KEYED INGRESS IS ALSO AVAILABLE. KEYED EGRESS IS ALSO AVAILABLE.

ITEMS TO BE PROVIDED BY DIVISION 28 SUPPLIER:
CREDENTIAL READER DEVICES.
REQUIRED POWER AND WIRING TO THE ELECTRIC STRIKE.

Hardware Group No. 10

L103

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	AXIS SYSTEM	SUPPLIED BY ELECTRICAL		AXS

NOTE: PROVIDE RIV-NUT TYPE FASTENERS WHERE PROPER REINFORCEMENT IN THE FRAME IS NOT PRESENT. FIELD VERIFY ALL EXISTING OPENINGS TO CONFIRM FUNCTIONALITY OF NEW HARDWARE ITEMS.
NOTE: BALANCE OF HARDWARE THAT IS EXISTING TO REMAIN IS HINGES, CLOSER, SILENCERS/GASKETING, KICKPLATE AND WALL STOP.

AXIS SYSTEM RETRACTS LATCH ALLOWING THE DOOR TO BE OPENED. KEYED INGRESS IS ALSO AVAILABLE. KEYED EGRESS IS ALSO AVAILABLE.

ITEMS TO BE PROVIDED BY DIVISION 28 SUPPLIER:
AXIS SYSTEM.

Hardware Group No. 11

L104A T105A T105B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	ROTON HINGE	780-112HD	CLR	ROT
2	EA	PUSH/PULL BAR	9190HD-10"-NO	630	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	CLOSER	PR7500	689	NOR
2	EA	BLADE STOP SPACER	6891	689	NOR
2	EA	PA DROP PLATE	7788	689	NOR

Hardware Group No. 12

R102A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ROTON HINGE	780-112HD	CLR	ROT
1	EA	PUSH/PULL BAR	9190HD-10"-NO	630	IVE
1	EA	OH STOP	100S	630	GLY
1	EA	CLOSER	PR7500	689	NOR
1	EA	BLADE STOP SPACER	6891	689	NOR
1	EA	PA DROP PLATE	7788	689	NOR

Hardware Group No. 13

T105D

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ROTON HINGE	780-112HD	CLR	ROT
1	EA	ROTON HINGE	780-112HD-EPT10	CLR	ROT
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	L980S	689	SAR
1	EA	ELECTRIFIED EXIT DEVICE	56-8804	626	SAR
1	EA	EXIT DEVICE	8810	626	SAR
1	EA	RIM CYLINDER	34	626	SAR
1	EA	MORTISE CYLINDER	41	626	SAR
2	EA	90 DEG OFFSET PULL	8190HD 10" STD	630	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	CLOSER	PR7500	689	NOR
1	SET	MEETING STILE	8193AA-S	AA	ZER
1	EA	WEATHER STRIPPING	BY DOOR/FRAME MANUFACTURER		B/O
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-V3-223	A	ZER
2	EA	DOOR CONTACT	SUPPLIED BY ELECTRICAL		TBD
1	EA	CREDENTIAL READER	SUPPLIED BY ELECTRICAL		TBD
1	EA	POWER SUPPLY	3500 AS REQ.		SAR

CREDENTIAL READER IS TO RETRACT LATCH AND SHUNT ANY ALARM ASSOCIATED WITH THE DOOR CONTACT ALLOWING THE DOOR TO BE OPENED. KEYED INGRESS IS ALSO AVAILABLE. FREE EGRESS IS ALWAYS AVAILABLE.

ITEMS TO BE PROVIDED BY DIVISION 28 SUPPLIER:
CREDENTIAL READER.
DOOR CONTACTS.
REQUIRED WIRING FROM POWER SUPPLY TO ELECTRIFIED EXIT DEVICE.
REQUIRED POWER AND WIRING TO THE DOOR CONTACTS.

Hardware Group No. 14

L104B

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	ROTON HINGE	780-112HD	CLR	ROT
1	EA	ROTON HINGE	780-112HD-EPT10	CLR	ROT
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	L980S	689	SAR
1	EA	ELECTRIFIED EXIT DEVICE	56-8804	626	SAR
1	EA	EXIT DEVICE	8810	626	SAR
1	EA	RIM CYLINDER	34	626	SAR
1	EA	MORTISE CYLINDER	41	626	SAR
2	EA	90 DEG OFFSET PULL	8190HD 10" STD	630	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	CLOSER	PR7500	689	NOR
1	SET	MEETING STILE	8193AA-S	AA	ZER
1	EA	WEATHER STRIPPING	BY DOOR/FRAME MANUFACTURER		B/O
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-V3-223	A	ZER
2	EA	DOOR CONTACT	SUPPLIED BY ELECTRICAL FIELD VERIFY CONDITION OF EXISTING AND REPLACE AS REQUIRED		TBD
1	EA	CREDENTIAL READER	SUPPLIED BY ELECTRICAL FIELD VERIFY CONDITION OF EXISTING AND REPLACE AS REQUIRED		TBD
1	EA	POWER SUPPLY	3500 AS REQ.		SAR

NOTE: FIELD VERIFY EXISTING CARD READER AND DOOR CONTACTS USABILITY. REINSTALL EXISTING IF THEY ARE IN GOOD WORKING ORDER. PROVIDE NEW IF THEY ARE NOT USABLE.

CREDENTIAL READER IS TO RETRACT LATCH AND SHUNT ANY ALARM ASSOCIATED WITH THE DOOR CONTACT ALLOWING THE DOOR TO BE OPENED. KEYED INGRESS IS ALSO AVAILABLE. FREE EGRESS IS ALWAYS AVAILABLE.

ITEMS TO BE PROVIDED BY DIVISION 28 SUPPLIER:
CREDENTIAL READER.
DOOR CONTACTS.
REQUIRED WIRING FROM POWER SUPPLY TO ELECTRIFIED EXIT DEVICE.
REQUIRED POWER AND WIRING TO THE DOOR CONTACTS.

Hardware Group No. 15

T105C

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	ROTON HINGE	780-112HD	CLR	ROT
1	EA	REMOVABLE MULLION	L980S	689	SAR
2	EA	EXIT DEVICE	8810	626	SAR
1	EA	MORTISE CYLINDER	41	626	SAR
2	EA	90 DEG OFFSET PULL	8190HD 10" STD	630	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	CLOSER	PR7500	689	NOR
1	SET	MEETING STILE	8193AA-S	AA	ZER
1	EA	WEATHER STRIPPING	BY DOOR/FRAME MANUFACTURER		B/O
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-V3-223	A	ZER
2	EA	DOOR CONTACT	SUPPLIED BY ELECTRICAL		TBD

MONITOR ONLY.

ITEMS TO BE PROVIDED BY DIVISION 28 SUPPLIER:
DOOR CONTACTS.
REQUIRED POWER AND WIRING TO THE DOOR CONTACTS.

END OF SECTION 087100

SECTION 088000
GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Glazing of interior doors and sidelights.
2. Glazing of exterior and interior aluminum storefront windows, entrance framing and doors.
3. Glazing of borrowed lites.

B. Related Requirements:

1. Section 081113 "Hollow Metal Doors & Frames" for glazing of new H.M doors and frames.
2. Section 084113 "Aluminum Storefront Windows" for glazing of new aluminum windows.
3. Section 085113 "Aluminum Framed Entrances" for glazing of new aluminum Entrances.

1.3 QUALITY ASSURANCE

A. Comply with all pertinent codes and regulations, including the Consumer Product Safety Commission Safety Standard for Architectural Glazing Materials (16 CFR 1201) and the State of Illinois Safety Glazing Materials Act.

B. Comply with all pertinent recommendations in the Glazing Manual of the Flat Glass Marketing Association.

C. All glass shall bear glass manufacturer's label stating variety and grade.

1.4 SUBMITTALS

A. Product Data: Submit manufacturers' product data describing each type of glass and glazing item specified herein.

B. Samples: Submit for Architect's review 2 samples, 6" square, of each type of glass required.

C. Manufacturer's Instructions: Submit glazing gasket manufacturer's recommendations for each installation situation.

1.5 WARRANTIES

A. Installer shall guarantee installed work to be waterproof for a period of 5 years.

B. Insulating glass units shall be warranted for 10 years against failure**,** including interpane dusting or misting and internal dew point rising above -50°F. Warranty shall provide for replacement of glass and glazing**,** including labor.

1.6 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver glazing materials to job site in sealed containers with manufacturer's original labels attached to each piece of glass. Provide UL labels for fire rated glass. Provide cushions at edges to prevent impact damage.

B. Store glass on edge, under cover and protect from staining.

C. Avoid deformation of units. Protect faces from scratches and abrasion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Insulating-Glass Units: ASTM E 2190, certified through IGCC as complying with requirements of IGCC. PPG is the basis-of design manufacturer or Owner approved equal products of Guardian and Pilkington during the bidding phase. Glass types shall be as follows:

1. GL 1: 1/4” Clear Tempered Glass

2. GL-2: PPG 1” Insulated Solarban R100-Tempered:

   a. ¼” tempered on clear neutral reflective Low-E #2 surface.
   b. ½” airspace with argon.
   c. ¼” clear tempered.

3. GL-3: PPG 1” Insulated Solarban R100-Laminated

   a. ¼” tempered on clear neutral reflective Low-E #2 surface.
   b. ½” airspace with argon.
   c. ¼” laminate – 1/8” clear - 030 Clear PVB – 1/8” clear:

4. GL 4: Fire Rated Safety Clear Glass. See drawings for ratings.

5. GL-5: Translucent Fire Rated Glass: 1/3 hr. Fire Rated Safety Glass.

6. GL-6: 1” Insulated Metal Panel: : 1" thick insulated sandwich panels consisting of an isocyanurate core laminated to 1/8" tempered hardboard substrates with smooth aluminum skins.

   a. “R” Value of Core: At least 6.
   b. Finish: On both sides of panels shall be smooth aluminum with a Kynar 500 finish in colors as follows.

      1) Exterior Face: Color as approved by Architect
      2) Interior Face: Color as selected by Architect.
   c. Lamination: With thermo-plastic, moisture and fungus resistant adhesive, subjected to direct heat before assembly closure in order to drive off excess solvents.
   d. Acceptable Manufacturer: Mapes Industries, Citadel Architectural Products or Architect approved equal.

2.2 Glazing Materials:

A. Approved Manufacturers: Use products of the following:

1. Tremco Manufacturing Co.
2. G.E.
3. Dap, Inc.
4. Pecora Corp.
5. Protective Treatments, Inc. (PTI).
6. Vetrotech (Saint-Gobain).

B. Setting Blocks: Neoprene, 70-90 durometer hardness, having proven compatibility with sealants used, width of rabbet less 1/16" by lengths sufficient for weight of glass supported.

C. Spacers: Neoprene, 40-50 durometer hardness, having proven compatibility with sealants used.

D. Compressible Filler Rod: Closed-cell or waterproof-jacketed rod stock of synthetic rubber or plastic foam, proven to be compatible with sealants used, flexible and resilient, with 5-10 psi compression strength for 25% deflection.

E. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

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 PREPARATION

A. Clean the glazing channel, or other framing members to receive glass, immediately before glazing. Remove coatings that are not firmly bonded to the substrate. Remove lacquer from metal surfaces wherever elastomeric sealants are used. Verify that weep holes are free of obstructions.

B. Apply primer or sealer to joint surfaces wherever recommended by sealant manufacturer.

C. Cut glass with smooth straight edges to full sizes required by openings. Do not attempt to cut, seam, nip or abrade glass that is tempered, heat strengthened, or coated.

3.3 INSTALLATION

A. Glass:

1. Set glass on setting blocks at quarter points, and fix without springing or inducing bowing. Install with proper bite and clearances all around.
2. Glass having waviness shall be set with waves placed horizontally unless Architect directs otherwise. Lites viewed in series or as a group shall have uniform draw, bow and similar characteristics.
3. Tempered glass having tong marks shall be installed so that tong marks are within rabbets at top of opening.

3.4 CLEANING

A. All glass shall be left whole, free from checks or other defects, and cleanly washed inside and out and the building left ready for occupancy when directed by the Architect.

B. Any defective glass that may appear after cleaning shall be removed and replaced with perfect glass.

END OF SECTION 088000

SECTION 092900
GYPSUM BOARD SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Provide and install gypsum board partition on metal studs with acoustical insulation.

B. Related Requirements: Section includes surface preparation and the application of paint systems

1. Section 081113 "Hollow Metal Doors & Frames" for hollow metal door frame set in gypsum board wall.
2. Section 099113 "Painting" for finish painting of gypsum board surfaces.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 FRAMING MATERIALS

A. Metal Studs: Zinc coated steel channel studs, 20-gauge, 3-5/8" size except as required otherwise, conforming to ANSI/ASTM C 645 or GA 201 or GA 216.

B. Runner Tracks:

1. 20-gauge metal, matching stud width. Use tracks with minimum 1-1/4" leg when indicated or directed.
2. Deflection Track: Provide for deck deflection by using "VertiTrack" manufactured by The Steel Network, Inc., tel: 888-474-4876 or approved equal, complete with manufacturer's patented fasteners having step bushings sized to the gauge of the studs.

C. Reinforcing Strips: Electro-galvanized 20-gauge sheet steel meeting ASTM A 525, 8" wide.

D. Angle Connectors: Galvanized 20-gauge sheet steel meeting ASTM A 525, formed into angle with 1-1/2" legs.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Board,: ASTM C 1396/C 1396M, Fire rated, tapered edge, conforming to ANSI/ASTM C 36 & C 1396, 5/8" thick:

1. "Tough Rock Fireguard X Abuse Resistant Gypsum Board" by Georgia Pacific.
2. "Gold Bond Hi-Abuse XP Gypsum Board" by National Gypsum Company.
3. "Fiberock Abuse Resistant Interior Panels" by USG.
4. Or approved equal

2.4 FINISH MATERIALS

A. Edge and Corner Reinforcement: Manufacturer's standard trim beads made of hot-dip galvanized steel with either knurled and perforated or expanded flanges, and beaded for concealment of flanges in joint compound. Vinyl trimNOT allowed.

1. Corner Beads: Paper-faced heavy gauge metal or plastic with extra wide flanges, equal to USG "B1XW EL" or No-Coat "Ultracorner".
2. Edge Beads: Paper-faced heavy gauge metal or plastic "L" type with extra wide flanges, equal to USG "B4 (1")" or No-Coat "L Trim.
3. Control Joint Beads: Flexible expansion channel, such as USG #093 or Gold Bond ".093 Zinc Control Joint."

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Reinforcing Tape: Perforated joint reinforcing tape, paper or fiberglass, asbestos free.

C. Joint Compound: Ready mixed all-purpose drywall joint compound**,** type and mix as required for conditions of humidity and temperature. Use topping type compound for finishing coats.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Fasteners: Screws meeting ASTM **C 954** and the following:

1. For direct attachment to masonry: Tapcon Screws or Perma-Grip Nails as recommended by Gypsum Board mfg.
2. For metal to metal framing: 1/2" long**,** Type S**,** shallow pan-head screws.
3. For gypsum board: 1-1/4" Type S bugle-head screws.
4. For tracks to concrete: Powder-actuated stud pins sized to penetrate concrete at least 1/2".
5. For moving (deflection) joints: "VertiClip Step Bushing Fasteners" sized to match gauge of studs.

C. Acoustical Sealant: One of the following:

1. USG "Acoustical Sealant"
2. W.W. Henry Co. "313 Sound Control Sealant"
3. Tremco "Acoustical Sealant"
4. Pecora "Acoustical Sealant BA-98"
5. Norton "Norseal V730 and V740FR Acoustical Foam Tape"

D. Acoustical Insulation: Sound attenuation blanket of thickness to produce an STC rating of not less than 48 in the constructions indicated, as manufactured by Johns Manville (Schuller), USG or Zonolite Grace.

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 FRAMING INSTALLATION

A. Partitions:

1. Base Tracks: Install continuous tracks, straight and true, accurately aligned to the layout at base and at tops of studs. Set floor tracks in a continuous bead of acoustical sealant. Secure tracks at each end and a maximum of 24" o.c. in between. Use powder actuated pin anchors for anchoring to concrete.
2. Studs: Set studs plumb, not more than 16" o.c. and not more than 2" from abutting walls. In each line of studs, face flanges all in the same direction.
3. Partition Heights: All studs shall extend to heights as noted on Drawings.
4. Stud Securement: Studs shall engage both floor and top runners. Secure studs to tracks with 2 screws at top and 2 screws at bottom, one each at both inside and outside flanges.
5. Top Track: Provide multiple runner track installation, at top of wall to accommodate deck deflection.
6. Stud Flanges: Do not cut to accommodate pipes, conduit, etc. without Architect's specific approval for each case.

B. Control Joints:

1. Placement: As indicated, consistent with lines of building spaces. Provide additional control joints in locations approved by General Contractor so that no expanse of wall exceeds 30 feet.
2. Framing: Frame each control joint in walls with 2 nearly abutting studs set back to back. Seal each side of space between studs with bead of sealant.
3. Control joints shall be installed both sides of door frames up to top of wall.

3.3 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. 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.

C. 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.

D. Form control and expansion joints with space between edges of adjoining gypsum panels.

E. 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.

F. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

3.4 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Type X: Vertical surfaces unless otherwise indicated.

B. Single-Layer Application:

1. 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.

2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Acoustical Insulation: Install acoustical blanket insulation in all interior partition stud spaces. Insulation shall extend to ceiling level unless noted otherwise and fill all voids. Place insulation behind and around electrical and mechanical items within partitions and tight to items passing through partitions.

C. Acoustical Sealant: Apply sealant continuously to joint between gypsum board and bottom track at partitions filled with acoustical insulation. Also, seal any untaped edges or corner joints butting into other wall materials at insulated partitions.

D. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

E. Interior Trim: Install cornerbeads at outside corners.

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 or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: At panel surfaces that will not be visible.
2. Level 4: At panel surfaces that will be covered by finish painting.

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.

END OF SECTION 092900

SECTION 095123
ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Acoustical tiles for ceilings.
2. Acoustical ceiling suspension systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, submit product data from manufacturer's brochures describing each of the products to be used.

B. Samples:

1. Submit samples of acoustical materials and suspension system members for review before ordering any materials.
2. For each exposed product and for each color and texture specified, 6-inches- in size.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Tile: Set of full-size Samples of each type, color, pattern, and texture.
2. Exposed Moldings and Trim: Set of 6-inch long Samples of each type and color.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Maintenance Stock: Furnish not less than 1 unopened bundle of each type of acoustical ceiling units for future maintenance. Distribute quantities in approximate proportion to the different types of units installed. Deliver to location on site designated by Owner.

1.5 QUALITY ASSURANCE

A. Qualifications of Installers: Use only personnel who are thoroughly trained and experienced in the erection of the selected systems.

B. Installation Standards: Comply with recommendations of the current CISCA "Ceiling Systems Handbook" except as specified otherwise hereinafter, and maintain a copy of the handbook at the site for Architect's inspection while work of this Section is being accomplished.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 WARRANTIES

A. Ceiling Panels: Where so specified herein below**,** products shall be warranted to be free from defects in materials and workmanship for a period of 10 years from date of purchase when subjected to the conditions of temperature and humidity specified.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
2. Smoke-Developed Index: 450 or less.

2.2 ACOUSTICAL TILES, GENERAL

A. Source Limitations:

1. Acoustical Ceiling Tile: Obtain each type from single source from single manufacturer.
2. Suspension System: Obtain each type from single source from single manufacturer.

B. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E 795.

C. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.

2.3 ACOUSTICAL TILES

A. Acoustical Ceiling Panels Types:

1. Type ACT-1: Angled tegular, fissured 24" x 24" x 3/4", lay-in panels; Accepted Products, Armstrong #1717 or approved equal during bidding.

2.4 METAL SUSPENSION SYSTEMS

A. Exposed Grid Ceiling Suspension Systems: Rigid metal, complying with ASTM C 635, intermediate duty system, consisting of interlocking cross tees and main tee runners (not less than .020" thick) made from cold rolled, zinc-bonded or electro-galvanized steel and creating flush joints at intersections.

1. Components shall support items penetrating the ceilings, including light fixtures and HVAC outlets/inlets.
2. Tee sections shall be double web type with a 1" exposed flange cap finished in baked white enamel.
3. Hold-Down Clips (for use where specified): Manufacturer's standard electro-galvanized steel hold-down clips.
4. Use USG "Donn DX" suspension systems for 24" x 24" grids or approved equal.

B. Wall Molding: Angle type, hemmed metal molding with finish to match grid system.

C. Hanger Wire: Pre-stretched, galvanized, soft-annealed mild steel wire conforming to ASTM A 641, 12-gauge.

D. Carrying Channels (for bridging between structural members overhead): Hot or cold rolled steel 1-1/2" channels painted with black asphaltic rust inhibitive paint and weighing not less than 475 lbs. per 1000 lineal feet.

E. Tie Wire for Attachment of Channels to Structure: Galvanized steel wire conforming to ASTM A 641, 16-gauge.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing and substrates to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine acoustical tiles before installation. Reject acoustical tiles 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 tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION OF SUSPENDED ACOUSTICAL TILE CEILINGS

A. General: Install acoustical panel ceilings to comply with ASTM C 636, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. 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.
3. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
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 and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical tiles.

1. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.

1. Fit adjoining tile to form flush, tight joints. Scribe and cut tile for accurate fit at borders and around penetrations through tile.
2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tile and moldings, spaced 12 inches o.c.

3.4 CLEANING

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

END OF SECTION 095123

SECTION 096519
RUBBER BASE

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. Preparation of existing wall surface to receive new rubber base and transitions.
2. Installation of new rubber base and transitions.

B. Related Requirements:

1. Section 099100 "Gypsum Board Systems" for gypsum board walls.
2. Section 096813 “Carpet Tile” for carpet.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Submit 3 sets of samples of each type**,** color and finish of rubber base.

1. Provide manufacturer**’**s standard 6" long samples of rubber base.
2. Include full range of colors and pattern variations.

C. Submit a letter from the rubber base manufacturer that the adhesive proposed to be used is compatible with the rubber base.

1.4 QUALITY ASSURANCE

A. Manufacturers: Wherever possible**,** provide rubber base**,** adhesives and accessories produced by a single manufacturer.

B. Flammability: Provide only materials**,** including adhesives**,** which will produce an installation having:

1. Critical Radiant Flux of not less than 0.45 watts per cm^2 when tested per ASTM E 648.
2. Smoke Density no greater than 450 when tested per ASTM E 662.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear feet of each type, color, pattern, and size of rubber base installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store rubber base and installation materials in dry spaces protected from the weather.

B. Install rubber base after other finishing operations, including painting, have been completed.

1.7 WARRANTY

A. Provide a 2 year installation warranty.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Wall Base:

1. Manufacturer: Mannington Burke
2. Contact: Ryan Lindquist 630.272.7788 Ryan.Lindquist@mannington.com
   a. Rubber Vinyl blend material complying with ASTM F 1861, 6” base. 4” Base at Cabinets only.
   b. Use Manufacturers recommended adhesive. Refer to drawings for locations. 1/8" .080” thick, Style B coved profile.
   c. Color: 523 Black Brown at schools.
   d. Provide rubber base as required.

B. Use Manufacturers recommended adhesives and follow product data sheets, and installation methods for all rubber base and accessories.

C. Edge Transitions:

1. Manufacturer: Mannington Burke
2. Contact: Ryan Lindquist 630.272.7788 Ryan.Lindquist@mannington.com
3. Provide even heights between floor finishes, for a smooth level transition between flooring heights/types. Skim such with Portland based cement product may be used to achieve level heights between flooring types.
4. Provide Mannington Burke transitions at all locations where two flooring types meet. Install using manufacturers recommended transition strip adhesives and accessories. Profile of transition, either 152, 150 or other will be provided based on best solution for each transition on site. Notify architect prior to ordering, of areas requiring transition profile other than 152 or 150, for review and approval.
   a. Color: 523 Black Brown at all schools.
   b. Provide rubber base as required. See drawings for locations.

D. Use Manufacturers recommended adhesives and follow product data sheets, and installation methods for all base, transitions, and accessories.

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 rubber base.

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

C. Compliance: Comply with manufacturer’s product data, including product technical bulletins, product catalog, installation instructions.

D. Verify that wall surfaces to receive rubber base are free of bond breakers. Report to Contractor in writing any surfaces unsuitable to develop a permanent bond.

E. Start of rubber base installation work shall be construed as acceptance of the suitability of the surfaces to receive work and acceptance of full responsibility for completed work. Remove and replace at no charge to Owner all work under this Section which may require removal in order to correct defects caused by insufficient examination and preparation of the substrates.

3.2 PREPARATION

A. Clean and prepare to a satisfactory condition all surfaces scheduled to receive rubber base.

B. Prepare walls and cabinet bases to receive new wall base as required. Remove bond breakers down to a solid**,** durable substrate. Fill voids with approved filler.

3.3 RUBBER BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing rubber base.

B. Apply rubber base to walls, in rooms and areas where base is required.

C. Install rubber base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere rubber base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of rubber base with manufacturer's recommended adhesive filler material.

F. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 REPAIR & CLEANING

A. Repair or replace damaged installed products.

B. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

3.5 PROTECTION

A. Protect rubber base from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

END OF SECTION 096519

SECTION 096813
CARPET TILE

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 modular carpet tile.

1. Preparation of concrete floors to receive new carpeting and wall surface to receive new rubber base to include:

   a. Moisture testing of concrete floors.
   b. Documentation of tests.

2. Moisture Mitigation if required.
3. Provide and Install Carpet tile

B. Related Requirements:

1. Section 096519 “Rubber Base” for rubber base and transition strips.

1.3 QUALITY ASSURANCE

A. Installer’s Qualifications: Carpet Installation Company: Shall be certified by carpet manufacturer and shall have at least 5 years’ satisfactory experience in the installation of carpets of the types specified. Only qualified and experienced carpet mechanics working under proper supervision shall be employed on the project.

B. Flammability Test Requirements: Provide only materials, including adhesives, which will produce an installation having a Critical Radiant Flux of not less than 0.45 watts per square centimeter when tested by the Flooring Radiant Panel Test.

C. Adhesive Test Requirements: The suitability of the adhesive will require testing as further specified herein after under EXAMINATION.

1.4 SUBMITTALS

A. Certifications:

1. Manufacturer shall submit certification that materials manufactured are in accordance with materials herein specified. Include certified laboratory test report for flammability requirements.
2. Manufacturer shall submit certification that Installer is a factory approved installer.

B. Samples: Submit samples of carpets. Label samples, stating color or shade, location in which they are to be used and manufacturer's name. Carpet samples shall be at least one tile per pattern.

C. Maintenance Supply: Provide 5% maintenance stock of each type of carpet used. Package unused carpet tiles in boxes suitable for preservation of carpet in long term storage. Deliver packaged tiles to location in building designated by Owner

D. Maintenance Manuals: Obtain from manufacturer and submit for Owner's use, 3 copies of manufacturer's complete maintenance recommendations for carpet(s) installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery and installation of carpeting shall be coordinated with completion schedule for the various areas.

B. Carpet shall be stored away from construction activities and shall be protected against moisture, dust and vermin.

C. Installation shall not begin in any area until painting and ceiling work for that area have been completed.

1.6 GUARANTEES

A. Guarantees shall start at an adjusted date if carpet is installed after the date of Substantial Completion.

B. Provide a 2 year installation warranty in addition to other warranties standard to the manufacturer for the carpets selected.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Walk off Carpet at Lewis Lemon, Ellis, RESA

Acceptable Manufacturer and Product: Shaw Contract

1. Contact: Greg Huntley 630.417.4196 greg.huntley@shawcontract.com
2. Style: Entrée Tile – Modular Tile 24" x 24"
3. Collection: Steppin' Out
4. Color: Charcoal 31569
5. Installation Method: Quarterturned.

At Marshall, walk off carpet tiles provided by owner, to match existing. Walk off carpet shall continue into office area at hollow metal door as needed for patch. Provide clean straight line where walk off meets existing carpet. Transition strip may be required, notify architect to determine if needed.

B. Carpet at Ellis Elementary:

Acceptable Manufacturer and Product: Mannington

1. Contact: Ryan Lindquist 630.272.7788 Ryan.Lindquist@mannington.com

2. CPT- 1

   a. Style: Mainboard – Tile 24" x 24"
   b. Collection: Glitch Art
   c. Color: Direct Current 13406 (orange/aqua stripe)

3. CPT- 2

   a. Style: Mainboard – Tile 24" x 24"
   b. Collection: Glitch Art
   c. Color: Re-Format 14408 (lime/aqua stripe)

4. Match existing pattern on site: Ashlar Installation Method. Install CPT-1 and CPT-2 carpet tiles in a random mix, 50% of each. Place randomly, creating no visual pattern between the placement of the two tiles. All stripes within carpet tile pattern shall run in same direction.

C. Carpet at Lewis Lemon:

Acceptable Manufacturer and Product: Mannington

1. Contact: Ryan Lindquist 630.272.7788 Ryan.Lindquist@mannington.com

2. CPT- 1

   a. Style: Mainboard – Tile 24" x 24"
   b. Collection: Glitch Art
   c. Color: Direct Current 13406 (orange/aqua stripe)

3. Ashlar Installation Method.. All stripes within carpet tile pattern shall run in same direction.

2.2 ACCESSORIES

A. Carpet:

1. All seam tape, edge sealers and other accessories shall be as recommended by the carpet manufacturer.
2. Adhesives: Use Manufacturers recommended adhesive. Water based, strippable, waterproof type, compatible with substrate and carpeting materials, as recommended by carpet manufacturer.

3. See specification section “096513 Rubber Base” for rubber base, transitions, and accessories.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that building air temperature and relative humidity are within manufacturers’ recommended limits and that concrete floor temperatures are within 20°F of surrounding air temperatures.

B. Provide required floor Moisture Vapor Emission Rate (MVER) testing, pH testing and Relative Humidity testing prior to flooring installations. MVER Testing (ASTM F-1869-10), RH Testing (ASTM F-2170 -10), pH Testing (ASTM F-710-10). A minimum of one test per 1,000 square feet of flooring space is required. Check manufacturer's full requirements and warranties prior to installation. Cost for testing is paid for by the flooring contractor.

1. Moisture meter readings and plastic mat test results will not be accepted as conclusive.

a. Perform tests in areas where drying is most restricted but not closer than 5ft to a perimeter**.**

b. Report adverse conditions including documentation of test results to the general contractor in writing.

C. Submit Moisture readings to the Architect for review with owner. If readings are higher than manufacturers recommended limits, moisture mitigation is required, a change order will be processed to cover the cost of the mitigation. The change order will be based on the unit price cost for the Bone Dry System as listed on the Bid Form.

D. At areas requiring Moisture Mitigation, The Flooring Contractor shall provide:

Acceptable Manufacturer and Products:

1. Bone Dry Pro Surface Sealer System, for use on chemically abated slabs.
2. Bone Dry Pro Sealer System, for use on new concrete slabs, or existing slabs not abated.

Bone Dry Contact: James Gourley james@bonedryproducts.com

www.bonedryproducts.com (262) 694- 9748 ext 803

Provide all physical materials for complete Bone Dry Sealer system. Follow manufacturer’s complete specification sections and product data sheets. Follow manufacturers full recommended preparation and installation methods. Provide documentation of any type of adhesive solvent/chemicals used, to determine manufacturers recommended prep methods.

a. Clean floor of all foreign substances – drywall, paint, dust, debris.
b. Scarify/Etch concrete.
c. Fully protect all adjacent surfaces. Flooring contractor responsible to

remove product from of any adjacent surfaces.

d. Apply Bone Dry.

e. Wait 24 hours, prior to flooring installation.

3. Follow Manufactures installation methods
4. Register project with Bone Dry Manufacturer. Provide Manufacturers certificate of 20 year warrantee.
5. Provide written documentation from Bone Dry that their system is approved for use with each flooring type and their adhesive.

