

**PROJECT MANUAL – CONSTRUCTION DOCUMENTS**

# **City of Concord Fleet Services Facility**

605 Alfred Brown Jr Court SW  
Concord, NC 28025

**Architect Project No. 0604-0572**

## **OWNER**

City of Concord  
PO Box 308  
Concord, North Carolina 28026

## **ARCHITECTS**

C Design Inc  
1000 W. MOREHEAD ST, SUITE 120  
CHARLOTTE, NORTH CAROLINA 28208  
PHONE: (704) 376.6000

**100% - CONSTRUCTION DOCUMENTS 03/07/2024**  
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C Design Inc Project # 0604-0572  
03.07.2024

City of Concord  
Fleet Services Facility

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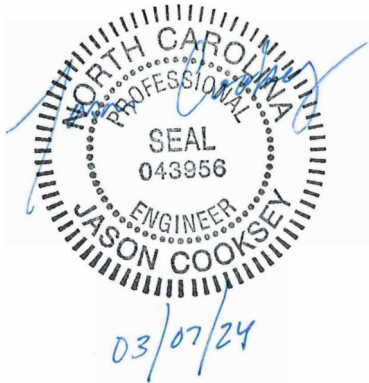



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### **APPENDIX**

Geotechnical Engineering Report the Concord Fleet Services Facility, 880 Warren C. Coleman Blvd., Concord, North Carolina, performed by Stewart. F23004.00. Prepared May 25, 2023.

**END OF TABLE OF CONTENTS 00 01 10**

SECTION 00 01 07 - SEALS PAGE

<p>I hereby certify that the portion of this technical submission described below was prepared by me or under my direct supervision and that I am a duly registered engineer under the laws of the State of North Carolina.</p> <p><u>Jason Cooksey, PE</u> <u>March 7, 2024</u> Date</p> <p>Specifications covered by this seal: Structural sections in Division 01, Division 03, Division 04, and Division 05</p>	
<p>I hereby certify that the portion of this technical submission described below was prepared by me or under my direct supervision and that I am a duly registered engineer under the laws of the State of North Carolina.</p> <p><u>Adam J. Senk, PE</u> <u>March 6, 2024</u> Date</p> <p>Specifications covered by this seal: Fire Protection, Division 21 and Division 28</p>	
<p>I hereby certify that the portion of this technical submission described below was prepared by me or under my direct supervision and that I am a duly registered engineer under the laws of the State of North Carolina.</p> <p><u>Brad W. Bumgarner, PE</u> <u>March 7, 2024</u> Date</p> <p>Specifications covered by this seal: Plumbing and Mechanical, Division 22, Division 23, Division 33</p>	
<p>I hereby certify that the portion of this technical submission described below was prepared by me or under my direct supervision and that I am a duly registered engineer under the laws of the State of North Carolina.</p> <p><u>Jesus Gonzalez, PE</u> <u>March 6, 2024</u> Date</p> <p>Specifications covered by this seal: Electrical, Division 26</p>	



**1.1 GEOTECHNICAL DATA**

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.
  
- B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firms reporting the subsurface conditions do not warranty the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.
  
- C. A Geotechnical Engineering Report the Concord Fleet Services Facility, 880 Warren C. Coleman Blvd., Concord, North Carolina, performed by Stewart. F23004.00. Prepared May 25, 2023 is available for viewing as appended to this Document.
  - 1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
  - 2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.

**END OF DOCUMENT 00 31 32**

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**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Project information.
  - 2. Work covered by Contract Documents.
  - 3. Work by Owner.
  - 4. Work under separate contracts.
  - 5. Purchase contracts.
  - 6. Owner-furnished products.
  - 7. Access to site.
  - 8. Coordination with occupants.
  - 9. Work restrictions.
  - 10. Specification and Drawing conventions.

**1.3 PROJECT INFORMATION**

- A. Project Identification: Fleet Services Building.
  - 1. Project Location: 605 Alfred Brown Jr Court SW, Concord, NC 28025.
- B. Owner: Fleet Services Building:
  - 1. Owner's Representative: Jacklyn Deal; 704.920.5401.
- C. Architect: C Design Inc.
- D. Other Consultants: C Design has retained the following design professionals who have prepared designated portions of the Contract Documents:
  - 1. See drawings for this information.

**1.4 WORK COVERED BY CONTRACT DOCUMENTS**

- A. The Work of Project is defined by the Contract Documents and consists of the following:
  - 1. The project will contain a new Fleet Services Facility, new vehicle wash equipment in an existing vehicle wash facility, and a Fueling Station.

**1.5 WORK UNDER SEPARATE CONTRACTS**

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

**1.6 PURCHASE CONTRACTS**

- A. General: Owner has negotiated Purchase contracts with suppliers of material and equipment to be incorporated into the Work. Owner will assign these Purchase contracts to Contractor. Include costs for purchasing, receiving, handling, storage if required, and installation of material and equipment in the Contract Sum unless otherwise indicated.
  - 1. Contractor's responsibilities are same as if Contractor had negotiated Purchase contracts, including responsibility to renegotiate purchase and to execute final purchasing agreements.

**1.7 OWNER-FURNISHED PRODUCTS (OF/CI)**

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products and making building services connections.
- B. Owner-Furnished Products:
  - 1. Furniture.
  - 2. Security system equipment and cabling.
  - 3. Breakroom appliances and equipment
  - 4. Building Signage

**1.8 ACCESS TO SITE**

- A. Use of Site: See General Conditions of owner/contractor agreement.

**1.9 COORDINATION WITH OCCUPANTS**

- A. Full Owner Occupancy: Owner will not occupy the building during construction period.

**1.10 WORK RESTRICTIONS**

- A. Work Restrictions, See General Conditions of owner/contractor agreement.

**1.11 SPECIFICATION AND DRAWING CONVENTIONS**

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:



## **SECTION 01 10 00 - SUMMARY**

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1. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.
2. Conflicts: Specifications and Drawings are complimentary, and one does not take precedent over the other. Should a conflict arise between the Drawings and Specifications the Architect shall be notified immediately for the correct interpretation.

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 10 00**

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## **SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES**

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### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

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

#### **1.2 MINOR CHANGES IN THE WORK**

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

#### **1.3 PROPOSAL REQUESTS**

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Work Change Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
  - 2. Within time specified in Proposal Request after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include 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 using Contractor's Standard Form. Any contractor-initiated deviations from the contract documents due to contractor errors, omissions, etc. shall be submitted as an RFD (request for deviation).
  - 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 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.

#### **1.4 CHANGE ORDER PROCEDURES**

- A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor.

## **SECTION 01 26 00 - CONTRACT MODIFICATION PROCEDURES**

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- B. Change order log to be kept current at all times and reviewed in change management meetings.

### **1.5 CONSTRUCTION CHANGE DIRECTIVE**

- A. Construction Change Directive: Architect may issue a Construction Change Directive instructing Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 26 00**

## **SECTION 01 29 00 – PAYMENT PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Payment procedure shall also be in accordance with any additional requirements as described in Section 4 of the supplemental General Conditions.

#### **1.2 SCHEDULE OF VALUES**

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Correlate line items in the schedule of values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with continuation sheets.
    - b. Submittal schedule.
    - c. Items required to be indicated as separate activities in Contractor's construction schedule.
- 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 the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
    - a. Related Specification Section or Division.
    - b. Description of the Work.
    - c. Name of subcontractor.
    - d. Name of manufacturer or fabricator.
    - e. Name of supplier.
    - f. Change Orders (numbers) that affect value.
    - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
      - 1) Labor.
      - 2) Materials.
      - 3) Equipment.
  - 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of Contract Sum.
  - 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

## **SECTION 01 29 00 – PAYMENT PROCEDURES**

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. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Unit-Cost Allowances: Provide a separate line item in the schedule of values for each unit-cost allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. 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.
9. 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.

### **1.3 APPLICATIONS FOR PAYMENT**

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
  1. Initial Application for Payment, Application for Payment at time of Beneficial Occupancy, and final Application for Payment at Project Acceptance 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 Instructions to Bidders and General Conditions of the Contract.
- C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
  4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- E. Stored Materials:
  1. In requesting payment for materials stored on or off the site, the Contractor shall submit with his Application for Payment the following:
    - a. An itemized list of the stored material prepared in sufficient detail to identify the materials and their value.
    - b. Evidence such as bills of sale or such other proof as may be requested by the Owner or Architect to substantiate that the materials listed have been paid for by

## **SECTION 01 29 00 – PAYMENT PROCEDURES**

- the Contractor, or for materials stored at the site only, a notarized statement from the materials supplier stating that the materials will become the property of the Owner upon payment by the Owner to the Contractor.
- c. In addition, for material stored off the site, the Contractor shall submit with his Application for Payment the following:
    - 1) Evidence that the materials are stored at the location previously agreed to in writing.
    - 2) No payment will be made for material stored off the site until the storage location has been agreed upon in writing.
    - 3) Evidence that the storage location is bonded.
    - 4) Evidence that the materials are insured while in storage and while in transit to the site.
    - 5) Evidence that transportation to the site will be provided.
  - d. The Architect may review the materials in their storage location.
    - 1) This review, if performed, is an extra service for which the Owner shall pay the Architect and for which the Contractor shall reimburse the Owner by Change Order.
- F. Transmittal: Submit, as many as required, signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required. Owner may require approval in writing from Contractor's Bonding Company to be submitted with each Application for Payment.
- 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. 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 baseline construction schedule (preliminary if not final).
  - 4. Schedule of unit prices.
  - 5. Submittal schedule (preliminary if not final).
  - 6. Copies of building permits.
  - 7. Certificates of insurance and insurance policies.
  - 8. Performance and payment bonds.
- H. 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.
- I. 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.
- J. Refund of Sales and Use Taxes: North Carolina General Statute 105-164.14(e) authorizes refunds to the state of county sales and use taxes paid by contractors on materials which are incorporated into a state building or structure. The Contractor shall report all county sales and use taxes paid, in accordance with Article 4.31.2.

## **SECTION 01 29 00 – PAYMENT PROCEDURES**

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- K. Submittal of Tax Forms. The Contractor shall attach to each request for payment certified statements of county sales and use taxes paid on materials claimed for payment on the request. Certified statements in the same format shall be obtained from all subcontractors and provided with the request for payment. The Designer will not approve payment for any materials until the supporting county tax statement has been provided. The statement must include the cons of any tangible personal property withdrawn from the contractor's warehouse stock and the amount of county sales or use tax paid thereon by the contractor. These certified statements may be subject to audit. Contractors shall not include any tax paid on supplies, tools and equipment, which they use to perform their contracts and shall include only those building materials, supplies, fixtures and equipment which actually become a part of or annexed to the building or structure. The position of a sale is the retailer's place of business located within a taxing county where the vendor becomes contractually obligated to make the sale. Therefore, it is important that the county tax be reported for the county of sale rather than the county of use. When property is purchased from out-of-state vendors and the county tax is charged, you should identify the county where delivery is made when reporting the county tax

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 29 00**



## **SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Coordination drawings.
  - 3. RFIs.
  - 4. Digital project management procedures.
  - 5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

#### **1.2 DEFINITIONS**

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

#### **1.3 GENERAL COORDINATION PROCEDURES**

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
  - 1. Preparation of Contractor's construction schedule.
  - 2. Preparation of the schedule of values.
  - 3. Installation and removal of temporary facilities and controls.
  - 4. Delivery and processing of submittals.
  - 5. Progress meetings.
  - 6. Preinstallation conferences.
  - 7. Project closeout activities.
  - 8. Startup and adjustment of systems.

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### 9. Project Closeout activities

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work

### **1.4 COORDINATION**

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

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 Component to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Coordination: Each contractor shall coordinate its construction operations with those of other contractors and entitles to ensure efficient and orderly installation if each part of the Work. Each contractor shall coordinate its operations with operations, included in different Sections that depend on each other for proper installation, connection, and operation.

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

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

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

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

### **1.5 KEY PERSONNEL**

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

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of individuals assigned to Project.

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

### **1.6 REQUEST FOR INFORMATION (RFI)**

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
  2. Coordinate and submit RFIs in a prompt manner 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 and Construction Manager.
  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.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Through the Contractor's construction management software.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
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 coordination information already indicated in the Contract Documents.
    - d. Requests for adjustments in the Contract Time or the Contract Sum.
    - e. Requests for interpretation of Architect's actions on submittals.
    - f. Incomplete RFIs or inaccurately prepared RFIs.

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Architect's time for response will date from time of receipt by Architect of additional information.

3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
  - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly at OAC meetings. Use software log that is part of Owner's e-builder software platform. Software log with not less than the following:
  1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number including RFIs that were returned without action or withdrawn.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

### **1.7 PROJECT MEETINGS**

- A. General:
  1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Contractor will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, for review three days prior of the following meeting.
- B. Preconstruction Conference: Architect will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
  1. Conduct the conference to review responsibilities and personnel assignments.
  2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule.
    - b. Phasing.
    - c. Critical work sequencing and long lead items.
    - d. Designation of key personnel and their duties.
    - e. Lines of communications.

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- f. Procedures for processing field decisions and Change Orders.
  - g. Procedures for RFIs.
  - h. Procedures for testing and inspecting.
  - i. Procedures for processing Applications for Payment.
  - j. Distribution of the Contract Documents.
  - k. Submittal procedures.
  - l. Sustainable design requirements.
  - m. Preparation of Record Documents.
  - n. Use of the premises and existing building.
  - o. Work restrictions.
  - p. Working hours.
  - q. Owner's occupancy requirements.
  - r. Responsibility for temporary facilities and controls.
  - s. Procedures for moisture and mold control.
  - t. Procedures for disruptions and shutdowns.
  - u. Construction waste management and recycling.
  - v. Parking availability.
  - w. Office, work, and storage areas.
  - x. Equipment deliveries and priorities.
  - y. First aid.
  - z. Security.
  - aa. Progress cleaning.
  - bb. Green Globe sustainable design requirements
4. Minutes: Contractor responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, and Owner's Commissioning Authority of scheduled meeting dates.
  - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents.
    - b. Options.
    - c. Related RFIs.
    - d. Related Change Orders.
    - e. Purchases.
    - f. Deliveries.
    - g. Submittals.
    - h. Sustainable design requirements.
    - i. Possible conflicts.
    - j. Compatibility requirements.
    - k. Time schedules.
    - l. Weather limitations.
    - m. Manufacturer's written instructions.
    - n. Warranty requirements.
    - o. Compatibility of materials.
    - p. Acceptability of substrates.
    - q. Temporary facilities and controls.
    - r. Space and access limitations.

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- s. Regulations of authorities having jurisdiction.
  - t. Testing and inspecting requirements.
  - u. Installation procedures.
  - v. Coordination with other work.
  - w. Required performance results.
  - x. Protection of adjacent work.
  - y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of Record Documents.
    - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - c. Submittal of written warranties.
    - d. Requirements for completing sustainable design documentation.
    - e. Requirements for preparing operations and maintenance data.
    - f. Requirements for demonstration and training.
    - g. Preparation of Contractor's punch list.
    - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    - i. Submittal procedures.
    - j. Owner's partial occupancy requirements.
    - k. Installation of Owner's furniture, fixtures, and equipment.
    - l. Responsibility for removing temporary facilities and controls.
  4. Minutes: Contractor conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Contractor will conduct progress meetings at intervals agreed upon with the Owner and Architect.
1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority, Construction Manager, and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of previous progress meeting. Review

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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) Status of sustainable design documentation.
- 5) Deliveries.
- 6) Off-site fabrication.
- 7) Access.
- 8) Site utilization.
- 9) Temporary facilities and controls.
- 10) Progress cleaning.
- 11) Quality and work standards.
- 12) Status of correction of deficient items.
- 13) Field observations.
- 14) Status of RFIs.
- 15) Status of Proposal Requests.
- 16) Pending changes.
- 17) Status of Change Orders.
- 18) Pending claims and disputes.
- 19) Documentation of information for payment requests.

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

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

- F. Coordination Meetings: Conduct Project Coordinator will conduct Project coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: Contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

- a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction

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schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

- b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
  - c. Review present and future needs of each contractor present, including the following:
    - 1) Interface requirements.
    - 2) Sequence of operations.
    - 3) Status of submittals.
    - 4) Deliveries.
    - 5) Off-site fabrication.
    - 6) Access.
    - 7) Site utilization.
    - 8) Temporary facilities and controls.
    - 9) Work hours.
    - 10) Hazards and risks.
    - 11) Progress cleaning.
    - 12) Quality and work standards.
    - 13) Change Orders.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION (Not Used)**

END OF SECTION 01 31 00



**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Startup construction schedule.
  - 2. Contractor's Construction Schedule.
  - 3. Daily construction reports.
  - 4. Field condition reports.

**1.2 DEFINITIONS**

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
  - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
- C. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- D. Event: The starting or ending point of an activity.
- E. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. PDF file.
- B. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

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- D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
  2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
  3. Total Float Report: List of activities sorted in ascending order of total float.
- E. Weekly Construction Report: Submit at weekly intervals.

### **1.4 QUALITY ASSURANCE**

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
1. Review software limitations and content and format for reports.
  2. Verify availability of qualified personnel needed to develop and update schedule.
  3. Discuss constraints, including interim milestones.
  4. Review delivery dates for Owner-furnished products.
  5. Review schedule for work of Owner's separate contracts.
  6. Review submittal requirements and procedures.
  7. Review time required for review of submittals and resubmittals.
  8. Review requirements for tests and inspections by independent testing and inspecting agencies.
  9. Review time required for Project closeout and Owner startup procedures.
  10. Review and finalize list of construction activities to be included in schedule.
  11. Review procedures for updating schedule.

### **1.5 COORDINATION**

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

### **1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL**

- A. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final
- C Design Inc Project # 0604-0572  
03.07.2024
- City of Concord  
Fleet Services Facility

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Acceptance.

1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  3. Submittal Review Time: Include review and resubmittal times indicated in Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
  4. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
  5. Beneficial Occupancy: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
  6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.
1. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
  2. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  3. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction.
    - b. Uninterruptible services.
    - c. Partial occupancy before Substantial Completion.
    - d. Use-of-premises restrictions.
    - e. Seasonal variations.
    - f. Environmental control.
  4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
    - a. Subcontract awards.
    - b. Submittals.
    - c. Purchases.
    - d. Fabrication.
    - e. Sample testing.
    - f. Deliveries.
    - g. Installation.
    - h. Tests and inspections.
    - i. Adjusting.
    - j. Curing.
    - k. Startup and placement into final use and operation.

## **SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTS**

- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Beneficial Occupancy, and Final Acceptance, and the following interim milestones:
  - 1. Permanent HVAC.
  - 2. Designer Inspection.
  - 3. State Agency Review and Inspections
  - 4. Owner Review and Inspections
  
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
  - 1. Unresolved issues.
  - 2. Unanswered Requests for Information.
  - 3. Rejected or unreturned submittals.
  - 4. Notations on returned submittals.
  
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
  
- G. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
  
- H. Submit required Schedules in the following formats:
  - a. Oracle Primavera P6 .XER file
  - b. PDF electronic file.

### **1.7 STARTUP CONSTRUCTION SCHEDULE**

- A. A. Bar-Chart Schedule: Submit start-up horizontal bar-chart-type construction schedule within seven days of date established for the Notice to Proceed.
  
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
  
- C. Submit required Schedules in the following formats:
  - a. Oracle Primavera P6 .XER file
  - b. PDF electronic file.

### **1.8 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)**

- A. General: Prepare network diagrams using AON (activity-on-node) format.
  
- B. Startup Network Diagram: Submit diagram within 14 days of date established for the Notice to Proceed. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
  
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a cost- and resource-loaded,

## **SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTS**

time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for the Notice to Proceed.
    - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
  2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
  3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
  4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    - a. Preparation and processing of submittals.
    - b. Mobilization and demobilization.
    - c. Purchase of materials.
    - d. Delivery.
    - e. Fabrication.
    - f. Utility interruptions.
    - g. Installation.
    - h. Work by Owner that may affect or be affected by Contractor's activities.
    - i. Testing and inspection.
    - j. Punch list and final completion.
    - k. Activities occurring following final completion.
  2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
  3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
  4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
    - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

## **SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTS**

1. Contractor or subcontractor and the Work or activity.
  2. Description of activity.
  3. Main events of activity.
  4. Immediate preceding and succeeding activities.
  5. Early and late start dates.
  6. Early and late finish dates.
  7. Activity duration in workdays.
  8. Total float or slack time.
  9. Average size of workforce.
  10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, address the following and summarize in a narrative:
1. Identification of activities that have changed.
  2. Changes in early and late start dates.
  3. Changes in early and late finish dates.
  4. Changes in activity durations in workdays.
  5. Changes in the critical path.
  6. Changes in total float or slack time.
  7. Changes in the Contract Time.
- H. Submit required Schedules in the following formats:
- a. Oracle Primavera P6 .XER file
  - b. PDF electronic file.
- 1.9 REPORTS**
- A. Weekly Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. Photographs of current activities
  2. List of subcontractors at Project site.
  3. List of separate contractors at Project site.
  4. Equipment at Project site.
  5. Material deliveries.
  6. High and low temperatures and general weather conditions, including presence of rain or snow.
  7. Testing and inspection.
  8. Meetings and significant decisions.
  9. Unusual events.
  10. Stoppages, delays, shortages, and losses.
  11. Orders and requests of authorities having jurisdiction.
  12. Change Orders received and implemented.
  13. Construction Change Directives received and implemented.
  14. Equipment or system tests and startups.
  15. Partial completions and occupancies.
- B. Field Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

**SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTS**

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**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 32 00**

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## **SECTION 01 33 00 - SUBMITTAL PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

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

#### **1.2 DEFINITIONS**

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as action submittals.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as informational submittals.
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

#### **1.3 ACTION SUBMITTALS**

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Architect and additional time for handling and reviewing submittals required by those corrections.
  - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  - 2. Initial Submittal: Submittal schedule must be submitted by second pay application. Include submittals required during the first 30 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
  - 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
  - 4. Format: Arrange the following information in a tabular format:
    - a. Scheduled date for first submittal.
    - b. Specification Section number and title.
    - c. Submittal category: Action, informational.
    - d. Name of subcontractor.
    - e. Description of the Work covered.
    - f. Scheduled date for Architect's final release or approval.
    - g. Scheduled dates for purchasing.
    - h. Scheduled dates for installation.

## **SECTION 01 33 00 - SUBMITTAL PROCEDURES**

- i. Activity or event number.
5. Submit in electronic (PDF) format unless otherwise indicated upon review of the submittal schedule requiring paper copies.

### **1.4 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. Submit all submittal items required for each Specification Section concurrently as one file unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
  4. Resubmittals shall be all inclusive of all items regardless of prior approval. Supplant rejected items with revised/resubmitted items.
- B. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
  1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 days for review of each resubmittal.
  4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
  5. Extensive Review: For such items requiring extensive review, initial review may require additional time. Architect will identify and coordinate upon review of submittal schedule.
- C. Identification and Information: Place a permanent label or title block on each paper copy submittal item for identification.
  1. Indicate name of firm or entity that prepared each submittal on label or title block.
  2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
  3. Include the following information for processing and recording action taken:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Name of subcontractor.
    - f. Name of supplier.

## **SECTION 01 33 00 - SUBMITTAL PROCEDURES**

- 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., 06 10 00.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 06 10 00.01.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.
- D. Identification and Information: Identify and incorporate information in each electronic submittal file as follows:
- E. Options: Identify options requiring selection by the Architect.
- F. Deviations: Identify deviations from the Contract Documents on submittals.
- G. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will return submittals, without review, received from sources other than Contractor.
- 1. Transmittal Form: Provide locations on form for the following information:
    - a. Project name.
    - b. Date.
    - c. Destination (To:).
    - d. Source (From:).
    - e. Names of subcontractor, manufacturer, and supplier.
    - f. Category and type of submittal.
    - g. Submittal purpose and description.
    - h. Specification Section number and title.
    - i. Indication of full or partial submittal.
    - j. Drawing number and detail references, as appropriate.
    - k. Transmittal number, numbered consecutively.
    - l. Submittal and transmittal distribution record.
    - m. Remarks.
    - n. Signature of transmitter.
  - 2. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.
- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
- 1. Note date and content of previous submittal.
  - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.

## **SECTION 01 33 00 - SUBMITTAL PROCEDURES**

3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- I. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- J. Use for Construction: Use only final submittals that are marked with approval notation from Architect's action stamp.

### **PART 2 - PRODUCTS**

#### **2.1 SUBMITTAL PROCEDURES**

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  1. Action Submittals: Submit electronic (.pdf) files of each submittal, unless otherwise indicated.
  2. Informational Submittals: Submit electronic (.pdf) files of each submittal, unless otherwise indicated.
  3. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
  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 notarized statement on original paper copy certificates and certifications where indicated.
  5. Test and Inspection Reports Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  4. For equipment, include the following in addition to the above, as applicable:

## **SECTION 01 33 00 - SUBMITTAL PROCEDURES**

- a. Wiring diagrams showing factory-installed wiring.
  - b. Printed performance curves.
  - c. Operational range diagrams.
  - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:
  - a. Submit electronic (.pdf) files of Product Data, unless otherwise indicated.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
  1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 30 by 42 inches.
  3. Submit Shop Drawings in the following format:
    - a. Submit electronic (.pdf) files of each submittal unless otherwise indicated upon review of the submittal schedule requiring paper copies.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
  1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
  3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

## **SECTION 01 33 00 - SUBMITTAL PROCEDURES**

4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
  - a. Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
  
5. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
  - a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project record sample.
    - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
    - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
  
- E. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
  1. Type of product. Include unique identifier for each product.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.
  5. Submit product schedule in the following format:
    - a. Submit electronic (.pdf) files of product schedule or list, unless otherwise indicated.
  
- F. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
  
- G. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
  
- H. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
  
- I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  1. Name, address, and telephone number of entities performing subcontract or supplying products.

## **SECTION 01 33 00 - SUBMITTAL PROCEDURES**

2. Number and title of related Specification Section(s) covered by subcontract.
  3. Drawing number and detail references, as appropriate, covered by subcontract.
  4. Submit subcontract list in the following format:
    - a. Submit electronic (.pdf) files of subcontractor list, unless otherwise indicated.
- J. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- K. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- L. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on American Welding Society (AWS) forms. Include names of firms and personnel certified.
- M. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- N. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- O. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- P. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- Q. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- R. Product Test Reports: Submit written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- S. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
1. Name of evaluation organization.
  2. Date of evaluation.
  3. Time period when report is in effect.
  4. Product and manufacturers' names.
  5. Description of product.
  6. Test procedures and results.
  7. Limitations of use.

## **SECTION 01 33 00 - SUBMITTAL PROCEDURES**

- T. Schedule of Tests and Inspections: Comply with requirements specified in Division 01 Section "Quality Requirements."
- U. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- V. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
- W. Field Test Reports: Submit reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- X. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- Y. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

### **2.2 DELEGATED-DESIGN SERVICES**

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

## **PART 3 - EXECUTION**

### **3.1 CONTRACTOR'S REVIEW**

- A. Submittal is subject to immediate rejection if complete review by Contractor is not evident.



## **SECTION 01 33 00 - SUBMITTAL PROCEDURES**

- B. 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.
- C. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."
- D. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

### **3.2 ARCHITECT'S ACTION**

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
  - 1. No Exceptions.
  - 2. Exceptions As Noted.
  - 3. Revise and Resubmit.
  - 4. Rejected.
  - 5. For Information Only.
  - 6. Not Reviewed.
- C. 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.
- D. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- E. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- F. Submittals not required by the Contract Documents may not be reviewed and may be discarded.
- G. Material Safety Data Sheets (SDSs): Submit information directly to Owner; do not submit to Architect.
  - 1. Architect will not review SDSs and will return them with no action taken.

END OF SECTION 01 33 00

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## **SECTION 01 40 00 - QUALITY REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

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

#### **1.2 DEFINITIONS**

- A. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- B. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- C. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- D. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- E. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- F. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- G. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- H. Quality-Control Services: Tests, inspections, procedures, and related actions during and after

## **SECTION 01 40 00 - QUALITY REQUIREMENTS**

execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect or Construction Manager.

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

### **1.3 DELEGATED-DESIGN SERVICES**

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

### **1.4 CONFLICTING REQUIREMENTS**

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements are specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for direction before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

### **1.5 INFORMATIONAL SUBMITTALS**

- A. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- B. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  1. Specification Section number and title.
  2. Entity responsible for performing tests and inspections.
  3. Description of test and inspection.
  4. Identification of applicable standards.
  5. Identification of test and inspection methods.
  6. Number of tests and inspections required.
  7. Time schedule or time span for tests and inspections.
  8. Requirements for obtaining samples.
  9. Unique characteristics of each quality-control service.

### **1.6 REPORTS AND DOCUMENTS**

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  1. Date of issue.
  2. Project title and number.
  3. Name, address, telephone number, and email address of testing agency.

## **SECTION 01 40 00 - QUALITY REQUIREMENTS**

4. Dates and locations of samples and tests or inspections.
  5. Names of individuals making tests and inspections.
  6. Description of the Work and test and inspection method.
  7. Identification of product and Specification Section.
  8. Complete test or inspection data.
  9. Test and inspection results and an interpretation of test results.
  10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and reinspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of technical representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, telephone number, and email address of factory-authorized service representative making report.
  2. Statement that equipment complies with requirements.
  3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  4. Statement whether conditions, products, and installation will affect warranty.
  5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

### **1.7 QUALITY ASSURANCE**

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

## **SECTION 01 40 00 - QUALITY REQUIREMENTS**

- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
  - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7
  - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

### **1.8 QUALITY CONTROL**

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
  - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
  - 2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

## **SECTION 01 40 00 - QUALITY REQUIREMENTS**

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  2. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. **Retesting/Reinspecting:** Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. **Associated Services:** Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspection equipment at Project site.
- G. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

### **1.9 SPECIAL TESTS AND INSPECTIONS**

## **SECTION 01 40 00 - QUALITY REQUIREMENTS**

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

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION**

#### **3.1 TEST AND INSPECTION LOG**

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
  2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Architect.
  4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

#### **3.2 REPAIR AND PROTECTION**

- A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 73 00 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00



**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. A. Reference standards, definitions and specification format and content

**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. Where the words "Provide", "Furnish", and/or "Install" are used, it is intended that the Contractor shall purchase and install completely any materials as required unless otherwise noted. All materials shall be appropriate for the intended service. Install all materials and equipment in complete accordance with the manufacturer's recommendations.
- G. "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 Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

**PART 2 - PRODUCTS (Not Used)**

**PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 42 00**

# **SECTION 01 45 33 - SPECIAL INSPECTIONS AND TESTING PROGRAM**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Contractor responsibilities for special inspection and testing.
  - 2. Special Inspection program and reporting requirements.
  - 3. Attachment A to this Specification Section includes the Submittal of Special Inspections.
  - 4. Attachment B to this Specification Section includes Special Inspector qualifications, reporting requirements, and material specific inspections and tests.
    - a. This information is for the Contractor reference only and is not part of the Contract Documents.
    - b. It is included to assist the Contractor in understanding the Owner-provided Services so that those services may be factored into the Contractor's pricing and schedule.
    - c. The Service Provider(s) responsible for the Owner-provided Services will be selected after Contract award.
- B. Purpose:
  - 1. This Document was developed to address the requirements of the 2015 International Building Code IBC, section 1704.1, including:
    - a. One or more special inspectors will be hired by the Owner or the Owner's Agent to provide inspections during constructions on the types of work listed under Section 1704.
  - 2. A Statement of Special Inspections will be submitted to the Building Code Official as a condition for permit issuance. This statement is included as Attachment A to this Specification. Attachment B includes a complete list of materials and work requiring special inspections, the inspections to be performed and a list of the minimum qualifications of the individuals, approved agencies or firms intended to be retained for conducting such inspections.
- C. Related Specification Sections include but are not necessarily limited to:

### **1.2 DEFINITIONS**

- A. Special Inspector: Representative of the Owner approved inspection agency designated for that portion of the work.
- B. Testing Agency: Approved agency, not affiliated or hired by the Contractor, which is responsible for the materials testing requirements of the project including but not limited to concrete cylinder breaks, soils testing, and masonry materials testing.
- C. Statement of Special Inspections: Document provided to the Building Code Official outlining special inspections and tests to be done on the project and frequency of required test.
- D. Soils Engineer or Geotechnical Engineer: For the purposes of Special Inspection "Soils Engineer," "Geotechnical Engineering," and "Special Inspector" shall be interchangeable as pertains to the Division 31 specifications.

## **SECTION 01 45 33 - SPECIAL INSPECTIONS AND TESTING PROGRAM**

E. NICET: National Institute for Certification in Engineering Technologies.

### **1.3 CONTRACTOR'S RESPONSIBILITIES**

- A. Cooperate with testing agency personnel, special inspector, and agents of the Building Code Official and provide access to the work.
  - 1. Providing access to the work shall include all labor and facilities to perform inspections and tests as listed in the specifications for the duration of the inspections or tests involved.
  - 2. Provide means to obtain and handle samples taken on site.
- B. Attend a pre-construction meeting to coordinate and clarify inspection and testing procedures, requirements.
- C. Notify special inspector and/or testing agency of work to be inspected/tested minimum of 24 hours prior.
- D. Work for which special inspections are required shall remain accessible and exposed for the purposes of special inspections until completion of required special inspections.
- E. Any portion of work that is not in conformance shall be corrected and re-inspected. Such portions of the work shall not be covered or concealed until authorized by Owner's Representative.
- F. Work to be inspected should be complete at time of inspector's arrival on-site.
- G. Payment for Special Inspection services will be in accordance with the following:
  - 1. Payment described below is for the Testing Agency and Special Inspector costs and does not include the Contractor's costs listed in Paragraph 1.3 A.
  - 2. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined in Item 4 below.
    - a. Inspection reveals work is satisfactory.
    - b. Owner pays all costs associated with this inspection.
  - 3. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined in Item 4 below.
    - a. Inspection reveals work is deficient.
    - b. Contractor corrects deficiencies within timeframe defined in Item 4) below.
    - c. Work is re-inspected and work is satisfactory.
    - d. Owner pays all costs associated with this inspection.
  - 4. After Contractor notification, inspector arrives at site and work is not ready for inspection when inspector arrives.
    - a. Inspector will remain on-site for a maximum of 2 hours awaiting the completion of the work.
    - b. If work is not ready for inspection at the end of this period, inspector will be dismissed until Contractor requests re-inspection.
    - c. All costs associated with this inspection trip will be charged to the Contractor.
  - 5. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined above.
    - a. Inspection reveals work is deficient.
    - b. Contractor attempts to correct deficiencies within 2 HR timeframe and calls for re-inspection.
    - c. Work is re-inspected and found to still be deficient.
    - d. Inspector will be dismissed.

## **SECTION 01 45 33 - SPECIAL INSPECTIONS AND TESTING PROGRAM**

- e. All costs associated with this inspection trip will be charged to the Contractor.
- 6. Owner will pay for "passing" soils on the Project. Costs of corrective actions and cost of failed test areas requiring retesting are the sole responsibility of the Contractor. For additional specific payment requirements for soils see the respective Division 31 Section.

H. Special Inspection is intended to be an independent quality assurance. Special Inspections shall not relieve the Contractor of any quality assurance, quality control, workmanship, or warranty responsibilities. Contractor's own personnel shall review all work to be inspected for conformance with Contract Documents prior to calling for inspection.

### **1.4 Reporting Duties and Authority**

- A. A pre-construction meeting to coordinate and clarify inspection, testing, and procedural requirements will be held per 01 series specifications.
  - 1. The meeting is to be attended by:
    - a. Owner.
    - b. Engineer.
    - c. Building Code Official or designee.
    - d. Testing Agency and Special Inspectors.
    - e. General Contractor.
    - f. Appropriate Sub-contractor(s).
- B. Special Inspector shall report all deficient work to the Contractor as soon as possible.
  - 1. Deficient work that has been covered up or concealed prior to re-inspection shall be reported to the Engineer and the Building Code Official.
- C. Special Inspector does not have authority to stop work or modify the requirements of the Contract Documents.

**PART 2 - PRODUCTS - (NOT USED)**

**PART 3 - EXECUTION - (NOT USED)**

**END OF SECTION 01 45 33**

**SECTION 01 45 33 - SPECIAL INSPECTIONS AND TESTING PROGRAM**

**ATTACHMENT A TO SECTION 01 45 33**  
**SUBMITTAL OF SPECIAL INSPECTIONS**

**Statement Date:** [ \_\_\_\_\_ ]

**Project Name:** [ \_\_\_\_\_ ]

**Project Address:** [ \_\_\_\_\_ ]

**Owner:** [ \_\_\_\_\_ ]

**Registered Design Professional in Responsible Charge (DPRC):** [ \_\_\_\_\_ ]

The Statement of Special Inspections (Statement) is submitted as a condition for permit issuance in accordance with the Special Inspection requirements of the Building Code. The Special Inspection program is outlined in Specification Section 01 45 33 and Attachments A and B. A detailed explanation of the requirements for Special Inspections and Testing can be found in specification Section 01 45 33 of the Project Manual in conjunction with the Technical Specifications for each material.

Monthly Special Inspection reports will be submitted to the DPRC and the Building Official. Discovered discrepancies will be brought to the immediate attention of the Contractor for correction. If the discrepancies are not corrected, the discrepancies will be brought to the attention of the DPRC and the Building Official. Only documents that are prepared and signed or sealed by the Special Inspectors (SI) are valid.

The SI is responsible for verifying all information on each document prior to signing or sealing and directly forwarding it to the DPRC and Building Official. The SI is responsible for verifying all inspectors under his supervision maintain current certifications during the course of the project. At the conclusion of each individual Special Inspection type, the SI will complete a Final Report.