E. Before beginning work to lay new carpet, examine all surfaces over which work is to be applied. Report to the Architect and General Contractor in writing any surface defects, documentation of test results, and conditions that are unsuitable to receive work.

F. Start of flooring installation work shall be construed as acceptance of the suitability of the surfaces to receive work and acceptance of full responsibility for completed work. Remove and replace at no charge to Owner all work under this Section which may require removal in order to correct defects caused by insufficient examination and preparation of the substrates.

3.2 PREPARATION

A. Should excessive alkalinity be discovered, treat the affected areas with a water solution containing 10% muriatic or acetic acid and allow solution to dry.

B. Skim coat ALL areas to receive new flooring using Schonox SL Patch Portland Cement Based compound, at 1/8”, or a Schonox Leveler, or equal following manufactures recommended installation, product data sheets, and specifications.

C. Fill saw cut joints, construction joints, expansion joints, cracks and depressions with flexible vinyl filler or portland cement product as required to prevent show-through.

D. Clean and prepare to a satisfactory condition all surfaces scheduled to receive carpeting.

E. Check the match of carpet tiles to ensure that there is no visible variation between dye lot runs.

3.3 INSTALLATION

A. Carpet Tiles:

1. Glue vinyl backed carpet tile directly to floor. Use manufacturer’s recommended application pattern for adhesive and cover floor evenly with adhesive.
2. Follow manufacturer’s recommended installation for fillers.
3. Install transition strip at all exposed edges of carpet and where carpet abuts any other floor material, except at ceramic tile, in which case, the edging will be provided with the tile. Edging shall be one continuous piece at doors and wherever standard lengths permit. Securely fasten edging to floors.

   a. When carpet ends at doorway and door swings over carpet, place carpet under door (but not beyond door) and finish carpet with nose of edge strip aligned with the edge of the stop on the door frame.

b. When carpet ends at doorway and door swings away from carpet, place carpet up to face of door and finish carpet with edge strip having its nose aligned with the edge of the stop on the door frame.

3.4 ADJUSTMENTS

A. Tiles that have not "seated" in level plane with surrounding tile shall be removed and cleaned and re-set with new adhesive.
   1. Misaligned joints in base shall be reset or replaced with new, properly fitting pieces as required.
   2. Any resilient base or transition strip that shrinks on the wall or between two flooring types within 1 year of installation shall be replaced at no charge to the Owner.

B. Tile showing broken corners or fracture lines entirely across their surfaces, or flawed unparallel linear patterns on surface shall be warmed, removed and new tile of same color, etc., substituted. Repair tile showing minor breaks and fractures or inconsistencies on vinyl backing.

3.5 PROTECTION

A. No furniture or other heavy objects shall be placed on carpet until the adhesive has cured.

B. Protect carpet after installation against stains and accumulations of dust and debris.

3.6 CLEANING AND PROTECTION

A. The completed installation shall be free of scraps, carpet ripples and puckers. Clean up all dirt and debris. Clean all spots with proper remover. Remove loose threads; reweave any ravels at seams or edges.

B. Damage: Repair any damage to existing paintwork, millwork, walls, doors, floors, etc., caused by carpet installation.

C. Upon completion of the installation remove all waste, excess materials, protective coverings, tools and equipment.

D. Carefully and thoroughly vacuum clean all new installed carpet to Owner's satisfaction. Do not begin vacuuming until perimeter resilient base has cured at least 10 days. When schedules allow, do not begin vacuuming until 14 days after installation of resilient base.

END OF SECTION 096813

SECTION 099113
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 finish painting of:

1. Existing and new gypsum board walls.
2. New and existing hollow metal frames and doors.
3. New and Existing CMU
4. New and Existing Interior/Exterior steel lintels.

B. Related Requirements: Section includes surface preparation and the application of paint systems

1. Section 017300 "Execution" for patched and existing adjacent existing masonry wall to be finish painted in field to be finish painted in field.
2. Section 081113 "Hollow Metal Door Frames" for hollow metal doors and frames to be finish painted in field.
3. Section 092900 "Gypsum Board System" for partitions to be finish painted.

1.3 SUBMITTALS

A. Product Data: Submit for Architect's review on all products to be used. List each material and cross-reference it to the specified paint and finish system and application. Identify by manufacturer's catalog number and general classification.

B. Color Samples: When so requested, submit samples of each finish and topcoat color for Architect's review. Also, submit samples on portions of work at the site as directed by Architect, not less than 4ft x 4ft size.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Maintenance Supply: Deliver to Owner in unused containers 1 gallon of each type and color of paint used on the Project. Mark each container with color and room names/numbers where paint was used, without obscuring manufacturer's label. Deliver these containers to place on site designated by Owner.

1.5 QUALITY ASSURANCE

A. Comply with State of Illinois Regulations (effective date July 1, 2009) regarding VOC (Volatile Organic Compounds).

1.6 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 (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Approved Manufacturer: Sherwin Williams

B. Approved Products: Manufacturer's products listed hereinafter in the Painting Schedule represent types and grades required. Comparable products of other manufacturers listed in preceding paragraph will also be acceptable.

C. Grades: Materials not displaying manufacturer's identification as a best-grade product will not be acceptable.

D. Thinners: Paint manufacturer's preferred solvent.

E. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Conditions: Applicator must examine areas and conditions under which painting work is to be done and shall notify Contractor in writing of conditions detrimental to proper and timely completion of work.

B. Moisture Contents: Do not apply coatings to surfaces where electronic moisture meter indicates values above 12%, except that for wood, moisture content may be not exceed 15%.

C. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.3 REPAINTING EXISTING PAINTED SURFACES

A. Surface Preparation:

1. Do not paint existing surfaces until any items attached to existing surfaces and not scheduled for painting (e.g. door hardware) have been removed. (The trade removing the attachments shall replace them to their original positions after painting is complete.).
2. Wash surfaces to be repainted.
3. Remove all loose**,** blistered**,** cracked or otherwise defective paint and varnish. Sand surfaces smooth**,** free of depressions. Cut out and fill cracks or other defects to match adjoining surfaces.

3.4 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint entire exposed surface of door frames.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

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

3.5 FIELD QUALITY CONTROL

A. Architect's Inspection: All work where a coat of material has been applied must be inspected and approved by Architect before application of succeeding specified coat**;** otherwise no credit for the coat applied will be given and the work in question shall be recoated.

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

3.6 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 PAINTING SCHEDULE

A. New and Existing Interior Gypsum Board Walls

1 coat	S-W Protective & Marine Coatings, DTM Acrylic Coating
2 coats	S-W Pro Industrial Pre Catalyzed Water Based Epoxy, K45 Series, eg-shell

B. New and Existing Interior Hollow Metal Doors and Frames

1 coat -	S-W Pro-Industrial ProCryl Universal Acrylic Primer**,** B66-1310**.**
2 coats -	S-W Pro Industrial Water Based Acrylic B66-660 Series, Semi Gloss

C. New and Existing Concrete Masonry Units

1 coat -	S-W PrepRite Block Filler, B25W25 Series (use if unpainted surface).
2 coat -	S-W Pro Industrial Pre Catalyzed Water Based Epoxy, K45 Series, Eg-Shel.

D. New and Existing Interior and Exterior Steel Lintels

1 coat -	S-W Pro-Industrial ProCryl Universal Acrylic Primer**,** B66-1310**.** (use if unpainted surface).
2 coats -	S-W Pro Industrial Water Based Acrylic B66-660 Series, Semi Gloss

E. Existing Interior Disturbed Surfaces & Walls During Construction: Touch up existing as required to match existing.

3.8 PAINT COLORS PER SCHOOL

A. Ellis Elementary: Walls: SW7016 Mindful Gray

B. Lewis Lemon: Please notify architect 2-3 weeks prior to beginning paint, for paint plan to be provided. Up to 4 colors may be used. Colors below are school standards. Not final.
1. Field: SW7632 Modern Gray
2. Accent: SW6916 Impetuous
3. Accent: SW7611 Tranquil Aqua
4. Accent: SW7036 Accessible Beige
5. Accent: SW7018 Dovetail

C. RESA: Walls: SW6385 Dover White. Hollow Metal Doors/Frames SW7018 Dovetail, or match to Benjaman Moore P2360 Bronzetone.. HM color To be finalized by owner/architect.

D. Marshall: Walls SW7015 Repose Gray. Accent Wall on West Wall in General Office T102: SW6588 Plummy, if required.

END OF SECTION 099113

SECTION 101400
EXTERIOR SIGNAGE

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. Furnishing and installation of exterior wall signage.

B. Related Requirements:

1. Section 074213 "Formed Metal Wall Panels" for exterior wall substrate.

1.3 QUALITY ASSURANCE

A. Refer to drawings for layout and signage types to be provided.

B. Sign Maker shall not proceed with fabrication without Owner's written approval of texts.

C. Installation of signs shall be only by highly experienced and accomplished craftsmen.

D. Submit 2 actual sign samples for Architect’s review and approval.

1.4 ACTION SUBMITTALS

A. Make submittals under provisions of Section 013300 – Submittal Procedures.

B. Submit 2 copies of manufacturer's specifications and installation instructions for each type of identifying device required.

C. Submit 3 samples of each color and finish of exposed materials and accessories required for identifying devices.

D. Submit Shop Drawings for fabrication and erection of identifying devices. Include plans, elevations, and large-scale details of sign wording and lettering layout for review and approval. Show anchorages and accessory items.

PART 2 - PRODUCTS

2.1 MATERIALS AND MANUFACTURERS

A. Exterior Cast Aluminum Signage:

1. Approved Manufacturers:

a. Best Sign Systems.
b. Gemini.
c. Scott.

2. Type: Flat metal direct wall mounted without stand-offs, cast Aluminum with flat face. Color: Charcoal gray as selected by Architect. Provide physical finish samples.
3. Font: as determined by Architect.
4. Sizes: 10” high x 1” depth.
5. Location: Placement on site shall be approved by Architect prior to installation.
6. See drawings for further details.

B. Inserts and Anchorages:

1. Furnish inserts and anchoring devices that must be built into masonry for the installation of signage.
2. Use concealed fasteners and anchors unless indicated to be exposed.
3. furnish nonferrous-metal or stainless-steel devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Installer must examine the substrates and conditions under which the identifying devices are to be installed and notify the Architect in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint

B. Mounting Methods.

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101400

SECTION 312000
EARTH MOVING

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 earth moving work consisting of:

1. Excavation for footings and foundations.
2. Rough grading for new concrete slabs-on-grade and stoops on grade.
3. Removal of unsatisfactory material below rough grade and subgrade levels as required.
4. Provision of granular materials from offsite for structural fill as required.
5. Classifying and stockpiling usable excavated material, on site, for re-use.
6. Preparation of subgrades to receive fills.
7. Filling, backfilling and compaction of fills.
8. Finish grading of disturbed site areas.
9. Removal of excess excavated materials.

B. Related Requirements:

1. Section 033000 "Cast-In-Place Concrete" for cast-in-place concrete work.

1.3 COORDINATION

A. Coordinate earth moving work for building with civil earthwork.

1.4 SUBMITTALS

A. Process all submittals per requirements in Section 013300 – Submittal Procedures.

B. Submit to the Soil Testing Service 50 pound representative samples of each proposed fill material at least 2 days prior to the start of any filling operation.

C. The Soil Testing Service shall submit 2 copies of all test reports to Owner's Representative.

1.5 QUALITY ASSURANCE

A. Soil Testing and Inspection Service:

1. The Owner shall engage the services of a soils testing service, to test in-place foundation soils and other soil materials proposed for use in the Work.
2. Costs for the first testing of an area shall be paid for by the Owner. All testing required for checking and correcting faulty work or work to be re-done shall be paid for by the Contractor at his own expense.
3. Services shall include:

    a. Observation of proofrolling.
    b. Sieve analysis of material to be used for compacted fill beneath footings and for fill beneath concrete slabs in exterior areas.
    c. Tests for maximum dry density of compacted fill materials.
    d. In-place field dry density tests for every 2,500 square feet of area of each layer of compacted subgrade fill under building slabs, other than drainage fill, as directed by Owner's Representative.
    e. In-place field dry density tests, per ASTM D 1556 or ASTM D 2922 and D3017, for each layer of compacted fill under all footings, as directed by Owner's Representative.
    f. If compaction is found to be unsatisfactory, extra in-place field dry density tests to determine the extent of recompaction work required.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 FIELD CONDITIONS

A. Existing Conditions: The excavation contractor shall visit the site prior to submitting his bid in order to determine the existing conditions under which he will be obliged to operate and the extent of the site preparation work required.

B. Existing Utilities:

1. Locate existing underground utilities in the areas of work before starting earthwork operations. If utilities are to remain in place, provide adequate means of protection during earthwork operations.
2. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Owner's Representative immediately as to how to proceed.
3. Do not interrupt existing utilities serving facilities occupied or used by the Owner or others, except when permitted in writing by the Owner's Representative and then only after acceptable temporary utility services have been arranged.
4. Demolish and completely remove from the site underground utilities indicated to be removed. Coordinate with local utility companies for shut-off and capping or sealing of services if lines are active.

C. Explosives: The use of explosives will not be permitted.

1.8 PROTECTION OF PERSONS AND PROPERTY

A. Barricade open excavations made as a part of earthwork operations and post with warning lights. Operate warning lights during hours from dusk to dawn each day and as otherwise required.

B. Protect benchmarks and existing structures, roads, sidewalks, paving and curbs against damage from vehicular or foot traffic.

C. Protect from frost the bottoms of excavations and soils around and beneath foundations.

1.9 BRACING, SHEETING AND SHORING

A. Provide bracing, sheeting and shoring for the sides of excavations as necessary to prevent movement or settlement of adjacent structures, utilities, roads and streets, etc. The cost of bracing, sheeting and shoring required shall be deemed to have been included as part of the Contract Sum.

B. The Contractor shall be entirely responsible for the strength and adequacy of all such bracing, sheeting and shoring, and is liable for any damage or injury caused by or resulting from improperly supported soils and structures. He shall, if required, submit fully detailed Shop Drawings for review prior to placement; however, such review shall not diminish the Contractor's responsibilities in any way.

C. The Contractor shall issue any notices to owner of adjoining property that may be required by any pertinent laws or ordinances. Furnish copies of such notices to Owner's Representative.

D. If the safety of any adjacent structures, utilities, etc., shall appear to be endangered, take all proper means to support such embankments, structures, utilities, etc., and notify the Owner. Do not resume operation without the Owner's permission.

E. Provide and place bracing and shoring ordered by the Owner when necessary to safeguard adjacent buildings, etc. If the Contractor fails to comply promptly when so ordered, the required bracing and shoring may be placed by order of the Owner at the Contractor's expense. Any such action shall not relieve the Contractor of responsibility for the bracing and shoring or liability for damage.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Fill Materials: Shall be obtained from excavations on the site, provided the material meets the following requirements and is approved by the testing lab. Fill material from offsite shall be obtained from borrow pits approved by the testing lab.

B. Fill Supporting Footings: Well graded granular material, sand or gravel, tested by the testing laboratory. Not more than 10% shall pass #200 sieve; except that fill placed during wet weather or in wet areas shall have no more than 5% passing #200 sieve. Cohesive soils from excavations on the site may be used provided they can be compacted to 95% of maximum density as determined by ASTM D 1557-78.

C. Fill Under Interior Floor Slabs, UP TO Drainage Course: Granular material of friable earth, or clay of low plasticity, tested by the testing laboratory.

D. Drainage Fill Directly Under Interior Floor Slabs: Natural hard, clean sand; or naturally or artificially graded mixture of crushed gravel or crushed stone acceptable to the Owner's Representative and the testing service.

E. Fill Under Concrete Pads and Stoops: Granular fill, the same as used for footings.

F. Other (Ordinary) Backfill and Fill: Reasonably uniform soil materials free of organic or frozen material, debris, trash, and of stones 4" or greater in diameter. Soils from excavations on site may be used provided they can be compacted to the densities specified.

PART 3 - EXECUTION

3.1 SITE CLEARING

A. General:

1. Except as otherwise indicated, remove trees, shrubs, grass, weeds and other vegetation, improvements, or obstructions that directly interfere with installation of new construction. Remove tree stumps and remove roots projecting above surface of finish grade.
2. Carefully and cleanly cut roots and branches of trees indicated to be left standing, where such roots and branches obstruct facilities to be constructed. Do not remove branches and roots for the convenience of construction operations except as approved by Owner for each tree. After cutting branches and roots, immediately apply an approved wound dressing.

B. Topsoil Removal: Strip topsoil from areas to be excavated for construction. Remove heavy growths of grass from areas before stripping.

1. Remove topsoil down to subsoils.
2. Where trees are indicated to be left standing, stop topsoil stripping a sufficient distance from such trees to prevent damage to the main root system.
3. Topsoil which has been removed without intermingling with other soils and is reasonably free of clay lumps, stones, and other objects over 2" in diameter, and without weeds, roots, and other objectionable material, shall be stockpiled for completion of the work. Topsoil not meeting these criteria may only be used for landscape work and shall be stockpiled separately or removed from the site.
4. Construct stockpiles so as to drain precipitation freely. Cover storage piles as required to prevent wind-blown dust and erosion.

3.2 WATER CONTROL

A. Grade around excavated areas so as to prevent water from running into trenches, areas for slabs-on-grade and excavations; and grade so as to prevent water from running onto adjacent properties or public thoroughfares.

B. Keep excavations dry with pumps, piping and temporary drains until backfilling is completed.

C. Do not discharge drainage water lines into municipal sewers without municipal approval.

D. Ensure that water discharge does not contain silt.

3.3 EXCAVATION

A. General: Excavate for all work to elevations and dimensions indicated, plus sufficient space to permit erection and installation of forms for footings and foundation walls.

1. Notify testing lab and Owner of all unexpected sub-surface conditions. Discontinue work in area until Owner provides notification to resume work.

B. All subgrades for footing and building slabs shall be approved by the soils testing service. Give soils testing service adequate notice as to when excavations are scheduled to reach subgrade elevations shown on Drawings.

C. Authorized Additional Excavation: If an unacceptable subgrade material is encountered at the subgrade elevation shown on the Drawings, the Owner may direct the Contractor to excavate to a greater depth by way of Change Order.

D. Unauthorized Excavations: If an acceptable subgrade is encountered at the subgrade elevation shown on the Drawings and excavation goes to a greater depth, no additional payment shall be made by the Owner for such excavation nor for backfilling to repair the over excavation.

E. Rock Excavation:

1. Definition: Excavation of boulders or pieces of rock, concrete, or masonry measuring more than 1/2 cubic yard; or hard shale or solid ledge rock and masonry requiring continuous use of pneumatic tools or drilling to be removed.
2. Contractor must demonstrate inability to remove by hand pick or by power excavator used for other excavation. Prior to removal, obtain written approval from Owner's Representative that material to be removed qualifies for extra payment.

F. Protect footing and building slab excavations from freezing until excavations are completely backfilled.

3.4 FILLING AND COMPACTION

A. General:

1. Remove all debris from excavations before backfilling.
2. No fill to be compacted shall be placed in free water, or on frozen ground.
3. Manipulate and wet the fill materials as required to obtain uniform moisture content throughout. Fills shall be placed at +2% of the material's optimum moisture content. Mix lean to fat clays with lower plasticity clays and/or hydrated lime or lime byproduct materials as necessary to achieve required compaction values.

4. Prior to placement of fills under footings, slabs and pavings, the upper 12" of subgrade shall be brought to within 2% of optimum moisture and compacted to not less than 90% per Modified Proctor Method.
5. All subgrades shall be approved by the soils testing service just prior to placement of fills. Should subgrade become frozen, desiccated, saturated or disturbed, remove the affected material, or scarify, moisture condition and recompact the affected materials. Notify soils testing service well ahead of when excavations are scheduled to reach the subgrade elevations required.
6. Proofroll after placement of fill to verify compliance.

B. Placing Fill to be Compacted:

1. Placement: Place fill material in layers not exceeding 8" in thickness, starting in the deepest area and progressing approximately parallel to the finished grade.
2. Testing Between Layers: Compaction of each layer shall be tested as specified. Obtain approval from Owner's Representative before next layer of fill is started.
3. Drainage Course Under Interior Concrete Slabs On Grade: Install a layer of the specified granular fill 6" thick, such that, after compaction, the top of the fill will be at the bottom elevation of the slab as indicated by the Drawings, plus 0", minus 1/2".
4. Fill Under Exterior Platform Slabs: Extend granular fill down to bottom of platform foundation.

C. Compaction Procedures:

1. Compact the soils immediately after placement, while they retain their optimum moisture content; otherwise, manipulate and wet the soil as required to obtain the required moisture content uniformly throughout.
2. Suspend compaction operations when proper results cannot be obtained because of rain or soggy conditions, or when other conditions are unsatisfactory.
3. Compact with vibratory compaction and/or rolling equipment to the specified densities. Compaction by travel of grading equipment will not be considered adequate. Use small vibratory or hand tamping compactors whenever fill is placed adjacent to walls or around footings and columns.
4. Each layer of fill shall be compacted all across its surface to the required density before additional fill may be placed.
5. If compaction is found to be unsatisfactory, recompact until required density is achieved.

D. Compaction Densities:

1. Granular Fill Under Footings, Building Slabs and Exterior Platforms: 95% of maximum density, per Modified Proctor Test (ASTM D 1557).
2. Cohesive Soil Fills Within Perimeter of Building Foundations: 95% of maximum laboratory density, per Modified Proctor Test (ASTM D 1557).
3. Fills To 10 Feet Outside of Building Perimeter: 95% of maximum density, per Modified Proctor Test (ASTM D 1557).

E. Replacement of Over-Excavation:

1. Where over-excavation has been authorized, provide approved granular fill to replace the materials excavated from below the designated design subgrade and compact the fill to the required densities. Payment for such additional work will be in accordance with the established unit prices.
2. When authorized over-excavation causes the width of the excavation to be increased, fill the excavation to the extended width with the appropriate fill materials and compact the fill to the required densities. Payment for the additional fill work required will be in accordance with the established unit prices.
3. Where over excavation has not been authorized, fill with granular fill compacted to the required density at the required elevation without additional payment.

3.5 ROUGH GRADING

A. General: Uniformly grade new filled areas, including adjacent transition areas, and as otherwise indicated within the limits of construction. Include any areas disturbed by construction operations.

1. Smooth the finished surfaces within specified tolerances, with uniform levels of slopes between points where elevations are shown, or between such points and existing grades.
2. The degree of finish required will be that ordinarily obtainable from either blade-grader or scraper operations.

B. Interior of Building: Rough grade the areas under slabs-on-grade to not less than 6" nor more than 6-1/2", plus the slab thickness, below finish floor line. Grade the surface so as to be free from irregular surface changes.

3.6 MAINTENANCE

A. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

B. Protection of Graded Areas: Protect newly graded areas from traffic and erosion, and keep free of trash and debris.

1. Repair and re-establish grades in settled, eroded, and rutted areas to the specified tolerances.
2. Any settlement of areas shall be filled level and smoothed out, and shall be repaired so as to maintain the required grade level for a period of one year.

3.7 DISPOSAL OF EXCESS AND WASTE MATERIALS

A. Remove excavated material unsuitable for fill or backfill from Owner’s property before backfill operations begin. After backfilling is completed, remove from Owner's property all excess fill material.

B. Areas under stockpiles not indicated as receiving new construction shall be restored to original condition.

C. All off-site hauling shall be in tight beds such as to prevent spilling onto streets or highways. Use drip pans where necessary to prevent spilling. Off-site haul routes shall be approved by the appropriate county and city authorities for disposal of wastes from this contract.

D. All excess material removed from site shall become the property of the Contractor. Legally dispose of all materials removed from the site.

END OF SECTION 312000

SECTION 21 05 53
IDENTIFICATION FOR FIRE-SUPPRESSION 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. Pipe labels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Kolbi Pipe Marker Co.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping.

F. Pipe-Label Colors:

1. Background Color: Safety Red.

2. Letter Color: White.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 PIPE LABEL INSTALLATION

A. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit a view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

END OF SECTION 21 05 53

SECTION 21 13 13
WET-PIPE SPRINKLER 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. Pipes, fittings, and specialties.
2. Cover system for sprinkler piping.
3. Sprinklers.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including hydraulic calculations and analysis data signed by the qualified professional responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Domestic water piping.
2. HVAC refrigerant piping.
3. Items penetrating finished ceiling include the following:

a. Lighting fixtures and lighting control devices.
b. Air outlets and inlets.
c. Ceiling Speakers
d. Fire Alarm Devices

B. Qualification Data: Active Fire Protection Contractor License for the State of Illinois.

C. Design Data:

1. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, including hydraulic calculations.

D. Field Test Reports:

1. Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Provide one of each installed sprinkler head type at each school.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional services needed to assume design responsibility. Base calculations on results of fire-hydrant flow test.

2. Active Fire Protection Contractor License for the State of Illinois.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Provide hydraulically calculated wet-pipe sprinkler system design.

1. Available fire-hydrant flow test records were not available at the time of design. Fire Protection Contractor shall perform a flow test at the closest hydrant location and advise the engineer of the results as soon as possible.

2. Sprinkler system design shall be approved by authorities having jurisdiction.

a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
b. Sprinkler Occupancy Hazard Classifications:

1) Building Service Areas: Ordinary Hazard, Group 1.
2) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
3) General Storage Areas: Ordinary Hazard, Group 1.
4) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
5) Classrooms, Gymnasium and Public Areas: Light Hazard.
6) Kitchen/Concession Areas: Ordinary Hazard, Group 1.

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.12 gpm over 3000-sq. ft. area.

4. Maximum Protection Area per Sprinkler: According to UL listing.
5. Maximum Protection Area per Sprinkler:
a. Classrooms, Gymnasium and Public Spaces: 225 sq. ft.
b. Storage Areas: 130 sq. ft.
c. Mechanical Equipment Rooms: 130 sq. ft.
d. Electrical Equipment Rooms: 130 sq. ft.
e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 30, Black-Steel Pipe: ASTM A 135/A 135M; ASTM A 795/A 795M, Type E; or ASME B36.10M wrought steel, with wall thickness not less than Schedule 30 and not more than Schedule 40. Pipe ends may be factory or field formed to match joining method.

C. Thinwall Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.

D. Schedule 10, Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

E. Nonstandard OD, Thinwall Black-Steel Pipe: ASTM A 135/A 135M or ASTM A 795/A 795M thinwall with plain ends and wall thickness less than Schedule 10.

F. Malleable- or Ductile-Iron Unions: UL 860.

G. Cast-Iron Flanges: ASME 16.1, Class 125.

H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick, ASME B16.21, nonmetallic and asbestos free, or EPDM rubber gasket.

a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

J. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Shurjoint Piping Products USA Inc.
b. Smith-Cooper International.
c. Tyco Fire Products LP.

2. Pressure Rating: 175-psig minimum.

3. Painted Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

K. Steel Pressure-Seal Fittings: UL 213, FM Global-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

2.3 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International.
b. Tyco Fire Products LP.

2. Standard: UL 213.

3. Pressure Rating: 175-psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-tee and -cross fittings.

6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Aegis Technologies, Inc.
   b. CECA, LLC.

2. Standard: UL 1474.

3. Pressure Rating: 250-psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

C. Flexible Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Fivalco Inc.
   b. FlexHead Industries, Inc.

2. Standard: UL 1474.

3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175-psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.4 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc. (The).
3. Tyco Fire Products LP.
4. Viking.
5. Victaulic Company.

B. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

C. Pressure Rating for Automatic Sprinklers: 175-psig minimum.

D. Automatic Sprinklers with Heat-Responsive Element:

1. Early-Suppression, Fast-Response Applications: UL 1767.

2. Nonresidential Applications: UL 199.
3. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

E. Sprinkler Finishes: Painted white to match ceiling system.

F. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

G. Sprinkler Guards:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Globe Fire Sprinkler Corporation.
b. Reliable Automatic Sprinkler Co., Inc. (The).
c. Tyco Fire Products LP.
d. Victaulic Company.

2. Standard: UL 199.

3. Type: Wire cage with fastening device for attaching to sprinkler, where applicable.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

M. Fill sprinkler system piping with water.

N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 21 05 17 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 21 05 18 "Escutcheons for Fire-Suppression Piping."

3.2 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

N. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

O. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

P. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and NFPA 13 for supports.

3.4 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.5 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Coordinate with fire-alarm tests. Operate as required.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.7 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.9 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Schedule 30, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 30, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Schedule 30, black-steel pipe with plain ends; steel welding fittings; and welded joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:

1. Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Schedule 10 black-steel pipe with plain ends; welding fittings; and welded joints.

E. Standard-pressure, wet-pipe sprinkler system, NPS 5 and larger, shall be one of the following:

1. Thinwall or Schedule 10 black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Thinwall or Schedule 10 black-steel pipe with plain ends; welding fittings; and welded joints.

3.10 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers (include guards in gymnasium).
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.
4. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where required.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 21 13 13

SECTION 23 05 17
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Grout.
3. Silicone sealants.

B. Related Requirements:

1. Section 07 84 13 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anti-corrosion coated or zinc coated, with plain ends and integral welded waterstop collar.

B. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 GROUT

A. Description: Nonshrink, recommended for interior and exterior sealing openings in nonfire-rated walls or floors.

B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.3 SILICONE SEALANTS

A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, use NT.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
2. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.

C. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use sealants appropriate for size, depth, and location of joint.

D. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke-Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 07 84 13 "Penetration Firestopping."

3.2 SLEEVE SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Interior Partitions:

    a. Piping Smaller Than NPS 6: Steel pipe sleeves.

b. Piping NPS 6 and larger: Galvanized-steel sheet sleeves.

END OF SECTION 23 05 17

SECTION 23 05 18
ESCUTCHEONS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Escutcheons.

1.3 DEFINITIONS

A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. BrassCraft Manufacturing Co.; a Masco company.
2. Dearborn Brass.
3. Keeney Manufacturing Company (The).

2.2 ESCUTCHEONS

A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped steel with polished, chrome-plated finish and spring-clip fasteners.

D. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.

E. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. Escutcheons for New Piping and Relocated Existing Piping:

a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
b. Insulated Piping: One-piece stainless steel with polished stainless-steel finish.
c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
f. Bare Piping in Equipment Rooms: One-piece stamped steel or split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.

3.2 FIELD QUALITY CONTROL

A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 23 05 18

SECTION 23 05 23
BALL VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Stainless steel ball valves.

1.2 DEFINITIONS

A. CWP: Cold working pressure.

B. RPTFE: Reinforced polytetrafluoroethylene.

C. SWP: Steam working pressure.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. ASME Compliance:

1. ASME B1.20.1 for threads for threaded-end valves.
2. ASME B16.1 for flanges on iron valves.
3. ASME B16.5 for flanges on steel valves.
4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
5. ASME B16.18 for cast copper solder-joint connections.
6. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
7. ASME B16.34 for flanged and threaded end connections.
8. ASME B31.1 for power piping valves.
9. ASME B31.9 for building services piping valves.

B. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 4 and larger.
2. Hand Lever: For quarter-turn valves smaller than NPS 4.

E. Valves in Insulated Piping:

1. Provide 2-inch extended neck stems.
2. Extended operating handles with nonthermal-conductive covering material, and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

F. Valve Bypass and Drain Connections: MSS SP-45.

2.3 BRASS BALL VALVES

A. Brass Ball Valves, Two Piece with Full Port and Stainless Steel Trim, Threaded Ends or Soldered Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. A.Y. McDonald Mfg. Co.
   b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   c. Hammond Valve.
   d. Watts.

2. Standard: MSS SP-110.
3. SWP Rating: 150 psig.
4. CWP Rating: 600 psig.
5. Body Design: Two piece.
6. Body Material: Forged brass.
7. Ends: Threaded or soldered.
8. Seats: PTFE.
9. Stem: Stainless steel.