The Special Inspection program does not relieve the Contractor or any other entity of any contractual duties, including quality control, quality assurance, or safety. The Contractor is solely responsible for construction means, methods, and job site safety. Failure to adhere to the SI program as outlined herein may result in a stop work notice being issued by the Building Official.

Respectfully submitted,  
Design Professional in Responsible Charge,

[ \_\_\_\_\_ ]  
Type or Print Name

License # [ \_\_\_\_\_ ]

Expires: [ \_\_\_\_\_ ]

Signature

\_\_\_\_\_  
Date

**END OF ATTACHMENT A**

# **SECTION 01 45 33 - SPECIAL INSPECTIONS AND TESTING PROGRAM**

## **ATTACHMENT B TO SECTION 01 45 33** **SPECIAL INSPECTIONS, INSPECTOR QUALIFICATIONS AND REPORTING** **REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.1 Summary**

- A. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Section 03 05 05 - Concrete Testing and Inspection.
  - 4. Section 04 22 00 - Concrete Masonry.
  - 5. Section 05 12 00 - Structural Steel.
  - 6. Division 31 - Earthwork.

#### **1.2 Qualifications**

- A. Qualifications stated here are the minimum recommended by the Engineer. If the Building Code Official has more stringent qualifications, the more stringent qualifications will take precedence.
- B. All Special Inspections and Testing to be done under the direction of a Professional Engineer or Registered Architect registered in the State of North Carolina herein referred to as Registered Professional for Special Inspections (RPSI).
- C. Soil, concrete, masonry, mortar, grout, steel and aluminum related testing.
  - 1. The Testing Agency shall have a minimum of 10 years experience in the testing of these materials.
  - 2. The Testing Agency's technician(s) conducting this testing:
    - a. Shall have a minimum of five years experience in the testing of soil, concrete, mortar, grout, steel and aluminum as appropriate.
  - 3. Concrete related work:
    - a. International Code Council certification for Reinforced Concrete and American Concrete Institute Concrete Field Testing Technician – Grade 1.
- D. Special Structural Inspections:
  - 1. Professional Engineers or Architects, licensed in the State of North Carolina, may perform special inspections in accordance with their license qualifications.
  - 2. Other individuals, working under the direct supervision of a licensed engineer and meeting the following qualifications, may perform special inspections.
  - 3. Soils related work:
    - a. NICET Level II Certification in geotechnical engineering technology/construction; or
    - b. Registered Geologist; or
    - c. Engineer Intern under the direct supervision of a Licensed Professional Engineer.
  - 4. Concrete related work:
    - a. International Code Council certification for Reinforced Concrete Special Inspector or American Concrete Institute Concrete Construction Special Inspector.
    - b. Alternatively, may be an Engineer Intern under the direct supervision of a Licensed Professional Engineer.

## **SECTION 01 45 33 - SPECIAL INSPECTIONS AND TESTING PROGRAM**

5. Masonry related work:
  - a. Shall be certified by the International Code Council or American Concrete Institute for structural masonry and one year of related experience.
  - b. Alternatively, may be an Engineer Intern with a minimum of two years appropriate training.
6. Steel and aluminum related work:
  - a. Frame and material verification IBC Table 1704.3, Items 3 and 6.:
  - b. Welding:
    - 1) American Welding Society as a Certified Welding Inspector; or
    - 2) International Code Council Structural Steel and Welding Certification and American Welding Society Qualified and one year of related experience; or
    - 3) NDT Level II or II Certificate (for non-destructive testing only).
  - c. High strength bolting:
    - 1) International Code Council Structural Steel and Welding Certification and one year related experience.
    - 2) Alternatively, may be an Engineer Intern with appropriate training.
7. Other equivalent certifications will not be acceptable unless approved by the Engineer.

### **1.3 Reporting Duties and Authority**

- A. Reporting requirements for special inspector per IBC 2015 for Building System Related Work.
  1. Comply with requirements of IBC Section 1704.1.2.
  2. Provide written documentation of all inspections and testing.
    - a. Include exact location of work.
    - b. If testing of specimens is included, include detailed information on storage and curing of specimens prior to testing.
  3. Furnish inspection and test reports to the Contractor, the Engineer's Project Manager and the Owner's on-site representative.
    - a. Indicate that work inspected was done in conformance with approved construction documents.
    - b. Immediately report any discrepancies to the Contractor for correction.
    - c. If the discrepancies are not corrected in a timely fashion, notify the Engineer's Project Manager and Owner's on-site representative.
  4. Issue an electronic report summarizing all inspections, corrective action notifications and resolution of discrepancies and non-conforming work every two weeks (14 calendar days).
    - a. Copy will be available to:
      - 1) Engineer's Project Manager.
      - 2) Owner.
      - 3) The Building Code Official.
      - 4) General Contractor.
  5. At the end of the Project, the RPSI shall compile all test reports for each inspected material and for each Special Inspector and summarize into a single PDF and submit to the Engineer and Building Code Official.
    - a. Final summary report to be signed and sealed by a Registered Professional for Special Inspections stating:
      - 1) The required Special Inspections have been performed.
      - 2) All discrepancies have been resolved except as specifically stated in the summary report.
- B. Special Inspector shall report all deficient work to the Contractor as soon as possible.
  1. Deficient work that has been covered up or concealed prior to re-inspection shall be reported to the Engineer and the Building Code Official.



## **SECTION 01 45 33 - SPECIAL INSPECTIONS AND TESTING PROGRAM**

- C. Special Inspector does not have authority to stop work or modify the requirements of the Contract Documents.

### **1.4 Material specific special inspections and tests**

- A. Material specific requirements for special inspection and testing are listed in the technical specifications listed below. Special inspection and testing requirements will be located in each appropriate technical specification under "SOURCE QUALITY CONTROL", "FIELD QUALITY CONTROL" and/or "QUALITY ASSURANCE" as appropriate for each material.

### **1.5 Soils**

- A. Special Inspection/testing will be provided per IBC Section 1704.7 and Table 1704.7 as required to determine that the site has been prepared in accordance with the approved soils report, and to verify the allowable soil bearing pressure, materials, compaction densities, trenching and backfill and conformance to the project Specifications.
- B. Inspection/testing requirements are listed separately in Specification Division 31 and are indicated as the work to be done by the Geotechnical Engineer, Testing Agency, or Special Inspections and Testing Provider.

### **1.6 Concrete**

- A. Special Inspection and testing will be provided per IBC Table 1704.4. Inspection is required for material verification, reinforcing steel, embedded bolts, mechanical splices, concrete tests, welding of reinforcing, concrete placement and curing, and waterstop placement.
- B. Inspection and testing requirements are listed separately in Specification Section 03 05 05 and are indicated as the work to be done by the Special Inspector or Testing Agency.

### **1.7 Masonry**

- A. Special Inspection and testing will be provided per IBC Table 1704.5.3 (Level 1). Inspection is required for material tests and verification, reinforcing steel, embedded bolts and anchorage, grout placement, and welding of reinforcing.
- B. Inspection/testing requirements are listed separately in Specification Section 04 22 00 and are indicated as the work to be done by the Special Inspector.

### **1.8 Steel, Stainless steel, and Aluminum**

- A. Special Inspection will be provided for structural steel and aluminum per IBC Section 1704.2, 1704.3 and Table 1704.3. Inspection is required for material verification, high-strength bolting, welding and other work noted on the Contract Documents.
- B. Inspection/testing requirements are listed separately in Section 05 12 00 and Section 05 50 00 and are indicated as the work to be done by the Special Inspector. Inspection requirements listed are applicable to aluminum, stainless steel, and structural steel.

**SECTION 01 45 33 - SPECIAL INSPECTIONS AND TESTING PROGRAM**

**PART 2 - PRODUCTS - (NOT USED)**

**PART 3 - EXECUTION - (NOT USED)**

**END OF ATTACHMENT B**

## Statement of Special Inspections

---

Project: City of Concord, Fleet Services Facility  
 Location: 605 Alfred Brown Jr Court SW, Concord, NC 28025  
 Owner's Representative: Jacklyn Deal  
 Owner's Address: 850 Alred Brown Jr Court SW, Concord, NC 28025

This Statement of Special Inspections is submitted as a condition for permit issuance in accordance with the Special Inspection requirements of the 2018 North Carolina State Building Code. It includes a Schedule of Special Inspection Services applicable to this project, the name of the Special Inspector, the identity of other approved agencies retained for conducting Special Inspections, and the required inspector qualifications. This Statement of Special Inspections was prepared by the following Designers of Record:

Structural	Jason Cooksey, PE	(Signature)	(Date)
	(Type or print name)		
Architectural		(Signature)	(Date)
	(Type or print name)		
Mechanical		(Signature)	(Date)
	(Type or print name)		
Other		(Signature)	(Date)
	(Type or print name)		

The Special Inspector shall keep records of all special inspections and tests and shall furnish reports to the State Construction Office and the Designers of Record. Reports shall indicate if the work inspected or tested was or was not completed in conformance with the approved construction documents. Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the State Construction Office and the Designers of Record. The Special Inspections program does not relieve the Contractor of his or her responsibilities.

Interim reports shall be submitted to the State Construction Office, Owner, and the Designers of Record.

Interim Report Frequency: Monthly

A Final Report of Special Inspections documenting completion of all required Special Inspections, testing, and correction of any discrepancies should be submitted prior to issuance of a Certificate of Use and Occupancy.

Job Site safety and means and methods of construction are solely the responsibility of the Contractor.

Owner's Authorization

Accepted for the SCO by:

\_\_\_\_\_  
Signature Date

\_\_\_\_\_  
Signature Date

## Schedule of Special Inspection Services<sup>a</sup>

The following sheets comprise the required schedule of special inspections for this project. The construction divisions which require special inspections for this project are as follows.

- |  |   |
|--|---|
| <input checked="" type="checkbox"/> Structural Steel & High Strength Bolting | <input type="checkbox"/> Helical Pile Foundations                     |
| <input checked="" type="checkbox"/> Welding of Structural Steel              | <input type="checkbox"/> Rammed Aggregate Piers & Stone Columns       |
| <input checked="" type="checkbox"/> Cold-Formed Steel Deck                   | <input type="checkbox"/> Sprayed Fire-Resistant Material              |
| <input checked="" type="checkbox"/> Open-Web Steel Joists & Joist Girders    | <input type="checkbox"/> Mastic & Intumescent Fire-Resistant Coatings |
| <input type="checkbox"/> Cold-Formed Steel Framing                           | <input type="checkbox"/> Exterior Insulation & Finish System          |
| <input checked="" type="checkbox"/> Concrete Construction                    | <input type="checkbox"/> Fire-Resistant Penetrations & Joints         |
| <input checked="" type="checkbox"/> Masonry Construction <sup>b</sup>        | <input type="checkbox"/> Smoke Control                                |
| <input type="checkbox"/> Wood Construction                                   | <input type="checkbox"/> Retaining Wall & Systems > 5 Feet            |
| <input checked="" type="checkbox"/> Soils                                    | <input type="checkbox"/> Special Inspections for Wind Resistance      |
| <input type="checkbox"/> Driven Deep Foundations                             | <input type="checkbox"/> Special Inspections for Seismic Resistance   |
| <input type="checkbox"/> Cast-in-Place Deep Foundations                      |   |

a. The inspection frequency indicated on the following inspection tables are "C" continuous, "P" periodic, & "O" random on a daily basis.

b. Level A is the minimum inspection program for empirically / prescriptively designed masonry in Risk Category I, II or III structures.

Level B is the minimum inspection program for empirically / prescriptively designed masonry in Risk Category IV structures and engineered masonry in Risk Category I, II or III structures. Level C is the minimum inspection program for engineered masonry in Risk Category IV structures. Engineered masonry structures are those designed in accordance with portions of the TMS 402-13 / ACI 530-13/ASCE 5-13 other than Part 4 or Appendix A.

Inspection Agents	Firm Name & Point of Contact	Address / Phone / E-mail
1. Special Inspector (SI-1)	TBD	
2. Testing Agency (TA-1)	TBD	
3. Testing Agency (TA-2)	TBD	
4. Geotechnical Engineer (GE-1)	TBD	
5. Other (O-1)	TBD	

Note: The inspection and testing agent(s) shall be engaged by the Owner or the Registered Design Professional of Record acting as the Owner's agent, and not by the Contractor or Subcontractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the State Construction Office, prior to commencing work.

Seismic Design Category:  A  B  C  D

Basic Wind Speed ( $V_{asd}$ ):  90-109mph  110-119mph   $\geq 120$ mph

Wind Exposure Category:  B  C  D

Schedule of Special Inspection Services

## Structural Steel and High-Strength Bolting

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			AISC 360	NCBC	
1. Fabricator Certification / Verification of Quality Control Procedures					
a. Verify fabricator qualifications	<input checked="" type="checkbox"/>	C		1704.2.5.1	
b. Review material test reports & certifications	<input checked="" type="checkbox"/>	C	N5.2		
c. Collect certificates of compliance from the steel fabricator at completion of fabrication	<input checked="" type="checkbox"/>	C		1704.5	
2. Inspections Prior to High-Strength Bolting at Pretensioned and Slip-Critical Joints					
a. Collect manufacturer's certifications for fastener materials	<input type="checkbox"/>	C	Table (Tbl) N5.6-1		
b. Fasteners are marked per ASTM requirements	<input type="checkbox"/>	P	Tbl N5.6-1		
c. Ensure correct fasteners and bolting procedures are selected for joint details	<input type="checkbox"/>	P	Tbl N5.6-1		
d. Verify connecting elements, including the appropriate faying surface condition and hole preparation when specified, comply with the construction documents	<input type="checkbox"/>	P	Tbl N5.6-1		
e. Observe and document pre-installation verification testing by installation personal for fastener assemblies and methods	<input type="checkbox"/>	P	Tbl N5.6-1		
f. Verify proper storage provided for all fastener components	<input type="checkbox"/>	P	Tbl N5.6-1		
3. Inspections During High-Strength Bolting at Pretensioned and Slip-Critical Joints					
a. Ensure correct fastener assemblies placed in all holes and washers, when specified, are positioned as required	<input type="checkbox"/>	P	Tbl N5.6-2		
b. Verify joint brought to snug-tight condition prior to pretensioning	<input type="checkbox"/>	P	Tbl N5.6-2		
c. Verify fastener components not turned by the wrench prevented from rotating	<input type="checkbox"/>	P	Tbl N5.6-2		
d. Ensure fasteners are pretensioned in accordance with RCSC, progressing from the most rigid point towards free edges	<input type="checkbox"/>	P	Tbl N5.6-2		
4. Document acceptance or rejection of bolted connections after high-strength bolting is complete	<input type="checkbox"/>	C	Tbl N5.6-3		
5. Structural Details					
a. Verify diameter, grade, type and length of anchor rods and other embedded items supporting structural steel	<input checked="" type="checkbox"/>	P	N5.7		
b. Inspection of fabricated assemblies & erected steel framing verifying compliance with the construction documents	<input checked="" type="checkbox"/>	P	N5.7		
6. Composite Construction					
a. Verify placement & installation of steel deck	<input type="checkbox"/>	P	Tbl N6.1		
b. Observe placement and installation of steel headed stud anchors			Tbl N6.1		
c. Document acceptance or rejection of composite construction elements	<input type="checkbox"/>	P	Tbl N6.1		

### Schedule of Special Inspection Services

## Welding of Structural Steel

Inspection Task	Task Req'd	Freq	Code Reference		Agent
			AISC 360	NCBC	
1. Inspections Prior to Welding			N5.4		
a. Collect & review welding procedure specification (WPS) and verify manufacturer certifications for welding consumables	<input checked="" type="checkbox"/>	C	Table (Tbl) N5.4-1		
b. Confirm weld material type & grade	<input checked="" type="checkbox"/>	P	Tbl N5.4-1		
c. Confirm method of welder identification	<input checked="" type="checkbox"/>	P	Tbl N5.4-1		
d. Inspection of fit-up for groove & fillet welds including access hole configuration & finish	<input checked="" type="checkbox"/>	P	Tbl N5.4-1		
2. Inspections During Welding			N5.4		
a. Verify welder qualifications	<input checked="" type="checkbox"/>	P	Tbl N5.4-2		
b. Verify proper control and handling of welding consumables	<input checked="" type="checkbox"/>	P	Tbl N5.4-2		
c. Monitor environmental conditions	<input checked="" type="checkbox"/>	P	Tbl N5.4-2		
d. Monitor proper implementation of WPS	<input checked="" type="checkbox"/>	P	Tbl N5.4-2		
e. Inspection of welding techniques including no welding over cracked tack welds	<input checked="" type="checkbox"/>	P	Tbl N5.4-2		
3. Inspections After Welding			N5.4, N5.5		
a. Verify welds have been cleaned	<input checked="" type="checkbox"/>	P	Tbl N5.4-3		
b. Confirm the installed size, length and location of welds matches the contract documents	<input checked="" type="checkbox"/>	C	Tbl N5.4-3		
c. Verify welds meet visual acceptance criteria	<input checked="" type="checkbox"/>	C	Tbl N5.4-3		
d. Confirm arc strikes comply with Part 5.28 of AWS D1.1	<input checked="" type="checkbox"/>	C	Tbl N5.4-3		
e. Visually observe web k-area for cracks within 3" of welded doubler plates, continuity plates and stiffeners	<input checked="" type="checkbox"/>	C	Tbl N5.4-3		
f. Backing and weld tabs removed per contract documents	<input checked="" type="checkbox"/>	C	Tbl N5.4-3		
g. Observe and inspect weld repair activities	<input checked="" type="checkbox"/>	C	Tbl N5.4-3		
h. For Risk Category III or IV structures, conduct ultrasonic testing (UT) of CJP groove welds in materials $\geq 5/16"$ at butt, T- and corner joints subject to transversely applied tension loading	<input type="checkbox"/>	C	N.5.5b, N5.5e		
i. For Risk Category II structures, conduct ultrasonic testing (UT) of CJP groove welds in materials $\geq 5/16"$ at butt, T- and corner joints subject to transversely applied tension loading	<input checked="" type="checkbox"/>	P	N.5.5b, N5.5f		
j. Conduct magnetic particle testing (MT) or liquid penetrant testing (PT) at thermally cut surfaces of access holes for rolled section with $t_f > 2"$ and built-up shape with $t_w > 2"$	<input type="checkbox"/>	C	N5.5c		
k. Radiographic or ultrasonic inspection at joints subject to fatigue	<input checked="" type="checkbox"/>	C	N5.5d, Tbl A-3.1		
l. Document acceptance / rejection of welded joints and members	<input checked="" type="checkbox"/>	C	Tbl N5.4-3, N5.5g		

Schedule of Special Inspection Services  
**Cold-Formed Steel Deck**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			SDI QA/QC	NCBC	
1. Prior to deck placement, verify deck and deck accessories comply with the construction documents	<input checked="" type="checkbox"/>	C	Table (Tbl) 1.1		
2. Inspection Tasks After Deck Placement					
a. Verify the installation of deck & deck accessories complies with the construction documents	<input checked="" type="checkbox"/>	C	Tbl 1.2		
b. Verify that deck materials' mill certifications comply with the construction documents	<input checked="" type="checkbox"/>	C	Tbl 1.2		
3. Inspection Tasks Prior to Deck Welding					
a. Collect welding procedure specification (WPS)	<input checked="" type="checkbox"/>	P	Tbl 1.3		
b. Collect manufacturer certifications for welding consumables	<input checked="" type="checkbox"/>	P	Tbl 1.3		
c. Verify material type and grade	<input checked="" type="checkbox"/>	P	Tbl 1.3		
d. Check welding equipment	<input checked="" type="checkbox"/>	P	Tbl 1.3		
4. Inspection Tasks During Deck Welding					
a. Verify welder qualifications	<input checked="" type="checkbox"/>	P	Tbl 1.4		
b. Verify proper control and handling of welding consumables	<input checked="" type="checkbox"/>	P	Tbl 1.4		
c. Monitor environmental conditions	<input checked="" type="checkbox"/>	P	Tbl 1.4		
d. Monitor proper implementation of WPS	<input checked="" type="checkbox"/>	P	Tbl 1.4		
5. Inspection Tasks After Welding					
a. Verify size and location of welds, including support, sidelap and perimeter welds	<input checked="" type="checkbox"/>	C	Tbl 1.5		
b. Verify welds meet visual acceptance criteria	<input checked="" type="checkbox"/>	C	Tbl 1.5		
c. Observe weld repair activities	<input checked="" type="checkbox"/>	C	Tbl 1.5		
6. Inspection Tasks Prior to Mechanical Fastening					
a. Verify manufacturer installation instructions available for mechanical fasteners	<input checked="" type="checkbox"/>	P	Tbl 1.6		
b. Proper tools available for fastener installation	<input checked="" type="checkbox"/>	P	Tbl 1.6		
c. Verify proper storage of mechanical fasteners	<input checked="" type="checkbox"/>	P	Tbl 1.6		
7. Inspection Tasks During Mechanical Fastening					
a. Observe fastener spacing and position	<input checked="" type="checkbox"/>	P	Tbl 1.7		
b. Verify fasteners are installed in accordance with manufacturer's instructions	<input checked="" type="checkbox"/>	P	Tbl 1.7		
8. Inspection Tasks After Mechanical Fastening					
a. Check spacing, type and installation of support fasteners	<input checked="" type="checkbox"/>	C	Tbl 1.8		
b. Check spacing, type, and installation of sidelap fasteners	<input checked="" type="checkbox"/>	C	Tbl 1.8		
c. Check spacing, type, and installation of perimeter fasteners	<input checked="" type="checkbox"/>	C	Tbl 1.8		
d. Verify repair activities	<input checked="" type="checkbox"/>	C	Tbl 1.8		
9. Document acceptance or rejection of deck & deck accessories for all phases of construction	<input checked="" type="checkbox"/>	C	Tbls 1.1 thru 1.8		

Schedule of Special Inspection Services  
**Open-Web Steel Joists and Joist Girders**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			Standard	NCBC	
1. Fabricator Certification / Verification of Quality Control Procedures					
a. Verify fabricator qualifications	<input checked="" type="checkbox"/>	C		1704.2.5.1	
b. Collect certificate of compliance from steel joist producer at completion of manufacture	<input checked="" type="checkbox"/>	C		1704.5, 2207.5	
2. Observe bolted and welded joist end connections	<input checked="" type="checkbox"/>	P	SJI-K 5.3, 5.6, SJI-LH/DLH 104.4, 104.7, SJI-JG 1004.4, 1004.6, SJI-CJ 104.4, 104.7	Table (Tbl) 1705.2.3	
3. Verify size, spacing and connection of standard horizontal and diagonal bridging	<input checked="" type="checkbox"/>	P	SJI-K 5.4, SJI-LH/DLH 104.5, SJI-JG 1004.5, 1004.9, SJI-CJ 104.5	Tbl 1705.2.3	
4. Verify size, spacing and connection of bridging that differs from the SJI specifications listed by Part 2207.1 of the NCBC	<input checked="" type="checkbox"/>	P		Tbl 1705.2.3	



Schedule of Special Inspection Services  
**Cold-Formed Steel Framing**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			Standard	NCBC	
1. Fabricator Certification / Verification of Quality Control Procedures					
a. Verify fabricator qualifications	<input type="checkbox"/>	C		1704.2.5.1	
b. Collect certificates of compliance from the steel fabricator at completion of fabrication	<input type="checkbox"/>	C		1704.5	
2. For trusses clear spanning 60 feet or more, verify that both temporary and permanent restraints and braces are installed in accordance with the approved truss submittal package.	<input type="checkbox"/>	P		1705.2.4	

## Schedule of Special Inspection Services Concrete Construction

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			Standard <sup>a</sup>	NCBC	
1. Inspect reinforcement, including prestressing tendons, and verify placement	<input checked="" type="checkbox"/>	P	ACI Ch.20, 25.2, 25.3, 26.6.1- 26.6.3	1908.4	
2. Reinforcing Bar Welding:			AWS D1.4		
e. Verify weldability of reinforcing bars other than ASTM A706 and collect reports	<input type="checkbox"/>	P	ACI 26.6.4	1704.5	
f. Inspect single-pass fillet welds $\leq 5/16$ "	<input type="checkbox"/>	P	ACI 26.6.4		
g. Inspect all welds other than single-pass fillet welds $\leq 5/16$ "	<input type="checkbox"/>	C	ACI 26.6.4		
3. Concrete Anchors:					
a. Inspect anchors cast in concrete	<input checked="" type="checkbox"/>	P	ACI 17.8.2		
b. Inspect adhesive anchors installed in hardened concrete with horizontally or upwardly inclined orientations that resist sustained tension loads	<input checked="" type="checkbox"/>	C	ACI 17.8.2.4		
c. Inspect adhesive anchors installed in hardened concrete with orientations different from Item 3.b	<input checked="" type="checkbox"/>	P	ACI 17.8.2		
d. Inspect mechanical anchors installed in hardened concrete	<input checked="" type="checkbox"/>	P	ACI 17.8.2		
4. Collect mix designs and verify the correct mix used during installation	<input checked="" type="checkbox"/>	P	ACI Ch19, 26.4.3, 26.4.4	1904.1, 1904.2, 1908.2, 1908.3	
5. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete	<input checked="" type="checkbox"/>	C	ASTM C172, ASTM C31, ACI 26.4, 26.12	1908.10	
6. Inspect concrete and shotcrete placement for proper application techniques	<input checked="" type="checkbox"/>	C	ACI 26.5	1908.6, 1908.7, 1908.8	
7. Collect reports of preconstruction tests for shotcrete when preconstruction tests are required by NCBC Section 1908.4	<input checked="" type="checkbox"/>	C		1704.5, 1908.5	
8. Verify maintenance of specified curing temperature and techniques	<input checked="" type="checkbox"/>	P	ACI 26.5.3- 26.5.5	1908.9	
9. Inspections for prestressed concrete					
a. Observe application of prestressing force	<input type="checkbox"/>	C	ACI 26.10		
b. Inspect grouting of bonded prestressing tendons	<input type="checkbox"/>	C	ACI 26.10		
10. Verify concrete strength prior to stressing of PT tendons and prior to removal of shores and forms from PT & mild beams and structural slabs	<input type="checkbox"/>	P	ACI 26.11.2		
11. Inspect erection of precast members	<input type="checkbox"/>	P	ACI 26.8		
12. Inspect formwork for shape, location and dimensions of the concrete member being formed	<input type="checkbox"/>	P	ACI 26.11.1.2(b)		
13. Collect mill test reports for ASTM A615 rebar used by SFRS special moment frames, special structural walls or coupling beams	<input type="checkbox"/>	C	ACI 20.2.2.5	1704.5	

a. References to "ACI" in this table are to the ACI 318-14.

Schedule of Special Inspection Services  
**Masonry – Level A**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			TMS 402 <sub>a</sub>	TMS 602 <sub>a</sub>	
1. Prior to construction, verify certificates of compliance used in masonry construction	<input checked="" type="checkbox"/>	P	Table 3.1.1	Art. 1.5	

a. References to "TMS402" in this table are to the TMS402/ACI530/ASCE5-13. References to "TMS602" are to TMS602/ACI530.1/ASCE6-13.

Schedule of Special Inspection Services  
**Masonry – Level B**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			TMS 402 <sub>a</sub>	TMS 602 <sub>a</sub>	
1. Test & verify slump flow & visual stability index as delivered to site for self-consolidating grout	<input type="checkbox"/>	C	Table (Tbl) 3.1.2	Art. 1.5B.1.b.3	
2. Test & verify f'm & f <sup> AAC</sup> prior to construction	<input type="checkbox"/>	C	Tbl 3.1.2	Art. 1.4B	
3. Verify compliance with the approved submittals	<input type="checkbox"/>	P	Tbl 3.1.2	Art. 1.5	
4. As masonry construction begins, verify that the following are in compliance:					
a. Proportions of site-prepared mortar	<input type="checkbox"/>	P		Art. 2.1, 2.6A	
b. Construction of mortar joints	<input type="checkbox"/>	P		Art. 3.3B	
c. Grade and size of prestressing tendons and anchorages	<input type="checkbox"/>	P		Art. 2.4B, 2.4H	
d. Location of reinforcement, connectors and prestressing tendons and anchorages	<input type="checkbox"/>	P		Art. 3.4, 3.6A	
e. Prestressing technique	<input type="checkbox"/>	P		Art. 3.6B	
f. Properties of thin-bed mortar at AAC masonry	<input type="checkbox"/>	C / P <sub>b</sub>		Art. 2.1C	
5. Prior to grouting, verify that the following comply:					
a. Grout space is clean, and cleanouts provided when required	<input type="checkbox"/>	P		Art. 3.2D, 3.2F	
b. Grade, type & size of reinforcement & anchor bolts, & prestressing tendons & anchorage	<input type="checkbox"/>	P	Sec. 6.1	Art. 2.4, 3.4	
c. Placement of reinforcement, connectors, and prestressing tendons and anchorage	<input type="checkbox"/>	P	Sec. 6.1, 6.2.1, 6.2.6, 6.2.7	Art. 3.2E, 3.4, 3.6A	
d. Proportions of site-prepared grout and prestressing grout for bonded tendons	<input type="checkbox"/>	P		Art. 2.6B, 2.4G.1.b	
e. Construction and size of mortar joints	<input type="checkbox"/>	P		Art. 3.3B	
6. Verify during construction:					
a. Size and location of structural elements	<input type="checkbox"/>	P		Art. 3.3F	
b. Type, size, and location of anchors, including other details of anchorage of masonry to structural members, frames, or other construction	<input type="checkbox"/>	P	Sec. 1.2.1(e), 6.1.4.3, 6.2.1		
c. Welding of reinforcement	<input type="checkbox"/>	C	Sec. 8.1.6.7.2, 9.3.3.4(c), 11.3.3.4(b)		
d. Preparation, construction, and protection of masonry during cold weather (temperature < 40°F) or hot weather (temperature > 90°F)	<input type="checkbox"/>	P		Art. 1.8C, 1.8D	
e. Application & measurement of prestress force	<input type="checkbox"/>	C		Art. 3.6B	
f. Verify placement of grout and prestressing grout for bonded tendons	<input type="checkbox"/>	C		Art. 3.5, 3.6C	
g. Placement of AAC masonry units and construction of thin-bed mortar joints	<input type="checkbox"/>	C / P <sub>b</sub>		Art. 3.3B.9, 3.3F.1.b	
7. Observe preparation of grout specimens, mortar specimens, and or prisms	<input type="checkbox"/>	P		Art. 1.4.B.2.a.3, 1.4.B.2.b.3, 1.4.B.2.c.3, 1.4.B.3, 1.4.B.4	

- a. References to "TMS402" in this table are to the TMS402/ACI530/ASCE5-13. References to "TMS602" are to TMS602/ACI530.1/ASCE6-13.  
b. AAC masonry shall be continuously inspected for the first 5000-square feet and periodically inspected afterwards.

Schedule of Special Inspection Services  
**Masonry – Level C**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			TMS 402 <sub>a</sub>	TMS 602 <sub>a</sub>	
1. Test & verify $f'_m$ & $f'_{AAC}$ prior to construction & for every 5,000 square feet during construction	<input type="checkbox"/>	C	Table (Tbl) 3.1.3	Art. 1.5	
2. Test & verify proportions of materials in premixed / preblended mortar, prestressing grout, and grout other than self-consolidating, as delivered to site	<input type="checkbox"/>	C	Tbl 3.1.3		
3. Test & verify slump flow & visual stability index as delivered to site for self-consolidating grout	<input type="checkbox"/>	C	Tbl 3.1.3	Art. 1.5B.1.b.3	
4. Verify compliance with the approved submittals	<input type="checkbox"/>	P	Tbl 3.1.3	Art. 1.5	
5. Verify that the following are in compliance:					
a. Proportions of site-mixed mortar, grout and prestressing grout for bonded tendons	<input type="checkbox"/>	P		Art. 2.1, 2.6A, 2.6B, 2.6C, 2.4G.1.b	
b. Grade, type, & size of reinforcement & anchor bolts, & prestressing tendons & anchorage	<input type="checkbox"/>	P	Sec 6.1	Art. 2.4, 3.4	
c. Placement of masonry units and construction of mortar joints	<input type="checkbox"/>	P		Art. 3.3B	
d. Placement of reinforcement, connectors, and prestressing tendons and anchorages	<input type="checkbox"/>	C	Sec 6.1, 6.2.1, 6.2.6, 6.2.7	Art. 3.2E, 3.4, 3.6A	
e. Grout space is clean, and cleanouts provided when required	<input type="checkbox"/>	C		Art. 3.2D, 3.2F	
f. Placement of grout and prestressing grout for bonded tendons	<input type="checkbox"/>	C		Art. 3.5, 3.6C	
g. Size and location of structural elements	<input type="checkbox"/>	P		Art. 3.3F	
h. Type, size, and location of anchors including other details of anchorage of masonry to structural members, frames, or other construction	<input type="checkbox"/>	C	Sec. 1.2.1(e), 6.1.4.3, 6.2.1		
i. Welding of reinforcement	<input type="checkbox"/>	C	Sec 8.1.6.7.2, 9.3.3.4(c), 11.3.3.4(b)		
j. Preparation, construction, and protection of masonry during cold weather (temperature < 40°F) or hot weather (temperature > 90°F)	<input type="checkbox"/>	P		Art. 1.8C, 1.8D	
k. Application and measurement of prestressing force	<input type="checkbox"/>	C		Art. 3.6B	
l. Placement of AAC masonry units and construction of thin-bed mortar joints	<input type="checkbox"/>	C		Art. 3.3B.9, 3.3F.1.b	
m. Properties of thin-bed mortar for AAC masonry	<input type="checkbox"/>	C		Art. 2.1C.1	
6. Observe preparation of grout specimens, mortar specimens, and or prisms	<input type="checkbox"/>	C		Art. 1.4B.2.a.3, 1.4B.2.b.3, 1.4B.2.c.3, 1.4B.3, 1.4B.4	

a. References to "TMS402" in this table are to the TMS402/ACI530/ASCE5-13. References to "TMS602" are to TMS602/ACI530.1/ASCE6-13.

Schedule of Special Inspection Services  
**Wood Construction**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			Standard	NCBC	
1. Fabricator certification / verification of quality control procedures for prefabricated wood structural elements and assemblies					
a. Verify fabricator qualifications	<input type="checkbox"/>	C		1704.2.5.1, 1705.5	
b. Collect certificates of compliance from the fabricator at completion of fabrication	<input type="checkbox"/>	C		1704.5, 1705.5	
2. High-load diaphragms				2306.2	
a. Verify that wood structural panel sheathing is the correct grade and thickness	<input type="checkbox"/>	P		1705.5.1	
b. Verify nominal size of framing members and blocking at adjoining panel edges	<input type="checkbox"/>	P	AWC-SDPWS 4.2.7.1.2	1705.5.1	
c. Nail and or staple diameter, length, quantity and spacing comply with the contract documents	<input type="checkbox"/>	P		1705.5.1	
3. For metal-plate-connected trusses clear spanning 60 feet or more, verify that both temporary and permanent restraints and braces are installed in accordance with the approved truss submittal package	<input type="checkbox"/>	P		1705.5.2	

Schedule of Special Inspection Services  
**Soils**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agents
			Standard	NCBC	
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity	<input checked="" type="checkbox"/>	P		1705.6	
2. Verify excavations extend to proper depth and have reached the correct soil material	<input checked="" type="checkbox"/>	P		1705.6	
3. Perform classification and testing of compacted fill materials	<input checked="" type="checkbox"/>	P		1705.6	
4. Verify that materials used, densities, lift thickness and procedures used during placement and compaction of compacted fill are in accordance with the approved soils report and the construction documents	<input checked="" type="checkbox"/>	C		1705.6	
5. Prior to placement of compacted fill, verify that the subgrade has been prepared in accordance with the approved soils report and the construction documents	<input checked="" type="checkbox"/>	P		1705.6	

**Schedule of Special Inspection Services**  
**Driven Deep Foundations** a b c

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agents
			Standard	NCBC	
1. Verify that deep foundation materials, sizes and lengths comply with the construction documents	<input type="checkbox"/>	C		1705.7	
2. Observe pile load tests and determine capacities of test elements ensuring compliance with the construction documents.	<input type="checkbox"/>	C		1705.7	
3. Inspect driving operations and maintain complete and accurate records for each element	<input type="checkbox"/>	C		1705.7	
4. Verify placement, location, plumbness, hammer size and type, blow count per foot of penetration, required penetrations to achieve design capacity, tip and butt elevations, damage and anomalies	<input type="checkbox"/>	C		1705.7	

- a. For steel elements, perform additional inspections in accordance with Section 1705.2 of the North Carolina Building Code and the applicable Schedules included herein
- b. For concrete elements and concrete-filled elements, perform additional inspections in accordance with Section 1705.3 of the North Carolina Building Code and the applicable Schedules included herein
- c. For specialty elements, perform additional inspections as determined by the registered design professional in responsible charge and the applicable Schedules included herein



Schedule of Special Inspection Services  
**Cast-in-Place Deep Foundations** <sup>a</sup>

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agents
			Standard	NCBC	
1. Observe drilling operations and maintain complete and accurate records	<input type="checkbox"/>	C		1705.8	
2. Verify deep foundation materials comply with the construction documents	<input type="checkbox"/>	C		1705.8	
3. Verify pile placement, location, plumbness, diameters, bell diameter (if applicable), lengths, rock embedment, end-bearing strata capacity, and anomalies	<input type="checkbox"/>	C		1705.8	
4. Record concrete or grout volumes	<input type="checkbox"/>	C		1705.8	

a. For concrete elements and concrete-filled elements, perform additional inspections in accordance with Section 1705.3 of the North Carolina Building Code and the applicable Schedules included herein

Schedule of Special Inspection Services  
**Helical Pile Foundations**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agents
			Standard	NCBC	
1. Confirm the following are in compliance with the construction documents prepared by the registered design professional in responsible charge: The installation equipment used, pile dimension, pile placement location, tip elevations, final depth, and final installation torque	<input type="checkbox"/>	C		1705.9	

Schedule of Special Inspection Services  
**Rammed Aggregate Piers & Stone Columns**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			Standard	NCBC	
1. Verify that the pier installation program and soil parameters are in accordance with the approved soils report and the construction documents	<input type="checkbox"/>	C		1705.1.1	
2. During installation, verify the aggregate properties, type and number of lifts of aggregate, pier size, installed depth, top elevation and applied ram energy	<input type="checkbox"/>	P		1705.1.1	
3. Review the modulus load testing, uplift pull-out testing, bottom or crowd stabilization tests and dynamic cone penetration test results from production pier elements and verify that all comply with the design specifications	<input type="checkbox"/>	C		1705.1.1	

Schedule of Special Inspection Services  
**Sprayed Fire-Resistant Materials** <sup>a</sup>

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			Standard	NCBC	
4. Prior to the application of sprayed on fire resistant materials, verify structural member surfaces are prepared in accordance with the approved fire-resistance design and the written instructions of the approved manufacturer	<input type="checkbox"/>	P		1705.14.2	
5. During the application of sprayed on fire resistant materials, verify that the following are in compliance:					
a. Substrate has minimum ambient temperature before and after application as specified by the fire resistance design and approved manufacturer's written instructions	<input type="checkbox"/>	P		1705.14.3	
b. Work area properly ventilated during and after application				1705.14.3	
c. Thickness of sprayed on material conforms with the approved fire resistance design and NCBC minimums	<input type="checkbox"/>	P		1705.14.4, 1705.14.4.4, 1705.14.4.5, 1705.14.4.6, 1705.14.4.7, 1705.14.4.8, 1705.14.4.9	
d. The density of sprayed on materials is not less than the requirements of the approved fire-resistance design	<input type="checkbox"/>	P		1705.14.5	
e. The cohesive / adhesive bond strength is not less than 150 pounds per square foot	<input type="checkbox"/>	P		1705.14.6	

a. Inspections shall be performed after the rough installation of electrical, automatic sprinkler, mechanical and plumbing systems, and suspension systems for ceilings.