10. Ball: Stainless steel, vented.
11. Port: Full.

2.4 STAINLESS STEEL BALL VALVES

A. Stainless Steel Ball Valves, Two Piece with Full Port, Threaded or Flanged Ends:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. A.Y. McDonald Mfg. Co.
   b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
   c. Hammond Valve.

2. Standard: MSS SP-110.
3. CWP Rating: 200 psig.
4. Body Design: Split body.
5. Body Material: Type 316 stainless steel.
6. Ends: Threaded or flanged.
7. Seats: PTFE.
8. Stem: Type 316 stainless steel.
9. Ball: Type 316 stainless steel.
10. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.

B. Provide support of piping adjacent to valves such that no force is imposed upon valves.

C. Locate valves for easy access.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full valve actuation movement.

F. Valve Tags: Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for valve tags and schedules.

G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valves with specified SWP classes or CWP ratings are unavailable, provide the same types of valves with higher SWP classes or CWP ratings.

B. Select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
5. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.5 HEATING-WATER VALVE SCHEDULE

A. Copper Piping: Brass ball valves, two piece with stainless steel trim, full port, and threaded or solder-joint ends.

B. Steel Piping:

1. Stainless Steel ball valves, Class 150.

END OF SECTION 23 05 23

SECTION 23 05 53
IDENTIFICATION 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. Equipment labels.
2. Pipe labels.
3. Valve Tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

1.4 CLOSEOUT SUBMITTALS

A. Equipment Label Schedule: Include a listing of all equipment to be labeled with the content for each label.

B. Valve Tag Schedule: Include a listing of all valves to be tagged with the content for each tag.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Brady Corporation.
   b. Carlton Industries, LP.
   c. Kolbi Pipe Marker Co.
   d. Marking Services, Inc.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: White.
4. Background Color: Black.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number and Drawing numbers where equipment is indicated (plans, details, and schedules).

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brady Corporation.
2. Carlton Industries, LP.
3. Craftmark Pipe Markers.
4. Kolbi Pipe Marker Co.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction according to ASME A13.1.

C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service (heating hot water supply, heating hot water return, refrigerant piping, condensate drain piping, etc.); also include the following:

1. Pipe size.
2. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

F. Lettering Size: Size letters according to ASME A13.1 for piping.

G. Pipe Label Color Schedule:

1. Condensate Drain Piping: Black letters on a yellow background.
2. Refrigerant Piping: Black letters on a safety-white background.
3. Heating Hot Water Supply: White letters on a green background.

4. Heating Hot Water Return: White Letters on a green background.
5. Gas Piping: Black letters on Yellow background.

2.3 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link, beaded chain, cable tie; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses. Valve-tag schedule shall be included in operation and maintenance data.

1. Include valve-tag schedule in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.

B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Within 3 ft. of each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Within 3 ft. of equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 25 feet along each run. Reduce intervals to 10 ft. in areas of congested piping, ductwork, and equipment.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape: 1-1/2 inches, round.
2. Valve-Tag Color: Natural brass finish.

END OF SECTION 23 05 53

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Testing, Adjusting, and Balancing of Hydronic Piping Systems:

   a. Variable-flow hydronic systems.

2. Pipe leakage tests verification.
3. HVAC Control system verification.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

F. TDH: Total dynamic head.

G. UFAD: Underfloor air distribution.

1.4 QUALITY ASSURANCE

A. TAB Specialists Qualifications, Certified by AABC, NEBB, or TABB:

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
2. TAB Technician: Employee of the TAB specialist and certified by AABC.

B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.7.2.3 - "System Balancing."

D. Code and AHJ Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.5 FIELD CONDITIONS

A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

E. Examine test reports specified in individual system and equipment Sections.

F. Examine HVAC equipment, and verify that they are accessible and their controls are connected and functioning.

G. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

H. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.

I. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

J. Examine operating safety interlocks and controls on HVAC equipment.

K. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes the following:

1. Equipment and systems to be tested.
2. Strategies and step-by-step procedures for balancing the systems.
3. Instrumentation to be used.
4. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Hydronics:

a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed.
b. Piping is complete with terminals installed.
c. Water treatment is complete.
d. Systems are flushed, filled, and air purged.
e. Strainers are pulled and cleaned.
f. Control valves are functioning in accordance with the sequence of operation.
g. Shutoff and balance valves have been verified to be 100 percent open.
h. Pumps are started and proper rotation is verified.
i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
j. Variable-frequency controllers' startup is complete and safeties are verified.
k. Suitable access to balancing devices and equipment is provided.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system in accordance with the procedures contained in ASHRAE 111 and in this Section.

B. Cut insulation, ducts, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
2. Where holes for probes are required in piping or hydronic equipment, install pressure and temperature test plugs to seal systems.
3. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 23 07 19 "HVAC Piping Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 TESTING, ADJUSTING, AND BALANCING OF HVAC EQUIPMENT

A. Test, adjust, and balance HVAC equipment indicated on Drawings, including, but not limited to, the following:

1. Motors.
2. Fans and ventilators.
3. Terminal units.
4. Unit heaters.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' Record drawings duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

3.6 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports for pumps, coils, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required coil and equipment flow rates with pump design flow rate.

B. Prepare schematic diagrams of systems' Record drawings piping layouts.

C. In addition to requirements in "Preparation" Article, prepare hydronic systems for testing and balancing as follows:

1. Check expansion tank for proper setting.
2. Check highest vent for adequate pressure.
3. Check flow-control valves for proper position.
4. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
5. Verify that motor controllers are equipped with properly sized thermal protection.

6. Check that air has been purged from the system.

D. Measure and record upstream and downstream pressure of each piece of equipment.

E. Measure and record upstream and downstream pressure of pressure-reducing valves.

F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.

1. Check settings and operation of each safety valve. Record settings.

3.7 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals, and proceed as specified above for hydronic systems.

B. Adjust the variable-flow hydronic system as follows:

1. Verify that the pressure-differential sensor(s) is located as indicated.
2. Determine whether there is diversity in the system.

C. For systems with no flow diversity:

1. Adjust pumps to deliver total design flow.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gauge heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.

c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

2. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.

b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

3. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

4. For systems with pressure-independent valves at terminals:

a. Measure differential pressure and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

5. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

6. Prior to verifying final system conditions, determine the system pressure-differential set point(s).
7. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
8. Mark final settings and verify that all memory stops have been set.
9. Verify final system conditions as follows:

a. Re-measure and confirm that total flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
c. Mark final settings.

D. For systems with flow diversity:

1. Determine diversity factor.
2. Simulate system diversity by closing required number of control valves, as approved by Architect.
3. Adjust pumps to deliver total design flow.

a. Measure total water flow.

1) Position valves for full flow through coils.
2) Measure flow by main flow meter, if installed.
3) If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.

b. Measure pump TDH as follows:

1) Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
2) Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
3) Convert pressure to head and correct for differences in gauge heights.
4) Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
5) With valves open, read pump TDH. Adjust pump discharge valve or speed until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.

c. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.

4. Adjust flow-measuring devices installed in mains and branches to design water flows.

a. Measure flow in main and branch pipes.
b. Adjust main and branch balance valves for design flow.
c. Re-measure each main and branch after all have been adjusted.

5. Adjust flow-measuring devices installed at terminals for each space to design water flows.

a. Measure flow at terminals.
b. Adjust each terminal to design flow.
c. Re-measure each terminal after it is adjusted.
d. Position control valves to bypass the coil, and adjust the bypass valve to maintain design flow.
e. Perform temperature tests after flows have been balanced.

6. For systems with pressure-independent valves at terminals:

a. Measure differential pressure, and verify that it is within manufacturer's specified range.
b. Perform temperature tests after flows have been verified.

7. For systems without pressure-independent valves or flow-measuring devices at terminals:

a. Measure and balance coils by either coil pressure drop or temperature method.
b. If balanced by coil pressure drop, perform temperature tests after flows have been verified.

8. Open control valves that were shut. Close a sufficient number of control valves that were previously open to maintain diversity, and balance terminals that were just opened.
9. Prior to verifying final system conditions, determine system pressure-differential set point(s).
10. If the pump discharge valve was used to set total system flow with variable-frequency controller at 60 Hz, at completion, open discharge valve 100 percent, and allow variable-frequency controller to control system differential-pressure set point. Record pump data under both conditions.
11. Mark final settings and verify that memory stops have been set.
12. Verify final system conditions as follows:

a. Re-measure and confirm that total water flow is within design.
b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
c. Mark final settings.

3.8 PROCEDURES FOR HEAT-TRANSFER COILS

A. Measure, adjust, and record the following data for each hydronic coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Measure, adjust, and record the following data for each electric heating coil:

1. Nameplate data.
2. Airflow.
3. Entering- and leaving-air temperature at full load.
4. Air pressure drop.
5. Voltage and amperage input of each phase at full load.
6. Calculated kilowatt at full load.
7. Fuse or circuit-breaker rating for overload protection.

3.9 PIPE LEAKAGE TESTS

A. Witness the pipe pressure testing performed by Installer.

B. Verify that proper test methods are used and that leakage rates are within specified limits.

C. Report deficiencies observed.

3.10 HVAC CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify HVAC control system is operating within the design limitations.
2. Confirm that the sequences of operation are in compliance with Contract Documents.
3. Verify that controllers are calibrated and function as intended.
4. Verify that controller set points are as indicated.
5. Verify the operation of lockout or interlock systems.
6. Verify the operation of valve and damper actuators.
7. Verify that controlled devices are properly installed and connected to correct controller.
8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.
9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions.

3.11 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Heating-Water Flow Rate: Plus 10 percent or minus 5 percent. If design value is less than 10 gpm, within 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.12 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
2. Include a list of instruments used for procedures, along with proof of calibration.
3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.

13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans performance forms, including the following:

    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Heating coil, dry-bulb conditions.
    e. Face and bypass damper settings at coils.
    f. Fan drive settings, including settings and percentage of maximum pitch diameter.
    g. Settings for pressure controller(s).
    h. Other system operating conditions that affect performance.

16. Test conditions for pump performance forms, including the following:

    a. Variable-frequency controller settings for variable-flow hydronic systems.
    b. Settings for pressure controller(s).
    c. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Water and steam flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

E. Electric-Coil Test Reports: For electric coils of terminal units, include the following:

1. Unit Data:

    a. System identification.
    b. Location.
    c. Coil identification.
    d. Capacity in Btu/h.
    e. Number of stages.
    f. Connected volts, phase, and hertz.
    g. Rated amperage.
    h. Airflow rate in cfm.
    i. Face area in sq. ft.
    j. Minimum face velocity in fpm.

2. Test Data (Indicated and Actual Values):

    a. Heat output in Btu/h.
    b. Airflow rate in cfm.
    c. Air velocity in fpm.
    d. Entering-air temperature in deg F.
    e. Leaving-air temperature in deg F.
    f. Voltage at each connection.
    g. Amperage for each phase.

F. Hot Water-Coil Test Reports: For hot water reheat coils of terminal units, include the following:

1. Unit Data:

   a. System and air-handling-unit identification.
   b. Location and zone.
   c. Room or riser served.
   d. Coil make and size.
   e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

   a. Airflow rate in cfm.
   b. Average face velocity in fpm.
   c. Air pressure drop in inches wg.
   d. Water flow rate in gpm.
   e. Water pressure drop in feet of head or psig.
   f. Entering-water temperature in deg F.
   g. Leaving-water temperature in deg F.
   h. Water pressure drop in feet of head or psig.
   i. Entering-air temperature in deg F.
   j. Leaving-air temperature in deg F.

3.13 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.

B. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 20 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.

E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
2. If the second final inspection also fails, Owner may pursue others Contract options to complete TAB work.

F. Prepare test and inspection reports.

3.14 ADDITIONAL TESTS

A. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 05 93

SECTION 23 07 19
HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes insulation for HVAC piping systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type opf product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or craft training program.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of manufacturer, fabricator, type, description, and size.

1.5 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and finishes and for space required for maintenance.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84 by a testing agency acceptable to authority having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," and "Indoor Piping Insulation Schedule," articles for where insulating materials are applied.

B. Products do not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.

D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.

E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.

F. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Johns Manville; a Berkshire Hathaway company.
   b. Knauf Insulation.
   c. Owens Corning.

2. Preformed Pipe Insulation: Type I, Grade A, with factory-applied ASJ.
3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

G. Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C547.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Johns Manville; a Berkshire Hathaway company.
    b. Knauf Insulation.
    c. Owens Corning.

2. Preformed Pipe Insulation: Type II, Grade A with factory-applied ASJ jacket.
3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.

2.3 INSULATING CEMENTS

A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Ramco Insulation, Inc.

2.4 ADHESIVES

A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.

2.5 SEALANTS

A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.

B. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.
    c. Owens Corning.

2. Permanently flexible, elastomeric sealant.

    a. Service Temperature Range: Minus 150 to plus 250 deg F.
    b. Color: White or gray.

C. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Childers Brand; H. B. Fuller Construction Products.
    b. Foster Brand; H. B. Fuller Construction Products.

2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.

2.7 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M Industrial Adhesives and Tapes Division.
    b. Avery Dennison Corporation, Specialty Tapes Division.
    c. Ideal Tape Co., Inc., an American Biltrite Company.
    d. Knauf Insulation.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. 3M Industrial Adhesives and Tapes Division.
    b. Ideal Tape Co., Inc., an American Biltrite Company.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.8 SECUREMENTS

A. Staples: Outward-clinching insulation staples, nominal 3/4 inch wide, stainless steel or Monel.

B. Wire: 0.062-inch soft-annealed, galvanized steel.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. C & F Wire Products.
b. Johns Manville; a Berkshire Hathaway company.
c. RPR Products, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.

D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 2 inches o.c.
4. For below-ambient services, apply vapor-barrier mastic over staples.
5. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 07 84 13 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.

2. Insulate pipe elbows, fittings, valves, and strainers using prefabricated fitting insulation made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate flanges, mechanical couplings, and unions using a section of oversized preformed pipe insulation to fit. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
4. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
5. For services not specified to receive a field-applied jacket, except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.6 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.7 PIPING INSULATION SCHEDULE, GENERAL

A. Insulation conductivity and thickness per pipe size comply with schedules in this Section or with requirements of the International Energy Code, whichever is more stringent.

B. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

3.8 INDOOR PIPING INSULATION SCHEDULE

A. Heating-Hot-Water Supply and Return, 200 Deg F and Below:

1. NPS 1-1/4 and Smaller: Insulation is the following:

   a. Glass-Fiber, Preformed Pipe Insulation, Type I, 0.25 – 0.29 Conductivity: 1.5 inch thick.

2. NPS 1-1/2 and Larger: Insulation is the following:

   a. Glass-Fiber, Preformed Pipe Insulation, Type I, 0.25 – 0.29 Conductivity: 2 inches thick.

END OF SECTION 23 07 19

SECTION 23 09 23
DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Direct digital control (DDC) system equipment and components for monitoring and controlling of HVAC, exclusive of instrumentation and control devices.

B. Related Requirements:

1. Section 23 09 24 "Control Valves" for control valves that connect to DDC systems.
2. systems.
3. Section 23 09 28 "Temperature Instruments" for vibration instruments that connect to DDC systems.
4. Section 23 09 93 "Sequence of Operations for HVAC DDC" for control sequences in DDC systems.
5. Section 26 05 53 "Identification for Electrical Systems" for identification requirements for communications components.

1.2 DEFINITIONS

A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.

B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.

C. BACnet Specific Definitions:

1. BACnet: Building Automation Control Network Protocol, ASHRAE 135. A communications protocol allowing devices to communicate data and services over a network.
2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
4. BACnet Testing Laboratories (BTL): Organization responsible for testing products for compliance with ASHRAE 135, operated under direction of BACnet International.

D. Binary: Two-state signal where a high signal level represents "ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.

E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: network controllers, programmable application controllers, and application-specific controllers.

F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.

G. COV: Changes of value.

H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.

I. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems to be capable of operating in a standalone mode using the last best available data.

J. E/P: Voltage to pneumatic.

K. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.

L. HLC: Heavy load conditions.

M. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI) and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.

N. I/P: Current to pneumatic.

O. LAN: Local area network.

P. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

Q. Mobile Device: A data-enabled phone or tablet computer capable of connecting to a cellular data network and running a native control application or accessing a web interface.

R. Modbus TCP/IP: An open protocol for exchange of process data.

S. MS/TP: Master-slave/token-passing, ISO/IEC/IEEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.

T. MTBF: Mean time between failures.

U. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.

V. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.

W. Peer to Peer: Networking architecture that treats all network stations as equal partners.

X. POT: Portable operator's terminal.

Y. RAM: Random access memory.

Z. RF: Radio frequency.

AA. Router: Device connecting two or more networks at network layer.

BB. Server: Computer used to maintain system configuration, historical and programming database.

CC. TCP/IP: Transport control protocol/Internet protocol.

DD. UPS: Uninterruptible power supply.

EE. USB: Universal Serial Bus.

FF. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.

GG. VAV: Variable air volume.

HH. WLED: White light emitting diode.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation, operation, and maintenance instructions including factors effecting performance.
5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.

    a. DDC controllers.
    b. Enclosures.
    c. Electrical power devices.
    d. Accessories.
    e. Instruments.
    f. Control valves and actuators.

6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.
7. Each submitted piece of product literature to clearly cross reference specification and drawings that submittal is to cover.

B. Shop Drawings:

1. General Requirements:

   a. Include cover drawing with Project name, location, Owner, Architect, Contractor, and issue date with each Shop Drawings submission.
   b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.

2. Include plans, elevations, sections, and mounting details where applicable.
3. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Plan Drawings indicating the following:

   a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork, and piping.
   b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
   c. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
   d. Proposed routing of wiring, cabling, conduit, and tubing; coordinated with building services for review before installation.

5. Schematic drawings for each controlled HVAC system indicating the following:

   a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each valve, if included in Project.
   b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
   c. A graphic showing location of control I/O in proper relationship to HVAC system.
   d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
   e. Unique identification of each I/O that to be consistently used between different drawings showing same point.
   f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays, and interface to DDC controllers.
   g. Narrative sequence of operation.
   h. Graphic sequence of operation, showing all inputs and output logical blocks.

6. Control panel drawings indicating the following:

   a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
   b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates, and allocated spare space.
   c. Front, rear, and side elevations and nameplate legend.
   d. Unique drawing for each panel.

7. DDC system network riser diagram indicating the following:

    a. Each device connected to network with unique identification for each.
    b. Interconnection of each different network in DDC system.
    c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or optical fiber cable type. Indicate raceway type and size for each.
    d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.

8. DDC system electrical power riser diagram indicating the following:

    a. Each point of connection to field power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
    b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
    c. Each product requiring power with requirements (volts/phase//hertz/amperes/connection type) listed for each.
    d. Power wiring type and size, race type, and size for each.

9. Monitoring and control signal diagrams indicating the following:

    a. Control signal cable and wiring between controllers and I/O.
    b. Point-to-point schematic wiring diagrams for each product.
    c. Control signal tubing to sensors, switches, and transmitters.
    d. Process signal tubing to sensors, switches, and transmitters.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

    a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
    b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
    c. As-built versions of submittal Product Data.
    d. Names, addresses, email addresses, and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
    e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set points and variables.
    f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
    g. Licenses, guarantees, and warranty documents.
    h. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
    i. Owner training materials.

1.6 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.

1. Adjust, repair, or replace failures at no additional cost or reduction in service to Owner.
2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.

a. Install updates only after receiving Owner's written authorization.

3. Perform warranty service during normal business hours and commence within 24 hours of Owner's warranty service request.
4. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DDC SYSTEM MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Distech Controls.

2.2 DDC SYSTEM DESCRIPTION

A. Microprocessor-based monitoring and control including analog/digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices to achieve a set of predefined conditions.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 NETWORKS

A. Acceptable networks for network controllers include the following:

1. IP.

2.4 NETWORK COMMUNICATION PROTOCOL

A. Use network communication protocol(s) that are open to Owner and available to other companies for use in making future modifications to DDC system.

B. ASHRAE 135 Protocol:

1. Use ASHRAE 135 communication protocol as sole and native protocol used throughout entire DDC system.

2. DDC system to not require use of gateways except to integrate HVAC equipment and other building systems and equipment; not required to use ASHRAE 135 communication protocol.
3. If used, gateways to connect to DDC system using ASHRAE 135 communication protocol and Project object properties and read/write services indicated by interoperability schedule.
4. Use operator workstations, controllers, and other network devices that are tested and

2.5 ASHRAE 135 GATEWAYS

A. Include BACnet communication ports, whenever available as an equipment OEM standard option, for integration via a single communication cable. BACnet-controlled plant equipment includes, but is not limited to, boilers, and variable-speed drives.

B. Include gateways to connect BACnet to legacy systems where indicated, existing non-BACnet devices, and existing non-BACnet DDC-controlled equipment.

C. Include with each gateway an interoperability schedule showing each point or event on legacy side that BACnet "client" will read, and each parameter that BACnet network will write to. Describe this interoperability of BACnet services, or BIBBs, defined in ASHRAE 135, Annex K.

D. Gateway Minimum Requirements:

1. Read and view all readable object properties on non-BACnet network to BACnet network, and vice versa, where applicable.
2. Write to all writable object properties on non-BACnet network from BACnet network, and vice versa, where applicable.
3. Include single-pass (only one protocol to BACnet without intermediary protocols) translation from non-BACnet protocol to BACnet, and vice versa.
4. Comply with requirements of Data Sharing Read Property, Data Sharing Write Property, Device Management Dynamic Device Binding-B, and Device Management Communication Control BIBBs in accordance with ASHRAE 135.
5. Hardware, software, software licenses, and configuration tools for operator-to-gateway communications.
6. Backup programming and parameters on CD media with ability to modify, download, backup, and restore gateway configuration.

2.6 NETWORK DDC CONTROLLERS

A. Each school has an existing JACE.

1. Interface new equipment with the existing Bacnet or Lon (see drawings for each school) JACE to adhere to Owner standards already in-place and to achieve integration.

2.7 APPLICATION-SPECIFIC CONTROLLERS

A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment or system. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.

1. Capable of standalone operation and continued control functions without being connected to network.
2. Share data between networked controllers and other network devices.

B. Communication: Application-specific controllers are to communicate with other application-specific controllers and devices on network, and to programmable application controllers and network controllers.

C. Operator Interface: Equip controllers with a service communications port for connection to portable operator's workstation.

D. Serviceability:

1. Equip controller with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Connect wiring and cable connections to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Use nonvolatile memory and maintain all BIOS and programming information in event of power loss.

2.8 ENCLOSURES

A. General:

1. House each controller and associated control accessories in an enclosure. Enclosure is to serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies, and transformers.
2. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
3. Supply each enclosure with complete set of as-built schematics, and wiring diagrams and product literature located in pocket on inside of door.

B. Internal Arrangement:

1. Arrange internal layout of enclosure to group and protect electric, and electronic components associated with controller, but not an integral part of controller.
2. Arrange layout to group similar products together.
3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
4. Factory or shop install products, tubing, cabling, and wiring complying with requirements and standards indicated.
5. Terminate field cable and wire using heavy-duty terminal blocks.
6. Install maximum of two wires on each side of terminal.
7. Include enclosure field electric power supply with toggle-type switch located at entrance inside enclosure to disconnect power.
8. Include enclosure with line-voltage nominal 20 A GFCI duplex receptacle for service and testing tools. Wire receptacle on hot side of enclosure disconnect switch and include with 5 A circuit breaker.
9. Mount products within enclosure on removable internal panel(s).
10. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). Nameplates are to have at least 1/4-inch-high lettering.
11. Label each end of cable, wire, and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.

C. Wall-Mounted, NEMA 250, Type 1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Cooper B-line; brand of Eaton, Electrical Sector.
    b. Hammond Mfg. Co. Inc.
    c. Hoffman; brand of nVent Electrical plc.
    d. Saginaw Control and Engineering.

2. NRTL listed in accordance with UL 50 or UL 50E.
3. Construct enclosure of steel.
4. Finish enclosure inside and out with polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Exterior Color: Gray.
    b. Interior Color: Gray.

5. Hinged door full size of front face of enclosure and supported using the following:

    a. Enclosures Sizes Less Than 36 Inches Tall: Multiple butt hinges.
    b. Enclosures Sizes 36 Inches Tall and Larger: Continuous piano hinges.

6. Removable internal panel with white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
7. Internal panel mounting hardware, grounding hardware, and sealing washers.
8. Grounding stud on enclosure body.
9. Thermoplastic pocket on inside of door for record Drawings and Product Data.

D. Wall-Mounted, NEMA 250, Types 4 and 12:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Cooper B-line; brand of Eaton, Electrical Sector.
    b. Hammond Mfg. Co. Inc.
    c. Hoffman; brand of nVent Electrical plc.
    d. Saginaw Control and Engineering.

2. NRTL listed in accordance with UL 508A.
3. Seam and joints are continuously welded and ground smooth.
4. Where recessed enclosures are indicated, include enclosures with face flange for flush mounting.
5. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
6. Single-door enclosure sizes up to 60 inches tall by 36 inches wide.
7. Double-door enclosure sizes up to 36 inches tall by 60 inches wide.
8. Construct enclosure of steel.
9. Finish enclosure inside and out with polyester powder coating that is electrostatically applied and then baked to bond to substrate.

    a. Exterior Color: Gray.
    b. Interior Color: Gray.

10. Corner-formed door, full size of enclosure face, supported using multiple concealed hinges with easily removable hinge pins.

    a. Sizes through 24 Inches Tall: Two hinges.
    b. Sizes between 24 Inches through 48 Inches Tall: Three hinges.
    c. Sizes Larger Than 48 Inches Tall: Four hinges.

11. Double-door enclosures with overlapping door design to include unobstructed full-width access.

    a. Single-door enclosures 48 inches and taller, and all double-door enclosures, with three-point (top, middle and bottom) latch system.

12. Removable internal panel with white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
13. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
14. Grounding stud on enclosure body.
15. Thermoplastic pocket on inside of door for record Drawings and Product Data.

2.9 RELAYS

A. General-Purpose Relays:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allen Bradley; by Rockwell Automation.
    b. Functional Devices Inc..
    c. Siemens Industry, Inc., Building Technologies Division.
    d. Square D; Schneider Electric USA.

2. NRTL listed.
3. Heavy-duty, electromechanical type; rated for at least 10 A at 250 V ac and 60 Hz.
4. SPDT, DPDT, or three-pole double-throw, as required by control application.
5. Plug-in-style relay with 8-pin octal or multiblade plug for DPDT relays and 11-pin octal] or multiblade plug for three-pole double-throw relays.
6. Construct contacts of silver, silver alloy, or gold.
7. Enclose relay in a polycarbonate dust-tight cover.
8. Include LED indication and push-to-test override button to test manual operation of relay without power on coil.
9. Performance:

    a. Mechanical Life: At least 10 million cycles.
    b. Electrical Life: At least 100,000 cycles at rated load.
    c. Power Consumption: 2 VA or less.
    d. Ambient Operating Temperatures: Minus 30 to 140 deg F.

10. Equip relays with coil transient suppression to limit transients to non-damaging levels.
11. Plug each relay into industry-standard, 35 mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
12. Include relay socket with screw terminals. Mold into socket the coincident screw terminal numbers.

B. Current Sensing Relays:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Eaton.
    b. Functional Devices Inc.
    c. Square D; Schneider Electric USA.

2. NRTL listed.
3. Monitors ac current.
4. Independent adjustable controls for pickup and dropout current.
5. Energized when supply voltage is present and current is above pickup setting.
6. De-energizes when monitored current is below dropout current.
7. Dropout current is adjustable from 50 to 95 percent of pickup current.
8. Visual indication of contact status.
9. Include current transformer, if required for application.
10. House current sensing relay and current transformer if required in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors applications and NEMA 250, Type 4 for outdoor applications.

C. Combination On-Off Status Sensor and On-Off Control Relays:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Functional Devices Inc.
    b. Veris Industries.

2. Description:

    a. On-off control and on-off status indication in a single device.
    b. LED status indication of activated relay and current trigger.
    c. Closed-Open-Auto override switch located on the load side of relay.

3. Performance:

    a. Ambient Temperature: Minus 30 to 140 deg F.
    b. Voltage Rating: Single-phase loads rated for 300 V ac. Three-phase loads rated for 600 V ac.

4. Status Indication:

    a. Current Sensor: Integral sensing for single-phase loads up to 20 A and external solid or split sensing ring for three-phase loads up to 150 A.
    b. Current Sensor Range: As required by application.
    c. Current Set Point: Fixed or adjustable, as required by application.
    d. Current Sensor Output:

5. Relay: SPDT, continuous-duty coil; rated for 10-million mechanical cycles.
6. Enclosure: NEMA 250, Type 12 enclosure for indoor applications; NEMA 250, Type 4 enclosure for outdoor applications.

2.10 ELECTRICAL POWER DEVICES

A. Control Transformers:

1. Sizing Criteria: Size control transformers for total connected load, plus additional 50 percent of connected load for future spare capacity.
2. Transformer Minimum Capacity: 100 VA.
3. Protection: Provide transformers with both primary and secondary fuses.
4. Enclosure: House control transformers in NEMA 250 enclosures, type as indicated in "Performance Requirements" Article for application.

2.11 CONTROL WIRE AND CABLE

A. Wire: Single conductor control wiring above 24 V.

1. Wire Size: Minimum 14 AWG.
2. Conductors: 7/24 soft annealed copper strand with 2- to 2.5-inch lay.
3. Conductor Insulation: 600 V, Type THWN or Type THHN, and 90 deg C in accordance with UL 83.
4. Conductor Insulation Colors: Black (hot), white (neutral), and green (ground).
5. Furnish on spools.

B. Single, Twisted-Shielded, Instrumentation Cable above 24 V:

1. Wire Size: Minimum 18 AWG.
2. Conductors: Twisted, 7/24 soft annealed copper strand with a 2- to 2.5-inch lay.
3. Conductor Insulation: Type THHN/THWN or Type TFN rating.
4. Conductor Insulation Colors:

    a. Twisted Pair: Black and white.
    b. Twisted Triad: Black, red, and white.

5. Shielding: 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
6. Outer Jacket Insulation: 600 V, 90 deg C rating, and Type TC cable.
7. Furnish on spools.

C. Single, Twisted-Shielded, Instrumentation Cable 24 V and Less:

1. Wire Size: Minimum 18 AWG.
2. Conductors: Twisted, 7/24 soft annealed copper stranding with a 2- to 2.5-inch lay.
3. Conductor Insulation: Nominal 15-mil thickness, constructed from flame-retardant PVC.
4. Conductor Insulation Colors:

    a. Twisted Pair: Black and white.
    b. Twisted Triad: Black, red, and white.

5. Shielding: 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
6. Outer Jacket Insulation: 300 V, 105 deg C rating, and Type PLTC cable.
7. Furnish on spools.

D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.

1. Comply with following requirements for balanced twisted pair cable described in Section 26 05 23 "Control-Voltage Electrical Power Cables."

a. Plenum rated.
b. Unique color that is different from other cables used on Project.

2.12 RACEWAYS

A. Comply with requirements in Section 26 05 33 "Raceway and Boxes for Electrical Systems" for electrical power raceways and boxes.

B. Comply with requirements in Section 27 05 28 "Pathways for Communications Systems" for raceways for balanced twisted pair cables and optical fiber cables.

2.13 IDENTIFICATION

A. Control Equipment, Instruments, and Control Devices:

1. Laminated acrylic or melamine plastic sign bearing unique identification.

   a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.