Schedule of Special Inspection Services  
**Mastic and Intumescent Fire-Resistant Coatings**

Inspection Task	Task Req'd	Freq <sup>(a)</sup>	Reference for Criteria		Agents
			Standard	NCBC	
1. Prior to application, verify preparation of substrate and suitability of primers, if present, are in accordance with approved fire resistance design, approved manufacturer's written instructions, and the requirements of AWCI 12-B	<input type="checkbox"/>	P	AWCI 12-B	1705.15	
2. Observe the application of fire-resistant coatings ensuring compliance with approved fire resistance design, approved manufacturer's written instructions, and the requirements of AWCI 12-B	<input type="checkbox"/>	P	AWCI 12-B	1705.15	
3. After adequate drying but prior to the application of any topcoat, measure the final mastic / intumescent material thickness ensuring compliance with the construction documents and approved material / installation submittals. Measurements must consider the thickness of primers or other existing coatings on the surface of the substrate.	<input type="checkbox"/>	P	AWCI 12-B	1705.15	

Schedule of Special Inspection Services  
**Exterior Insulation and Finish Systems (EIFS)**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			Standard	NCBC	
1. Verify that EIFS is installed in conformance with project specifications	<input type="checkbox"/>	P		1705.16	
2. If a water resistive barrier coating complying with ASTM E2570 is installed over a sheathing substrate, verify that the water-barrier and drainage strip are installed in conformance with the project specifications.	<input type="checkbox"/>	P		1705.16.1	

Schedule of Special Inspection Services  
**Fire-resistant Penetrations and Joints** <sup>a</sup>

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			Standard	NCBC	
1. Inspect through-penetration firestop systems at fire walls, fire barriers, smoke barriers and fire partition walls in accordance with ASTM E2174	<input type="checkbox"/>	P		1705.17.1, 714.3.1.2	
2. Inspect penetration firestop systems at penetrations through membranes that are part of a horizontal assembly in accordance with ASTM E2174	<input type="checkbox"/>	P		1705.17.1, 714.4.2	
3. Inspect fire-resistant joint systems in accordance with ASTM 2393	<input type="checkbox"/>	P		1705.17.2, 715.3, 715.4	

a. The inspection of fire-resistant penetrations and joints applies only to high-rise buildings or buildings assigned to Risk Category III or IV.

Schedule of Special Inspection Services  
**Retaining Walls Exceeding 5 Feet** <sub>a b c d</sub>

Inspection Task	Task Req'd	Freq <sup>(a)</sup>	Reference for Criteria		Agent
			Standard	NCBC	
1. Foundation support system is adequate for the intended site conditions	<input type="checkbox"/>	P		1807.2.5.1	
2. Verify that retaining wall materials and installations are in compliance with the construction documents	<input type="checkbox"/>	P		1807.2.5.2	
3. Verify that actual soil conditions are similar to those anticipated by the approved engineered design	<input type="checkbox"/>	P		1807.2.5.3	
4. Examination of backfill materials for compliance with the approved specifications	<input type="checkbox"/>	P		1807.2.5.4	
5. Confirm that all subsoil drainage piping is undamaged, drains freely to the designated outlet or structure, and has been installed per the approved engineered design	<input type="checkbox"/>	P		1807.2.5.4	

a. All retaining walls exceeding 5 feet in height require special inspections.

b. For concrete retaining walls and footings, perform additional inspections in accordance with Section 1705.3 of the North Carolina Building Code and the applicable Schedules included herein

c. For masonry retaining walls, perform additional inspections in accordance with Section 1705.4 of the North Carolina Building Code and the applicable Schedules included herein

d. For soils, perform additional inspections in accordance with Section 1705.6 of the North Carolina Building Code and the applicable Schedules included herein



Schedule of Special Inspection Services  
**Smoke Control**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			Standard	NCBC	
1. During erection of ductwork and prior to concealment, perform leakage testing and record device location(s)	<input type="checkbox"/>	P		1705.18.1.1	
2. Upon completion of smoke control system, perform pressure difference testing, flow measurements, and detection and control verification	<input type="checkbox"/>	P		1705.18.1.2	

Schedule of Special Inspection Services  
**Special Inspections for Wind Resistance**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			Standard	NCBC	
1. Prior to any work taking place, each contractor responsible for the construction of a wind-resisting system or component shall submit a written statement of contractor responsibility	<input type="checkbox"/>	C		1704.4	
2. Structural Wood					
a. Verify field gluing operations pertinent to the main wind force-resisting system	<input type="checkbox"/>	C		1705.11.1	
b. Inspect nailing, anchoring, and fastening of components within the main windforce-resisting system including shear walls, diaphragms, drag struts, braces & hold-downs	<input type="checkbox"/>	P		1705.11.1	
3. Cold-Formed Steel Light Frame Construction					
a. Inspect welding operations at elements of the main windforce-resisting system	<input type="checkbox"/>	P		1705.11.2	
b. Inspect screw attachment, bolting, anchoring, and fastening of elements within the main windforce-resisting system including shear walls, braces, diaphragms collectors, drag struts and hold-downs	<input type="checkbox"/>	P		1705.11.2	
4. Wind-resisting components					
a. Inspect the fastening of roof covering, roof deck and supporting roof framing connections	<input type="checkbox"/>	P		1705.11.3.1	
b. Inspect the fastening of exterior wall coverings & the wall connections to the roof / floor diaphragms & framing members	<input type="checkbox"/>	P		1705.11.3.2	

Structural Wood and Cold-Formed Steel Light-Frame Construction Main Wind-Force Resisting System(s) Subject to Special Inspections:

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Roof Cladding Components and Connections Subject to Special Inspections:

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Wall Cladding Components and Connections Subject to Special Inspections:

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Schedule of Special Inspection Services  
**Special Inspections for Seismic Resistance**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			Standard	NCBC	
1. Prior to any work taking place, each contractor responsible for the construction of a seismic-resisting system or component shall submit a written statement of contractor responsibility	<input type="checkbox"/>	C		1704.4	
2. Structural Steel (see following tables)	<input type="checkbox"/>	O/C		1705.12.1	
3. Structural Wood					
a. Verify field gluing operations of elements of the seismic force-resisting system (SFRS)	<input type="checkbox"/>	C		1705.12.2.1	
b. Inspect nailing, bolting, anchoring & other fastening at elements of SFRS	<input type="checkbox"/>	P		1705.12.2.2	
4. Cold-Formed Steel Light Frame Construction					
a. Verify welding operations of elements of the SFRS	<input type="checkbox"/>	P		1705.12.3.1	
b. Inspect screw attachment, bolting, anchoring, & fastening used by SFRS	<input type="checkbox"/>	P		1705.12.3.2	
c. Inspect special bolted moment frames	<input type="checkbox"/>	P		1705.12.9	
5. Verify erection & fastening of exterior cladding, non-bearing walls and veneer	<input type="checkbox"/>	P		1705.12.5	
6. Confirm anchorage of access floors	<input type="checkbox"/>	P		1705.12.5.1	
7. Confirm anchorage of storage racks	<input type="checkbox"/>	P		1705.12.7	
8. Collect certificates of compliance for qualifying equipment, supports, attachments & components; verify correctness of labels & installation	<input type="checkbox"/>	C	ASCE7 13.2.2, 13.2.1	1705.12.4, 1705.13.2	
9. Plumbing, Mechanical, Electrical Components					
a. Verify anchorage of elec. equip for emergency & standby power systems	<input type="checkbox"/>	P		1705.12.6	
b. Verify installation & anchorage of pipe & duct systems carrying hazardous materials & associated mech units	<input type="checkbox"/>	P		1705.12.6	
c. Confirm the installation & anchorage of vibration isolation systems with nominal clearances $\leq \frac{1}{4}$ "	<input type="checkbox"/>	P		1705.12.6	
d. Inspect & test seismic isolation systems at seismic isolated structures	<input type="checkbox"/>	P	ASCE7 17.8	1705.12.8, 1705.13.4	

Seismic-Force Resisting System(s) subject to Special Inspections:

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Seismic-Resisting Components and Connections Subject to Special Inspections:

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Schedule of Special Inspection Services  
**Special Inspections for Seismic Resistance**  
**Structural Steel & High-Strength Bolting**

Inspection Task	Task Req'd	Freq <sub>a</sub>	Reference for Criteria		Agent
			AISC 341	NCBC	
1. Inspections Prior to Bolting					
a. Proper fasteners selected for the joint detail	<input checked="" type="checkbox"/>	O	Table J7-1		
b. Correct bolting procedure selected for joints	<input checked="" type="checkbox"/>	O	Table J7-1		
c. Faying surface condition, hole preparation, etc. meet applicable requirements for connecting elements		O	Table J7-1		
d. Pre-installation verification testing by installation personnel observed for fastener assemblies and methods used	<input checked="" type="checkbox"/>	O	Table J7-1		
e. Fastener components are stored properly	<input checked="" type="checkbox"/>	O	Table J7-1		
2. Inspection Tasks During Bolting					
a. Fastener assemblies placed in all holes and washers are positioned as required	<input checked="" type="checkbox"/>	O	Table J7-2		
b. Joint brought to "snug tight" prior to pretensioning operation	<input checked="" type="checkbox"/>	O	Table J7-2		
c. Fastener component not turned by the wrench prevented from rotating	<input checked="" type="checkbox"/>	O	Table J7-2		
d. Bolt pretensioning progresses systematically from the most rigid point toward the free edge	<input checked="" type="checkbox"/>	O	Table J7-2		
3. After bolting activities are complete, document accepted and rejected connections	<input checked="" type="checkbox"/>	C	Table J7-3		
4. Verify contour, finish and dimensional tolerances of reduced beam sections (RBS)	<input checked="" type="checkbox"/>	C	Table J8-1		
5. Ensure no holes or unapproved attachments made by fabricator or erector in protected zone	<input checked="" type="checkbox"/>	C	Table J8-1		
6. Inspection of Composite Structures Prior to Concrete Placement					
a. Verify reinforcing steel type and grade	<input checked="" type="checkbox"/>	O	Table J9-1		
b. Determine carbon equivalent for reinforcing steel other than ASTM A706	<input checked="" type="checkbox"/>	O	Table J9-1		
c. Verify reinforcing size, spacing & orientation	<input checked="" type="checkbox"/>	O	Table J9-1		
d. Verify reinforcing steel not re-bent in field	<input checked="" type="checkbox"/>	O	Table J9-1		
e. Reinforcing tied & supported as required	<input checked="" type="checkbox"/>	O	Table J9-1		
d. Required reinforcing clearances are provided	<input checked="" type="checkbox"/>	O	Table J9-1		
e. Composite member has required size	<input checked="" type="checkbox"/>	O	Table J9-1		
7. Inspection of Composite Structures During Concrete Placement					
a. Verify mix design, compressive strength, maximum aggregate size, maximum slump	<input type="checkbox"/>	O	Table J9-2		
b. Limits on water added at the truck or pump	<input type="checkbox"/>	O	Table J9-2		
c. Proper placement to limit segregation	<input type="checkbox"/>	O	Table J9-2		
8. After concrete placement of composite structures, verify specified f'c achieved at specified age	<input type="checkbox"/>	C	Table J9-3		

Schedule of Special Inspection Services  
**Special Inspections for Seismic Resistance**  
**Welding of Structural Steel**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			AISC 341	NCBC	
1. Visual Inspections Prior to Welding					
a. Verify type & grade of connection materials	☒	O	Table J6-1		
b. Welder identification system established	☒	O	Table J6-1		
c. Fit-up & joint geometry of groove welds <ul style="list-style-type: none"> <li>• Joint preparation</li> <li>• Dimensions including alignment, root opening, root face &amp; bevel</li> <li>• Cleanliness of steel surfaces</li> <li>• Tack weld quality &amp; location</li> <li>• Backing type &amp; fit</li> </ul>		O	Table J6-1		
d. Verify configuration & finish of access holes	☒	O	Table J6-1		
e. Inspect fit-up of fillet welds including dimensions, alignment, root gaps, cleanliness of steel surfaces, tack weld quality, and tack weld location	☒	O	Table J6-1		
2. Visual Inspection Tasks During Welding					
a. Verify welding procedure specification (WPS) followed: Settings on welding equipment, travel speed, welding materials selected, shielding gas type & flow rate, preheat applied, interpass temperature maintained, weld position (F, V, H, OH), and intermix of filler metals avoided unless approved by engineer of record	☒	O	Table J6-2		
b. Verify welder qualifications	☒	O	Table J6-2		
c. Control & handling of welding consumables, including packaging & exposure	☒	O	Table J6-2		
d. Environmental conditions, including wind speed, precipitation & temperature, within defined limits	☒	O	Table J6-2		
e. Verify welding techniques: Interpass & final cleaning, each pass within profile limitations, and each pass meets quality requirements	☒	O	Table J6-2		
f. No welding over cracked tack welds	☒	O	Table J6-2		
3. Visual Inspections Tasks After Welding					
g. Verify welds are cleaned	☒	O	Table J6-3		
h. Confirm correct weld size, length & location	☒	C	Table J6-3		
i. Welds meet visual acceptance criteria: Crack prohibition, weld/base-metal fusion, crater cross section, weld profiles and size, undercut & porosity	☒	C	Table J6-3		
j. Confirm placement of reinforcing or contouring fillet welds	☒	C	Table J6-3		
k. Verify backing removed, weld tabs removed & finished, and fillet welds added	☒	C	Table J6-3		
l. Observe repair activities	☒	C	Table J6-3		

Schedule of Special Inspection Services  
**Special Inspections for Seismic Resistance**  
**Non-Destructive Testing (NDT) of Welded Joints**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			AISC 341	Standard	
1. Web base metal tested for cracks using magnetic particle testing (MT) when doubler plates, continuity plates or stiffeners are welded in the k-area. MT inspection shall include k-area metal within 3" of the weld and be performed $\geq$ 48hours	<input type="checkbox"/>	C	Part J6.2a		
2. Inspect complete Joint Penetration (CJP) Groove Welds in materials $\geq$ 5/16" thick					
a. Ultrasonic testing (UT) performed on 100% of CJP groove welds except for ordinary moment frames for which only <i>demand critical welds</i> need be tested	<input type="checkbox"/>	C	Part J6.2b, J6.2g	AWS D1.1 Table 6.2	
b. MT performed on 25% of beam-to-column CJP groove welds except for ordinary moment frames for which only <i>demand critical welds</i> need be tested	<input type="checkbox"/>	P	Part J6.2b, J.6.2h		
c. At the end of welds where weld tabs have been removed (excluding continuity plate weld tabs), MT performed on 100% of beam-to-column joints receiving UT in accordance with Item 2.a above	<input type="checkbox"/>	C	Part J6.2f, J.6.2h		
3. UT check for base metal lamellar tearing & laminations at base metal thickness $\geq$ 1½" loaded in tension in through-thickness direction in tee & corner joints where connected material is $\geq$ ¾" and contains CJP groove welds	<input type="checkbox"/>	C	Part J6.2c	AWS D1.1 Table 6.2	
4. At welded splices & connections, MT or penetrant testing performed at thermally cut surfaces of beam copes and access holes when flange thickness > 1½" (rolled shapes) or web thickness > 1½" (built-up shape)	<input type="checkbox"/>	C	Part J6.2d		
5. MT performed on welds & adjacent areas of reduced beam section (RBS) cut surface repaired by welding or on base metal of RBS cut surfaces if a sharp notch was removed by grinding	<input type="checkbox"/>	C	Part J6.2e		

Schedule of Special Inspection Services  
**Special Inspections for Seismic Resistance**  
**Steel H-Piles**

Inspection Task	Task Req'd	Freq	Reference for Criteria		Agent
			AISC 341	NCBC	
1. Ensure no holes or unapproved attachments made by responsible contractor in protected zone	<input type="checkbox"/>	C	Table J10-1		



## **SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

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

#### **1.2 USE CHARGES**

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

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas parking areas for construction personnel.
- B. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage, including delivery, handling, and storage provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.

#### **1.4 QUALITY ASSURANCE**

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

#### **1.5 PROJECT CONDITIONS**

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

## **SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS**

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet high with galvanized-steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top rails. Provide landscape fabric on one side of fencing to reduce noise, dust and visual impact. Gates shall be lockable.

#### **2.2 TEMPORARY FACILITIES**

- A. Field Office:
  - 1. Provide Furniture required for Project-site documents.
  - 2. Provide Conference room of sufficient size to accommodate meetings of 10 individuals.
  - 3. Provide technology required for digital presentations.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
  - 1. Store combustible materials apart from building.

#### **2.3 EQUIPMENT**

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Owner will permit the use of the permanent HVAC system under provisions of this Section. If temporary heating is required, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
  - 3. Permanent HVAC System: Owner will permit the use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction and clean HVAC system as required in Division 01 Section "Closeout Procedures". Contractor will be responsible for costs of steam and chilled water to operate the permanent HVAC system.

## **SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS**

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
  - 1. Locate facilities to limit site disturbance as specified in Section 01 10 00 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

#### **3.2 TEMPORARY UTILITY INSTALLATION**

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
  - 2. Unless specifically authorized the Contractor's personnel will not be allowed to use the Owner's toilets and drinking water facilities.
  - 3. Coordinate connection of Water, sewer, gas, electricity, etc., with local utility companies.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- E. Heating: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
  - 1. Provide temporary dehumidification systems when required to reduce moisture levels to level required to allow installation or application of finishes
- G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
  - 1. Install electric power service overhead unless otherwise indicated.
  - 2. Coordinate temporary construction power with the local power company, Duke Energy.

## **SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS**

3. Provide the following temporary service, as a minimum, for temporary construction power. Provide additional temporary power as required.
- H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
  2. Install lighting for Project identification sign

### **3.3 SUPPORT FACILITIES INSTALLATION**

- A. General: Comply with the following:
1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
  2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
  2. Remove snow and ice as required to minimize accumulations.
- D. Project Signs:
1. Identification of a construction project and those principal parties participation in the project has been provided by preceding work. No additional signs identifying participants shall be used.
  2. Warning and safety signs are to be used as required. All other informational signage must be kept to a minimum.
  3. All signs shall be maintained by the Contractor in a first-class condition, throughout the duration of the project, by re-painting, repairing, and re-erecting as necessary and as required.
  4. Unauthorized signs are not permitted.
- E. Waste Disposal Facilities: Comply with requirements specified in Division 01 "Construction Waste Management and Disposal."
- F. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

## **SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS**

### **3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION**

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  - 1. Comply with work restrictions specified in Division 01 "Summary."
- B. Temporary Erosion and Sedimentation Control: Comply with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and requirements specified in Division 31 "Site Clearing."
- C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- D. Tree and Plant Protection: Comply with requirements specified in Division 01 "Temporary Tree and Plant Protection."
- E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.
- F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates. . The Construction area shall be enclosed with a six feet (6') high (minimum) chain link type fence with top rail. At the completion of the project the Contractor shall remove the construction fence completely including below ground level. Fence posts shall not be sawed off flush with the soil line.
  - 1. Extent of Fence: As indicated on Drawings.
  - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- I. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
  - 1. Prohibit smoking in construction areas.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be

## **SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS**

- followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### **3.5 MOISTURE AND MOLD CONTROL**

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

## **SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS**

### **3.6 OPERATION, TERMINATION, AND REMOVAL**

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  - 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
  - 3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Division "Closeout Procedures."

**END OF SECTION 01 50 00**

**SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

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

**1.2 DEFINITIONS**

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved by Architect 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.

**1.3 QUALITY ASSURANCE**

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

**1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING**

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

## **SECTION 01 60 00 - SUBSTITUTIONS**

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

### **1.5 PRODUCT WARRANTIES**

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
  2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
  1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
  3. Refer to 02 through 49 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 "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 meeting requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.

## **SECTION 01 60 00 - SUBSTITUTIONS**

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- B. Visual Matching Specification: Where Specifications require "match Architect's sample," provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
  - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 01 25 00 "Substitution Procedures" for proposal of product.
- 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.

### **PART 3 - EXECUTION (Not Used)**

**END OF SECTION 01 60 00**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Cutting and patching.
  - 5. Coordination of Owner-installed products.
  - 6. Progress cleaning.
  - 7. Starting and adjusting.
  - 8. Protection of installed construction.
  - 9. Correction of the Work.

**1.2 DEFINITIONS**

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

This project may not require this level of submittals. Specific information submittals are listed in several sections (many in MP&E) for information.

**1.3 QUALITY ASSURANCE**

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
  - 1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
  - 2. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
  - 3. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

- C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.
- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

**1.4 WARRANTY**

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

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. General: Comply with requirements specified in other Sections.
  - 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services; and other utilities.
  - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.

2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work.
  2. List of detrimental conditions, including substrates.
  3. List of unacceptable installation tolerances.
  4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### **3.2 PREPARATION**

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Division 01 "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.
- B. General: Engage a professional engineer to lay out the Work using accepted surveying practices.

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  2. Establish limits on use of Project site.
  3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  4. Inform installers of lines and levels to which they must comply.
  5. Check the location, level and plumb, of every major element as the Work progresses.
  6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
  7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

**3.4 FIELD ENGINEERING**

- A. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
  2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- B. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- C. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- D. Final Property Survey: Before Substantial Completion, prepare a Final engage a licensed land surveyor registered in the State of North Carolina to prepare a final property survey showing



significant features (real property), topography, sizes, locations, elevations, and inverts of all existing and new underground utility lines installed or encountered on the Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. During the installation of the site utilities, the Contractor shall collect three-dimensional top of utility location data a minimum of every 100 linear feet and each valve, fitting, horizontal change in direction or major change in elevation. Contractor shall submit this information and incorporate this into the Record Documents.

**3.5 INSTALLATION**

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  1. Make vertical work plumb and make horizontal work level.
  2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
  4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Where possible, select tools or equipment that minimize production of excessive noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
  1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
  2. Allow for building movement, including thermal expansion and contraction.
  3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Repair or remove and replace damaged, defective, or nonconforming Work.
  - 1. Comply with Division 01 "Closeout Procedures" for repairing or removing and replacing defective Work.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.
- K. During construction, once the interior layout has been partitioned off into rooms, all rooms shall be identified on the site by a number that corresponds with the number on the design drawings, unless another numbering system is agreed upon by the Owner.

**3.6 CUTTING AND PATCHING**

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Temporary Support: Provide temporary support of work to be cut.
- C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- D. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
  - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  - 6. Proceed with patching after construction operations requiring cutting are complete.
- E. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will minimize evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- F. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

**3.7 OWNER-INSTALLED PRODUCTS**

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

**3.8 PROGRESS CLEANING**

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
  3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

## SECTION 01 73 00 - EXECUTION

- a. Use containers intended for holding waste materials of type to be stored.
4. The construction site, and adjacent campus area, shall be kept free from the accumulation of trash, litter, or debris at all times. Trash cans/dumpsters shall be emptied and the contents removed from campus before they overflow. Removal of litter, rubbish, and debris are to performed daily by the Contractor. Use of University trash receptacles for such debris is not allowed. The outdoor burning of trash and debris on campus is not allowed either.
5. The Contractor shall be fully responsible for the containment of mud and debris on the site as well as removal of these from roads and walkways.
6. Grass and other vegetation on the construction site shall be trimmed or mowed to maintain a neat appearance. Grass inside the construction area should generally be mowed once a week during the growing season.
7. Debris shall not be allowed to accumulate in corridors or stairways, and as the various stages of construction are completed, the work must be protected to prevent soiling or spotting, particularly with regard to flooring systems. Carpet shall be cleaned and without spots or traffic patterns. Resilient floors shall be cleaned, sealed, properly finished and of a uniform appearance with no streaks or smears.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  1. Remove liquid spills promptly.
  2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 "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 ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

**3.9 STARTING AND ADJUSTING**

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

**3.10 PROTECTION OF INSTALLED CONSTRUCTION**

- A. Landscaping and Grounds
  - 1. Notify Owner before construction begins so they may determine if any plant material within the construction site can be salvaged. Two weeks advance notification is required so the Owner may remove trees and shrubs that will be retained by the Owner for use elsewhere.
  - 2. Special attention should be given to any trees, shrubs or lawn that will remain inside the construction area. To protect such materials, a landscape protection fence shall be installed prior to the initial stage of grading, excavation, or tree removal. This fence or barricade shall be a minimum of 3 feet high and shall be required to remain in place for as long as is practical. The landscape protection area should extend to at least the drip line of any trees or shrubs that are to remain.
  - 3. No storage, access or activity of any kind shall be permitted in the landscape protection areas. This specifically includes the felling of trees into the landscape protection area. No limbs, tops, stumps, fill, material storage or equipment shall be permitted in the landscape protection areas at any time.
  - 4. Care shall be taken to protect trees and shrubs from damage by cranes, falling objects, etc. Trees and shrubs shall not be pruned or moved by the Contractor. When pruning or moving is necessary, the Designer shall be notified and the work will in turn be performed by the Owner at no cost to the Contractor.
  - 5. Trees outside the construction limits shall be protected from:
    - a. Compaction of root area by equipment, materials, or fill dirt.
    - b. Trunk damage by moving equipment, material storage, mauling or bolting.
    - c. Poisoning by pouring solvents, gas, paint, etc, on or around roots.
    - d. Damage of branches by improper equipment activity.
    - e. Cutting of roots within the drip line of the tree.
  - 6. It is specifically prohibited to fell or bulldoze trees into a wooded area that will be adjacent to the site being cleared for construction. Site clearing should be done so as to prevent damage to wooded areas adjacent to the project.
  - 7. Trees shall not be used as props or anchors for materials, guy wires, cables or utility

wires.

8. Damaged trees, shrubs or lawns shall be repaired or replaced by a tree surgeon or nurseryman in a manner acceptable to the University and cost of the repairs or replacements shall be paid by the Contractor.

**B. Underground Utilities Lines**

1. Each Contractor who does excavation work will be responsible for location of underground utilities prior to excavation. The Contractor may obtain the services of a commercial utilities locator and/or call the various utility companies who may have lines in the area. With regard to excavation within any public right-of-way, the General Statutes of North Carolina require Contractors to notify the NC One-Call Center (ULOCO) at 1- 800-632-4949; <http://www.ncocc.org> for Excavation Manual online, at least two days but not more than 10 days prior to beginning the excavation. The Contractor will be responsible for the consequences of any utility interruption caused by his or her excavation, and will be responsible for the cost of repairing any damage done to the utilities themselves.

**C. Storm Drainage System**

1. Appropriate measures, such as block and gravel filters or silt fences, shall be provided during construction as required to protect catch basins, storm drains, and streams from the entry of all silt and construction debris. The Designer should refer to the North Carolina Erosion and Sediment Control Planning and Design Manual.
2. The residue from the cleaning of ready-mix trucks, wheelbarrows, concrete buddies, etc. shall be contained and the residue removed from the campus with other refuse.
3. No debris shall be dumped into drains or catch basins. Contractor shall be responsible for cleaning or replacing drain lines if a violation occurs.
4. The Designer's Erosion and Sediment Control Plan for the project should clearly state which measures are temporary and which measures are permanent. All temporary erosion control measures including silt fencing, inlet protection measures, and sediment traps should be required to be removed by the Contractor after the site is stabilized and prior to final inspection."

**D. Terminal Buildings, Streets, and Sidewalks**

1. The Contractor shall be responsible for protection of existing buildings, roof, trees, shrubbery and lawn areas from damage by vehicles, equipment, overhead cranes, falling objects, etc.
2. The Contractor shall be responsible for protecting the campus streets and walks connecting to the project from deposits of mud, sand, stone, litter, or debris in any form, and shall remove any such debris immediately before it becomes a traffic hazard or is carried into the surrounding buildings.
3. Where equipment must cross walks, lawns, and other transitional areas used by pedestrian and vehicular traffic, the Contractor shall provide a minimum protection of 3/4" thick plywood sheets for equipment to roll over.

**END OF SECTION 01 73 00**

## **SECTION 01 77 00 - CLOSEOUT PROCEDURES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Inspection procedures.
  - 2. Warranties.
  - 3. Final cleaning.

#### **1.2 DEFINITIONS**

- A. Closeout: Closeout is hereby defined to include general requirements near end of Contract Time, in preparation for substantial completion, final payment, normal termination of contract, occupancy by Owner and similar actions evidencing completion of the work. Specific requirements for individual units of work are specified in below. Time of closeout is directly related to substantial completion, and therefore may be either a single time period for entire work or a series of time periods for individual parts of the work which have been certified as substantially complete at different dates. That time variation (if any) shall be applicable to other provisions of this section.

#### **1.3 SUBSTANTIAL COMPLETION**

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

## **SECTION 01 77 00 - CLOSEOUT PROCEDURES**

will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

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

### **1.4 FINAL COMPLETION**

- A. Preliminary Procedures: Before requesting Architect's/Engineer's final completion inspection, complete the following:
1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
  2. Submit certified copy of Architect's inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. 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.

### **1.5 LIST OF INCOMPLETE ITEMS (PUNCH LIST)**

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
1. 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. Include the following information at the top of each page:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Page number.
  4. Submit list of incomplete items in the following format:
    - a. Three paper copies of product schedule or list, unless otherwise indicated. Architect will return two copies.



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### **1.6 WARRANTIES**

- A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Utilization/ Substantial Completion: Submit properly executed warranties within 15 days of Substantial Completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
  - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
  - 4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
  - 1. Use cleaning products that comply with Green Seal's GS-37,

### **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:

## **SECTION 01 77 00 - CLOSEOUT PROCEDURES**

- a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
  - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
  - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
  - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
  - e. Remove snow and ice to provide safe access to building.
  - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
  - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
  - h. Sweep concrete floors broom clean in unoccupied spaces.
  - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
  - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - k. Remove labels that are not permanent.
  - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    - 1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
  - m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - n. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity
  - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - q. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
    - 1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
  - r. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
  - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 01 50 00 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 "Construction Waste Management and Disposal."

END OF SECTION 01 77 00

## **SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory manuals.
  - 2. Emergency manuals.
  - 3. Systems, subsystem and equipment operation manuals.
  - 4. Systems and equipment maintenance manuals.
  - 5. Product maintenance manuals.

#### **1.2 DEFINITIONS**

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

#### **1.3 CLOSEOUT SUBMITTALS**

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
  - 1. Two paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.
  - 2. Six electronic copies on flash drives.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

- 1.4 **Digital Copy:** In addition to the paper copies noted above provide six digital copies of Operation and Maintenance Data along with one hard copy set of Record Project Documents listed in Division 01 Section "Project Record Documents" and provide one on CD. Arrange contents of CD by systems under Section numbers and sequence of the Table of Contents of the Project

## **SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA**

Manual. Digital format to be PDF.

### **1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS**

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
  
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
  - 1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary, to provide essential information for proper operation or maintenance of equipment or system.
    - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
  - 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  - 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
  - 4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
  - 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

## **SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA**

### **1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS**

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
  2. Table of contents.
  3. Manual contents.
- B. Title Page: Include the following information:
1. Subject matter included in manual.
  2. Name and address of Project.
  3. Name and address of Owner.
  4. Date of submittal.
  5. Name and contact information for Contractor.
  6. Name and contact information for Construction Manager.
  7. Name and contact information for Architect.
  8. Name and contact information for Commissioning Authority.
  9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

### **1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL**

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
  2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
  3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

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### **1.8 EMERGENCY MANUALS**

- A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- B. Content: Organize manual into a separate section for each of the following:
  - 1. Type of emergency.
  - 2. Emergency instructions.
  - 3. Emergency procedures.
- C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
  - 1. Fire.
  - 2. Flood.
  - 3. Gas leak.
  - 4. Water leak.
  - 5. Power failure.
  - 6. Water outage.
  - 7. System, subsystem, or equipment failure.
  - 8. Chemical release or spill.
- D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- E. Emergency Procedures: Include the following, as applicable:
  - 1. Instructions on stopping.
  - 2. Shutdown instructions for each type of emergency.
  - 3. Operating instructions for conditions outside normal operating limits.
  - 4. Required sequences for electric or electronic systems.
  - 5. Special operating instructions and procedures.

### **1.9 SYSTEMS AND EQUIPMENT OPERATION MANUALS**

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  - 2. Performance and design criteria if Contractor has delegated design responsibility.
  - 3. Operating standards.

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

C. Descriptions: Include the following:

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

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

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

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

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

### **1.10 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS**

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

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

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures,

## **SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA**

maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
  - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
    - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.



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

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

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

### **1.11 PRODUCT MAINTENANCE MANUALS**

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

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

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

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

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

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

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

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

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

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

## **PART 2 - PRODUCTS**

### **2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY**

A. Organization: Include a section in the directory for each of the following:

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

### **2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS**

- A. A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
  2. Table of contents.
  3. Manual contents.
- B. Title Page: Include the following information:
1. Subject matter included in manual.
  2. Name and address of Project.
  3. Name and address of Owner.
  4. Date of submittal.
  5. Name and contact information for Contractor.
  6. Name and contact information for Construction Manager.
  7. Name and contact information for Architect.
  8. Name and contact information for Commissioning Agent.
  9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals: Submit manuals in the form of hard copy, bound and labeled volumes.

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1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
  - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
  - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
  - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
  - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

### **2.3 OPERATION MANUALS**

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

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8. Engineering data and tests.
  9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
  2. Equipment or system break-in procedures.
  3. Routine and normal operating instructions.
  4. Regulation and control procedures.
  5. Instructions on stopping.
  6. Normal shutdown instructions.
  7. Seasonal and weekend operating instructions.
  8. Required sequences for electric or electronic systems.
  9. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
1. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

### **2.4 PRODUCT MAINTENANCE MANUALS**

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
- 1.
  2. Product name and model number.
  3. Manufacturer's name.
  4. Color, pattern, and texture.
  5. Material and chemical composition.
  6. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.
  2. Types of cleaning agents to be used and methods of cleaning.
  3. List of cleaning agents and methods of cleaning detrimental to product.
  4. Schedule for routine cleaning and maintenance.
  5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

## **SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA**

### **2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS**

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual,
  - 1. identified by product name and arranged to match manual's table of contents. For each product,
  - 2. list name, address, and telephone number of Installer or supplier and maintenance service agent,
  - 3. and cross-reference Specification Section number and title in Project Manual and drawing or
  - 4. schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard maintenance instructions and bulletins.
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
  - 3. Identification and nomenclature of parts and components.
  - 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions.
  - 2. Troubleshooting guide.
  - 3. Precautions against improper maintenance.
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - 5. Aligning, adjusting, and checking instructions.
  - 6. Demonstration and training video recording, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.

## **SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA**

### **PART 3 - EXECUTION**

#### **3.1 MANUAL PREPARATION**

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
  - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original project record documents as part of operation and maintenance manuals.
  - 2. Comply with requirements of newly prepared record Drawings in Division 01 Section "Project Record Documents."
- G. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

**END OF SECTION 01 78 23**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for project record documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.

**1.2 CLOSEOUT SUBMITTALS**

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit two set(s) of marked-up record prints.
- B. Record Specifications: Submit two paper copies of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit two paper copies annotated PDF electronic files and directories of each submittal.
  - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit two paper copies of each submittal.
- E. Digital Copy: In addition to the paper copies noted above provide one digital copy of Record Specifications, Record Product Data, Miscellaneous Record Submittals, all Operations and Maintenance Data listed in Section 01 78 23 including manuals, manufacturer's data, warranties, drawings and provide on CD. Arrange contents of CD by systems under Section numbers and sequence of the Table of Contents of the Project Manual. Digital format to be PDF.