2. Letter size as follows:
   a. DDC Controllers: Minimum of 0.5 inch high.
   b. Gateways: Minimum of 0.5 inch high.
   c. Enclosures: Minimum of 1 inch high.
   d. Instruments: Minimum of 0.25 inch high.
   e. Control Valve Actuators: Minimum of 0.25 inch high.

3. Engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers color-coded black with contrasting white center exposed by engraving through outer layer.
4. Fastened with drive pins.
5. Instruments, control devices, and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require additional identification.

B. Raceway and Boxes:

1. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
2. Paint cover plates on junction boxes and conduit same color as tape banding for conduits. After painting, label cover plate "HVAC Controls".

2.14 SOURCE QUALITY CONTROL

A. Testing Agency: The Commissioing Agent will evaluate the following in accordance with industry standards for each product, and to verify DDC system reliability specified in performance requirements:

1. DDC controllers.
2. Gateways.

B. Product(s) will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates.

B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.

C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

D. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

A. Communication Interface to Equipment with Integral Controls:

1. DDC system has communication interface with equipment having integral controls and having communication interface for remote monitoring or control.
2. Equipment to Be Connected:

a. Cabinet Unit Heaters specified in Section 23 82 39 "Electric Unit Heaters."
b. Fin Tube Radiators specified in Section 23 82 36 "Finned-Tube Radiation Heaters."

3.3 CONTROL DEVICES FOR INSTALLATION BY INSTALLERS

A. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.

B. Deliver the following to plumbing and HVAC piping installers for installation in piping. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. Control valves, which are specified in Section 23 09 24 "Control Valves."

3.4 GENERAL INSTALLATION REQUIREMENTS

A. Install products level, plumb, parallel, and perpendicular with building construction.

B. Neatly support products, tubing, piping wiring, and raceways.

C. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Firestop Penetrations Made in Fire-Rated Assemblies: Comply with requirements in Section 07 84 13 "Penetration Firestopping."

E. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 07 92 00 "Joint Sealants."

F. Welding Requirements:

1. Restrict welding and burning to supports and bracing.
2. No equipment is cut or welded without approval. Welding or cutting will not be approved if there is risk of damage to adjacent Work.
3. Welding, where approved, is to be by inert-gas electric arc process and is to be performed by qualified welders in accordance with applicable welding codes.
4. If requested on-site, show satisfactory evidence of welder certificates indicating ability to perform welding work intended.

G. Fastening Hardware:

1. Wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

H. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

3.5 INSTALLATION OF CONTROLLERS

A. Install controllers in enclosures to comply with indicated requirements.

B. Connect controllers to field power supply.

C. Install controllers with latest version of applicable software and configure to execute requirements indicated.

D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

E. Installation of Programmable Application Controllers:

1. DDC system provider and DDC system manufacturer to determine quantity and location of network controllers to satisfy requirements indicated.

2. Install controllers in a protected location that is easily accessible by operators.
3. Locate top of controller within 72 inches of finished floor.

F. Application-Specific Controllers:

1. DDC system provider and DDC system manufacturer to determine quantity and location of application-specific controllers to satisfy requirements indicated.
2. For controllers not mounted directly on equipment being controlled, install controllers in a location that is easily accessible by operators.

3.6 INSTALLATION OF ENCLOSURES

A. Install the following items in enclosures, to comply with indicated requirements:

1. Gateways.
2. Controllers.
3. Electrical power devices.
4. Relays.
5. Accessories.

B. Attach wall-mounted enclosures to wall using the following types of steel struts:

1. For NEMA 250, Type 1 Enclosures: Use corrosion-resistant-coated steel strut and hardware.
2. For NEMA 250, Type 4 and 12 Enclosures and Enclosures: Use stainless steel strut and hardware.
3. Install plastic caps on exposed cut edges of strut.

C. Align top of adjacent enclosures.

D. Install floor-mounted enclosures located in mechanical equipment rooms on concrete housekeeping pads. Attach enclosure legs using stainless steel anchors.

E. Install continuous and fully accessible wireways to connect conduit, wire, and cable to multiple adjacent enclosures. Wireways used for application are to have protection equal to NEMA 250 rating of connected enclosures.

3.7 ELECTRIC POWER CONNECTIONS

A. Connect electrical power to DDC system products requiring electrical power connections.

B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade to provide a fully functioning DDC system. Work is to comply with NFPA 70 and other requirements indicated.

C. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers" for electrical power circuit breakers.

D. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for electrical power conductors and cables.

E. Comply with requirements in Section 26 05 33 "Raceway and Boxes for Electrical Systems" for electrical power raceways and boxes.

3.8 INSTALLATION OF IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems" for identification products and installation.

3.9 INSTALLATION OF CONTROL WIRE, CABLE, AND RACEWAY

A. Comply with NECA 1.

B. Wire and Cable Installation:

1. Comply with installation requirements in Section 26 05 23 "Control-Voltage Electrical Power Cables."
2. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.

    a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.

3. Terminate wiring in a junction box.

    a. Clamp cable over jacket in a junction box.
    b. Individual conductors in the stripped section of cable is to be slack between the clamping point and terminal block.

4. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
5. Install signal transmission components in accordance with IEEE C2, REA Form 511a, NFPA 70, and as indicated.
6. Use shielded cable to transmitters.
7. Use shielded cable to temperature sensors.
8. Perform continuity and meager testing on wire and cable after installation.

C. Conduit Installation:

1. Comply with Section 26 05 33 "Raceway and Boxes for Electrical Systems" for control-voltage conductors.

3.10 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.11 DDC SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests, and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material, and support.

E. Control Valve Checkout:

1. For pneumatic control valves, verify that pressure gauges are provided in each air line connected to the valve actuator and positioner.
2. Verify that control valves are installed correctly for flow direction.
3. Verify that valve body attachment is properly secured and sealed.
4. Verify that valve actuator and linkage attachment are secure.
5. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
6. Verify that valve ball, disc, or plug travel is unobstructed.
7. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace valve if leaks persist.

F. Instrument Checkout:

1. Verify that instrument is correctly installed for location, orientation, direction, and operating clearances.
2. Verify that attachment is properly secured and sealed.
3. Verify that conduit connections are properly secured and sealed.
4. Verify that wiring is properly labeled with unique identification, correct type, and size and is securely attached to proper terminals.
5. Inspect instrument tag against approved submittal.
6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
8. For temperature instruments, verify the following:

    a. Sensing element type and proper material.
    b. Length and insertion.

3.12 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION, AND TESTING

A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.

B. Provide written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.

C. For each analog instrument, make three-point test of calibration for both linearity and accuracy.

D. Equipment and procedures used for calibration to comply with instrument manufacturer's written instructions.

E. Provide diagnostic and test equipment for calibration and adjustment.

1. Use field testing and diagnostic instruments and equipment with an accuracy at least twice the instrument accuracy of instrument to be calibrated. For example, test and calibrate an installed instrument with accuracy of 1 percent using field testing and diagnostic instrument with accuracy of 0.5 percent or better.

F. Calibrate each instrument in accordance with instruction manual supplied by instrument manufacturer.

G. If after calibration the indicated performance cannot be achieved, replace out-of-tolerance instruments.

H. Comply with field testing requirements and procedures indicated by ASHRAE's Guideline 11, "Field Testing of HVAC Controls Components," in the absence of specific requirements, and to supplement requirements indicated.

I. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

J. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact making or breaking.

K. Control Valves:

1. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Check and document open and close cycle times for applications with cycle time less than 30 seconds.
3. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

L. Meters: Check meters at zero, 50, and 100 percent of Project design values.

M. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

N. Switches: Calibrate switches to make or break contact at set points indicated.

O. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

3.13 DDC SYSTEM CONTROLLER CHECKOUT

A. Verify power supply.

1. Verify voltage, phase, and hertz.
2. Verify that protection from power surges is installed and functioning.
3. Verify that ground fault protection is installed.
4. If applicable, verify if connected to UPS unit.
5. If applicable, verify if connected to backup power source.
6. If applicable, verify that power conditioning units are installed.

B. Verify that wire and cabling are properly secured to terminals and labeled with unique identification.

3.14 FINAL REVIEW

A. Submit written request to Commissioning Agent when DDC system is ready for final review. State the following:

1. DDC system has been thoroughly inspected for compliance with Contract Documents and found to be in full compliance.
2. DDC system has been calibrated, adjusted, and tested and found to comply with requirements of operational stability, accuracy, speed, and other performance requirements indicated.
3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
4. DDC system is complete and ready for final review.

B. Upon receipt of written request for final review, to start review within 14 business days and upon completion issue field report(s) documenting observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in reviewer's field report(s) and submit second written request after all deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Prepare and submit closeout submittals when no deficiencies are reported.

E. Part of DDC system final review shall to include demonstration to parties participating in final review.

1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.
3. Demonstration to include, but not be limited to, the following:
   a. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation.
   b. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.
   c. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.
   d. Trends, summaries, logs, and reports set up for Project.
   e. Data entry to show Project-specific customizing capability including parameter changes.
   f. Execution of digital and analog commands in graphic mode.

3.15 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.16 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain DDC system.

END OF SECTION 23 09 23

SECTION 23 09 24
CONTROL VALVES

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 control valves and actuators for DDC systems.

B. Related Requirements:

1. Section 23 09 23 "Direct Digital Control (DDC) System for HVAC" control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 23 09 93 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 23 09 93.

1.3 DEFINITIONS

A. Cv: Design valve coefficient.

B. DDC: Direct-digital control.

C. NBR: Nitrile butadiene rubber.

D. PTFE: Polytetrafluoroethylene

E. RMS: Root-mean-square value of alternating voltage, which is the square root of the mean value of the square of the voltage values during a complete cycle.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.

4. Installation, operation, and maintenance instructions, including factors affecting performance.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For control valves to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Fabricate and label products to comply with ASME Boiler and Pressure Vessel Code where required by authorities having jurisdiction.

C. Ground Fault: Products shall not fail due to ground fault condition when suitably grounded.

D. Determine control valve sizes and flow coefficients by ISA 75.01.01.

E. Control valve characteristics and rangeability shall comply with ISA 75.11.01.

F. Selection Criteria:

1. Control valves shall be suitable for operation at following conditions:

   a. Heating Hot Water: 100 – 220 Deg F.

2. Control valve shutoff classifications shall be FCI 70-2, Class IV or better unless otherwise indicated.
3. Modulating two-way pattern water valves shall have linear flow-throttling characteristics. The total flow through the valve shall remain constant regardless of the valve's position.
4. Modulating butterfly valves shall have linear flow-throttling characteristics.
5. Fail positions unless otherwise indicated:

   a. Heating Hot Water: Last position.

6. Globe-type control valves shall pass the design flow required with not more than 95 percent of stem lift unless otherwise indicated.
7. Rotary-type control valves, such as ball and butterfly valves, shall have Cv falling between 65 and 75 degrees of valve full open position and minimum valve Cv between 15 and 25 percent of open position.
8. Selection shall consider viscosity, flashing, and cavitation corrections.
9. Valves shall have stable operation throughout full range of operation, from design to minimum Cv.
10. Minimum Cv shall be calculated at 10 percent of design flow, with a coincident pressure differential equal to the system design pump head.
11. In water systems, select modulating control valves at terminal equipment for a design Cv based on a pressure drop of 5 psig at design flow unless otherwise indicated.

12. In water systems, use ball- or globe-style control valves for valves NPS 2 and smaller and butterfly style for valves larger than NPS 2.

2.2 BALL-STYLE CONTROL VALVES

A. Ball Valves with Two Ports and Characterized Disk:

1. Manufacturers: Subject to compliance with requirements, provide products by the following, or owner approved equal during bidding:

    a. Belimo B3 Series.

2. Pressure Rating for NPS 1 and Smaller: Nominal 600 WOG.
3. Pressure Rating for NPS 1-1/2 through NPS 2: Nominal 400 WOG.
4. Close-off Pressure: 200 psig.
5. Process Temperature Range: Zero to 212 deg F.
6. Body and Tail Piece: Cast bronze ASTM B61, ASTM B62, ASTM B584, or forged brass with nickel plating.
7. End Connections: Threaded (NPT) ends.
8. Ball: 300 series stainless steel.
9. Stem and Stem Extension:

    a. Material to match ball.
    b. Blowout-proof design.
    c. Sleeve or other approved means to allow valve to be opened and closed without damaging the insulation or the vapor barrier seal.

10. Ball Seats: Reinforced PTFE.
11. Stem Seal: Reinforced PTFE packing ring with a threaded packing ring follower to retain the packing ring under design pressure with the linkage removed. Alternative means, such as EPDM O-rings, are acceptable if an equivalent cycle endurance can be demonstrated by testing.
12. Flow Characteristics for A-Port: Equal percentage.
13. Flow Characteristics for B-Port: Modified for constant common port flow.

2.3 ELECTRIC AND ELECTRONIC CONTROL VALVE ACTUATORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following, or owner approved equal during bidding:

1. Belimo

B. Actuators for Hydronic Control Valves: Capable of closing valve against system pump shutoff head.

C. Position indicator and graduated scale on each actuator.

D. Type: Motor operated, with or without gears, electric and electronic.

E. Voltage: 24-V ac.

F. Deliver torque required for continuous uniform movement of controlled device from limit to limit when operated at rated voltage.

G. Function properly within a range of 85 to 120 percent of nameplate voltage.

H. Construction:

1. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
2. For Actuators more than 100 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.

I. Field Adjustment:

1. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
2. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.

J. Modulating Actuators:

1. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
2. Control Input Signal:

   a. Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for 0- 10 V dc or 4-20 mA signals.

K. Position Feedback:

1. Equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
2. Provide a position indicator and graduated scale on each actuator indicating open and closed travel limits.

L. Fail-Safe:

1. Provide actuator to fail to last position.

M. Integral Overload Protection:

1. Provide against overload throughout the entire operating range in both directions.
2. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.

N. Valve Attachment:

1. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to valve shaft without the need for connecting linkages.
2. Attach actuator to valve drive shaft in a way that ensures maximum transfer of power and torque without slippage.
3. Bolt and set screw method of attachment is acceptable only if provided with at least two points of attachment.

O. Temperature and Humidity:

1. Temperature: Suitable for operating temperature range encountered by application with minimum operating temperature range of 20 to 140 deg F.
2. Humidity: Suitable for humidity range encountered by application; minimum operating range shall be from 5 to 95 percent relative humidity, non-condensing.

P. Enclosure:

1. Suitable for ambient conditions encountered by application.
2. NEMA 250, Type 2 for indoor and protected applications.
3. NEMA 250, Type 4 or Type 4X for outdoor and unprotected applications.
4. Provide actuator enclosure with heater and control where required by application.

Q. Sound:

1. Non-Spring Return: 45 dBA.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for valves installed in piping to verify actual locations of piping connections before installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROL VALVE APPLICATIONS

A. Control Valves:

1. Select from valves specified in "Control Valves" Article to achieve performance requirements and characteristics indicated while subjected to full range of system operation encountered.

3.3 INSTALLATION, GENERAL

A. Furnish and install products required to satisfy most stringent requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Properly support instruments, tubing, piping, wiring, and conduits to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to a force.

D. Provide ceiling, floor, roof, and wall openings and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that

could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

E. Firestop penetrations made in fire-rated assemblies and seal penetrations made in acoustically rated assemblies.

F. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that will cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

G. Install products in locations that are accessible and that will permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.4 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

3.5 CONTROL VALVES

A. Install pipe reducers for valves smaller than line size. Position reducers as close to valve as possible but at distance to avoid interference and impact to performance. Install with manufacturer-recommended clearance.

B. Install flanges or unions to allow drop-in and -out valve installation.

C. Valve Orientation:

1. Where possible, install globe and ball valves installed in horizontal piping with stems upright and not more than 15 degrees off of vertical, not inverted.
2. Install valves in a position to allow full stem movement.
3. Where possible, install butterfly valves that are installed in horizontal piping with stems in horizontal position and with low point of disc opening with direction of flow.

D. Clearance:

1. Locate valves for easy access and provide separate support of valves that cannot be handled by service personnel without hoisting mechanism.
2. Install valves with at least 12 inches of clear space around valve and between valves and adjacent surfaces.

E. Threaded Valves:

1. Note internal length of threads in valve ends, and proximity of valve internal seat or wall, to determine how far pipe should be threaded into valve.
2. Align threads at point of assembly.
3. Apply thread compound to external pipe threads, except where dry seal threading is specified.
4. Assemble joint, wrench tight. Apply wrench on valve end as pipe is being threaded.

F. Flanged Valves:

1. Align flange surfaces parallel.
2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.6 CONNECTIONS

A. Connect electrical devices and components to electrical grounding system. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with valve identification on valve and on face of ceiling directly below valves concealed above ceilings.

3.8 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

3.9 CHECKOUT PROCEDURES

A. Control Valve Checkout:

1. Check installed products before continuity tests, leak tests, and calibration.
2. Check valves for proper location and accessibility.
3. Check valves for proper installation for direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.
4. For pneumatic products, verify air supply for each product is properly installed.
5. For pneumatic valves, verify that pressure gauges are provided in each air line to valve actuator and positioner.

6. Verify that control valves are installed correctly for flow direction.
7. Verify that valve body attachment is properly secured and sealed.
8. Verify that valve actuator and linkage attachment are secure.
9. Verify that actuator wiring is complete, enclosed, and connected to correct power source.
10. Verify that valve ball, disc, and plug travel are unobstructed.
11. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

3.10 ADJUSTMENT, CALIBRATION, AND TESTING

A. Stroke and adjust control valves following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.

B. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer's recommended procedure, so valve is 100 percent closed, 50 percent closed, and 100 percent open at proper air pressures.

C. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.

D. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

END OF SECTION 23 09 24

SECTION 23 09 27
TEMPERATURE INSTRUMENTS

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. Air temperature sensors.
2. Air temperature RTD transmitters.

B. Related Requirements:

1. Section 23 09 23 "Direct-Digital Control System for HVAC" for control equipment and software, relays, electrical power devices, uninterruptible power supply units, wire, and cable.
2. Section 23 09 93 "Sequence of Operations for HVAC Controls" for requirements that relate to Section 23 09 93.

1.3 DEFINITIONS

A. RTD: Resistance temperature detector.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.
3. Product description with complete technical data, performance curves, and product specification sheets.
4. Installation operation and maintenance instructions, including factors affecting performance.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.

2. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.
4. Include number-coded identification system for unique identification of wiring, cable, and tubing ends.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Product installation location shown in relationship to room, duct, pipe, and equipment.
2. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices, and other installed devices.
3. Sizes and locations of wall access panels for instruments installed behind walls.
4. Sizes and locations of ceiling access panels for instruments installed in inaccessible ceilings.

B. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For instruments to include in operation and maintenance manuals.

1.7 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of instruments that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Environmental Conditions:

1. Instruments shall operate without performance degradation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified and encountered for installed location.

a. If instrument alone cannot meet requirement, install instrument in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, filtered, and ventilated as required by instrument and application.

2. Instruments and accessories shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Instruments not available with integral enclosures complying with requirements indicated shall be housed in protective secondary enclosures. Instrument's installed location shall dictate following NEMA 250 enclosure requirements:

    a. Outdoors, Protected: Type 3.
    b. Outdoors, Unprotected: Type 4.
    c. Indoors, Heated with Filtered Ventilation: Type 1.
    d. Indoors, Heated with Non-Filtered Ventilation: Type 12.
    e. Indoors, Heated and Air Conditioned: Type 1.
    f. Mechanical Equipment Rooms:
    g. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 12.
    h. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4X.

2.2 AIR TEMPERATURE SENSORS

A. Platinum RTDs: Common Requirements:

1. 100 or 1000 ohms at zero deg C and a temperature coefficient of 0.00385 ohm/ohm/deg C.
2. Two-wire, PTFE-insulated, 22-gage stranded copper leads.
3. Performance Characteristics:

    a. Range: Minus 50 to 275 deg F.
    b. Interchangeable Accuracy: At 32 deg F within 0.5 deg F.
    c. Repeatability: Within 0.5 deg F.
    d. Self-Heating: Negligible.

4. Transmitter Requirements:

    a. Transmitter required for each 100-ohm RTD.
    b. Transmitter optional for 1000-ohm RTD, contingent on compliance with end-to-end control accuracy.

B. Space Air Temperature Sensors:

1. 1000 ohms platinum RTD.
2. Temperature Range: Minus 50 to 212 deg F
3. Sensor assembly shall include a temperature sensing element mounted under a flush, brushed-aluminum cover.
4. Provide a mounting plate that is compatible with the surface shape that it is mounted to and electrical box used.
5. Concealed wiring connection.

2.3 AIR TEMPERATURE RTD TRANSMITTERS

A. Source Limitations: Obtain temperature-measuring sensors and transmitters and airflow from single manufacturer.

B. House electronics in NEMA 250 enclosure.

1. Duct: Type 1.
2. Outdoor: Type 4X.
3. Space: Type 1.

C. Conduit Connection: 1/2-inch

D. Functional Characteristics:

1. Input:

a. 100-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.
b. 1000-ohm platinum RTD temperature coefficient of 0.00385 ohm/ohm/deg C, two-wire sensors.

2. Span (Adjustable):

a. Space: 40 to 90 deg F.
b. Supply Air Cooling and Heating: 40 to 120 deg F.
c. Supply Air Cooling Only: 40 to 90 deg F.
d. Supply Air Heating Only: 40 to 120 deg F.
e. Exhaust Air: 50 to 100 deg F.
f. Return Air: 50 to 100 deg F.
g. Mixed Air: Minus 40 to 140 deg F.
h. Outdoor: Minus 40 to 140 deg F.

3. Output: 4- to 20-mA dc, linear with temperature; RFI insensitive; minimum drive load of 600 ohms at 24-V dc .
4. Zero and span field adjustments, plus or minus 5 percent of span. Minimum span of 50 deg F.
5. Match sensor with temperature transmitter and factory calibrate together.

E. Performance Characteristics:

1. Calibration Accuracy: Within 0.1 percent of the span.
2. Stability: Within 0.2 percent of the span for at least 6 months.
3. Combined Accuracy: Within 0.5 percent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.

C. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPERATURE INSTRUMENT APPLICATIONS

A. Air Temperature Sensors:

1. Duct: 1000-ohm platinum RTD.
2. Outdoor: 1000-ohm platinum RTD.
3. Space: 1000-ohm platinum RTD.

B. Air Temperature Transmitters:

1. Duct: Air temperature RTD transmitter.
2. Outdoor: Air temperature RTD transmitter.
3. Space: Air temperature RTD transmitter.

3.3 INSTALLATION, GENERAL

A. Install products level, plumb, parallel, and perpendicular with building construction.

B. Properly support instruments, tubing, piping, wiring, and conduit to comply with requirements indicated. Brace all products to prevent lateral movement and sway or a break in attachment when subjected to force.

C. Provide ceiling, floor, roof, wall openings, and sleeves required by installation. Before proceeding with drilling, punching, or cutting, check location first for concealed products that could potentially be damaged. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

D. Fastening Hardware:

1. Stillson wrenches, pliers, and other tools that cause injury to or mar surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening nuts.
2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
3. Lubricate threads of bolts, nuts, and screws with graphite and oil before assembly.

E. Install products in locations that are accessible and that permit calibration and maintenance from floor, equipment platforms, or catwalks. Where ladders are required for Owner's access, confirm unrestricted ladder placement is possible under occupied condition.

3.4 ELECTRIC POWER

A. Furnish and install electrical power to products requiring electrical connections.

B. Furnish and install circuit breakers. Comply with requirements in Section 26 28 16 "Enclosed Switches and Circuit Breakers."

C. Furnish and install power wiring. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

D. Furnish and install raceways. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems."

3.5 TEMPERATURE INSTRUMENT INSTALLATIONS

A. Mounting Location:

1. Roughing In:

   a. Outline instrument mounting locations before setting instruments and routing cable, wiring, tubing, and conduit to final location.
   b. Provide independent inspection to confirm that proposed mounting locations comply with requirements indicated and approved submittals.

      1) Indicate dimensioned locations with mounting height for all surface-mounted products on Shop Drawings.
      2) Do not begin installation without submittal approval of mounting location.

   c. Complete installation rough-in only after confirmation by independent inspection is complete and approval of location is documented for review by Owner and Architect on request.

2. Install switches and transmitters for air temperature associated with individual air-handling units and associated connected ductwork and piping near air-handling units co-located in air-handling unit system control panel to provide service personnel a single and convenient location for inspection and service.
3. Install air temperature switches and transmitters for indoor applications in mechanical equipment rooms. Do not locate in user-occupied space unless indicated specifically on Drawings.
4. Mount switches and transmitters on walls, floor-supported freestanding pipe stands, or floor-supported structural support frames. Use manufacturer's mounting brackets to accommodate field mounting. Securely support and brace products to prevent vibration and movement.

B. Special Mounting Requirements:

1. Protect products installed outdoors from solar radiation, building and wind effect with stand-offs and shields constructed of Type 316 stainless.
2. Temperature instruments having performance impacted by temperature of mounting substrate shall be isolated with an insulating barrier located between instrument and substrate to eliminate effect. Where instruments requiring insulation are located in finished space, conceal insulating barrier in a cover matching the instrument cover.

C. Mounting Height:

1. Mount temperature instruments in user-occupied space to match mounting height of light switches unless otherwise indicated on Drawings. Mounting height shall comply with codes and accessibility requirements.
2. Mount switches and transmitters located in mechanical equipment rooms and other similar space not subject to code or state and Federal accessibility requirements within a range of 42 to 72 inches above the adjacent floor, grade, or service catwalk or platform.

   a. Make every effort to mount at 48 inches.

D. Seal penetrations to ductwork, plenums, and air-moving equipment to comply with duct static-pressure class and leakage and seal classes indicated using neoprene gaskets or grommets.

E. Space Temperature Sensor Installation:

1. Conceal assembly in an electrical box of sufficient size to house sensor and transmitter, if provided.
2. Install electrical box with a faceplate to match sensor cover if sensor cover does not completely cover electrical box.
3. In finished areas, recess electrical box within wall.
4. In unfinished areas, electrical box may be surface mounted if electrical light switches are surface mounted. Use a cast-aluminum electric box for surface-mounted installations.
5. Align electrical box with other electrical devices such as visual alarms and light switches located in the vicinity to provide a neat and well-thought-out arrangement. Where possible, align in both horizontal and vertical axis.

F. Outdoor Air Temperature Sensor Installation:

1. Mount sensor in a discrete location facing north.
2. Protect installed sensor from solar radiation and other influences that could impact performance.
3. If required to have a transmitter, mount transmitter remote from sensor in an accessible and serviceable location indoors.

G. Single-Point Duct Temperature Sensor Installation:

1. Install single-point-type, duct-mounted, supply- and return-air temperature sensors. Install sensors in ducts with sensitive portion of the element installed in center of duct cross section and located to sense near average temperature. Do not exceed 24 inches in sensor length.
2. Install return-air sensor in location that senses return-air temperature without influence from outdoor or mixed air.
3. Rigidly support sensor to duct and seal penetration airtight.
4. If required to have transmitter, mount transmitter remote from sensor at accessible and serviceable location.

H. Averaging Duct Temperature Sensor Installation:

1. Install averaging-type air temperature sensor for temperature sensors located within air-handling units, similar equipment, and large ducts with air tunnel cross-sectional area of 20 sq. ft. and larger.
2. Install sensor length to maintain coverage over entire cross-sectional area. Install multiple sensors where required to maintain the minimum coverage.
3. Fasten and support sensor with manufacturer-furnished clips to keep sensor taut throughout entire length.
4. If required to have transmitter, mount transmitter in an accessible and serviceable location.

3.6 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Each piece of wire, cable, and tubing shall have the same designation at each end for operators to determine continuity at points of connection. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

B. Install engraved phenolic nameplate with instrument identification and on face of ceiling directly below instruments concealed above ceilings.

3.7 CLEANING

A. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from exposed interior and exterior surfaces.

B. Wash and shine glazing.

C. Polish glossy surfaces to a clean shine.

D. Clean as recommended by manufacturer. Do not use material or methods which may damage finish surface or surrounding construction.

3.8 CHECK-OUT PROCEDURES

A. Check installed products before continuity tests, leak tests, and calibration.

B. Check temperature instruments for proper location and accessibility.

C. Verify sensing element type and proper material.

D. Verify location and length.

E. Verify that wiring is correct and secure.

3.9 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:

1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Equipment and procedures used for calibration shall meet instrument manufacturer's written instructions.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements and to supplement requirements indicated.

B. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistance source.

C. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact.

D. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

E. Switches: Calibrate switches to make or break contact at set points indicated.

F. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistance source.

3.10 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Perform according to manufacturer's written instruction.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Prepare test and inspection reports.

3.11 ADJUSTING

A. Adjust initial temperature set points.

B. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

3.12 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain instrumentation and control devices.

END OF SECTION 23 09 27

SECTION 23 09 93
SEQUENCE OF OPERATIONS FOR HVAC DDC

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 control sequences for DDC for HVAC systems, subsystems, and equipment.

B. Related Requirements:

1. Section 23 09 23 "DDC Systems for HVAC" for control equipment.

1.3 DEFINITIONS

A. Analog Output: Proportional output signal (zero- to 10-V dc, 4 to 20 mA).

B. Binary Output: On/off output signal or contact closure.

C. DDC: Direct digital control.

D. Digital Output: Data output that must be interpreted digitally.

1.4 ACTION SUBMITTALS

A. Product Data:

1. An instrumentation list for each controlled system. Label each element of the controlled system in table format. Show, in the table element name, type of device, manufacturer, model number, and control device product data sheet number.
2. A complete description of the operation of the control system, including sequences of operation. Include and reference a schematic diagram of the controlled system.

B. Shop Drawings:

1. Riser diagrams showing control network layout, communication protocol, and wire types.
2. Schematic diagram of each controlled system. Include all control points labeled with point names shown or listed. Show the location of control elements in the system.
3. Wiring diagram for each controlled system. Show all control elements labels. Where a control element is the same as that shown on the control system schematic, label with the same name. Label all terminals.

1.5 CABINET UNIT HEATERS (CUH)

A. Heating

1. Unit shall operate in heating mode as determined by the controlling wall mounted room temperature sensor.

   a. Electric heating element shall energize to provide the proper heat to meet the space occupied and unoccupied setpoints, adjustable at the DDC interface.

1.6 FIN TUBE RADIATORS (FTR)

A. Heating

1. Unit shall operate in heating mode as determined by the controlling wall mounted room temperature sensor.

   a. Unit shall modulate the hot water control valve to provide the proper heating to meet the space occupied and unoccupied setpoints, adjustable at the DDC interface.

B. Indicate the minimum following on the operator's workstation display terminal:

1. DDC system graphic with all adjustable setpoints described above.
2. DDC system occupied/unoccupied mode.
3. Time schedule.
4. Heating command.
5. Heating status.
6. Space temperature indication.
7. Space temperature set point, heating, occupied.
8. Space temperature set point, heating, unoccupied.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 23 09 93

SECTION 23 21 13
HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Steel pipe and fittings.
3. Joining materials.
4. Transition fittings.
5. Dielectric fittings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Pipe and tube.
2. Fittings.
3. Joining materials.
4. Transition fittings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:

1. Hot-Water Heating Piping: 100 psig at 200 deg F.
2. Drain Piping: 180 deg F.
3. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

2.2 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tube: ASTM B88, Type L.

B. DWV Copper Tube: ASTM B306, Type DWV.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.

E. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

F. Wrought Copper Unions: ASME B16.22.

2.3 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A53/A53M, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.

E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.

F. Wrought-Steel Fittings: ASTM A234/A234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Plain-End Mechanical-Joint Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
b. Shurjoint; a part of Aalberts Integrated piping Systems.
c. Victaulic Company.

2. Housing: ASTM A536 Grade 65-45-12 segmented ductile iron or type 304 stainless steel.
3. Housing coating: None.
4. Gasket: EPDM.
5. Sealing Mechanism: Double-lip sealing system or carbon steel case-hardened jaws.
6. Bolts, hex nuts, washers, or lock bars based on manufacturer's design.
7. Minimum Pressure Rating: Equal to that of the joined pipes.

I. Steel Pipe Nipples: ASTM A733, made of same materials and wall thicknesses as pipe in which they are installed.

2.4 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

D. Solder Filler Metals: ASTM B32, lead-free alloys. Include water-flushable flux according to ASTM B813.

E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. A.Y. McDonald Mfg. Co.
    b. HART Industrial Unions, LLC.
    c. Jomar Valve.
    d. Watts Water Technologies; a Watts company.
    e. Wilkins.

2. Description:

    a. Standard: ASSE 1079.
    b. Pressure Rating: 150 psig minimum at 200 deg F.
    c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. GF Piping Systems: Georg Fischer LLC.
    b. Watts Water Technologies; a Watts company.
    c. Wilkins.
    d. Zurn Industries, LLC.

2. Description:

    a. Standard: ASSE 1079.
    b. Factory-fabricated, bolted, companion-flange assembly.
    c. Pressure Rating: 150 psig minimum at 200 deg F.
    d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 2 and smaller, shall be the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Drain Piping: Same materials and joining methods as for piping specified for the service in which blowdown drain is installed.

D. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed according to piping manufacturer's written instructions.

3.2 INSTALLATION OF PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at slopes to allow draining.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to the following:

1. Section 23 05 23 "Ball Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install shutoff valve immediately upstream of each dielectric fitting.

T. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for identifying piping.

U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8/A5.8M.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 INSTALLATION OF DIELECTRIC FITTINGS

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for hangers, supports, and anchor devices.

B. Install hangers for copper tubing and steel piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping within 12 inches of each fitting and coupling.

D. Support vertical runs of copper tubing and steel piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.8 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 23 21 13

SECTION 23 21 16
HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Hydronic specialty valves.

B. Related Requirements:

1. Section 23 05 23 "Ball Valves for HVAC Piping" for specification and installation requirements for ball valves common to most piping systems.
2. Section 23 09 24 "Control Valves" for automatic control valve and sensor specifications, installation requirements, and locations.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product:

1. Include construction details and material descriptions for hydronic piping specialties.
2. Include rated capacities, operating characteristics, and furnished specialties and accessories.
3. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For hydronic piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Pipe Welding: Qualify procedures and operators in accordance with ASME BPVC, Section IX.

PART 2 - PRODUCTS

2.1 HYDRONIC SPECIALTY VALVES

A. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Bell & Gossett; a Xylem brand.
c. NIBCO INC.
d. Taco Comfort Solutions.
e. Watts Water Technologies; a Watts company.

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gauge Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

B. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
b. Bell & Gossett; a Xylem brand.
c. NIBCO INC.
d. Watts Water Technologies; a Watts company.

2. Body: Cast-iron or steel body, ball, butterfly, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass- and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gauge Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all piping specialties for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Examine threads on all devices for form and cleanliness.

C. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

D. Do not attempt to repair defective piping specialties; replace with new devices. Remove defective piping specialties from site.

3.2 INSTALLATION OF VALVES

A. Install calibrated-orifice balancing valve at the end of return main to supply main.

B. Install calibrated-orifice balancing valve at each branch connection to return main.

C. Install calibrated-orifice, balancing valve in the return pipe of each heating or cooling terminal.

3.3 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

END OF SECTION 23 21 16

SECTION 23 33 00
AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wall Louver

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Product installation location shown in relationship to room, duct, pipe, and equipment.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise

indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 WALL LOUVERS

A. Manufacturers:

1. Greenheck (Basis of Design).
2. Carnes.
3. Vent Products.
4. Ruskin.

B. Construction Requirements

1. Louver frame shall be 4 inch deep channel style with 0.081 inch extruded aluminum wall thickness. Louver blades shall be horizontal stationary drainable style located on 3.25 inch centers and 37.5 degree angle with 0.081 inch extruded aluminum wall thickness. Bird screen shall be internally mounted 0.75 inch x 0.051 inch flattened expanded aluminum. Performance Requirements:
2. Louvers shall be AMCA Licensed when tested in accordance with AMCA 500-L Air Performance and Water Penetration test procedures. Free area for size 48 inch x 48 inch louver shall not be less than 8.98 square feet (56.1%). Airflow resistance at 1000 feet per minute free area intake velocity shall not be greater than 0.172 inch water gauge pressure drop. Airflow resistance at 1000 feet per minute free area exhaust velocity shall not be greater than 0.152 inch water gauge pressure drop. Beginning point of water penetration shall not be less than 989 feet per minute free area intake velocity.

C. Accessories:

1. Bird screen.
2. Custom finish color, to be selected by Architect.

2.3 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G60.
2. Exposed-Surface Finish: Custom color as selected by Architect.

B. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and finish for exposed ducts.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

END OF SECTION 23 33 00

SECTION 23 82 36
FINNED-TUBE RADIATION HEATERS

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 hydronic, finned-tube radiation heaters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details and dimensions of custom-fabricated enclosures.
4. Indicate location and size of each field connection.
5. Indicate location and arrangement of piping valves and specialties.
6. Indicate location and arrangement of integral controls.
7. Include enclosure joints, corner pieces, access doors, and other accessories.
8. Include diagrams for power, signal, and control wiring.

C. Color Samples for Initial Selection: For finned-tube radiation heaters with factory-applied color finishes.

D. Color Samples for Verification: For each type of exposed finish.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 HOT-WATER FINNED-TUBE RADIATION HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Modine (Basis of Design).
2. Sterling HVAC Products; a Mestek company.
3. Trane.
4. Vulcan.

B. Performance Ratings: Rate finned-tube radiation heaters according to Hydronics Institute's "I=B=R Testing and Rating Standard for Finned-Tube (Commercial) Radiation."

C. Heating Elements: Copper tubing mechanically expanded into flanged collars of evenly spaced aluminum fins resting on element supports. One end of tube shall be belled.

D. Element Supports: Ball-bearing cradle type to permit longitudinal movement on enclosure brackets.

E. Front Panel: Minimum 18 gauge thick steel.

F. Floor-Mounted Pedestals: Conceal insulated piping at maximum 36-inch spacing. Pedestal-mounted back panel shall be solid panel matching front panel. Provide stainless-steel escutcheon for floor openings at pedestals.

G. Support Brackets: Locate at maximum 36-inch spacing to support front panel and element.

H. Finish: Manufacturer's custom color as selected by Architect.

I. Capacities and Characteristics – See Equipment Schedules on Project Drawings:

J. Accessories: Filler sections, corners, relay sections, and splice plates all matching the enclosure and grille finishes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive finned-tube radiation heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for hydronic-piping connections to verify actual locations before installation of finned-tube radiation heaters.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FINNED-TUBE RADIATION HEATER INSTALLATION

A. Install units level and plumb.

B. Join sections with splice plates and filler pieces to provide continuous enclosure.

C. Terminate enclosures with manufacturer's end caps except where enclosures are indicated to extend to adjoining walls.

D. Install piping within pedestals for freestanding units.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect hot-water finned-tube radiation heaters and components to piping according to Section 23 21 13 "Hydronic Piping" and Section 23 21 16 "Hydronic Piping Specialties."

   1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.

C. Install control valves as required by Section 23 09 24 "Control Valves."

D. Install piping adjacent to finned-tube radiation heaters to allow service and maintenance.

E. Ground electric finned-tube radiation heaters according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections:

   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Units will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 23 82 36

SECTION 23 82 39
ELECTRIC UNIT HEATERS

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 ceiling electric unit heaters with propeller fans and electric-resistance heating coils.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include details of anchorages and attachments to structure and to supported equipment.
4. Include equipment schedules to indicate rated capacities, operating characteristics, furnished specialties, and accessories.
5. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which fan coil units will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.

d. Access panels.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For ceiling electric unit heaters to include in operation, and maintenance manuals.

B. Startup service reports.

1.6 WARRANTY

A. Warranty: Manufacturer agrees to repair or replace components of electric unit heaters that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Parts: One year from date of Substantial Completion.
b. For Electric Heating Element: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 DESCRIPTION

A. Assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 CAPACITIES AND CHARACTERISTICS

A. See Equipment Schedule on drawings for Unit Capacities and Characteristics.

2.3 ELECTRIC CEILING UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. QMark (Basis of Design).
2. Berko
3. Markel Products; TPI Corporation
4. Chromalox, Inc.

B. Cabinet

1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners.

2. Finish: Baked enamel over baked-on primer with manufacturer's custom color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
3. Recessed Enclosure with T-bar mounting frame: Steel with finish to match cabinet. Enclosures to recess into a maximum 7 inches of ceiling space.

C. Coil

1. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection.

D. Fan and Motor

1. Fan: Aluminum propeller directly connected to motor. Fan control shall be bi-metallic, snap-action type and shall activate the fan immediately and continue to operate the fan after the thermostat is satisfied and until all heated air has been discharged. Thermal cutout shall be bi-metallic snap-action type designed to automatically shut off the heater in the event of overheating and reactivate the heater when temperature returns to normal.
2. Motor: Impedance protected, permanently lubricated, with totally enclosed rotor.

E. Controls

1. Controls: DDC wall mounted temperature sensor provided and installed by controls contractor. Include optional relay with unit.
2. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

F. Minimum interface with DDC System for HVAC Requirements (see points lists and flow diagrams for more information):

1. All controls (controllers, wiring, programming graphics, etc.) shall be provide and installed by controls contractor.
2. Interface relay for scheduled operation.
3. Interface relay to provide indication of fault at the central workstation.
4. Controls contractor to provide BACnet interface controller for central DDC system for HVAC workstation for the following functions:

   a. Adjust set points.
   b. Ceiling unit heater start, stop, and operating status.
   c. Data inquiry, including room-air temperature.
   d. Occupied and unoccupied schedules.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive ceiling unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for and electrical connections to verify actual locations before ceiling unit heater unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install electric unit heaters level and plumb.

B. Install wall-mounted temperature sensors in electrical outlet boxes at heights to match lighting controls. Verify location of temperature sensors and other exposed control sensors with Drawings and room details before installation.

C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

E. Label units according to requirements specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections.

1. Operational Test: After electrical circuitry has been energized, start baseboard heaters to confirm proper operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

3.4 SYSTEM STARTUP

A. Complete startup, startup tests and startup reports. Startup to be performed per Installation, Operation, and Maintenance Manual (IOM).

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

3.6 CLEANING

A. Clean as recommended by manufacturer. Do not use material or methods which may damage finish surface or surrounding construction.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain heating units.

END OF SECTION 23 82 39

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Fire-alarm wire and cable.
3. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cerro Wire LLC.
2. Encore Wire Corporation.
3. Southwire Company.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.
2. Type XHHW-2: Comply with UL 44.

2.2 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Wire & Cable Inc.
2. CommScope, Inc.
3. Superior Essex Inc.
4. West Penn Wire.

B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600 V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.

2.3 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M Electrical Products.
2. Burndy
3. Hubbell Incorporated, Power Systems.
4. Ideal Industries, Inc.
5. Service Wire Co.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Tin Plated Copper.
2. Type: One hole with standard barrels.
3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits:

1. Copper, Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Feeders below Slabs-on-Grade, and Underground rated 100A or greater: Type XHHW-2, single conductors in raceway.

B. Feeders below Slabs-on-Grade, and Underground rated less than 100A: Type THWN-2, single conductors in raceway.

C. Feeders above grade, exposed or concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors where feasible.

B. Complete raceway installation between conductor and cable termination points according to Section 26 05 33 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

F. Support cables according to Section 26 05 29 "Hangers and Supports for Electrical Systems."

3.4 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

A. Comply with NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 28 05 28 "Pathways for Electronic Safety and Security."

1. Install plenum cable in environmental airspaces, including plenum ceilings.
2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system must be installed in a dedicated pathway system.

    a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
3. Signaling Line Circuits: Power-limited fire-alarm cables must not be installed in the same cable or pathway as signaling line circuits.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

3.5 CONNECTIONS

A. 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-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 05 53 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping."

END OF SECTION 26 05 19

SECTION 26 05 23
CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Backboards.
2. Fire Alarm Cabling
3. RS-485 cabling.
4. Low-voltage control cabling.
5. Control-circuit conductors.
6. Identification products.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.

D. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency, RCDD, layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

1. Flame Travel Distance: 60 inches or less.
2. Peak Optical Smoke Density: 0.5 or less.
3. Average Optical Smoke Density: 0.15 or less.

C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

E. RoHS compliant.

2.2 BACKBOARDS

A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches.

B. Painting: Paint plywood on all sides and edges with flat grey fire retardant paint. Comply with requirements in Section 099123 "Interior Painting."

2.3 FIRE ALARM CABLE

A. Plenum-Rated, Shieded Cable: NFPA 70, Type FPLP for horn/strobe and initiating devices.

1. Multi-pair, solid copper conductors per ASTM B3.
2. No. 18 AWG through 12 AWG as required for Voltage Drop
3. Low Smoke Color Coded Polypropylene or PVC insulation.
4. Foil Shield.
5. Red PVC jacket.
6. Flame Resistance: Comply with NFPA 262.

B. Plenum-Rated, Shieded Cable: NFPA 70, Type FPLP-CI for all voice (speaker/strobe) signaling devices.

1. UL 2196 Certified 2-Hour rated, UL 1424 Listed
2. Multi-pair, solid copper conductors per ASTM B3.
3. No. 18 AWG through 12 AWG as required for Voltage Drop
4. Color Coded Polypropylene or PVC insulation.
5. Foil Shield.
6. Red PVC jacket.
7. Flame Resistance: Comply with NFPA 262.

2.4 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CMG.

1. Paired, one pair, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, one pair, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.

2.5 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. Multi-pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. Multi-pair, twisted, No. 18 AWG, stranded (19x30) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.6 CONTROL-CIRCUIT CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Encore Wire Corporation.
2. General Cable; General Cable Corporation.

B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

1. Smoke control signaling and control circuits.

2.7 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate cables.

B. Factory test twisted pair cables according to TIA-568-C.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Test cables on receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.

1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
2. Outlet boxes for cables shall be no smaller than 4 inches square by 1-1/2 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
3. Flexible metal conduit shall not be used.

B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
2. Install cable trays to route cables if conduits cannot be located in these positions.
3. Secure conduits to backboard if entering the room from overhead.
4. Extend conduits 3 inches above finished floor.
5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.
2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

C. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Install termination hardware as specified in Section 271500 "Communications Copper Horizontal Cabling" unless otherwise indicated.
3. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways.
2. Use insulated spade lugs for wire and cable connection to screw terminals.
3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches.
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches.
    c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 12 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.5 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.6 GROUNDING

A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.

C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

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

C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

D. Perform tests and inspections with the assistance of a factory-authorized service representative.

E. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy

specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

F. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.

G. End-to-end cabling will be considered defective if it does not pass tests and inspections.

H. Prepare test and inspection reports.

END OF SECTION 26 05 23

DIVISION 26 – ELECTRICAL

SECTION 26 05 29

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, Special Conditions, Mechanical and Electrical Supplemental Requirements 20 00 00 and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. This Section includes the following:
   1. Hangers and supports for electrical equipment and systems.
   2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing

B. RNC: Rigid metal conduit

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Nonmetallic slotted support systems.
   3. Submit UL Listed Through-Penetration Firestop Systems' details proposed for use on project.
   4. Trapeze hangers. Include Product Data for components.
   5. Steel slotted channel systems. Include Product Data for components.
   6. Nonmetallic slotted channel systems. Include Product Data for components.
   7. Equipment supports.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports and roof penetrations. These items are specified in Division 07 Section “Roof Accessories”.

PART 2 PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Allied Tube & Conduit
      b. Cooper B-Line, Inc.: a division of Cooper Industries.
      c. Thomas & Betts Corporation.
      d. Unistrut; Tyco International, Ltd.
   2. Metallic Coating: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   3. Channel Dimensions: Selected for applicable load criteria.
   4. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
   5. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
   6. Rated Strength: Selected to suit applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for type 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 non-armored 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 malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, 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. Power-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. Approval from structural engineer shall be obtained prior to the use of power-actuated fasteners.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         1) Hilti Inc.

2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
3) MKT Fastening, LLC
4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

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 in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-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 Division 05 Section “Metal Fabrications” for steel shapes and plates.

C. Install auxiliary transformer wall mounting brackets where wall mounted transformers are indicated on drawings. Utilize commercial and manufactured supports if available.

PART 3 EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT and RMC as required by NFPA 70. Minimum rod size will be ¼ inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted 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 for conduits 1 ¼ inch and larger, single-bolt conduit clamps for conduits 1 inch and smaller.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. 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.

C. 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. 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.
   5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts and Beam clamps (MSS Type 19, 21, 23, 25 or 27) complying with MSS SP-69.
   6. To Light Steel: Sheet metal screws.
   7. 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.

D. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 LIGHTING FIXTURES

A. Install channel supports across main grid runners or grid supports, securely tied down or anchored for fixtures and devices mounted in suspended ceiling systems so as not to cause tile to sag and so that fixture or device cannot be lifted, rotated, or displaced.

B. Lighting fixtures shall be supported to building structure independent of ceiling support system. Fixture support wires shall be same size and material used to support ceiling system. Provide adequate support so that fixture cannot be rotated or displaced. Contractor shall submit proposed method of fixture support to Engineer for review prior to installation.

3.4 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "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.

3.5 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 30 00 – “Cast-in-Place Concrete”.

C. Anchor equipment to concrete base.
   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.

3.6 PAINTING

A. Touchup: Comply with requirements in Section 09 90 00 – “Paints and Coatings” for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 05 19

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Type EMT-S raceways and elbows.
2. Type IMC raceways and elbows.
3. Type FMC-S raceways and fittings.
4. Type LFMC raceways and fittings.
5. Fittings for conduit, tubing, and cable.
6. Threaded metal joint compound.
7. Solvent cements.
8. Wireways and auxiliary gutters.
9. Termination boxes.
10. Cabinets, cutout boxes, junction boxes, and pull boxes.

B. Related Requirements:

1. Section 26 00 10 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data: For the following:

1. Wireways and auxiliary gutters.
2. Surface metal raceways.
3. Junction boxes.
4. Cabinets and cutout boxes.

PART 2 - PRODUCTS

2.1 TYPE EMT-S RACEWAYS AND ELBOWS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 797 and UL Category Control Number FJMX.

B. Steel Electrical Metal Tubing (EMT-S) and Elbows:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; Atkore International.
b. Western Tube; Zekelman Industries.
c. Wheatland Tube; Zekelman Industries.

2. Material: Steel.
3. Options:

a. Exterior Coating: Galvanized with clear coating.
b. Interior Coating: Zinc with organic top coating.
c. Minimum Trade Size: Trade size 3/4.

2.2 TYPE IMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 1242 and UL Category Control Number DYBY.

B. Steel Electrical Intermediate Metal Conduit (IMC):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; Atkore International.
b. Western Tube; Zekelman Industries.
c. Wheatland Tube; Zekelman Industries.

2. Options:

a. Exterior Coating: Zinc.
b. Interior Coating: Zinc with organic top coating.
c. Minimum Trade Size: Trade size 3/4.

2.3 TYPE FMC-S RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 1 and UL Category Control Number DXUZ.

B. Steel Flexible Metal Conduit (FMC-S):

1. Material: Steel.
2. Minimum Trade Size: Trade size 3/4.

2.4 TYPE LFMC RACEWAYS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 360 and UL Category Control Number DXHR.

B. Steel Liquidtight Flexible Metal Conduit (LFMC-S):

1. Material: Steel.
2. Minimum Trade Size: Trade size 3/4.

2.5 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Legrand Wiremold Series 2400D for combination Power/Data.
b. Legrand Wiremold Series 500 for single Power or Control circuits.

2.6 FITTINGS FOR CONDUIT, TUBING, AND CABLE

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.

B. Fittings for Type EMT and IMC Raceways:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; Atkore International.
b. Western Tube; Zekelman Industries.
c. Wheatland Tube; Zekelman Industries.
d. Crouse-Hinds; Eaton, Electrical Sector.
e. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.

2. General Characteristics: UL 514B and UL Category Control Number FKAV.
3. Options:

a. Material: Steel
b. Coupling Method: Compression coupling.
c. Expansion and Deflection Fittings: UL 651 with flexible external bonding jumper.

2.7 ELECTRICALLY CONDUCTIVE CORROSION-RESISTANT COMPOUNDS FOR THREADED CONDUIT

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 2419 and UL Category Control Number FOIZ.

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. ABB, Electrification Business.

2.8 WIREWAYS AND AUXILIARY GUTTERS

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 870 and UL Category Control Number ZOYX.

B. Metal Wireways and Auxiliary Gutters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ABB, Electrification Business.
b. B-line; Eaton, Electrical Sector.
c. Hoffman; nVent.
d. Square D; Schneider Electric USA.
e. Wiegmann; Hubbell Incorporated, Commercial and Industrial.

2. Additional Characteristics:

a. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
b. Finish: Manufacturer's standard enamel finish.

3. Options:

a. Degree of Protection: Type 1 unless otherwise indicated.
b. Wireway Covers: Screw-cover type unless otherwise indicated.

2.9 TERMINATION BOXES

A. Description: Enclosure for termination base consisting of lengths of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors or both.

B. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics: UL 1773 and UL Category Control Number XCKT.

C. Termination Boxes and Termination Bases for Installation on Line Side of Service Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. B-line; Eaton, Electrical Sector.
    b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    c. Erickson Electrical Equipment Company.
    d. Hoffman; nVent.
    e. Square D; Schneider Electric USA.

2. Additional Characteristics: Listed and labeled for installation on line side of service equipment.

D. Termination Boxes and Termination Bases for Installation on Load Side of Service Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. B-line; Eaton, Electrical Sector.
    b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    c. Erickson Electrical Equipment Company.
    d. Hoffman; nVent.
    e. Square D; Schneider Electric USA.

2. Additional Characteristics: Listed and labeled for installation on load side of service equipment.

2.10 CABINETS, CUTOUT BOXES, JUNCTION BOXES, AND PULL BOXES

A. Performance Criteria:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:

    a. Non-Environmental Characteristics: UL 50.
    b. Environmental Characteristics: UL 50E.

B. Indoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. B-line; Eaton, Electrical Sector.
    b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
    c. Hubbell Industrial Controls; Hubbell Incorporated, Commercial and Industrial.
    d. N J Sullivan Company.
    e. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
    f. Square D; Schneider Electric USA.
    g. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

3. Additional Characteristics: UL Category Control Number BGUZ.
4. Options:

a. Degree of Protection: Type 1.

C. Outdoor Sheet Metal Junction and Pull Boxes:

1. Description: Box with a blank cover that serves the purpose of joining different runs of raceway or cable.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. B-line; Eaton, Electrical Sector.
b. EGS; Emerson Electric Co., Automation Solutions, Appleton Group.
c. Hubbell Industrial Controls; Hubbell Incorporated, Commercial and Industrial.
d. N J Sullivan Company.
e. Raco Taymac Bell; Hubbell Incorporated, Commercial and Industrial.
f. Square D; Schneider Electric USA.
g. Wiring Device-Kellems; Hubbell Incorporated, Commercial and Industrial.

3. Additional Characteristics: UL Category Control Number BGUZ.

a. Options:
b. Degree of Protection: Type 4X or Type 6P.

PART 3 - EXECUTION

3.1 SELECTION OF RACEWAYS

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of raceways. Consult Architect for resolution of conflicting requirements.

B. Outdoors:

1. Exposed and Not Subject to Physical Damage: Corrosion-resistant EMT.
2. Exposed and Subject to Physical Damage: Corrosion-resistant IMC.
3. Concealed Aboveground: EMT.
4. Connections to Mechanical equipment: LFMC.

C. Indoors:

1. Exposed in non-finished areas and Not Subject to Physical Damage: EMT.
2. Exposed in non-finished areas and Subject to Physical Damage: IMC.
3. Exposed in finished areas: Surface Metal Raceway.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Damp or Wet Locations: Corrosion-resistant EMT.
6. Connections to Mechanical equipment: LFMC.
7. Concealed Connections to Lighting Fixtures: FMC.

D. Raceway Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.

3.2 SELECTION OF BOXES AND ENCLOSURES

A. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.

B. Degree of Protection:

1. Outdoors:
   a. Locations Subject to Potential Flooding: Type 6P.
   b. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
   c. Locations in-Ground or Exposed to Corrosive Agents: Type 4X.

2. Indoors:

   a. Type 1 unless otherwise indicated.
   b. Damp or Dusty Locations: Type 12.

C. Exposed Boxes Installed Less Than 8 ft Above Floor:

1. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.3 INSTALLATION OF RACEWAYS

A. Installation Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' written instructions, comply with NFPA 70 for installation of raceways. Consult Architect for resolution of conflicting requirements.
2. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
3. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
4. Comply with NECA NEIS 101 for installation of steel raceways.
5. Comply with NECA NEIS 102 for installation of aluminum raceways.
6. Comply with NECA NEIS 111 for installation of nonmetallic raceways.
7. Install raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
8. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
9. Raceway Terminations at Locations Subject to Moisture or Vibration:

   a. Provide insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

B. General Requirements for Installation of Raceways:

1. Complete raceway installation before starting conductor installation.

2. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of 2 ft above finished floor.
3. Install no more than equivalent of two 90-degree bends in conduit run. Support within 12 inch of changes in direction.
4. Make bends in raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
5. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
6. Support conduit within 12 inch of enclosures to which attached.
7. Install raceway sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings in accordance with NFPA 70.
8. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of raceways at the following points:

    a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
    b. Where an underground service raceway enters a building or structure.
    c. Conduit extending from interior to exterior of building.
    d. Conduit extending into pressurized duct and equipment.
    e. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
    f. Where otherwise required by NFPA 70.
9. Keep raceways at least 6 inch away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
10. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.

C. Requirements for Installation of Specific Raceway Types:

1. Type PVC:

    a. Do not install Type PVC conduit where ambient temperature exceeds 122 deg F. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
    b. Comply with manufacturer's written instructions for solvent welding and fittings.

D. Raceways Embedded in Slabs:

1. Run raceways larger than metric designator 27 (trade size 1) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place raceway close to slab support.
2. Arrange raceways to ensure that each is surrounded by a minimum of 2 inch of concrete without voids.
3. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
4. Change from PVC-80 to ENT before rising above floor.

E. Raceway Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.

1. EMT: Provide compression fittings. Comply with NEMA FB 2.10.

F. Raceways Penetrating Rooms or Walls with Acoustical Requirements:

1. Seal raceway openings on both sides of rooms or walls with acoustically rated putty or firestopping.

3.4 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 44
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS & CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Round sleeves.
2. Sleeve seal systems.
3. Grout.

B. Related Requirements:

1. See Section 07 84 13 "Penetration Firestopping" for sleeves through fire rated walls and assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

A. Wall Sleeves, Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advance Products & Systems, LLC.
   b. CCI Piping Systems.
   c. GPT; an EnPro Industries company.

2. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

2.2 SLEEVE SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Products & Systems, Inc.
2. BWM Company.
3. CALPICO, Inc.
4. Hilti Industries.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. W.R. Meadows, Inc.

B. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
2. Design Mix: 5000 psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 07 92 00 "Joint Sealants."

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for wall assemblies.

C. Aboveground, Exterior-Wall Penetrations: Seal penetrations using mechanical sleeve seal systems. Size sleeves to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.2 INSTALLATION OF SLEEVE SEAL SYSTEMS

A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION 26 05 44

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Special Conditions, and Electrical Supplemental Requirements 26 00 10 and Division 01 Specification Sections, apply to this section.

1.2 SUMMARY

A. This Section includes the following:
   1. Identification for raceways and metal-clad cable.
   2. Identification for conductors and communication and control cable.
   3. Instruction signs.
   4. Equipment identification labels.
   5. Miscellaneous identification products.

1.3 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.4 COORDINATION

A. Coordinate identification names, abbreviations, colors and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and in the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout the 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 CONDUCTORS AND CABLES

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with panel and circuit identification legend machine printed by thermal transfer or equivalent process.

2.2 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. 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.

2.3 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Paint materials and application requirements are specified in Section 09 00 00 – “Paint and Coatings”.

B. Fasteners for Labels and Signs: Self-tapping stainless steel screws, except contact type permanent commercial grade adhesive providing a permanent bond shall be used where screwed cannot or should not penetrate substrate.

C. Two-sided tape and dynamo tape adhesives are not acceptable.

PART 3 EXECUTION

3.1 APPLICATION

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, Branch Circuits, and Telecommunications Pull Boxes: Identify with paint as noted below.
   1. All junction box covers for the shall be painted as follows:
      a. Emergency Generator System – Yellow
      b. Fire Alarm System – Red
      c. Data Systems – Blue.

B. Power-Circuit Conductor Identification: For primary and secondary conductors in pull boxes, junction boxes and manholes/handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

C. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number.

D. At each junction box, the covers on junction boxes and pull boxes in areas that are not to be painted shall be marked with "Indelible Markers" to indicate the circuit number(s) of conductors in

the box. In areas where exposed conduit and junction boxes are to be painted, indicate circuit number(s) of conductors in the box on the inside cover of the box.

E. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source and circuit number.

F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and communications cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

   1. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

H. Instruction Signs:
   1. Operating Instructions: 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.
   2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer load shedding.

I. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

   1. Labeling Instructions:

      a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with ½-inch high letters on 1-1/2-inch-high label; where 2 lines of text are required, use labels 2 inches high.
      b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
      c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

   2. Equipment to Be Labeled:

      a. Panelboards, electrical cabinets, and enclosures.
      b. Access doors and panels for concealing electrical items.
      c. Electrical switchgear and switchboards.
      d. Emergency system boxes and enclosures

J. Engraved laminate signs shall be white lettering in a black field.

K. Where the electrical system is comprised of normal power and emergency power, the equipment connected to the normal power system shall have engraved laminate signs with white lettering in a black field. Equipment connected to the emergency power system shall have engraved laminate signs with white lettering in a yellow field.

3.2 COVER PLATES

A. All wiring device cover plates shall have panel name and circuit number serving device clearly marked on the back of each faceplate with indelible marker.

3.3 PANELBOARD CIRCUIT DIRECTORIES

A. Install in each panelboard a typewritten directory accurately indicating rooms and equipment being served. Verify actual room names and numbers to be used. Also, provide a copy of typewritten panelboard directories in Owner's close-out manuals.

3.4 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 non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.

2. Colors for 208/120-V Circuits:

   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
   d. Neutral: White.
   e. Ground: Green.
   f. Isolated Ground: Green/Yellow Tracer.

3. 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.

G. Painted Identification: Prepare surface and apply paint according to Section 09 90 00 – “Paintings and Coatings”.

END OF SECTION 26 05 53

SECTION 26 09 23
NETWORK LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. The lighting control system specified in this section shall provide time-based, sensor-based (both occupancy and daylight), 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 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 even if network connectivity to the greater system is lost.
   5. The system architecture shall facilitate remote operation via a computer connection.
   6. The system shall not require any centrally hardwired switching equipment.
   7. The system shall be capable of wireless, wired, or hybrid wireless/wired architectures.

B. Related Sections include the following:
   1. Division 26 Section 262726 “Wiring Devices” for wall-box dimmers, wall-switch occupancy sensors, and manual light switches

1.2 REFERENCES

A. ANSI/NFPA 70 – National Electrical Code (NEC) 2011

B. ICC – International Energy Conservation Code (IECC) 2009

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, and marked for intended use.

1.4 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, smoke detectors, fire-suppression system, and partition assemblies.

B. Coordinate lighting control components to form an integrated interconnection of compatible components.

C. Coordinate lighting controls with BAS (if necessary) either through IP based intercommunication of system or hardwired auxiliary relay outputs. Timeclock function for exterior lighting shall be through the BAS.