**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.

## SECTION 01 78 39 - PROJECT RECORD DOCUMENTS

- b. Accurately record information in an acceptable drawing technique.
  - c. Record data as soon as possible after obtaining it.
  - d. Record and check the markup before enclosing concealed installations.
  - e. Cross-reference record prints to corresponding photographic documentation.
2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
  7. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  8. Refer instances of uncertainty to Architect for resolution.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. 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. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.



## **SECTION 01 78 39 - PROJECT RECORD DOCUMENTS**

5. Note related Change Orders, record Product Data, and record Drawings where applicable.

B. Format: Submit record Specifications as paper copies in 3-ring binders and one digital copy on CD.

### **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 paper copies in 3-ring binders and one digital copy on CD.

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

### **2.4 MISCELLANEOUS RECORD SUBMITTALS**

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

B. Format: Submit miscellaneous record submittals as paper copies in 3-ring binders and one digital copy on CD.

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

## **PART 3 - EXECUTION**

### **3.1 RECORDING AND MAINTENANCE**

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

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

## **END OF SECTION 01 78 39**

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## **SECTION 01 79 00 - DEMONSTRATION AND TRAINING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
  - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
  - 2. Demonstration and training video recordings.

#### **1.2 INFORMATIONAL SUBMITTALS**

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

#### **1.3 QUALITY ASSURANCE**

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 "Quality Requirements," experienced in operation and maintenance procedures and training.
- B. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Division 01 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
  - 1. Inspect and discuss locations and other facilities required for instruction.
  - 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
  - 3. Review required content of instruction.
  - 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

#### **1.4 COORDINATION**

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

## **SECTION 01 79 00 - DEMONSTRATION AND TRAINING**

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

### **1.5 INSTRUCTION PROGRAM**

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  - 2. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Systems and equipment operation manuals.
    - c. Systems and equipment maintenance manuals.
    - d. Product maintenance manuals.
    - e. Project Record Documents.
    - f. Identification systems.
    - g. Warranties and bonds.
    - h. Maintenance service agreements and similar continuing commitments.
  - 3. Emergencies: Include the following, as applicable:
    - a. Instructions on meaning of warnings, trouble indications, and error messages.
    - b. Instructions on stopping.
    - c. Shutdown instructions for each type of emergency.
    - d. Operating instructions for conditions outside of normal operating limits.
    - e. Sequences for electric or electronic systems.
    - f. Special operating instructions and procedures.
  - 4. Operations: Include the following, as applicable:
    - a. Startup procedures.
    - b. Equipment or system break-in procedures.
    - c. Routine and normal operating instructions.
    - d. Regulation and control procedures.
    - e. Control sequences.
    - f. Safety procedures.
    - g. Instructions on stopping.

## **SECTION 01 79 00 - DEMONSTRATION AND TRAINING**

- h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
- a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
- a. Diagnostic instructions.
  - b. Test and inspection procedures.
7. Maintenance: Include the following:
- a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning.
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
8. Repairs: Include the following:
- a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

### **1.6 PREPARATION**

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

### **1.7 INSTRUCTION**

- A. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  - 1. Owner will furnish an instructor to describe Owner's operational philosophy.
  - 2. Owner will furnish Contractor with names and positions of participants.
- B. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

## **SECTION 01 79 00 - DEMONSTRATION AND TRAINING**

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1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- C. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral performance-based test.
- D. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

### **PART 2 - PRODUCTS**

### **PART 3 - EXECUTION**

**END OF SECTION 01 79 00**

# **SECTION 01 81 10 - WIND AND SEISMIC DESIGN CRITERIA**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. The following types of design criteria for the Project, including Work designed by (a) Engineer and (b) delegated design professional(s) retained by Contractor, Subcontractor, or Supplier and submitted for Engineer's approval under the Contract:
    - a. Wind loading.
    - b. Seismic.
    - c. Snow loading.
- B. Scope:
  - 1. Certain Work, expressly indicated, shall be designed, fabricated, and installed in accordance with the wind , snow, and seismic requirements of this Section and Laws and Regulations (including applicable building codes).
  - 2. This Section applies to all the Work. Where wind , snow, and seismic design criteria indicated in this Section conflict with wind , snow, and seismic design criteria set forth elsewhere in the Contract Documents, the more-stringent loading and requirements shall govern, unless clarified in writing by Engineer. Obtain Engineer's written interpretation or clarification of conflicts prior to performing the subject design and other associated Work.
  - 3. Contractor shall provide all labor, materials, equipment, tools, professional services, and incidentals to provide wind , snow, and seismic design for the Work.
  - 4. Such Work includes, but is not necessarily limited to, the following:
    - a. Anchorage of mechanical and electrical equipment and systems.
    - b. Anchorage of supports for piping, electrical conduits and cable trays, and similar Work.
    - c. Work requiring delegated professional design for the final, completed Project.

### **1.2 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordinate all wind , snow, and seismic design required of Contractor for the Work.

### **1.3 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Civil Engineers / Structural Engineering Institute (ASCE/SEI):
    - a. 7-10, Minimum Design Loads for Buildings and Other Structures.
  - 2. When referenced standards conflict, the most-stringent governs, unless specifically indicated otherwise in the Contract Documents or unless approved otherwise in writing by the Engineer.

### **1.4 SUBMITTALS**

- A. Action Submittals: Submit the following as part of the Submittals required in Divisions 02-49 Specifications that require wind , snow, and seismic delegated designs:
  - 1. Delegated Design Professional's "Instruments of Service" Submittals:

## **SECTION 01 81 10 - WIND AND SEISMIC DESIGN CRITERIA**

- a. Delegated design professional's "certification of compliance" required by Division 01, regarding structural calculations:
  - 1) Indicate compliance with performance and design criteria indicated in the Contract Documents.
  - 2) Indicate compliance with specific reference standards indicated in the building code and the associated Contract Documents.
  - 3) Indicate other information required for "certification of compliance" in accordance with Division 01.
- B. Informational Submittals: Submit the following as part of the Submittals required in Divisions 02-49 Specifications that require wind , snow, and seismic delegated designs:
  1. Delegated Design Professional's Calculations:
    - a. Such calculations shall include delegated design professional's seal, signature, and date and are to indicate the following, which will not be reviewed by Engineer except for the limited purposes indicated in Division 01:
      - 1) Indicate basis of design and lateral analysis as necessary and required to derive each loading and to indicate system stability, including compatibility of deflections and compatibility with allowable soil parameters, as applicable.
      - 2) Indicate design load to each connection to structure (where connection will attach to or interface with, or supported by, elements designed by Engineer).
      - 3) Indicate and provide complete lateral load resisting system that transfers all wind and seismic loads through load path to ground.
    2. Shop Drawings and Product Data Approved by Delegated Design Professional: The following are required but will be reviewed by Engineer only for the limited purposes indicated in Division 01:
      - a. Shop Drawings showing and indicating proposed wind , snow, and seismic controls Work designed by delegated design professional.
      - b. Product data showing and indicating proposed wind , snow, and seismic controls Work designed by delegated design professional.

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL DESIGN CRITERIA FOR WIND ,SNOW, AND SEISMIC**

- A. This Article 2.1 applies to wind , snow, and seismic design criteria.
- B. Design by delegated design professional retained by Contractor, Subcontractor, or Supplier shall comply with:
  1. Performance and design criteria indicated in the applicable Contract Documents, including this Section.
  2. Laws and Regulations, including applicable building code.
  3. Applicable reference standards indicated in the Contract Documents.
- C. Risk Category: II.
  1. Design in accordance with building code load combinations for, at Contractor's option, either service level or factored level.
  2. Mechanical and electrical equipment and systems loads are dead loads, except where mechanical elements, such as piping and tanks, are filled with material such as liquid or slurry (in which case the dead load of the pipe's or vessel's contents shall also be included).



## **SECTION 01 81 10 - WIND AND SEISMIC DESIGN CRITERIA**

### **2.2 WIND DESIGN CRITERIA**

- A. Wind Design Load Criteria:
  - 1. See Structural Drawings.
- B. Wind forces must be resisted by direct load transfer through fasteners to wind-resisting elements. Do not use connections that employ friction to transfer wind forces.

### **2.3 SEISMIC DESIGN CRITERIA**

- A. Seismic Design Load Criteria:
  - 1. See Structural Drawings.
  - 2. Component or system amplification factor, ( $a_p$ ) and component response modification factor ( $R_p$ ): In accordance with ASCE 7-10, Tables 13.5-1 and 13.6-1.
  - 3. Component Importance Factor:
    - a. All Components:  $I_p = 1.00$ .
- B. Seismic forces must be resisted by direct load transfer through fasteners to seismic-resisting elements. Do not use connections that employ friction to transfer seismic forces.

### **2.4 SNOW DESIGN CRITERIA**

- A. Snow Design Load Criteria:
  - 1. See Structural Drawings.
  - 2. Design considerations for partial loading, unbalanced snow, snow drift in the vicinity of adjacent structures or projections, sliding snow, and other applicable factors shall be considered at locations required by Laws and Regulations, including applicable building codes.
  - 3. In no event shall snow design load criteria or minimum snow load be less than required by authority having jurisdiction.

### **PART 3 - EXECUTION - (NOT USED)**

**END OF SECTION 01 81 10**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Contract Drawings and provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.
- B. Section 220800 - Commissioning of Plumbing Systems
- C. Section 230800 – Commissioning of Mechanical Systems
- D. Section 230901 – Commissioning of Integrated Automation Systems
- E. Section 260800 – Commissioning of Electrical Systems
- F. Commissioning Plan

**1.2 DESCRIPTION OF WORK**

- A. An independent third-party Commissioning Agent has been retained to lead the project participants through the commissioning process. The section below is provided for informational purposes and to inform the contractor of the extent of the commissioning process and the involvement required. The Commissioning Agent is RMF Engineering, Inc.
- B. The purpose of the construction phase commissioning is to provide the Owner and Operators of the facility with a high level of assurance that each commissioned system has been installed in the prescribed manner and operates within the performance guidelines set forth in the design intent. The Commissioning Agent shall provide the Owner with an unbiased, objective view of the system's installation, operation, and performance.
- C. This commissioning process shall not take away or reduce the responsibility of the System Design Professional(s) or installing Contractors to provide a finished product.
- D. Commissioning is intended to enhance the quality of system start-up and aid in the orderly transfer of systems to beneficial use by the owner. The Commissioning Agent will be a member of the construction team, cooperating and coordinating all commissioning activities with the Owner, Design Professionals, Construction Manager or General Contractor, Subcontractors, Manufacturers and Equipment Suppliers.

**1.3 DEFINITIONS**

- A. Commissioning Agent (CxA): The Commissioning Agent is a third-party consulting company interested in providing quality control to the project and quality assurance to the Owner. The Commissioning Agent provides a non-biased perspective of issues. The goal of the Commissioning Agent is to discover equipment and system issues early and resolve them quickly for an overall smooth construction process and to keep costs down for both the Owner and Contractor(s).
- B. Commissioning Team: The Commissioning Team is a group of individuals selected by each company to represent that company for direct involvement in the commissioning activities

## SECTION 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS

during the construction phase of the project. A minimum of one individual must be included to represent every company. Companies include but are not limited to; Commissioning Agent, Owner, Architect, System Design Engineer, Construction Manager or General Contractor, and all Sub-Contracting Companies.

- C. Design Professional(s) (Designers): The Design Professional(s) are the designers and design firm representatives for the architectural, fire protection, mechanical, electrical, plumbing, fire alarm, telecommunications security and other systems outside of the scope of the project. Typically, the Design Professional(s) do not include structural and civil design representatives unless structural or civil systems are specifically included within or are associated with the systems being commissioned.
- D. Contractor(s): The term Contractor(s) utilized herein refers to the primary contracting party responsible for the specific item being referenced. Contractor(s) may refer to one or more of the general contractors, construction managers, sub-contractors and/or vendors whom are responsible for the construction or other provisions regarding any of the systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems Included in Commissioning. Contracting parties outside of the scope of the systems being commissioned are not included.
- E. Subcontractors: The term Subcontractors utilized herein refers to the any and all subcontracting companies or vendors whom are responsible for the construction or other provisions regarding any of the systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems Included in Commissioning. Subcontracting parties outside of the scope of the systems being commissioned are not included.
- F. Functional Performance Tests (FPT): The FPT's are a series of system tests developed by the Commissioning Agent intended to verify the full functionality and operability of each of the Systems Included in Commissioning. FPT's include load testing, controls verification, sequencing, TAB verification, system integration, etc. FPT's are generated by the CxA, reviewed by the Cx Team, conducted by the responsible contractors and witnessed by the CxA.
- G. Pre-Verification Tests (PVT): The PVT's are exact copies of the Functional Performance Tests. This set of tests are specifically for the installing and testing contractors to perform all of their pre-testing activities. The difference between the FPT's and the PVT's is that the FPT's are witnessed by the CxA for final acceptance while the PVT's are not required to be witnessed. It is recommended that the Prime Contractor or Construction Manager witness the PVT's to ensure system readiness.

### 1.4 ROLES AND RESPONSIBILITIES

- A. Commissioning Agent
  1. The commissioning roles and responsibilities of the CxA are outlined within the Commissioning Plan. The CxA is not contractually obligated to complete any tasks defined within the Commissioning Specifications because they are independently contracted through the Owner.
  2. The Commissioning Agent shall NOT have any direct authority to order construction changes or make any project alterations without the written approval of the Owner or System Design Professional. Any changes or project alterations made by a Contractor(s) without such written approval shall be the responsibility of that Contractor(s).
  3. Prepare the Commissioning Plan. Update the Commissioning Plan after the Commissioning Kick-Off meeting. Include list of all contractors for commissioning events by name, firm and trade specialty. The Commissioning Plan is a living document which may be continuously updated throughout the project.

## SECTION 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS

4. Assist the contractors in scheduling the Commissioning Kick-Off Meeting. The CxA will host the Kick-Off Meeting at some convenient location and time suitable to the Owner, Designers, Contractors and Sub-Contractors. This meeting will review the Cx Plan and every aspect of the Commissioning Process specific to this project.
  5. Assist the contractors in integration of Commissioning Activities into the overall Construction Schedule.
  6. Review all documentation regarding changes to the Contract Documents or Clarifications. These include Meeting Minutes, Addendums, RFI's, Change Orders, ASI's, etc. for their effect on Commissioning.
  7. The Commissioning Agent shall receive a copy of all submittals pertaining to the systems being commissioned from the Contractor(s). The Commissioning Agent shall review all submittals for approval. CxA submittal review shall be coordinated with the Designer(s) review to avoid redundancy. Submittal approval by the Commissioning Agent shall not supersede any submittal comments or rejection by the Designer(s) and vice versa.
  8. The Commissioning Agent shall conduct Commissioning Meetings throughout the construction phase. Meetings shall be held more frequently as Commissioning Activities increase. Meetings are typically held monthly until systems are prepared for verification testing.
  9. The Commissioning Agent shall conduct periodic inspections of work in progress and shall generate and distribute a report for each inspection. All issues and discrepancies found during these inspections shall be listed on a Commissioning Issues Log, maintained by the Commissioning Agent.
  10. The CxA will provide Functional Performance Test procedures for the testing of the Systems being Commissioned. These tests are specifically custom designed by the Commissioning Agent for verifying each system operates per the design intent and meets both the Basis of Design (BOD) and the Owner's Project Requirements (OPR.)
  11. Included within the Functional Performance Tests are checks to verify the TAB Report. After both a review of the Final TAB Report and field verification of the TAB Report accuracy, the CxA will recommend acceptance of the Final Test, Adjustment and Balance Report.
  12. The CxA will witness Functional Performance Testing which shall be performed by the installing contractors. All issues and discrepancies found during Functional Performance Testing shall be listed on the Commissioning Issues Log, maintained by the Commissioning Agent.
  13. Prepare the Final Commissioning Report. Submit completed Functional Performance Tests as part of Final Report to the owner. Recommend acceptance of the Final Product, by the Owner, based upon the results of Commissioning.
  14. CxA will witness Functional Performance Tests to accommodate seasonal testing.
- B. Design Professional(s)
1. The commissioning roles and responsibilities of the System Design Professional(s) are outlined within the Commissioning Plan. The System Design Professional(s) is not contractually obligated to complete the tasks defined within the Commissioning Plan. Rather, the roles and responsibilities defined within the Commissioning Plan are in the best interest of the Owner and are required for the successful completion of Commissioning.
  2. The commissioning roles and responsibilities outlined within the Commissioning Plan do not supersede any contractual requirements between the Owner and the Systems Design Professional(s), nor do they relieve the Systems Design Professional(s) of any Designer or Construction Administrator responsibilities.
  3. The System Design Professional(s) must provide Construction Documentation including all Bid-Set Drawings and Specifications, Addendum, Change Orders, Architectural Supplemental Instructions, and Requests for Information. Additionally, the System Design Professional(s) shall distribute to the Commissioning Agent, a copy of all meeting minutes and site inspection reports for review. The Contractor, Architect and System Design Professional presented Value Engineering Proposals shall be submitted to the

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Commissioning Agent. It is the responsibility of the System Design Professional(s) and/or Architect to inform the Commissioning Agent of the Value Engineering Proposals which are accepted.

4. Conduct periodic inspections of work in progress as outlined within the contractual requirements between the Owner and the Systems Design Professional(s). Systems installation verification is not the responsibility of the Commissioning Agent. Rather, commissioning is implemented as a tool to assist the Systems Design Professional(s) with installation verification such that there is an overall increase in quality control.
5. The System Design Professional(s) retains responsibility for the overall system evaluation, adequacy of the system to meet design intent, capacity of the system, and other elements of the system design. The Commissioning Agent is not responsible for overall system functionality. Comments or issues found by the Commissioning Agent must be evaluated by the System Design Professional(s) prior to corrective actions.
6. The System Design Professional(s) shall review the Functional Performance Test Procedures provided by the Commissioning Agent. The System Design Professional(s) shall confirm that the test procedures follow the Sequence of Events and properly test the over functionality of the system as it was intended to operate.