D. The installing contractor shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

1.5 WARRANTY

A. All devices in lighting control system shall have a 5 year warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following: Sensor Switch, Inc.

2.2 SYSTEM REQUIREMENTS

A. System shall have an architecture that is based upon three main concepts; 1) intelligent lighting control devices 2) standalone lighting control zones 3) network backbone for remote or time based operation.

B. Intelligent lighting control devices shall consist of one or more basic lighting control components; occupancy sensors, photocell sensors, relays, dimming outputs, manual switch stations, and manual dimming stations. Combining one or more of these components into a single device enclosure should be permissible so as to minimize overall device count of system.

C. System must interface directly with intelligent LED luminaires such that only CAT-5e cabling is required to interconnect luminaires with control components such as sensors and switches (see *Networked LED Luminaire* section)

D. Intelligent lighting control devices shall communicate digitally, require <4 mA of current to function (Graphic wall stations excluded), and posses RJ-45 style connectors.

E. Lighting control zones shall consist of one or more intelligent lighting control components, be capable of stand-alone operation, and be capable of being connected to a higher level network backbone.

F. Devices within a lighting control zone shall be connected with CAT-5e low voltage cabling in any order.

G. Lighting control zone shall be capable of automatically configuring itself for default operation without any start-up labor required.

H. Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure with the backbone network or the management software becoming unavailable.

I. Power for devices within a lighting control zone shall come from either resident devices already present for switching (relay device) or dimming purposes, or from the network backbone. Standalone “bus power supplies” shall not be required in all cases.

J. All switching and dimming for a specific lighting zone shall take place within the devices located in the zone itself (i.e. not in a remotely located devices such as panels) to facilitate system robustness and minimize wiring requirements. Specific applications that require centralized or remote switching shall be capable of being accommodated.

K. Individual lighting zones shall be capable of being segmented into several “local” channels of occupancy, photocell, and switch functionality for more advanced configurations and sequences of operation.

L. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via either the wired or WiFi backbone.

M. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Note operating modes should be utilized only in manners consistent with local energy codes.

1. Auto-On / Auto-Off (via occupancy sensors)
   a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
   b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
   c. Pressing a switch will turn lights off. The lights will remain off regardless of occupancy until switch is pressed again, restoring the sensor to Automatic On functionality.
2. Manual-On / Auto-Off (also called Semi-Automatic)
   a. Pushing a switch will turn lights on.
   b. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
3. Manual-On to Auto-On/Auto-Off
   a. Pushing a switch will turn lights on.
   b. After initial lights on, zones with occupancy and/or photocell sensors turn lights on/off according to occupancy/vacancy and/or daylight conditions.
   c. Sequence can be reset via scheduled (ex. daily each morning) events
4. Auto-to-Override On
   a. Zones with occupancy sensors automatically turn lights on when occupant is detected.
   b. Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
   c. Sequence can be reset via scheduled (ex. daily each morning) events
5. Manual-to-Override On
   a. Pushing a switch will turn lights on.
   b. Zone lighting then goes into an override on state for a set amount of time or until the next time event returns the lighting to an auto-off style of control.
6. Sequence can be reset via scheduled (ex. daily each morning) events
   a. Auto On / Predictive Off
   b. Zones with occupancy sensors automatically turn lights on when occupant is detected.
   c. Zones with occupancy and/or photocell sensors turn lights off when vacancy or sufficient daylight is detected.
   d. If switch is pressed, lights turn off and a short “exit timer” begins. After timer expires, sensor scans the room to detect whether occupant is still present. If no occupancy is detected, zone returns to auto-on. If occupancy is detected, lights must be turned on via the switch.
7. Multi-Level Operation (multiple lighting levels per manual button press)
   a. Operating mode designed specifically for bi-level applications
   b. Enables the user to cycle through the up to four potential on/off lighting states using only a single button.
   c. Eliminates user confusion as to which of two buttons controls which load
   d. Three different transition sequences are available in order to comply with energy codes or user preference)
   e. Mode available as a setting on all nLight devices that have single manual on/off switch (ex. nWSX, nPODM, nPODM-DX).

f. Depending on the sequence selected, every button push steps through relays states according to below table

g. In addition to achieving bi-level lighting control by switching loads with relays, the ability to command dimming outputs to “step” in a sequence that achieves bi-level operation is present.

	Alternating Sequence		Full On Sequence		3 Step On Sequence	
Sequence State #	Relay 1	Relay 2	Relay 1	Relay 2	Relay 1	Relay 2
1	On	Off	On	Off	On	Off
2	Off	On	-	-	Off	On
3	-	-	On	On	On	On
4*	Off	Off	Off	Off	Off	Off

(*step only present for devices without separate off button)

N. System shall provide the option of having pre-terminated plenum rated CAT-5e cabling supplied with hardware.

2.3 INDIVIDUAL DEVICE SPECIFICATIONS

A. Networked System Occupancy Sensors

1. Occupancy sensors system shall sense the presence of human activity within the desired space and fully control the on/off function of the lights.
2. Sensors shall utilize passive infrared (PIR) technology, which detects occupant motion, to initially turn lights on from an off state; thus preventing false on conditions. Ultrasonic or Microwave based sensing technologies shall not be accepted.
3. For applications where a second method of sensing is necessary to adequately detect maintained occupancy (such as in rooms with obstructions), a sensor with an additional “dual” technology shall be used.
4. Dual technology sensors shall have one of its two technologies not require motion to detect occupancy. Acceptable dual technology includes PIR/Microphonics (also known as Passive Dual Technology or PDT) which both looks for occupant motion and listens for sounds indicating occupants. Sensors where both technologies detect motion (PIR/Ultrasonic) shall not be acceptable.
5. All sensing technologies shall be acoustically passive meaning they do not transmit sounds waves of any frequency (for example in the Ultrasonic range), as these technologies have the potential for interference with other electronic devices within the space (such as electronic white board readers). Acceptable detection technologies include Passive Infrared (PIR), and/or Microphonics technology. Ultrasonic or Microwave based sensing technologies shall not be accepted.

6. Sensors shall be available with zero, one, or two integrated Class 1 switching relays, and up to one 0-10 VDC dimming output. Sensors shall be capable of switching 120 / 277 / 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor. Relays shall be dry contacts.
7. Sensors shall be available with one or two occupancy “poles”, each of which provides a programmable time delay.
8. Sensors shall be available in multiple lens options which are customized for specific applications.
9. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
10. All sensors shall have two RJ-45 ports or capable of utilizing a splitter.
11. All sensors shall have the ability to detect when it is not receiving valid communication (via CAT-5 connections) and blink its LED in a pattern to visually indicate of a potential wiring issue
12. Every sensor parameter shall be available and configurable remotely from the software and locally via the device push-button.
13. 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-5 cabling.
14. 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.
15. Wall switch sensors shall recess into single-gang switch box and fit a standard GFI opening.
16. Wall switch sensors must 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.
17. Wall switch sensors shall have optional features for photocell/daylight override, vandal resistant lens, and low temperature/high humidity operation.
18. Wall switch sensors shall be available in four standard colors (Ivory, White, Light Almond, Gray)
19. Wall switch sensors shall be available with optional raise/lower dimming adjustment controls
20. Embedded sensors shall be capable of both PIR and Dual Technology occupancy detection
21. Embedded sensors shall have an optional photocell
22. Network system shall also have ceiling, fixture, recessed, & corner mounted sensors available.
23. Fixture mount sensors shall be capable of powering themselves via a line power feed.
24. Sensors shall have optional features for photocell/daylight override, dimming control, and low temperature/high humidity operation.
25. 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).
26. System shall have WiFi enabled fixture mountable sensors available.
27. Embedded sensors shall have an optional photocell and 0-10 VDC dimming output

B. Networked System Daylight (Photocell and or Dimming) Sensors
1. Photocell shall provide for an on/off set-point, and a deadband to prevent the artificial light from cycling. Delay shall be incorporated into the photocell to prevent rapid response to passing clouds.
2. Photocell and dimming sensor’s set-point and deadband shall be automatically calibrated through the sensor’s microprocessor by initiating an “Automatic Set-point Programming” procedure. Min and max dim settings as well as set-point may be manually entered.

3. Deadband setting shall be verified and modified by the sensor automatically every time the lights cycle to accommodate physical changes in the space (i.e., furniture layouts, lamp depreciation, or lamp outages).
4. Dimming sensors shall control 0 to 10 VDC dimmable ballasts by sinking up to 20 mA of class 2 current (typically 40 or more ballasts).
5. Photocell and dimming 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. (Note: This function should be performed prior to any dimming of the lamps including the “auto set-point” setting.)
6. Combination units that have all features of on/off photocell and dimming sensors shall also be available.
7. A dual zone option shall be available for On/Off Photocell, Automatic Dimming Control Photocell, or Combination units. The second zone shall be capable of being controlled as an “offset” from the primary zone.
8. Line voltage versions of the above described photocell and combination photocell/dimming sensors shall be capable of switching both 120 VAC, 277 VAC, and 347 VAC. Load ratings shall be 800 W @ 120 VAC, 1200 W @ 277 VAC, 1500 W @ 347 VAC, and ¼ HP motor load. Relays shall be dry contacts.

C. Networked System Power (Relay) Packs
1. 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.
2. Power Packs shall accept 120 or 277 VAC (or optionally 347 VAC), be plenum rated, and provide Class 2 power to the system.
3. All devices shall have two RJ-45 ports.
4. Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
5. 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. Note: UL Listing under Energy Management or Industrial Control Equipment automatically meets this requirement, whereas Appliance Control Listing does not meet this safety requirement.
6. When required by local code, Power Pack must install 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.
7. Power Packs and Power Supplies shall be available that are WiFi enabled.
8. Power (Secondary) Packs shall be available that provide up to 16 Amp switching of all lighting load types.
9. Power (Secondary) Packs shall be available that provide up to 5 Amps switching of all lighting load types as well as 0-10 VDC dimming or fluorescent ballasts/LED drivers.
10. Specific Secondary Packs shall be available that provide up to 5 Amps of switching as well as 0-10 VDC dimming of fluorescent ballasts/LED drivers.
11. Specific Secondary Packs shall be available that provide 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).

12. Specific Secondary Packs shall be available that provide up to 5 Amps of switching and can dim 120/277 VAC magnetic low voltage transformers.
13. Specific Secondary Packs shall be available that provide up to 4 Amps of switching and can dim 120 VAC electronic low voltage transformers.
14. Specific Secondary Packs shall be available that provide up to 5 Amps of switching of dual phase (208/240/480 VAC) lighting loads.
15. Specific Secondary Packs shall be available that require a manual switch signal (via a networked Wall Station) in order to close its relay.
16. Specific Power/Secondary Packs shall be available that are UL924 listed for switching of Emergency Power circuits.
17. Specific Secondary Packs shall be available that control louver/damper motors for skylights.
18. Specific Secondary Packs shall be available that provide a pulse on/pulse off signal for purposes of controlling shade systems via relay inputs.

D. Networked System Relay & Dimming Panels
1. Panel shall incorporate up to 4 normally closed latching relays capable of switching 120/277 VAC or up to 2 Dual Phase relays capable of switching 208/240/480 VAC loads.
2. Relays shall be rated to switch up to a 30A ballast load at 277 VAC.
3. Panel shall provide one 0-10VDC dimming output paired with each relay.
4. Panel shall power itself from an integrated 120/277 VAC supply.
5. Panel shall be capable of operating as either two networked devices or as one.
6. Panel shall supply current limited low voltage power to other networked devices connected via CAT-5.
7. Panel shall provide auxiliary low voltage device power connected wired directly to a dedicated terminal connection

E. Networked Auxiliary Input / Output (I/O) Devices
1. Devices shall be plenum rated and be inline wired, screw mountable, or have an extended chase nipple for mounting to a ½” knockout.
2. Devices shall have two RJ-45 ports
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. Specific I/O devices shall have a dimming control output that can control 0-10 VDC dimmable ballasts or LED drivers by sinking up to 20 mA of current (typically 40 or more ballasts).
5. Specific I/O devices shall have an input that read a 0-10 VDC signal from an external device.
6. Specific I/O devices shall have a switch input that can interface with either a maintained or momentary switch and run a switch event, run a local/remote control profile, or raise/lower a dimming output
7. Specific I/O devices shall sense state of low voltage outdoor photocells
8. Specific I/O devices shall enable RS-232 communication between lighting control system and Touch Screen based A/V control systems.
9. Specific I/O devices shall sense .

F. Networked LED Luminaires
1. Networked LED luminaire shall have a mechanically integrated control device
2. Networked LED luminaire shall have two RJ-45 ports
3. Networked LED luminaire shall be able to digitally network directly to other network control devices (sensors, photocells, switches, dimmers)

4. Networked LED luminaire shall provide low voltage power to other networked control devices
5. System shall be able to turn on/off LED luminaire without using a relay
6. System shall be able to maintain constant lumen output over the specified life of the LED luminarie (also called lumen compensation) by varying the input control power (and thus saving up to 20% power usage).
7. System shall indicate (via a blink warning) when the LED luminaire has reached its expected life (in hrs).

G. Networked System Wall Switches & Dimmers
1. Devices shall recess into single-gang switch box and fit a standard GFI opening.
2. Devices shall be available with zero or one integrated Class 1 switching relay.
3. Communication and low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
4. All sensors shall have two RJ-45 ports.
5. All devices shall provide toggle switch control. Dimming control and low temperature/high humidity operation are available options.
6. Devices shall be available in four colors (Ivory, White, Light Almond, Gray).
7. Devices with dimming control outputs can control 0-10 VDC dimmable ballasts by sinking up to 20 mA of current (typically 40 or more ballasts).
8. Devices with capacitive touch buttons shall provide audible user feedback with different sounds for on/off, raise/lower, start-up, and communication offline.
9. Devices with mechanical push-buttons shall provide tactile and LED user feedback.
10. Devices with mechanical push-buttons shall be made available with custom button labeling
11. 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.

H. Networked System Graphic Wall Station
1. 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.
2. Device shall enable configuration of lighting presets, switched, and dimmers via password protected setup screens.
3. Device shall enable user supplied .jpg screen saver image to be uploaded.
4. Device shall surface mount to single-gang switch box
5. Device shall have a micro-USB style connector for local computer connectivity.
6. Device shall have two RJ-45 ports for communication

I. Networked System Scene Controllers
1. Device shall have two to four buttons for selecting programmable lighting control profiles or acting as on/off switches.
2. Device shall recess into single-gang switch box and fit a standard GFI opening.
3. Devices shall provide LED user feedback.
4. Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors.
5. All sensors shall have two RJ-45 ports.
6. Device shall be capable of reprogramming other devices in its zone so as to implement user selected lighting scene.

7. 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).
8. Device shall have LEDs indicating current selection.

2.4 LIGHTING CONTROL PROFILES

A. Changes to the operation of the system shall be capable of being made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.

B. Lighting control profiles shall be capable of being created and applied to a single device, zone of devices, or customized group of zones.

C. All relays and dimming outputs shall be capable of being scheduled to track or ignore information regarding occupancy, daylight, and local user switches via lighting control profiles.

D. Every device parameter (e.g. sensor time delay and photocell set-point) shall be configurable via a lighting control profile.

E. All lighting control profiles shall be stored on the network control gateway device and on the software's host server.

F. Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.

G. Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.

H. Daylight savings time adjustments shall be capable of being performed automatically, if desired.

I. Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.

J. Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.5 START-UP & SUPPORT FEATURES

A. To facilitate start-up, all devices daisy-chained together (using CAT-5) shall automatically be grouped together into a functional lighting control zone.

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. Once software is installed, system shall be able to auto-discover all system devices without requiring any commissioning.

D. All system devices shall be capable of being given user defined names.

E. All devices within the network shall be able to have their firmware reprogrammed remotely and without being physically uninstalled for purposes of upgrading functionality at a later date.

F. All sensor devices shall have the ability to detect improper communication wiring and blink its LED in a specific cadence as to alert installation/startup personnel.

2.6 CONDUCTORS AND CABLES

A. All control cables shall be white to differentiate between data cabling.

B. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Specification Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

C. Classes 2 and 3 Control Cable: Multiconductor cable, Category 5e with solid-copper conductors not smaller than No. 23 AWG. Comply with requirements in Specification Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

D. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Specification Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables.

PART 3 EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with requirements in Specification Section 260519 – Low- Voltage Electrical Cables. Minimum conduit size shall be ½ inch.

B. Wiring within Enclosures: Comply with NECA 1. 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.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Specification Section 260573 – Identification for Electrical Systems.

B. Identify circuits or luminaries controlled by occupancy sensors at each sensor.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

B. Lighting control devices that fail tests and inspections are defective work.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits per building (total of 12) to Project during non-occupancy hours for this purpose.

3.6 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test and adjust field-assembled components and equipment installation, including connections and assist in field testing. Report results in writing.

B. 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 operation of each lighting control device, and adjust time delays.
   3. Test for circuit continuity.
   4. Verify that the control module features are operational.
   5. Check operation of local override controls.
   6. Test system diagnostics by simulating improper operation of several components selected by Architect.

3.7 SOFTWARE INSTALLATION

A. Install and program system software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.8 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. At least 8 hours of training shall be included covering maintenance, troubleshooting, module replacement, adjustment, and software configuration.

END SECTION 26 09 23

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 RELATED WORK AND REQUIREMENTS

A. Section 26 05 53 - Identification for Electrical Systems

B. Section 26 05 73 - Overcurrent Protective Device Coordination Study

C. Section 26 28 13 – Fuses

D. Section 26 29 13 - Enclosed Controllers

1.2 SUMMARY

A. Section Includes:
   1. Fusible switches.
   2. Non-fusible switches.
   3. Molded-case circuit breakers (MCCB's).
   4. Molded-case switches.
   5. Enclosures.

1.3 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
   2. Altitude: Not exceeding 6600 feet.

1.4 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces with all trades. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.5 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
   2. Provide spare fuse cabinets, Bussmann type SFC, to store all spare fuses. Locate cabinets as directed by the Owner.
   3. Fuse Pullers: Provide two for each size and type.

1.6 SUBMITTALS FOR REVIEW/RECORD

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Enclosure types and details for types.
2. Current, horsepower, and voltage ratings.
3. Short-circuit current rating.
4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.7 SUBMITTALS FOR RECORD ONLY

A. Test Reports: See Project Specification Section # 26 91 00

1. Megger Test Report: Only Service Entrance, >400A, or <400A Critical Applications
2. Infrared Scanning via FLIR Camera Software

B. O&M Data

PART 2 PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturer: The listing of a manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included here.

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical, Inc.; Cutler-Hammer Business Unit.
3. Siemens Energy & Automation, Inc.

B. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neural Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Set screw type, suitable for number, size, and conductor material.

2.2 NON-FUSIBLE SWITCHES

A. Manufacturer: The listing of a manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included here.

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical, Inc.; Cutler-Hammer Business Unit.
3. Siemens Energy & Automation, Inc.

B. Type HD, Heavy Duty, Single Throw, 240 and 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neural Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Set screw type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturer: The listing of a manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the Contractor to ensure that any submittals made are for products that meet or exceed the specifications included here.

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical, Inc.; Cutler-Hammer Business Unit.
3. Siemens Energy & Automation, Inc.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents indicated on the drawings.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits in each pole. Adjustable magnetic trip setting for circuit-breaker frame sizes 150 A and larger, adjustable from the front.

D. Construct with over center, trip-free toggle type operating mechanisms with quick make, quick break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position and operating in ambient temperature of 40 degrees C. Provide breakers with mechanical screw type removable connector lugs. AL/CU rated. Lugs shall be adequate to accept wire size indicated on the drawings.

E. Electronic Trip (shunt trip) Circuit Breakers: Field-replaceable rating plug, RMS sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I^2t response.

F. Where required to achieve system coordination with upstream and downstream overcurrent devices, solid-state circuit breakers shall be provided. All electronics shall be self-contained and require no external relaying, power supply, or accessories. Printed circuit cards shall be treated to resist moisture absorption, fungus growth, and signal leakage. All electronics shall be housed in an enclosure which provides protection against arcs, magnetic interference, dust, and other contaminants. Solid-sate sensing shall measure true RMS current with error less than one percent on systems with distortions through the 13th harmonic. Peak or average actuating devices are not acceptable. Current sensors shall be toroid construction, encased in a plastic housing, filled with epoxy to protect against damage and moisture and shall be integrally mounted on the breaker. Where indicated on the drawings, circuit breaker frames shall be rated for 100 percent continuous duty. Circuit breakers shall have tripping features as described below;

1. Longtime current pick up.
2. Adjustable long time delay.
3. Short time current pick up.
4. Adjustable short time delay.
5. Short time I square times t switch.
6. Instantaneous current pick up.
7. Ground fault current pick up, adjustable from 20 percent to 60 percent of sensor rating, but in no case greater than 1200 amperes. Sensing of ground fault current at the main bonding jumper or ground strap shall not be permitted. Provide ground fault only where indicated on the drawings.
8. Overload and short circuit and ground fault trip indicators shall be provided.

G. Interrupting ratings shall be as follows, unless otherwise indicated on drawings. Circuit breakers shall be fully rated for available fault current. Series rating is not acceptable.

H. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Set screw type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self- powered for solid state type trip units and remote-mounted and powered for magnetic type trip units with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact. Voltage as shown on project drawings.
6. Under-voltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Alarm Switch: One NC contact that operates only when circuit breaker has tripped.

2.4 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
   3. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Non-corrosive Liquids: NEMA 250, Type 12.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height (as noted on project drawings) unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.
   1. Examine fusible equipment for size and type of fuse to ensure selective coordination. Provide fuses of size and type as required by equipment manufacturer.
   2. Install fuses only after fault and coordination study has been finalized.
   3. Fuses shall not be installed until equipment is ready to be energized. If fuse size is too small to physically fit in disconnect switch, provide fuse reduction kit.

D. Circuit breakers and molded case switches shall be factory installed in enclosures.

E. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation" and in accordance with recognized industry practices.

F. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 26 05 53 - Identification for Electrical Systems.

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections to verify that installation has been performed as noted in installation section above.

B. Acceptance Testing Preparation:
1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

C. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
   c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

F. Test and/or permanently record the following:
1. Fuses:
   a. Equipment nameplate requirement.
   b. Actual fuse rating.
2. Circuit Breakers:
   a. Nameplate data.
   b. Actual trip settings.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 26 05 73 – Overcurrent Protective Device Coordination Study. Adjustable settings on circuit breakers shall be set to provide selective coordination, proper operation, and compliance with NEC.

END SECTION 26 28 16

SECTION 26 51 19
LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	(2010) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	(2015) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A580/A580M	(2015) Standard Specification for Stainless Steel Wire
ASTM A641/A641M	(2009a; R 2014) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	(2015; E 2016) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B164	(2003; R 2014) Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B633	(2015) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM D4674 REV A	(2002; R 2010) Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments

ILLUMINATING ENGINEERING SOCIETY (IES)

IES HB-10	(2011; Errata 2015) IES Lighting Handbook
IES LM-79	(2008) Electrical and Photometric Measurements of Solid-State Lighting Products
IES LM-80	(2015) Measuring Lumen Maintenance of LED Light Sources

IES RP-16	(2010; Addendum A 2008; Addenda B 2009; Addendum C 2016) Nomenclature and Definitions for Illuminating Engineering
IES TM-21	(2011; Addendum B 2015) Projecting Long Term Lumen Maintenance of LED Light Sources

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2012; Errata 1 2012; INT 1-4 2012; Errata 2 2013; INT 5-7 2013; INT 8-10 2014; INT 11 2015; INT 12 2016) National Electrical Safety Code
IEEE C62.41	(1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
IEEE C62.41.1	(2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	(2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2014) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ANSLG C78.377	(2015) American National Standard for Electric Lamps—Specifications for the Chromaticity of Solid State Lighting Products
NEMA C82.77	(2002) Harmonic Emission Limits - Related Power Quality Requirements for Lighting Equipment
NEMA ICS 2	(2000; R 2005; Errata 2008) Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2011) Enclosures
NEMA SSL 1	(2010) Electronic Drivers for Led Devices, Arrays, or Systems
NEMA SSL 3	(2011) High-Power White LED Binning for General Illumination
NEMA SSL 7A	(2015) Phase-Cut Dimming for Solid State Lighting: Basic Compatibility
NEMA WD 1	(1999; R 2015) Standard for General Color Requirements for Wiring Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2015; ERTA 2015) Life Safety Code
NFPA 70	(2017) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1472	(2015) UL Standard for Safety Solid-State Dimming Controls
UL 1598	(2008; Reprint Oct 2012) Luminaires
UL 20	(2010; Reprint Feb 2012) General-Use Snap Switches
UL 2043	(2013) Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces
UL 508	(1999; Reprint Oct 2013) Industrial Control Equipment
UL 8750	(2009; Reprint May 2014) UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products
UL 916	(2007; Reprint Aug 2014) Standard for Energy Management Equipment
UL 917	(2006; Reprint Aug 2013) UL Standard for Safety Clock-Operated Switches
UL 924	(2006; Reprint Dec 2015) Standard for Emergency Lighting and Power Equipment
UL 94	(2013; Reprint Jan 2016) Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
2. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each luminaire and for each color requiring custom finish.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved.

B. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.

C. Product Certificates: For each type of luminaire.

D. Product test reports.

E. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided 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.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 5 to 104 deg F.

1. Relative Humidity: Zero to 95 percent.

2.2 LUMINAIRE 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. Factory-Applied Labels: Comply with UL 1598. 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.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter, shape, size, wattage, and coating.
c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

D. DLC Compliance: Luminaires shall be DLC listed to qualify for utility incentives.

2.3 LIGHTING FIXTURES.

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acuity Brands.
2. Hubbell Lighting.

B. Nominal Operating Voltage: 120 V ac.

C. Lamp: See Fixture Schedule

D. Housings:

1. Extruded-aluminum housing and heat sink.
2. Anodized or powder-coat finish.

E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

F. With integral mounting provisions.

G. Standards:

1. UL Listing: Listed for location.
2. Recessed luminaires shall comply with NEMA LE 4.

H. Drivers: NEMA SSL 1, UL 8750. LED drivers must be electronic, UL Class 1, constant-current type and comply with the following requirements:

1. Output power (watts)and luminous flux (lumens) as shown in luminaire schedule for each luminaire type to meet minimum luminaire efficacy (LE) value provided.
2. Power Factor (PF) greater than or equal to 0.9 over the full dimming range when provided.

3. Current draw Total Harmonic Distortion (THD) of less than 20 percent.
4. Class A sound rating.
5. Operable at input voltage of 120-277 volts at 60 hertz.
6. Minimum 5 year manufacturer's warranty.
7. RoHS compliant.
8. Integral thermal protection that reduces or eliminates the output power if case temperature exceeds a value detrimental to the driver.
9. UL listed for dry or damp locations typical of interior installations.
10. Fully-dimmable using 0-10V control, or as indicated in luminaire schedule.

2.4 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A 36/A 36M for carbon structural steel.
2. ASTM A 568/A 568M for sheet steel.

C. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A 240/240 M.

D. Galvanized Steel: ASTM A 653/A 653M.

E. Aluminum: ASTM B 209.

2.5 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.6 LUMINAIRE SUPPORT

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage minimum.

D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

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. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.2 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 26 51 19

SECTION 26 52 13
EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exit signs.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Emergency Lighting Unit: A lighting unit with integral or remote emergency battery powered supply and the means for controlling and charging the battery and unit operation.

D. Fixture: See "Luminaire" Paragraph.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support, arranged by designation.

B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, coordinated with each other, using input from installers of the items involved:

B. Product Certificates: For each type of luminaire.

C. Sample Warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five year(s) from date of Substantial Completion.

B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

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. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.

C. Comply with NFPA 70 and NFPA 101.

D. Comply with NEMA LE 4 for recessed luminaires.

E. Comply with UL 1598 for recessed luminaires.

2.2 EXIT SIGNS

A. Internally Lighted Signs:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Lithonia Lighting; Acuity Brands Lighting, Inc.
   b. Philips Lighting Company
2. Operating at nominal voltage of 120 V AC.
3. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.

2.3 MATERIALS

A. Metal Parts:
1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:
1. Smooth operating, free of light leakage under operating conditions.
2. Designed to permit relamping without use of tools.

3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:
1. Tempered Fresnel glass or Clear, UV-stabilized acrylic.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:
1. Extruded aluminum housing.
2. powder coat or painted finish.

E. Conduit: See Section 260533 “Raceway and Boxes for Electrical Systems”, minimum 3/4 inch in diameter.

2.4 METAL FINISHES

A. 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 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:
1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position when testing emergency power unit.
3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of fixture weight.

E. Wall-Mounted Luminaire Support:
1. Attached using through bolts and backing plates on either side of wall.
2. Do not attach fixtures directly to gypsum board.

F. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of fixture oscillations. Support outlet box vertically to building structure using approved devices.

3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling Grid Mounted Luminaires:
1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.

H. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

D. For Emergency Lighting UPS Systems, provide site start-up and testing by the manufacturer's field service representative during normal working hours (Mon. - Fri. 8 a.m. - 5 p.m.). Site testing shall consist of a complete test of the UPS and accessories by the UPS manufacturer in accordance with manufacturer's standards. Manufacturer's approved service representative must perform commissioning for two year warranty to apply.

END OF SECTION 26 52 13

SECTION 27 05 28
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTSP

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. The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the horizontal cable pathway system of non-continuous cable supports or conduit as described in the drawings.

B. The drawings indicate the general route of the raceway system. Data presented on the drawings is as accurate as preliminary surveys and planning can determine. Accuracy is not guaranteed and field verification of all dimensions, routing, etc. is required.

C. Specifications and drawings are for assistance and guidance, but exact routing, locations, distances and levels will be governed by actual field conditions. Contractor is directed to make field surveys as part of his work prior to submitting system layout drawings.

D. Section Includes:

1. Non-continuous Cable Support
2. Flexible Raceway Systems
3. Conduits and Sleeves
4. Boxes, enclosures, and cabinets.

E. Related Requirements:

1. Division 27 Section " Grounding and Bonding for Communications Systems"
2. Division 27 Section "Communications Equipment Room Fittings".
3. Division 27 Section "Communication Horizontal Cabling".

1.3 REFERENCES

A. ANSI/NFPA 70 – National Electrical Code (NEC) 2008

B. ASTM B633 – Specification for Electrodeposited Coatings of Zink on Iron and Steel

C. ASTM A653 – Specification for Steel Sheet, Zink-Coated (Galvanized) by the Hot Dip Process

D. ASTM A123 – Specification for Zink (Hot Galvanized) Coatings on Iron and Steel

E. ASTM A510 – Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel

F. ASTM A 641 – Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire

G. ASTM A 580 – Standard Specification for Stainless Steel Wire

H. ASTM D 769 – Standard Specification for Black Oxide Coatings

I. NEMA VE 1-2002 – Metal Cable Tray Systems

J. NEMA VE 2-2006 – Cable Tray Installation Guidelines

K. UL Compliance - Provide products that are UL-classified and labeled

L. ANSI/TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces

M. ANSI/TIA J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications

N. IEC 61537 (2001) – Cable Tray Systems and Cable Ladder Systems for Cable Management

O. BICSI Telecommunications Distribution Methods Manual

1.4 DEFINITIONS

A. Engineer of Record: The engineer and engineering company that developed these contract documents, including the plans, diagrams and specifications.

B. EMT: Electrical Metal Tubing

C. ENT: Electrical Non-Metallic Tubing

D. GRC: Galvanized Rigid Conduit

E. IMC: Intermediate metal conduit.

F. RMC: Rigid Metal Conduit

1.5 DESCRIPTION

A. This system consists of empty raceways as shown on the drawings and described herein.

B. Horizontal pathways consist of structure that conceal, protect, support and provide access to horizontal cables between the telecommunication outlet/connector at the work area and the horizontal cross-connect in the serving area.

C. Where ceiling areas are used as pathways for telecommunication cables and connecting hardware follow all applicable rules covering installations in both air plenums and non-plenum hollow-ceiling systems as found in the applicable electrical and building codes and standards.

1.6 RESPONSIBILITIES

A. The term Electrical Contractor as used in this document refers to the company, group, or individual that has contract responsibility for implementing the terms and directives used in this specification document to produce the finished product described here.

B. The Electrical Contractor shall be responsible for providing all:

1. Equipment, J-hooks/Rings, and associated support, splices, terminating hardware, etc. as necessary to provide a functional cable support system.
2. Back-boxes, pull-boxes, junction boxes, conduit, and sleeves to support the low voltage systems.

C. The Electrical Contractor shall be responsible for coordinating installation with existing conditions and other trades on the job to insure pathways are not impeding other systems.

1.7 ACTION SUBMITTALS

A. Product Data

1. Provide manufacturer's catalog information showing dimensions, colors, and configurations.

2. Submittals shall include all items called for in PART 2 – PRODUCTS of this document and the manufacturers cut sheets for the following:

a. Continuous and non-continuous cable pathway and fittings
b. All boxes and enclosures.

B. Shop Drawings:

1. For custom enclosures and boxes. Include plans, elevations, sections, and attachment details.

1.8 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and installation supervisor.
B. Source quality-control reports.

1.9 QUALITY ASSURANCE

A. Installer Qualifications: Low Voltage Contractor must have personnel certified by the manufacturer on staff.

1. Installation Supervision: Installation shall be under the direct supervision of Competent Technician, who shall be present at all times when Work of this Section is performed at Project site.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Telecommunications Pathways and Spaces: Comply with ANSI/TIA-569-B and BICSI's Telecommunications Distribution Methods Manual.

1.10 COORDINATION WITH OTHER TRADES

A. Coordinate the cable pathways support systems as to not interfere with other building systems.

B. Coordinate routing of cable pathways with the work of other trades to maintain adequate working clearances above, below and to the sides of cable pathways.

PART 2 - PRODUCTS

2.1 NON-CONTINUOUS CABLE SUPPORT (J-HOOKS)

A. Acceptable Manufacturers

a. Cooper B-Line
b. Erico
c. Chatsworth Products, Inc.
d. Panduit

B. General

1. J-hooks shall have flared edges to prevent damage while installing cables.
2. J-hooks shall have an plastic, electro-galvanized or G 60 finish and shall be rated for indoor use for non-corrosive environments.
3. J-hook cable supports shall provide a bearing surface of sufficient width to comply with the bend radii of high performance cables.
4. J-hooks shall have a stainless steel cable latch retainer to provide containment of cables within the hook. The retainer shall be removable and reusable.

C. Size

1. J-Hooks shall provide a bearing surface of sufficient width to comply with required bend radii of high performance cables. J-hooks shall have a minimum bearing surface of 1 ¾ inches.
2. J-hooks shall have flared edges or be of a design as to relieve stress on cables at the bottom of the bundle that could impinge on the cables performance.

3. Follow Manufactures recommendations for allowable fill capacity for each size J-hook cable support. Typically fill capacity for a Caddy CAT32 type J-hook is 80 Cat 5 cables or 50 Cat 6 cables.

D. Support
1. J-hooks may be mounted to studs and stud walls. When mounting j-hooks to stud walls the j-hook shall be connected directly to the stud, the j-hook shall not be supported by the wall covering/ finish alone.
2. J-hooks may be supported by threaded rod. Refer to manufacturer's suggested attachment method to attach J-hook to threaded rod using standard nuts.
3. J-hooks may be supported by the use of beam attachments either factory or jobsite assembled either hammer or screw on type, C & Z perlin support, wall, concrete or joist support using factory approved attachment method.

E. Installation: Provide dedicated space surrounding the non-continuous cable pathways to permit access for installing and maintaining cables. Refer to Section 3.2 below for specific clearances required.

2.2 BOXES AND ENCLOSURES

A. Acceptable Manufacturers:

1. Panduit
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. Hoffman; a Pentair company.
4. Hubbell Incorporated; Killark Division.
5. RACO; a Hubbell company.
6. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with ANSI/TIA-569-B.
2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet-Metal Boxes: Comply with NEMA OS 1 and UL 514A.
D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
F. Typical Device Box Dimensions**:** 4-11/16 inches square by 2-1/8 inches deep (119 mm square by 60 mm deep), unless otherwise noted.
G. Gangable boxes are prohibited.
H. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

I. Enclosures:

1. Comply with UL 50 and NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
3. Nonmetallic Enclosures:

    a. Material: Plastic.
    b. Finished inside with radio-frequency-resistant paint.

4. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
5. Metal barriers to separate wiring of different systems and voltage.
6. Accessory feet where required for freestanding equipment.
7. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 CONDUITS/SLEEVES

A. General

1. Conduit/sleeve shall be EMT grade metallic conduit schedule 5 or heavier.
2. Any conduit/sleeve installed for communication cabling shall have a coupler on each end with a plastic bushing for cable protection.
3. Terminate metal conduit using connectors with plastic bushings.
4. Provide nylon or plastic pull strings in all conduit runs.

B. Fire Wall Penetrations

1. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section “Penetration Firestopping.”
2. Fire stop penetrations seal methods and materials shall be FM-approved and UL listed as applicable and as approved by the authorities having jurisdiction.
3. All sealing methods shall be submitted to the engineer of record for review prior to sealing.

2.4 NONMETALLIC RACEWAY

A. Acceptable Manufacturers

1. Legrand-Wiremold Eclipse PN05 Series
2. Panduit LDPH5 Series
3. Hubbell PW1

B. Flexible Raceway color shall be as selected by architect.

C. Non-metallic raceway shall meet the requirements:

1. NEC Articles 770 and 800 for Telecommunications Cables.
2. Raceway shall be UL Listed under UL 910 Standard for Plenum Application for Optical Fiber Raceway.

D. Flexible raceway shall be provided with a pull (mule) tape routed throughout the raceway containing footage markings.

E. All raceway fitting and accessories shall be manufactured by the same manufacturer as the non-metallic raceway.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Pathways shall primarily be constructed from wall/structure mounted J-hooks, J-hooks hung from ceiling, Ring type supports, or conduit supported as per the NEC.

B. J-hooks shall not be attached to the any drop ceiling grid wiring.

C. In finished areas, conceal conduits and flush mount boxes.

D. Conduit installation shall be coordinated with their respective termination equipment layouts at each backboard location as required to provide adequate dedicated space for equipment provided and installed by the Electrical Contractor .

E. Cable pathway systems shall be supported by support systems specifically designed and manufactured for the support of cable pathway systems. The cable pathway systems shall not be supported by other installed building systems.

F. Install all pathway systems as per manufacturers recommended practices and as per local governmental regulations and NEC, and BICSI regulations and practices.

G. All cable pathway routes are to be parallel and/or perpendicular with the outside walls of the building. Alternate paths must be approved by the engineer of record prior to installation of the cabling.

H. Cable pathways

1. A dedicated pathway shall be provided for each low voltage communications cabling sub-system, including but not limited to the structured cabling system, security systems, audio/visual systems and other low voltage control system cabling.

I. Non-Continuous Cable Pathways (J-Hooks/Rings)

1. Non-continuous cable support shall be located at intervals of four (4) feet maximum.
2. Non-continuous cable supports shall be installed such that all cable runs through them maintain a minimum clearance of 12-inches in relation to all fluorescent

lights and EMF sources. Any violations of this rule will be corrected at the contractor's Expense.

3. Horizontal cabling shall not lay on any ceiling or ceiling tile. All horizontal cabling shall maintain a minimum clearance of 6" above ceiling, ceiling tile and support channels.
4. Cable pathways shall not be routed parallel with electrical conduits or strapped to or supported by any electrical conduits or any other building service equipment.

J. Conduit/ Sleeves

1. Any section of conduit longer than 150 feet or containing more than a total 180 degrees of bends shall have pull boxes. These boxes will not be shown on drawings. Refer to the table below for pull box sizing.
2. Each conduit bend shall be a long sweep radius wherever possible. In no instance shall the inside radius or bend be less than six (6) times the internal diameter of the conduit for conduits that are 2" in diameter or less, for conduits larger than 2" the bend radius shall be no less than 10 (ten) times the inside diameter.
3. All sleeves shall be of a size as to not have more than 40% of the sleeve filled with low voltage cable at the completion of the installation. Provide a minimum of 50% capacity for future growth at each sleeve location.
4. In locations containing multiple sleeves, sleeves shall be filled to capacity before installing cabling in adjacent sleeves.
5. All conduits/sleeves shall be secured and strapped to building surfaces per National Electric Code (NEC 2008 Article 358.30 (A) and (B)).

K. Pull Boxes

1. Install pull boxes where required to maintain minimum bend radius at wall/pathway transitions.
2. All pull boxes installed in low voltage communications conduit runs shall be sized per NEC or Table 4.7 of the BICSI Telecommunications Distribution Methods Manual, which ever requirement results in a larger pull box.
3. Provide dedicated space encompassing pull box to permit access for installing and maintaining cables. Refer to Section 3.2 below for specific clearances required.

L. Firestopping

1. Comply with requirements in Division 07 Section "Penetration Firestopping" and ANSI/TIA-569-B.
2. Responsibility for sealing of opening around the exterior of the low voltage system sleeves shall be by the contractor as described below:

    a. Sleeves through fire rated and smoke walls created by the Low Voltage Contractor for cable pass through shall be the responsibility of the Low Voltage Contractor.

b. Sleeves through fire rated and smoke walls created by the Electrical Contractor for cable pass through shall be the responsibility of the Electrical Contractor.
c. Sleeves of openings between floors created by the Low Voltage Contractor for cable pass through shall be the responsibility of the Low Voltage Contractor.
d. Sleeves of openings between floors created by the Electrical Contractor for cable pass through shall be the responsibility of the Electrical Contractor.

3. Sealing of the space internal to all sleeves or openings specifically designated for telecommunications cabling shall be the responsibility of the Low Voltage Contractor.
4. Sealing material and application of this material shall be accomplished in such a manner which is acceptable to the local fire and building authorities having jurisdiction over this work.

M. Separation from EMI Sources:

1. Comply with BICSI TDMM and ANSI/TIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

a. Electrical Equipment Rating Less Than 2 kVA: No requirement.

b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).

c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).

6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.2 CLEARANCES AROUND CABLE PATHWAYS

A. Clearances shall be provided around all cable pathways to provide continuous access to the cable pathway during and following the installation process. Coordinate required clearances with all other trades prior to beginning work.

B. Provide a minimum clearance of 12” in front of all J-hook cable pathways for the entire height of the j-hook cable pathway.

C. Provide a minimum clearance of 6” above all J-hook cable pathways.

D. Provide a minimum clearance of 24” in front of each pull box location.

END OF SECTION 27 05 28

SECTION 27 15 00
COMMUNICATIONS HORIZONTAL CABLING

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. Use of a manufacturer's name and model or catalog number is for the purpose of establishing standard of quality, general configuration, and operating characteristics desired only. This specification is intended to be a minimum standard for function, operation and performance. Equipment catalog numbers are listed to establish this minimum.

B. Section Includes:

1. UTP cabling
2. Cable connecting hardware, patch panels, and cross-connects.
3. Telecommunications outlet/connectors.
4. Cable management system.

C. Related Requirements

1. Division 27 Section “Grounding and Bonding for Communications Systems” for grounding and bonding of equipment room fittings.
2. Division 27 Section "Pathways for Communications Systems" for cable trays and accessories.
3. Division 27 Section "Communications Room Fittings" for equipment racks, cabinets and enclosures.

1.3 SUMMARY OF WORK

A. Furnish and install complete with all accessories a horizontal Structured Cabling System (SCS). The SCS shall serve as a vehicle for transport of data, video and voice telephony signals throughout the network from designated demarcation points to outlets located at various desks, workstation and other locations as indicated on the contract drawings and described herein.

B. Wiring utilized for data and voice communications shall originate at network switches and concentrators either wall mounted, in vertical free standing equipment racks, and/or enclosed wall mounted vertical equipment racks located at the telecommunications Equipment Room (ER) and/or the Telecommunications Room (TR) location(s). All connectivity, wiring, terminations and patch bays between these designated demarcation points and outlet locations designated on the plans shall be considered part of the contract. Telecommunication Outlets (TO) shall be furnished, wired and installed by the SCS Electrical Contractor.

C. The system shall utilize a network of fiber optic, and unshielded twisted pair copper, riser and tie cables. Cables and terminations shall be provided and located as shown and in the quantities indicated on the drawings.

1. Fiber cables shall terminate on fiber patch panels and/or modular patch panels located at demarcation and termination points shown on the drawings.
2. All cables and terminations shall be identified and labeled per owner specifications at all locations.
3. All cables shall terminate in an alpha-numeric sequence at all termination locations.

D. All copper cable terminations shall comply with, and be tested to ANSI/TIA 568-C standards for Category Cable installations.

1.4 REFERENCES

A. ANSI/TIA-568-C.0 – Generic Telecommunications Cabling for Customer Premises

B. ANSI/TIA-568-C.1 - Commercial Building Telecommunications Wiring Standards, General requirements.

C. ANSI/TIA-568-C.2 - Commercial Building Telecommunications Wiring Standards, Balanced Twisted Pair Cabling Components.

D. ANSI/TIA-569-B - Commercial Building Standard for Telecommunications Pathways and Spaces.

E. ANSI/TIA-606-A – Administration Standards for Commercial Telecommunications Infrastructures.

F. ANSI J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.

G. International Standards Organization/International Electrotechnical Commission (ISO/IEC) 11801.

H. Underwriters Laboratories (UL®) Cable Certification and Follow up Program.

I. National Electrical Manufacturers Association (NEMA).

J. American Society for Testing Materials (ASTM).

K. National Electric Code (NEC®),2008

L. Institute of Electrical and Electronic Engineers (IEEE).

M. UL Testing Bulletin.

N. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps.

O. BICSI – TDMM, Building Industries Consulting Services International, Telecommunications Distribution Methods Manual (TDMM) most recent version.

1.5 RESPONSIBILITY

A. The term Electrical Contractor as used in this document refers to the company, group, or individual that has contract responsibility for implementing the terms and directives of this specification document and to produce the finished product as described here-in.

1.6 DEFINITIONS

A. Structured Cabling System (SCS): A SCS is defined as all required equipment and cabling including hardware, termination blocks, cross connect wire or cordage, patch panels, patch cords, telecommunication outlets, work area cords, UTP and fiber optic cable installed and configured to provide computer data and voice connectivity from each data or voice device to the network file server or voice network/switch designated as the service point of the local area network.

B. Work Area: The connection between the information outlet and the station equipment in the work area consists of cords, adapters, and other transmission electronics.

C. Horizontal Cabling: The horizontal cabling subsystem provides connections from the horizontal cross connect to the Telecommunication Outlets (TOs) in the work areas. It consists of the horizontal transmission media, the associated connecting hardware terminating this media and IOs in the work area. Each floor of a building is served by its own Horizontal Subsystem.

1. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
2. Bridge taps and splices shall not be installed in the horizontal cabling.
3. Splitters shall not be installed as part of the optical fiber cabling.

D. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.

E. Riser Backbone: The Riser Backbone subsystem links the equipment room (ER) and telecommunications rooms (TR). It consists of the backbone transmission media between these locations and the associated connecting hardware terminating this media. It is normally installed in a star topology, with first-level backbone cables beginning at the equipment room.

F. Campus Backbone: A Campus Backbone is used when a distribution system encompasses more than one building. The components and cables that provide the link between buildings constitute the Campus Backbone. This subsystem includes the backbone transmission media, associated connecting hardware terminating this media, and electrical protection devices to mitigate harmful voltages when the media is exposed to lightning and/or power surges. It is normally first-level backbone cables beginning at the equipment room of the hub building and extending to the intermediate cross connect in the equipment room of a satellite building.

G. Equipment Subsystem: The Equipment Subsystem consists of shared (common) electronic communications equipment in the equipment room, main cross connect or telecommunications closet and the transmission media required to terminate this equipment on the distribution hardware.

H. The Administration Subsystem: The Administration Subsystem links all of the subsystems together. It consists of labeling hardware for providing circuit identification

and patch cords or jumper wire used for creating circuit connections at the cross connects.

I. Engineer of Record: The engineer and engineering company that developed these contract documents, including the plans, diagrams and specifications.

1.7 ACTION SUBMITTALS

A. Schedules

1. Within 30 days of the notice to proceed, submit a full and complete schedule, in the form of a GANNT chart, for all phases and aspects of the work. A break down by building, floor, and work type (e.g. material delivery, pathways installation, rack/cabinet/frame installation, cable pulling, termination, labeling, testing)
2. Schedule shall be fully coordinated with the overall construction schedule.
3. Schedule shall include dates when the contractor needs certain specific areas to be accessible (e.g. Equipment Rooms, Telecommunications Rooms, Cable Pathways)

B. Product Data

1. Provide manufacturer's catalog information showing dimensions, colors, and configurations.
2. Submittals shall include all items called for in PART 2 – PRODUCTS of this document and the manufacturers cut sheets for the following:

    a. All fiber optic and copper cable: to include cross connect wire and cross connect cordage.
    b. All connectors and required tooling.
    c. All termination system components for each cable type.
    d. All grounding and building entrance protection surge suppression system components.
    e. All test equipment to be used for fiber and copper channels

3. A technical data sheet showing manufacturer's Guaranteed Channel Performance over the full swept frequency range of the category specification.

4. Technical data sheets shall include the physical specifications as well as the following electrical and transmission characteristics for the cable:

    a. Mutual Capacitance
    b. Impedance
    c. DC Resistance
    d. Attenuation
    e. Worst Pair-to-Pair Near End Crosstalk
    f. Power Sum Near End Crosstalk
    g. ELFEXT
    h. Power Sum ELFEXT
    i. Return Loss

C. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
2. Cabling administration drawings and printouts.

3. Wiring diagrams to show typical wiring schematics, including cross-connects.
4. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

D. Pre-Qualification Certificate

1. The Electrical Contractor shall submit the following documents with project proposal:

a. A letter of approval from the manufacturer indicating completion of pre-qualification requirements by installing vendor.
b. Submit proof from manufacturer of vendor's good standing in manufacturer's qualification program**.**
c. Submit training certificates for design, engineering and installation of the proposed products awarded to the Electrical Contractors assigned project manager and installers. (Only installers with manufacturer's certificate of competency in installing proposed SCS will be acceptable for this project).
d. The Equipment Provider and Electrical Contractor must offer a twenty (20) year extended warranty for the premises fiber cabling solution Material and Installation Guarantee and must be able to perform service under this warranty.
e. The Equipment Provider and Electrical Contractor must offer a twenty (20) year extended warranty for the premises copper cabling solution Material and Installation Guarantee and must be able to perform service under this warranty.
f. The Equipment Provider shall guarantee at the time of the bid that all UTP Category cabling and optical fiber cabling and components meet or exceed specifications (including installation) of ANSI/TIA-568-C.1, 568-C.2, 568-C.3 and ANSI/TIA-569-B.

E. Warranty Documentation

1. Provide complete documentation regarding the manufacturer's Extended Product Warranty and Application Assurance Program shall be submitted as part of the proposal. This shall include, but is not limited to: a sample of the warranty that will be provided to the customer when the installation is complete and documentation of the support procedure for warranty issues and guaranteed performance information.

2. A systems application assurance manual documenting the vendor supported applications and application guidelines shall be provided as part of the submittals.

1.8 INFORMATIONAL SUBMITTALS

A. Manufacturer and on-site delivery test results for all cabling.

B. Maintenance Data: For connectors to include in maintenance manuals.

1.9 CLOSEOUT SUBMITTALS

A. As-Built Documentation: As specified in Section 3.7 /H. /2. /b.

B. Test Results: Test results shall be submitted in both PDF form and in the native electronic file format of the test equipment.

1. As specified in Section 3.8.

a. Copper Test Results

2. Test equipment firmware and software versions.
3. Test equipment proof of calibration documentation.

1.10 QUALIFICATIONS

A. The electrical contractor selected to provide the installation of this system shall be trained by the manufacturing company in all aspects of design, installation, and testing of the products described herein so as to provide the manufacturer's warranty of the system.

B. The Electrical Contractor shall utilize the authorized manufacturer components and distribution channels in provisioning this Project.

C. The Electrical Contractor and design firm shall be in compliance with all federal, state and local statutes regarding qualifications of firms.

D. The Electrical Contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical and metallic copper premise distribution systems.

1.11 QUALITY ASSURANCE

A. The Electrical Contractor shall guarantee that all twisted pair copper and fiber optic cabling, cable pathways and associated components meet or exceed specifications (including installation) of ANSI/TIA/EIA-568-C.1, 568-C.2, 568-C.3 and 569-B.

B. Personnel/ Installer Qualifications: Submit credential and qualification information for each of the following individuals:

1. Installation Supervisor
2. Field Inspector

C. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

D. 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.

E. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A and BICSI's Telecommunications Distribution Methods Manual.

F. Grounding: Comply with ANSI-J-STD-607-A.

1.12 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight.
2. Visually inspect all cable upon delivery for damage during transport.
3. Store cables in dry areas that are free of potential pre-installation damage.

B. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 HORIZONTAL STRUCTURED CABLING SYSTEM

A. Horizontal cabling shall be Category 6 4-pair unshielded twisted pair (UTP) cabling that meets the channel requirements.

B. The horizontal structured cabling system specified in this specification shall be manufactured either by a single manufacturer or two manufacturers holding a high level partnership capable of providing the extended warranty outlined above. Including:

1. 4-Pair UTP Cabling
2. Modular RJ-45 Jacks
3. Modular Faceplates
4. Patch Panels
5. Patch/ Station Cords
6. 110-Style Punch Blocks

C. Acceptable Horizontal Structured Cabling System Manufactures:

1. Panduit
2. Commscope/Systimax
3. Belden
4. Siemon

2.2 PRODUCT WARRANTY AND APPLICATION ASSURANCE

A. The Structured Cabling System (SCS) shall be provided with an Extended Product Warranty and Application Assurance Program guaranteeing performance and operation of the SCS (including optical fiber and copper cabling).

B. Extended Product Warranty

1. The Extended Product Warranty covers product defects for all passive components of the SCS. Passive components are defined as those exhibiting no gain or contributing no energy. The manufacturer shall warrant, from the date a Registration Certificate is issued by the manufacturer to the end-user, the following:

2. The passive products that comprise the registered SCS will be free from manufacturing defects in material or workmanship under normal and proper use.

3. All SCS approved passive cabling products that comprise the registered SCS solution exceed the specification of ANSI/TIA-568-C.1, ANSI/TIA-568-C.2, ANSI/TIA-568-C.3 and exceed ISO/IEC 11801 standards and will conform to the guaranteed minimum performance specifications guaranteed head room published within the manufacturer's associated product data sheet and warranty platform documentation in effect at the time the Registration Certificate is issued for the duration of the extended warranty period.

C. Application Warranty

1. The Application Warranty shall cover failure of the SCS to operate all applications which the system was designed to support and all future applications which are developed to operate over ANSI/TIA-568-C permanent link/ channels.
2. The manufacturer shall warrant that the registered SCS solution will be free from failures which prevent operation of the specific applications for which the original SCS was designed.
3. Applications introduced in the future by recognized standards or user forums that utilize ANSI/TIA-568-C or ISO/IEC 11801 components and link/channel specifications for cabling shall be covered by the Application Warranty.

D. Term of Warranty

1. The Extended Product and Application Assurance Warranty shall span minimum 20 years from the date of issuance of the Registration Certificate or completion of installation, whichever is later.
2. The warranty shall be for the benefit of the person or entity to which the manufacturer's SCS Registration Certificate is issued and any successor in interest to the site in which such System was originally installed by the manufacturer or an Authorized manufacturer's Reseller.
3. If the manufacturer repairs the product, the repair shall utilize only new replacement parts. Replacement of existing parts shall be with new parts of the same design meeting or exceeding the performance of the replaced parts. Any such repair or replacement shall include a warranty for either 90 days or the remainder of the original warranty period, whichever is longer.

2.3 CATEGORY 6 UTP HORIZONTAL CABLING

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panduit: Pan Net TX6000
2. Systimax 71E GigaSPEED XL
3. Berk-Tek LANMark 1000/2000
4. General Cable GenSPEED 6500E
5. Belden 2413 Enhanced
6. Commscope 7504

C. Description: 100-ohm, four-pair UTP cable.

1. Comply with ICEA S-102-700-2004 for Category 6.
2. Comply with ANSI/TIA-568-C.2 for Category 6.
3. All cables shall be Plenum Rated and certified with the copper solution manufacturer as to provide the manufacturer's extended warranty as specified.
4. ALL Cable shall be verified using a UL Holographic identity card; non-conforming cable shall be rejected and replaced by the supplier.
5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

    a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
    b. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.

6. Cable Colors:

    a. Data/Voice: Blue
    b. Cameras: Green
    c. Security: Grey
    d. Printers/Copiers: Pink
    e. Projectors/Smartboards: Orange
    f. Clocks: White
    g. Video Door System: Purple

D. Category 6 Guaranteed Channel Performance

1. The Category 6, 4 pair UTP channel shall consist of all cable and components with four connections that comprise the full 100 meter (328 feet) length circuit from the Hub/Server/LAN Electronics port located in the ER and/or TR to the device port located at the User Work Station.
2. All copper cable and apparatus shall conform to the Category 6/ Class E Channel Performance Specification.
3. The Category 6, 4 pair UTP channel shall be capable of providing stable and continual performance up to 250 MHz over the entire swept frequency range.
4. The Category 6 cable and components shall be electrically compatible with future networks and backward compatible with existing Category 3, 5, 5e. Components of the Category 6 channel shall be engineered and manufactured to compensate for any Category 3, 5 or 5e component crosstalk and shall provide at least Category 3, 5 or 5e performance in all of the customer's existing installed base of voice/data/video. The Category 6 cable and components shall be physically compatible with existing installed base of equipment.
5. The Category 6 cable and components shall not require special cords, specialty tools or special installation requirements.
6. The Category 6, 4 pair UTP channel shall be capable of providing stable and continual performance from 0 MHz to 250 MHz over the entire swept frequency range.
7. The Delay Skew on the 100 meter channel shall not exceed 50 ns.
8. Each installed channel (consisting of cable, cords and up to four connections) shall provide the following performance above (margin/ headroom) the ANSI/TIA-568-C.2 standard for a Category 5e four connector channel over the entire swept frequency range from 0 MHz to 250 MHz:

    a. Insertion Loss: 5.0%
    b. NEXT (Near End Cross Talk): 6.0 dB
    c. PSNEXT (Power Sum Near End Cross Talk): 7.5 dB
    d. ELFEXT (Equal Level Far End Cross Talk): 6.0 dB

e. PSELFEXT (Power Sum Equal Level Far End Cross Talk): 8.0 dB
f. Return Loss: 2.0 dB

2.4 CATEGORY 6A U/UTP HORIZONTAL CABLING

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panduit: TX6A UTP
2. Commscope/Systimax: GigaSPEED X10D UTP
3. Berk-Tek: LANMark XTP UTP
4. General Cable: GenSPEED 10 UTP
5. Belden: 10GX UTP

C. Standard: Comply with TIA-568-C.2 for Category 6a cables.

D. Conductors: 100-ohm, 23 AWG solid copper.

E. Shielding/Screening: Unshielded twisted pairs (UTP).

F. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

1. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
2. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.

G. Jacket: Flame Retardant LS-PVC (FEP, PE).

1. Cable Colors:

a. WAP: Black

H. Category 6A Guaranteed Channel Performance

1. The Category 6A, 4 pair UTP channel shall consist of all cable and components with four connections that comprise the full 100 meter (328 feet) length circuit from the Hub/Server/LAN Electronics port located in the ER and/or TR to the device port located at the User Work Station.
2. The Category 6A, 4 pair UTP channel shall be capable of providing stable and continual performance up to 500 MHz over the entire swept frequency range.
3. Each installed channel (consisting of cable, cords and up to four connections) shall provide the following performance above (margin/ headroom) the ANSI/TIA-568-C.2 standard for a Category 6A four connector channel over the entire swept frequency range from 0 MHz to 500 MHz:

a. Insertion Loss: 3.0%
b. NEXT (Near End Cross Talk): 2.5 dB
c. PSNEXT (Power Sum Near End Cross Talk): 5.0 dB
d. PSACR-N (Power Sum Attenuation to End Cross Talk Ratio – Near End): 6.5 dB
e. PSACR-F (Power Sum Attenuation to End Cross Talk Ratio – Far End): 10.0 dB
f. PSANEXT (Power Sum Attenuation Near End Cross Talk): 2.0 dB
g. Return Loss: 3.0 dB

2.5 OUTLETS

A. Faceplates

1. Acceptable Manufacturers:

   a. Panduit: Mini Com Classic Sloped Faceplate
   b. Systimax: LE Series Faceplate
   c. Commscope: 107713 Angled Faceplate
   d. Siemon Teramax CT4-FP-80 Angled Faceplate
   e. Belden Mediaflex with Angled Inserts

2. General Requirements

   a. Faceplates shall be available in single, duplex, quadplex, and sixplex arrangements in a single gang configuration.
   b. The outlets shall be capable of being installed in any modular faceplate, frame, flush mounted box or surface-mounted box avoiding the need for special faceplates.
   c. Faceplate outlet openings shall be numbered on both sides for installation and maintenance identification.
   d. Faceplate shall be installed with the number of ports as required by the designated outlet. Each unused port shall contain a blank insert.
   e. Modular jack mounting in faceplate shall be in a vertically sloped/ angled configuration.

3. Modular Flush Mounted Faceplates

   a. Faceplates shall be High-impact, flame retardant, UL-rated 94V-0 thermoplastic.
   b. The standard faceplate color shall be white or off-white unless noted otherwise on the plans.

4. Metal Modular Faceplates shall be stainless steel.

B. Category 6 Gigabit Outlets

1. Acceptable Manufacturers:

   a. Panduit: Mini-Com TX6 Plus Jack Modules
   b. Commscope Gigaspeed XL MGS400
   c. Belden REVConnect CAT6+

2. All Category 6 outlets shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard, ISO/IEC 11801:2002 Second Edition and be part of the UL® LAN Certification and Follow-up Program.

3. The Category 6 outlets shall be backward compatible with Category 5e, 5 and 3 cords and cables.

4. Category 6 RJ-45 jacks shall be:

   a. 8-position/ 8-conductor modular outlets.
   b. Terminated utilizing insulation displacement.

c. Equipped with T568A and T568B universal wiring labels.

5. The outlet shall accept either the T568A or T568B wiring configurations. The T568B wiring scheme shall be used.

6. General specifications:

a. Meets or exceeds the mechanical, electrical, and clearance specifications in FCC Rules and Regulations, Part 68, Subpart F
b. Meet or exceed the Category 6 requirements in ISO/IEC 11801, CENELEC EN 50173, and ANSI/TIA-568-C.2.
c. Certifications: UL Listed, CSA Certified and AUSTEL approved.

7. Color of jacks:

a. Data/Voice: Blue

b. Cameras: Green

c. Security: Grey

d. Printers/Copiers: Pink

e. Projectors/Smartboards: Orange

f. Clocks: White

C. Category 6A UTP Gigabit Outlets

1. Acceptable Manufacturers:

a. Panduit: Mini-Com TX6A 10G UTP Jack Modules
b. Commscope Netconnect 6A UTP Jack Modules
c. Belden Revconnect 10GX UTP Jack Modules

2. All Category 6A outlets shall meet or exceed Category 6A transmission requirements for connecting hardware, as specified in ANSI/TIA-568-C.2 Commercial Building Telecommunications Cabling Standard, ISO/IEC 11801:2002 Second Edition and be part of the UL® LAN Certification and Follow-up Program.

3. The Category 6A outlets shall be backward compatible with Category 5e, 5 and 3 cords and cables.

4. Category 6A RJ-45 jacks shall be:

a. 8-position/ 8-conductor modular outlets.
b. Terminated utilizing insulation displacement.

5. The outlet shall accept either the T568A or T568B wiring configurations. The T568B wiring scheme shall be used.

6. General specifications:

a. Meets or exceeds the mechanical, electrical, and clearance specifications in FCC Rules and Regulations, Part 68, Subpart F
b. Meet or exceed the Category 6A requirements in ISO/IEC 11801, CENELEC EN 50173, and ANSI/TIA-568-C.2.

c. Certifications: UL Listed, CSA Certified and AUSTEL approved.

7. Color of jacks:

a. WAP: Black

2.6 MODULAR PATCH PANELS

A. Approved Patch Panels

1. 48-Port Patch Panel

a. Panduit: CP48WSBLY
b. Siemon MX-PNL-48
c. Commscope M2000-48
d. Belden Key Connect AX103115

B. The Category 6 modular jack panels shall meet or exceed the Category 6 standards requirements in ISO/IEC 11801 (2002), CENLEC EN 50173 (2002) and ANSI/TIA-569-C.2-10 and shall be UL Listed.

C. The 48 port panel shall be 2RU in height, (1 RU for 24 port) capable of accepting modular jacks.

D. The jack panels shall be 19-inch rack mountable.

E. The patch panel shall be available in 24 and 48 port configurations.

F. The patch panel shall ensure alien crosstalk performance.

G. Provide horizontal wire management containing patch cord organizers between each modular patch panel as shown on project drawings.

1. Shall have horizontal routing via metal distribution rings
2. Shall have plastic clips to provide vertical pathways for patch cables

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. Components of the SCS system shall be installed in a neat, workmanlike manner.

B. Wiring color codes shall be strictly observed and terminations shall be uniform throughout the system.

C. Identification markings and systems shall be uniform.

3.2 WIRING METHODS

A. Install cables in raceways and cable trays. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

B. Provide a minimum 6'-0" of service loop/ figure eight at the telecommunications rooms for each permanent link.

C. Provide a minimum of 18" of service loop/ figure eight in the ceiling above the telecommunications outlet for each channel.

D. Provide a minimum of 8" slack of cable at each copper UTP outlet location for jack termination.

E. Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 REQUIREMENTS FOR CABLE ROUTING AND INSTALLATION

A. Cabling

1. All communications cabling used throughout this project shall comply with the requirements as outlined in the National Electric Code (NEC®) Articles 725, 760, 770, and 800 and the appropriate local codes.
2. All copper cabling shall bear CMP (Plenum Rated) and/or appropriate markings for the environment in which they are installed.

B. Cable Pathway

1. In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Electrical Contractor shall bundle, in bundles of 50 or less, station wiring with cable ties snug, but not deforming the cable geometry.
2. Cable bundles shall be supported via "J" hooks or Ring attached to the existing building structure and framework at intervals of four (4) feet average with a maximum separation of five (5) feet
3. Plenum rated cable ties shall be used in all appropriate areas.
4. The Electrical Contractor shall adhere to the manufacturers' requirements for bending radius and pulling tension of all data and voice cables.
5. All cabling shall be run in and supported by cable pathways that are installed solely for the purpose of supporting low voltage communications cabling.
6. Cables shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid.
7. Cables shall not be attached to or supported by fire sprinkler heads or delivery systems or any environmental sensor located in the ceiling air space.
8. Cables shall maintain adequate separation from EMI and heat sources such as lighting fixtures etc.
9. Coordinate the support of cable pathways support systems with the work of other trades.
10. Coordinate routing of cable pathways with the work of other trades to maintain adequate working clearances above, below and to the sides of cable pathways.
11. Coordinate with other contractors during the final BIM coordination meetings to provide shared hangers to support cable pathway systems.

C. Penetrations of Walls, Floors and Ceilings

1. Prior consent: The Electrical Contractor shall make no penetration of floors, walls or ceiling without the prior consent from owner.

2. Sealing penetrations: The area around the exterior of the sleeve shall be sealed by the contractor who installed the sleeve, the area internal to the sleeve shall be sealed by the Electrical Contractor who pulled or placed the cables.
3. Penetrations through acoustical walls or other walls for cableways that have been provided for the Electrical Contractor or made by the Electrical Contractor such penetrations shall be sealed by the Electrical Contractor in compliance with applicable code requirements and as directed by Owner's Architect or General Contractor.

D. Fire Stopping

1. Responsibility for sealing of opening around the exterior of the low voltage system sleeves shall be by the contractor as described below:

   a. Sleeves through fire rated and smoke walls created by the Electrical Contractor for cable pass through shall be the responsibility of the Electrical Contractor.
   b. Sleeves through fire rated and smoke walls created by the Electrical Contractor for cable pass through shall be the responsibility of the Electrical Contractor.
   c. Sleeves of openings between floors created by the Electrical Contractor for cable pass through shall be the responsibility of the Electrical Contractor.
   d. Sleeves of openings between floors created by the Electrical Contractor for cable pass through shall be the responsibility of the Electrical Contractor.

2. Sealing of the space internal to all sleeves or openings specifically designated for telecommunications cabling shall be the responsibility of the Electrical Contractor.
3. Sealing material and application of this material shall be accomplished in such a manner which is acceptable to the local fire and building authorities having jurisdiction over this work.

E. Electrical Contractor Responsibility

1. The Electrical Contractor shall be responsible for damage to any surfaces or work disrupted as a result of his work. Repair of surfaces, including painting, shall be included as necessary.
2. The Electrical Contractor shall ensure that all recommended cable pulling tensions and pulling bending radius are not exceeded. Any cable bent or kinked to a radius less than the recommended dimension shall not be installed. Any cable that is bent or kinked to a radius less than the recommended dimension during installation shall be replaced by the Electrical Contractor at no additional cost to the project.

F. Horizontal Cabling

1. The Electrical Contractor shall supply horizontal cables to connect each information outlet to the backbone subsystem on the same floor.

2. Unless otherwise noted on the floor plans or within this document, the type of horizontal cables used for each work location shall be 4-pair unshielded twisted pair (UTP).
3. The 4-pair UTP cables shall be run using a star topology format from the administration subsystem (Telecommunications Room) on each floor to every individual Telecommunication Outlet.
4. All cable routes are to be parallel and/or perpendicular with the outside walls of the building. Alternate paths must be approved by the engineer of record prior to installation of the cabling.
5. The length of each individual run of horizontal cable from the administration subsystem (Telecommunications Room) on each floor to the Telecommunication Outlet shall not exceed 295 ft (90 m).
6. Conduit runs installed by the Electrical Contractor should not exceed 100 feet or contain more than two 90 degree sweeping bends without utilizing appropriately sized pull boxes.
7. The Electrical Contractor shall adhere to the manufactures recommendations and specifications with regard to the bending radius and pulling strength requirements of the 4-pair UTP cable during handling and installation.
8. The Electrical Contractor shall maintain the horizontal UTP cable twist rate for each pair in the cable to within 0.5-inches of the cable termination or to the manufacturer's termination instructions, whichever is more stringent. The cable jacket shall be removed only to the extent required to make the termination.
9. Each run of cable between the termination block and the information outlet shall be continuous without any joints or splices.
10. In suspended ceiling and raised floor areas where walker duct, cable trays or conduit are not available, the Electrical Contractor shall bundle station wiring with Velcro type cable ties at appropriate distances.
11. The Electrical Contractor shall conceal horizontal distribution wiring internally within the walls. If obstructions exist, the Electrical Contractor shall secure approval by Engineer prior to the use of an alternate method.
12. Every effort will be made to schedule the requirements under this Contract in such a manner so as to complete all above ceiling work without deconstruction of the existing ceiling system. In the event the Electrical Contractor is required to remove ceiling tiles, such Work shall not break or disturb grid and must be replaced to match existing if damaged.

3.4 ADMINISTRATION

A. The administration subsystem shall consist of wiring blocks and or patch panels for termination of copper cables or optical fibers. All wall field layouts to be as detailed on drawings or as approved by Engineer prior to installation.

B. Fields: Separate termination fields shall be created for voice and data applications if both are wall mounted.

C. Termination blocks: Termination blocks that require rotation after connection of horizontal/vertical wiring shall not be allowed.

D. Cross-connect wire: The Electrical Contractor shall provide cross-connect for cross connection and inter-connection of termination blocks.

3.5 SOURCE QUALITY CONTROL

A. Factory test UTP cables on reels according to ANSI/TIA-568-C.1.

B. Test UTP cables according to ANSI/TIA-568-C.2.

C. Cable will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 INSTALLATION

A. The Electrical Contractor shall maintain a current copy of the design drawings, specifications, installation schedule, equipment submittals and shop drawings at the job site at all times. These documents shall be made available to the Owner/Engineer at their request.

B. Throughout the project, the Electrical Contractor shall provide levels of manpower necessary to meet all construction schedules.

C. All installation shall be done in conformance with ANSI/TIA-568-C standards, federal and local standards and the SCS manufacturer Design and Installation guidelines.

1. The Electrical Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines will require the Electrical Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation at no additional cost to the owner. This shall also apply to any and all damages sustained to the cables by the Electrical Contractor during the implementation.

2. The Electrical Contractor shall make provisions so that all cabling is stored within a temperature controlled space to ensure that cabling is unspooled, manipulated, and worked with only when the cabling is within the manufacturer's installation temperature specifications and free of condensation.

D. Bonding and Grounding

1. Comply with requirements in Division 27 Section "Grounding and Bonding for Communications Systems" for grounding conductors and connectors.
2. Comply with ANSI-J-STD-607-A.
3. Grounding must be in accordance with the NEC, NFPA and all local codes and practices.
4. The Electrical Contractor shall be responsible for providing an approved ground at all newly installed distribution frames, and/or insuring proper bonding to any existing facilities.
5. The Electrical Contractor shall also be responsible for ensuring ground continuity by properly bonding all appropriate cabling, closures, cabinets, service boxes, and framework.

E. Power Separation: The Electrical Contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.

F. Separation from EMI Sources:

1. Comply with Article 800.52 of ANSI/NFPA 70, BICSI TDMM and ANSI/TIA-569-B recommendations for separating unshielded copper voice and data

communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

   a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
   c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

G. Miscellaneous Equipment: The Electrical Contractor shall provide any necessary screws, anchors, clamps, tie wraps, distribution rings, wire molding (ER & TR locations), miscellaneous grounding and support hardware, etc., necessary to facilitate the installation of the SCS system.

H. Special Equipment and Tools: It shall be the responsibility of the Electrical Contractor to furnish any special installation equipment or tools necessary to properly complete the System. Tools shall include, but are not limited to:

   1. Tools for terminating cables,
   2. Testing and splicing equipment for copper/fiber cables,
   3. Communication devices,
   4. Jack stands for cable reels,
   5. Cable wenches.

3.7 IDENTIFICATION/ LABELING

A. The Electrical Contractor shall be responsible for generating and placing printed labels for all cables and cords, distribution frames, and outlet locations at the time of delivery.

B. Adhere to the standards for identification/labeling as shown on project drawings.

C. All horizontal cables shall be labeled within 4” of terminations on each end using the full labeling scheme specified below (RRRR-LL-J).

D. Labels shall not be written by hand.

E. Patch Panel Jack Identification and Labeling: Each jack module shall be labeled with the format: RRRR-LL-J

1. “RRRR” shall be the Owner’s Room Number

   a. Coordinate room numbers with the owner prior to labeling; the Owner’s Room Number may not necessarily be the same as the Architectural Room Number.
   b. In the case of telecommunications rooms, use the numbering scheme as shown on project drawings (e.g. E101 for Equipment Room 101 or T303 for Telecommunications Room 303).

2. “LL” shall be a two-digit number indicating the outlet location within the room.

   a. The outlet location numbering shall start with 01 which shall be the first outlet located to the left of the door when entering the room. In rooms with more than one door, any door between the room and a hallway may be used as the starting point.
   b. Continue numbering outlets 02, 03, etc. continuing clockwise around the room along the walls.
   c. Continue lettering floor mounted outlets 04, 05, etc. from left to right the front to back across the room when facing into the room from the door.
   d. Continue lettering ceiling mounted outlets 06, 07, etc. from left to right then front to back across the room when facing into the room from the door.

3. “J” shall be the individual jack number within the outlet faceplate.

   a. Jack Position #1 (Upper Left)
   b. Jack Position #2 (Upper Right)
   c. Jack Position #3 (Lower Left)
   d. Jack Position #4 (Lower Right)

4. “C” shall identify the Rack or Cabinet number within the telecommunication room (e.g. A or B)

5. “F” shall identify the MPP field number within each rack or cabinet.

F. Station Outlet Identification: Each outlet shall be labeled with the format: RRRR-C-F-JJ detailed above.

G. Identification:

1. Identify system components, wiring, and cabling complying with ANSI/TIA-606-A-1. <u>All newly and installed cabling AND existing cabling shall be labeled.</u>

   a. Administration Class: 4.

b. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

2. Paint and label colors for equipment identification shall comply with ANSI/TIA-606-A-1 for Class 4 level of administration, including optional identification requirements of this standard.
3. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
4. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of ANSI/TIA-606-A-1. Furnish electronic record of all drawings, in software and format selected by Owner.
5. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in ANSI/TIA-606-A-1.

H. As-Built Documentation

1. Upon completion of the project, Electrical Contractor is to prepare "As-Built" documentation showing actual site conditions and installation as constructed. <u>All newly installed AND existing information outlet locations shall be located on as-built drawings.</u>

2. Provide copies of such documentation to Owner as mentioned below.

a. Upon completion of system installation, Electrical Contractor shall provide to Owner for its records the following:

1) ER and TR Diagrams which shall include:

a) Cable routing
b) Position of all components and
c) Detailed layout of the wall field
d) Labeling plan.

2) Work Area Floor Plans which shall Include:

a) Detailed cable routes
b) Approved labeling plan for all work areas.

3) Riser Distribution Plan
4) Cable Tray, Conduit, and Raceway Plans
5) Campus Distribution Plan

b. Documentation shall be in the following format:

1) Four (4) copies and one reproducible sepia of all diagrams and drawings in "D" size (24" x 36") or "E" size (30" x 42") as appropriate.

2) One (1) copy of electronic records provided in the latest AutoDesk AutoCAD format on four (4) CD/DVD-Rom discs.
3) One (1) copy of electronic project records including cut sheets, test results (provided in both PDF format and the native tester file format) and cable connectivity schedules provided on four (4) CD/DVD-Rom discs.

I. Additional Records: In addition to the engineering diagrams, the following items shall be provided by the Electrical Contractor: Cable Records and Assignments detailing all connections to equipment, horizontal cable or riser cable for both copper and fiber cables.

3.8 TESTING / WARRANTY

A. Copper Cable testing

1. Testing of all copper wiring shall be performed prior to system acceptance.

2. One hundred percent of the permanent installed links shall be tested for conformance to the manufacturers guaranteed performance levels as specified in the manufacturer's Extended Product Warranty platform**.**

   a. Any pairs not meeting or exceeding the requirements of the guaranteed performance levels shall be brought into compliance by the contractor, at no charge to the owner.
   b. All cabling shall exceed the specifications of ANSI/TIA-568-C.2 (specific to the Category standards the cabling is manufactured to) by the margins (headroom) specified in the manufacturer's Extended Product Warranty platform**.**

3. One hundred percent of the horizontal and riser wiring pairs shall be tested for opens, shorts, polarity reversals, transposition and presence of AC voltage.
4. The Electrical Contractor shall utilize a Fluke Link iQ Cable Analyzer to test all unshielded twisted pair cabling.
5. Test equipment shall be updated with the latest firmware and software releases available from the manufacturer of the test equipment.
6. All test equipment shall include valid proof of calibration within 12 months of the testing date. The calibration shall utilize the manufacturer's recommended calibration practices.
7. One hundred percent of horizontal cables shall be tested according to the manufacturer's instructions utilizing the latest firmware and software.

   a. Testing shall include all of the electrical parameters.
   b. The detailed test results shall include the following:

      1) Wire Map
      2) Length
      3) Insertion loss
      4) Near-End Cross Talk (NEXT)
      5) Power Sum Near-End Crosstalk (PSNEXT)
      6) Equal-Level Far End Crosstalk (ELFEXT)
      7) Power Sum Equal-Level Far-End Crosstalk (PSELFEXT)
      8) Return Loss
      9) Propagation delay
      10) Delay skew

8. Complete, end to end, test results shall be submitted to Engineer for review.

B. Extended Product and Application Assurance Warranty Work

1. Under the Extended Product and Application Assurance Warranty, the manufacturer shall replace any and all defective product or product not functioning to the levels guaranteed at the time of the warranty issue at the manufacturer's cost.
2. The manufacturer shall engage an authorized manufacturer's reseller to repair or replace any such defective product on behalf of the manufacturer at no cost to the owner.
3. The Extended Product Warranty shall include a minimum one (1) year installation warranty for the premises copper and optical cabling to correct all installation related problems/ issues at no cost to the owner.

3.9 COMPLETION OF WORK

A. At the completion of the System, the Electrical Contractor shall restore to its former condition, all aspects of the project site and on a daily basis, shall remove all waste and excess materials, rubbish debris, tools and equipment resulting from or used in the services provided under this Contract.

B. All clean up, restoration, and removal noted above will be by the Electrical Contractor and at no additional cost.

3.10 INSPECTION

A. On-going inspections shall be performed during construction by the Project Manager and/or System Engineer. All work shall be performed in a high quality manner and the overall appearance shall be clean, neat and orderly.

B. Upon completion of the project, the engineer representative will perform a final inspection of the installed cabling system with a Electrical Contractor's representative. The final inspection will be performed to validate that all horizontal and backbone cables were installed as defined in the drawing package.

END OF SECTION 27 15 00

SECTION 28 15 00
ACCESS CONTROL HARDWARE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Door Controllers
2. Card readers and Credential Cards
3. Cables

B. Related Requirements:

A. Section 26 05 33 Raceway and Boxes for Electrical Systems

B. Section 27 05 28 Pathways for Communication Systems

C. Section 27 05 26 Grounding and Bonding for Communication Systems

1.3 DEFINITIONS

A. Credential: Data assigned to an entity and used to identify that entity.

B. Identifier: A credential card; keypad personal identification number; or code, biometric characteristic, or other unique identification entered as data into the entry-control database for the purpose of identifying an individual. Where this term is presented with an initial capital letter, this definition applies.

C. Location: A Location on the network having a PC-to-controller communications link, with additional controllers at the Location connected to the PC-to-controller link with a TIA 485-A communications loop. Where this term is presented with an initial capital letter, this definition applies.

D. PC: Personal computer. Applies to the central station, workstations, and file servers.

E. RAS: Remote access services.

F. ROM: Read-only memory. ROM data are maintained through losses of power.

G. TCP/IP: Transport control protocol/Internet protocol.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Reference each product to a location on Drawings. Test and evaluation data presented in Product Data shall comply with SIA BIO-01.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For security system to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Hard copies of manufacturer's specification sheets, operating specifications, design guides, user's guides for software and hardware, and PDF files on USB media of the hard-copy submittal.
2. System installation and setup guides with data forms to plan and record options and setup decisions.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: All work shall be performed by Montel Technologies, LLC. Contact Clay Goodman (779) 771-6910.

B. Source Limitations: Obtain central station, workstations, controllers, Identifier readers, and all software through one source from single manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store in temperature- and humidity-controlled environment in original manufacturer's sealed containers. Maintain ambient temperature between 50 and 85 deg F, and not more than 80 percent relative humidity, noncondensing.

B. Open each container; verify contents against packing list; and file copy of packing list, complete with container identification, for inclusion in operation and maintenance data.

C. Mark packing list with the same designations assigned to materials and equipment for recording in the system labeling schedules that are generated by software specified in "Cable and Asset Management Software" Article.

D. Save original manufacturer's containers and packing materials and deliver as directed under provisions covering extra materials.

1.9 PROJECT CONDITIONS

A. Environmental Conditions: System shall be capable of withstanding the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Indoor, Controlled Environment: NEMA 250, Type 1 enclosure. System components, except the central-station control unit, installed in temperature-controlled indoor environments shall be rated for continuous operation in ambient conditions of 36 to 122 deg F dry bulb and 20 to 90 percent relative humidity, noncondensing.
2. Outdoor Environment: NEMA 250, NEMA 250, Type 3R enclosures. System components installed in locations exposed to weather shall be rated for continuous operation in ambient conditions of minus 30 to plus 122 deg F dry bulb and 20 to 90 percent relative humidity, condensing. Rate for continuous operation where exposed to rain as specified in NEMA 250, winds up to 85 mph and snow cover up to 24 inches thick.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION/OPERATION

A. Security access system hardware shall use a single database for access-control and credential-creation functions.

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. Comply with NFPA 70, "National Electrical Code."

2.3 DOOR CONTROLLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. S2.

B. Coordinate all requirements for system expansion with existing S2 hardware. Contractor shall provide all additional system equipment to support access control devices shown on plan.

C. Existing S2 Equipment:

1. Ellis: Expansion Room for 5 additional controller cards.
2. Lewis Lemon: Expansion Room available for additional cards.
3. RESA: Expansion Room for 1 additional card.
4. Thurgood Marshall: Expansion Room for 6 additional cards.

2.4 CARD READERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HID Global Corporation MiniProx.

B. Card-Reader Power: Powered from its associated controller, including its standby power source, and shall not utilize more than 110 mA at 12 VDC.

C. Response Time: Card reader shall respond to passage requests by generating a signal that is sent to the controller. Response time shall be 800 ms or less, from the time the card reader finishes reading the credential card until a response signal is generated.

D. Enclosure: Suitable for surface, and mullion mounting. Mounting types shall additionally be suitable for installation in the following locations:

1. Indoors, controlled environment.
2. Outdoors, uncontrolled environment.

E. Display: Digital visual LED indicator shall provide visible and audible status indications and user prompts. Indicate power on or off, whether user passage requests have been accepted or rejected, and whether the door is locked or unlocked.

F. Touch-Plate and Proximity Readers:

1. Active-detection proximity card readers shall provide power to compatible credential cards through magnetic induction, and shall receive and decode a unique identification code number transmitted from the credential card.
2. The card reader shall read proximity cards in a range from direct contact to at least 5 inches from the reader.

G. Communication Protocol: Compatible with local door controller.

2.5 DOOR CONTACTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bosch.

B. Provide 4-Wire, closed loop, commercial door contacts compatible with existing S2 security system.

C. Wire door contacts to both the S2 system and the Alarm system.

2.6 ACCESS CONTROL CABLES

A. General Cable Requirements: Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" and as recommended by system manufacturer for integration requirement.

B. Low-voltage control cable shall be sequentially marked at two-foot intervals.

C. Plenum rated composite cable (banana peel).

1. Belden 658AFS or equal CMP cable consisting of 4C/18 AWG shielded gray lock power cable, 3 Pr/22 AWG overall shield orange card reader cable, 2C/22 AWG shielded white door contact cable, and 4C/22 AWG shielded blue request to exit cable.

D. Plenum-Rated, Electronic Strike Cable: NFPA 70, Type CMP.

1. 4 No. 16 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.

3. Shielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

E. Plenum-Rated, Card Reader Cable: NFPA 70, Type CMP.
1. 3 pair, twisted, No. 22 AWG, stranded (19x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Plastic jacket.
4. Flame Resistance: NFPA 262, Flame Test.

F. Plenum-Rated Door Contact Cable: NFPA 70, Type CMP.
1. 2 No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Plastic jacket.
4. Flame Resistance: NFPA 262, Flame Test.

G. Plenum-Rated Request-to-Exit/ Spare Cable: NFPA 70, Type CMP.
1. 4 No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Plastic jacket.
4. Flame Resistance: NFPA 262, Flame Test.

2.7 VIDEO DOOR STATION

A. The video door station shall be Axis A8105(E) with the following characteristics:
a. Resolution: 1920x1200.
b. Frame Rate 25 fps.
c. Video: H.264 and MJPEG.
d. Audio: Two-way Full duplex.

B. Provide Network interface and wire to existing telecom room as indicated on drawings.

C. Provide (3) Door Release Buttons: Located at Main Desk, Principal, and Asst Principal.

D. Provide interface to existing S2 access control system for door strike control.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation.

B. Examine roughing-in for LAN and control cable conduit systems to PCs, controllers, card readers, and other cable-connected devices to verify actual locations of conduit and back boxes before device installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with recommendations in SIA CP-01.

B. Comply with TIA 606-B, "Administration Standard for Commercial Telecommunications Infrastructure."

C. Product Schedules: Obtain detailed product schedules from manufacturer of access-control system or develop product schedules to suit Project. Fill in all data available from Project plans and specifications and publish as Product Schedules for review and approval.

D. In meetings with Architect and Owner, present Product Schedules and review, adjust, and prepare final setup documents. Use approved, final Product Schedules to set up system software.

3.3 CABLING

A. Comply with NECA 1, "Good Workmanship in Electrical Construction."

B. Install cables and wiring according to requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

C. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

D. Wiring Method: Install wiring in raceway and cable tray except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use NRTL-listed plenum cable in environmental airspaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

E. Install LAN cables using techniques, practices, and methods that are consistent with Category 5e rating of components and optical fiber rating of components, and that ensure Category 6 and optical fiber performance of completed and linked signal paths, end to end.

F. Boxes and enclosures containing security-system components or cabling, and which are easily accessible to employees or to the public, shall be provided with a lock. Boxes above ceiling level in occupied areas of the building shall not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public shall be covered with a suitable cover plate and secured with tamperproof screws.

G. Install end-of-line resistors at the field device location and not at the controller or panel location.

3.4 CABLE APPLICATION

A. Comply with TIA 569-D, "Commercial Building Standard for Telecommunications Pathways and Spaces."

B. Cable application requirements are minimum requirements and shall be exceeded if recommended or required by manufacturer of system hardware.

C. Card Readers and Keypads:
   1. Install number of conductor pairs recommended by manufacturer for the functions specified.

2. Unless manufacturer recommends larger conductors, install No. 22 AWG wire if maximum distance from controller to the reader is 250 ft., and install No. 20 AWG wire if maximum distance is 500 ft..
3. For greater distances, install "extender" or "repeater" modules recommended by manufacturer of the controller.
4. Install minimum No. 18 AWG shielded cable to readers and keypads that draw 50 mA or more.

D. Install minimum No. 16 AWG cable from controller to electrically powered locks. Do not exceed 50 ft between terminations.

3.5 GROUNDING

A. Comply with Section 27 05 26 "Grounding and Bonding for Communications Systems."

B. Comply with IEEE 1100, "Recommended Practice for Power and Grounding Electronic Equipment."

C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

D. Bond shields and drain conductors to ground at only one point in each circuit.

E. Signal Ground:
1. Terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.
2. Bus: Mount on wall of main equipment room with standoff insulators.
3. Backbone Cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.6 INSTALLATION

A. Install devices as indicated, coordinate all final locations with architectural details and owner requirements..

3.7 IDENTIFICATION

A. In addition to requirements in this article, comply with applicable requirements in Section 27 05 53 "Identification for Communications Systems" and with TIA 606-B.

B. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

1. All wiring conductors connected to terminal strips shall be individually numbered, and each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with the name and number of the particular device as shown.
2. Each wire connected to building-mounted devices is not required to be numbered at the device if the color of the wire is consistent with the associated wire connected and numbered within the panel or cabinet.

C. At completion, cable and asset management software shall reflect as-built conditions.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. LAN Cable Procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use tester approved for type and kind of installed cable. Test for faulty connectors, splices, and terminations. Test according to TIA 568-C.1, "Commercial Building Telecommunications Cabling Standards - Part 1: General Requirements." Link performance for balanced twisted-pair cables must comply with minimum criteria in TIA 568-C.1.
2. Test each circuit and component of each system. Tests shall include, but are not limited to, measurements of power-supply output under maximum load, signal loop resistance, and leakage to ground where applicable. System components with battery backup shall be operated on battery power for a period of not less than 10 percent of the calculated battery operating time. Provide special equipment and software if testing requires special or dedicated equipment.
3. Operational Test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

C. Devices and circuits will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 STARTUP SERVICE

A. Engage a factory-authorized service representative to supervise and assist with startup service.

1. Complete installation and startup checks according to approved procedures that were developed in "Preparation" Article and with manufacturer's written instructions.
2. Enroll and prepare badges and access cards for Owner's operators, management, and security personnel.

END OF SECTION 28 15 00

SECTION 284621
ADDRESSABLE FIRE ALARM 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. System detectors.
2. Notification appliances.

B. Related Requirements:

1. Section 26 05 23 " Control-Voltage Electrical Power Cables" for cables and conductors for fire-alarm systems.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.

4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

a. Trained and certified by manufacturer in fire-alarm system design.
b. NICET-certified, fire-alarm technician.
c. Licensed or certified by the State of illinois.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
d. Riser diagram.
e. Device addresses.
f. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

g. Manufacturer's required maintenance related to system warranty requirements.
h. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:
1. Device address list.

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. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
2. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
3. Keys and Tools: One extra set for access to locked or tamperproofed components.
4. Audible and Visual Notification Appliances: One of each type installed.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm technician.

C. State of Illinois licensed Fire Alarm Installer

1.8 PROJECT CONDITIONS

A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.

B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Owner no fewer than 14 days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Owner's written permission.

C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FIRE-ALARM CONTROL PANEL

A. Manufacturers: Existing System:

1. Ellis: Honeywell Notifier, NFS-320 (Field Verify).
2. Lewis Lemon: SimplexGrinnell LP, 4100ES.
3. Thurgood Marshall: SimplexGrinnell LP, 4100ES.

2.3 SYSTEM SMOKE DETECTORS

A. Manufacturers: Match the FACP at each school.

B. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be two-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.

    a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
    b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
    c. Multiple levels of detection sensitivity for each sensor.

d. Sensitivity levels based on time of day.

C. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

D. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

2.4 MANUAL FIRE-ALARM BOXES

A. Manufacturers: Match the FACP at each school.

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, breaking-glass or plastic-rod, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACP.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm. Lifting cover actuates integral battery-powered audible horn intended to discourage false-alarm operation.
4. Material: Manual stations made of Lexan polycarbonate.
5. Able to be used in indoor areas.

2.5 NOTIFICATION APPLIANCES

A. Manufacturers: Match the FACP at each school.

B. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.

C. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

D. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

E. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

F. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

G. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.

1. Rated Light Output:

a. As required by NFPA 72.
b. Selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.

1. Replace existing control panel in existing part of the building.
2. Connect new equipment to existing monitoring equipment at the supervising station.
3. Expand, modify, and supplement existing monitoring equipment as necessary to extend existing control and monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.

C. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
5. HVAC: Locate detectors not closer than 60 inches from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

D. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

E. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

F. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

G. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

I. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways in new construction shall be concealed in walls.

B. Pathways above recessed ceilings and in concealed, accessible locations may be routed exposed in rings or J-Hooks.

C. Pathways for existing construction shall be:

1. Installed in EMT in non-finished spaces.
2. Pathways shall be pre-finished Metal Surface Raceway in finished areas.

3.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 08 71 00 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
2. Smoke dampers in air ducts of designated HVAC duct systems.
3. Magnetically held-open doors.
4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
5. Supervisory connections at valve supervisory switches.
6. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
7. Data communication circuits for connection to building management system.
8. Data communication circuits for connection to mass notification system.
9. Supervisory connections at fire-extinguisher locations.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 “Identification for Electrical Systems”.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

END OF SECTION 28 46 21