### C. Construction Manager / General Contractor

1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
2. Include commissioning requirements in the individual subcontracts for all disciplines relating to the systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems Included in Commissioning. Ensure full cooperation of all contracting, manufacturing and testing parties required to participate in commissioning.
3. Include cost for commissioning requirements in the contract price. Include specific line items within the Schedule of Values according to Specification 019113 Section 2.2 – Schedule of Values.
4. Schedule - Provide copies of the Project Schedule to the Commissioning Agent as outlined within Specification 019113 Section 2.1 – Project Schedule. Update the overall project schedule to reflect all Commissioning Activities. Ensure cooperation by subcontractors in coordinating the inclusion of subcontractor activities related to commissioning into the overall Project schedule.
5. Submittals - Provide all submittals to the Commissioning Agent as outlined within Specification 019113 Section 2.3 – Submittals.
6. Cx Representative - Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the entire commissioning program as described in the contract documents. Provide one or two representatives to specifically participate in Commissioning Activities and generally oversee the Commissioning Process. Retain these individuals for the duration of the project to ensure full comprehension and understanding of the scope of commissioning. The Primary Commissioning Representative for the Prime Contractor shall not be changed or replaced for the duration of the project.
7. Cx Meetings - Primary Representative shall attend every Commissioning Meeting. Ensure all Subcontractors also provide a representative at each Commissioning Meeting. These representatives are to remain the same individual throughout the construction project unless termination with the representing company occurs or their replacement is approved by the Owner and Commissioning Agent.
8. Cx Activities - Coordinate all scheduled commissioning activities with the Commissioning Agent. The Contractor(s) must apprise the Commissioning Agent of various construction activities. These activities include but are not limited to: Mock-Up Inspections, In-Wall Inspections, Above Ceiling Inspections, System Start-up, Equipment Start-up, Duct Pressure Tests, Pipe Pressure Tests, Electrical Tests, Pipe Flushing and Cleaning, Completion of Pre-Functional Checklists, readiness for Functional Performance Testing and System Completion.

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9. Issues Log - Remedy all contractual deficiencies as outlined within the Commissioning Issues Log. The Commissioning Agent shall issue an updated deficiency log throughout construction based upon site visits, Pre-Functional Checklist completion, Commissioning Meeting topics, Functional Performance Test results or any other commissioning activity.
10. Quality Control Tests - Upload all Quality Control Reports to Facility Grid. Utilize the organizational method provided by the Commissioning Agent for organizing the Quality Control Reports and upload them accordingly. Report files shall be PDF and shall be appropriately labeled to clearly identify contents. Follow Specification 019113 Section 3.5 – Quality Control and Start-Up Reporting.
11. System and Equipment Start-Up - Schedule, manage and coordinate equipment and systems energization and start-up activities. The Construction Manager/General Contractor is responsible for coordinating each sub-contractor and their vendor to submit all start-up materials for approval, distribute energization plan, schedule associated start-up activities and collect subcontractor record documentation of start-up. System and Equipment Start-Up to be managed according to Specification 019113 Section 3.3 – System and Equipment Start-Up.
12. Pre-Verification Tests - Distribute responsibility of PVT completion to the installing contractors. Verify completion of the PVT's by each contractor assigned responsibility. Regularly report PVT completion status to the Commissioning Agent. Ultimately, the Construction Manager/General Contractor must verify all PVT's have been fully and successfully executed.
13. Functional Performance Tests - Schedule, manage and coordinate the execution of the FPT's by the installing contractors with the Cx Team. The Construction Manager/General Contractor shall be responsible for testing each FPT with the necessary contractors to execute the tests, provide the necessary test equipment and with the Cx Team such that the CxA and any other team members are present to witness the tests. Remedy all contractual deficiencies for non-conformance with contract documents identified through Functional Performance Testing and other verification tests.

### D. Subcontractors

1. Subcontractor responsibilities are mostly outlined herein. Additional Subcontractor responsibilities are found in their individual associated Commissioning Specification for their Division. See specification 019113 Section 1.1 – Related Documents for the list of respective disciplines in addition to the requirements outlined herein.
2. Include commissioning requirements within the individual subcontract for systems to be commissioned as outlined within Specification 019113 Section 1.5 - Systems Included in Commissioning. Ensure full cooperation of all contracting, manufacturing, and testing parties required to participate in commissioning.
3. Include cost for commissioning requirements in the contract price. Include specific line items within the Schedule of Values according to Specification 019113 Section 2.2 – Schedule of Values.
4. Schedule - Provide activities and durations for incorporation into the overall Project Schedule to the Construction Manager/General Contractor as outlined within Specification 019113 Section 2.1 – Project Schedule.
5. Cx Representative - Ensure acceptable representation, with the means and authority to prepare and coordinate execution of the commissioning program as described in the contract documents. Provide one or two representatives to specifically participate in Commissioning Activities and generally participate in the Commissioning Process. Retain these individuals for the duration of the project to ensure full comprehension and understanding of the scope of commissioning. The Primary Commissioning Representative for the Prime Contractor shall not be changed or replaced for the duration of the project.
6. Cx Meetings - Primary Representative shall attend every Commissioning Meeting.
7. Cx Activities - The subcontractors must apprise the Commissioning Agent of various construction activities. These activities include but are not limited to: Mock-Up Inspections, In-Wall Inspections, Above Ceiling Inspections, System Start-up, Equipment

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Start-up, Duct Pressure Tests, Pipe Pressure Tests, Electrical Tests, Pipe Flushing and Cleaning, Completion of Pre-Functional Checklists, readiness for Functional Performance Testing and System Completion.

8. Issues Log - Remedy all contractual deficiencies as outlined within the Commissioning Issues Log. The Commissioning Agent shall issue an updated deficiency log throughout construction based upon site visits, Pre-Functional Checklist completion, Commissioning Meeting topics, Functional Performance Test results or any other commissioning activity.
9. Quality Control Tests – Submit all Quality Control Reports to the Construction Manager/General Contractor for upload to Facility Grid. Report files shall be PDF and shall be appropriately labeled to clearly identify contents. Follow Specification 019113 Section 2.4 – Quality Control Reports.
10. Energization & Start-Up - Schedule and coordinate equipment and systems energization and start-up activities. Communicate activities with the Cx Team, including manufacturers and vendors. Submit all start-up materials for approval, schedule associated start-up activities and submit records of start-up. Energization and Start-Up to be executed according to Specification 019113 Section 3.3 – Systems and Equipment Start-Up.
11. Pre-Verification Tests – Complete responsible portions of every PVT. Verify completion of portions of the PVT's needed to be completed by second tier subcontractors, vendors, manufacturers and/or third-party test agencies.
12. Functional Performance Tests - Coordinate and execute responsible portions of every FPT as done for the PVT's but with the CxA and other members of the Cx Team to witness. Remedy all contractual deficiencies for non-conformance with contract documents identified through Functional Performance Testing and other verification tests.

**1.5 SYSTEMS INCLUDED IN COMMISSIONING**

- A. The following systems are included in Commissioning. Equipment and Descriptions within the table below are a generalized sample description of the system and components. Every component of each system actually included within this project is included within the scope of commissioning. PFC column indicates if PFC's will be provided for the associated system equipment and components. FPT column indicates if functional testing will be performed for the associated system equipment and components.

<b>SYSTEM</b>	<b>EQUIPMENT &amp; DESCRIPTION</b>	<b>FPT</b>
<b>Plumbing Systems</b>		
Stand Alone Plumbing Systems	Eye Wash Systems, Drench Showers, Decon Areas, Sump Pumps, Gray & Harvest Water Systems, Associated Controls	Yes
Domestic Cold Water System	BFP, RPZ, Piping, Pressure Regulators, Fixtures, Booster Pumps, Associated Controls	Yes
Domestic Water Heating System	Lavatories, Sinks, Showers, Mixing Valves, Water Heaters, Pumps, Piping, Associated Controls	Yes
<b>Process Exhaust Systems</b>		
General Exhaust Systems	Exhaust Fans, Ductwork, VFD's, Associated Controls	Yes

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<b>SYSTEM</b>	<b>EQUIPMENT &amp; DESCRIPTION</b>	<b>FPT</b>
Engine Exhaust Systems	Exhaust Fans, Ductwork, VFD's, Associated Controls	Yes
<b>Terminal Equipment</b>		
General Terminal Units	Terminal Units used to support Central Station AHU's, Reheat Coils, Ductwork, Associated Controls	Yes
Terminal AC Components	AC units used to support local climate condition; Humidifiers, Radiators, Unit Heaters, Fan Coils Units, Ceiling Fans, Associated Controls	Yes
<b>Central Station Air Handling Systems</b>		
Energy Recovery Systems	Heat Recovery Wheels, Wrap around Coils, Dedicated AHU's, VFD's, Associated Controls	Yes
Central Air Handling Systems	Custom & Modular AHU's, Supply & Return Fans, VFD's Humidifiers, Ductwork, & Associated Controls	Yes
<b>Packaged Air Conditioning Systems</b>		
Central Air Conditioning Systems	Modular, Packaged, & Rooftop AHU's, Split A/C Systems, Supply & Return Fans, VFD's, Ductwork, & Associated Controls	Yes
Split A/C Systems	Split A/C Systems, Variable Refrigerant Systems, Ductwork, Piping & Associated Controls, etc.	Yes
<b>Instrumentation &amp; Controls</b>		
Energy Management & Control System (EMCS)	Overall Control System Test to verify the interconnected systems are integrated together properly and proper graphics are displayed, Verify Sequences, GUI, Etc.	Yes
Integrated Systems Test	Overall Control and Back-Up Power System Test to verify the operation of all building system through a power outage and restoration.	Yes
<b>Lighting Controls</b>		
Scheduled Lighting Controls	Fixtures, Switches, Timers, Light Sensors	Yes
Occupancy Sensor Controls	Control Panels, Sensors, Fixtures	Yes



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<b>SYSTEM</b>	<b>EQUIPMENT &amp; DESCRIPTION</b>	<b>FPT</b>
Daylight Controls	Fixtures, Switches, Light Sensors, Panels, Controls	Yes

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**1.6 COORDINATION**

- A. Overall Coordination of Commissioning Tasks is the responsibility of the Construction Manager/General Contractor. The Commissioning Agent does not have any direct control over contractors or the construction schedule and therefore, cannot dictate task schedule. However, the Commissioning Agent typically has the most Commissioning Experience and will assist with coordination of Commissioning Tasks by providing input and feedback to the Commissioning Team.
  
- B. The Owner, System Design Professionals, Commissioning Agent, Contractors, Sub-Contractors, Vendors and 3rd Part Test Agencies are all required to assist with Coordination. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.
  
- C. Various tasks included as part of the commissioning process must be coordinated by the Cx Team. These tasks require advance notification by the contractors to the Owner, Designers and Commissioning Agent for planning and participation. Tasks required to be coordinated with the Commissioning Team include but are not limited to:
  - 1. Submittal Reviews
  - 2. Quality Control Plans and Tests
  - 3. Electrical Energization
  - 4. Equipment and Systems Start-Up
  - 5. Third Party Testing
  - 6. Pre-Verification Testing
  - 7. Functional Performance Testing
  - 8. Close-Out Inspections
  - 9. Close-Out Document Review (O&M's, As-Builts, Warranties)
  
- D. The Commissioning Agent is to be considered a Third-Party Test and Inspection Agency. The Commissioning Agent will continue to serve the construction project if the schedule is extended, will repeat site visits and inspections if such activities prove deficiencies and attend additional testing to re-witness previously failed tests. However, these services are not inherently included within the scope of the Commissioning Agent.
  - 1. For these services, the Commissioning Agent will invoice the Owner for additional time required for commissioning activities including additional meetings, additional site visits, or additional witnessing of retests due to failed FPT's. The Commissioning Agent will invoice at an hourly rate (including travel time), plus expenses, and at the Owner discretion this cost can be deducted from the Construction Manager/General Contractor's Application of Payment.
  - 2. The Construction Manager/General Contractor may back charge the party responsible for the schedule extension, additional meetings, additional site visits, additional inspections or re-witnessing of test failure. It is the Construction Manager/General Contractor and Sub-Contractor's responsibility to maintain scheduled, verify completion prior inviting the Commissioning Agent to inspect work, and properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness testing.

**PART 2 - PRODUCTS**

**2.1 PROJECT SCHEDULE**

- A. Construction Manager/General Contractor shall submit the overall project schedule and regular schedule updates to the Commissioning Agent as they are provided to the Owner and Designers, typically on a monthly basis.
- B. Contractor(s) shall be required to incorporate all Commissioning Activities into the overall project schedule. Activities include:
  - 1. Quality Control Tests
  - 2. Electrical Energization Milestones
  - 3. Equipment and Systems Start-Up
  - 4. Third-Party Testing
  - 5. Close-Out Inspections
  - 6. Pre-Verification Tests
  - 7. Functional Performance Tests

**2.2 SCHEDULE OF VALUES**

- A. The Contractor(s) shall include within the Schedule of Values, specific line items to reflect Commissioning progress. For each system to be commissioned as outlined in Specification 019113 Section 1.5 – Systems Included in Commissioning, a line item shall be listed in the Schedule of Values for the following:
  - 1. System Start-Up
  - 2. Third Party Testing
  - 3. Functional Performance Tests
  - 4. Deferred Testing (Trending, Infrared Tests, Seasonal Tests, etc.)
- B. The Contractor(s) shall submit the proposed Schedule of Values to the Commissioning Agent for review. The Commissioning Agent shall review line items relevant to commissioning and systems to be commissioned. Any comments by the Commissioning Agent will be forwarded to the Designers for review and inclusion.

**2.3 SUBMITTALS**

- A. Contractor(s) shall submit all equipment and component submittals to the Commissioning Agent for each of the Systems to Be Commissioned as outlined within this specification section. Any comments by the Commissioning Agent will be forwarded to the Designers for review and inclusion. Submittals to be provided include:
  - 1. Manufacturer's Product Data
  - 2. Manufacturer's Installation Instructions - The Contractor(s) shall provide to the Commissioning Agent installation instructions for every piece of equipment and accessory included as part of a commissioned system.
  - 3. Shop Drawings
  - 4. Coordination Drawings
  - 5. Qualification Data
  - 6. Quality Control and Third-Party Test Reports
  - 7. Start-Up Plan and Equipment Start-Up Reports
  - 8. Controls Calibration Instructions - The Contractor(s) shall provide to the Commissioning Agent calibration instructions for each type of control device to be installed. Submit only

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control device calibration instructions for devices which have been approved by the Designers.

9. Operations and Maintenance Manuals
10. Red-Lines/Record As-Built Documents

### 2.4 QUALITY CONTROL PLAN

- A. The Construction Manager/General Contractor shall assemble a Quality Control Plan which specifically summarizes all of the Quality Control Inspections and Tests within the various specification sections. The Quality Control Plan shall indicate:
  1. Component/Equipment Description
  2. Specification Section
  3. Quality Control Test/Inspection Description
  4. Entity Conducting Quality Control Test/Inspection
  5. Whether the QC activity is required to be Witnessed
    - a. If the QC activity is required to be Witnessed, list the Witness agency
  6. Number of Tests/Inspections to be Conducted
    - a. This Number may increase or decrease as a result of installation progress
  7. Number of Tests/Inspections Conducted and Reports Provided
    - a. Number of Reports Provided must match the Number to be Conducted to indicate the task is complete.
- B. The Quality Control Plan is to be updated regularly to reflect current Number of Tests/Inspection to be Conducted and current Number of Test Reports Provided. Plan to be regularly updated and distributed to the Commissioning Team. See 019113 Section 3.7 – Quality Control Reporting for procedure details.

### 2.5 QUALITY CONTROL REPORTS

- A. Contractor(s) shall submit copies of all inspection and test reports and any additional reports relating to work performed by subcontractors and manufacturers as required by the project specifications. Reports shall include but are not limited to: specialty inspections, pressure tests, leakage tests, flushing and cleaning, chemical treatment, equipment repair, electrical equipment tests, TAB reports, gauge calibration, etc.
- B. Quality Control Reports is detailed throughout each individual system component and equipment specification. At a minimum, each Quality Control Report content shall include:
  1. System and Equipment being inspected or tested
    - a. Partial system/equipment tests must be detailed sufficiently to demonstrate the exact limits of the test. For example, a duct leakage test must identify exactly without question, what section of duct is being tested.
  2. Description of field quality control inspection or test
  3. Date of field quality control inspection or test
  4. Contracting Company executing field quality control inspection or test
  5. Individual Company Representative executing field quality control inspection or test
  6. Inspection or test Pass Criteria
  7. Inspection or test Findings, Readings and Measurements
  8. Inspection or test Results
- C. Quality control reports are to be submitted through the normal submittal procedures, reviewed by the design team and commissioning agents for approval. Reports are to be submitted within two weeks (14 Days) of the quality control activity being executed.

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- D. The final approved reports are to be uploaded to Facility Grid by the Construction Manager/General Contractor. Approved start-up reports are to be uploaded to facility grid within two weeks (14 days) of the approval by the design team via the submittal process. Reports are to be PDF files. PDF files are to be named using the following nomenclature:
  1. [Report Type] – [System] – [Equipment Designation] – [YYYY-MM-DD].pdf

### 2.6 SYSTEMS AND EQUIPMENT START-UP PLAN

- A. The Construction Manager/General Contractor shall work with the various subcontractors to oversee, plan and schedule all system and equipment energization and start-up activities.
- B. The CM/GC will provide a Systems and Equipment Start-Up Plan which details each activity from the first electrical component energization to the last controls component start-up. Each system energization and start-up activity is to be tracked. The plan shall indicate:
  1. Contractor performing Installation
  2. Date of installation complete
  3. Date of energization (power available)
  4. Contractor performing quality control (NETA, TAB, etc.)
  5. Date of Quality Control Testing
  6. Contractor performing start-up
  7. Date of start-up
- C. Systems and Equipment Start-Up Plan shall indicate dependencies, such as equipment start-ups which cannot occur until associated power energization is complete.
- D. The Systems and Equipment Start-Up Plan is to be updated weekly and distributed to the Commissioning Team throughout the Energization and Start-Up phase. See 019113 Section 3.3 – Systems and Equipment Start-Up for procedure details.
- E. Systems and Equipment Start-Up Plan shall show systems and equipment dependent upon Electrical Systems for power. The Plan shall show systems and equipment dependent on Plumbing Systems for water supply. The Plan shall show systems and equipment dependent upon Mechanical Systems for air conditioning and dehumidification as well as other mechanical systems for heat rejection. The Plan shall show systems and equipment dependent upon Communication Systems for integration and automation purposes.

### 2.7 CONTROLS START-UP RECORDS

- A. Controls Start-Up consists of energizing the controls system, uploading programming, verifying each sensing device reports back to the controls system correctly (point-to-point), verifying each modulating device is controlled by the control system correctly (point-to-point), verifying each sensor is correctly calibrated, and each control PID loop is correctly tuned. As such reports for these activities are to be submitted to ensure they have been performed completely.
- B. Controls Start-Up Records are to be formally submitted and once approved, posted to Facility Grid. See 019113 section 2.5 - Quality Control Reports for details.
- C. Calibration Records
  1. All controls devices, meters and gages require a Calibration Record including those that cannot be field calibrated. Calibration Records for devices that reportedly cannot be Field Calibrated must include device comparison readings to a Calibrated Hand-Held Device.
  2. Calibration records are to be submitted, reviewed and approved. Approved calibration records are to be uploaded to Facility Grid for the final commissioning records.

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Alternatively, calibration measurements may be recorded on the associated PVT form if fields are available.

- D. Point-to-Point Checkout
  - 1. All controls points require Point-to-Point Records where each device is individually checked to report back to the controls front end for correct labeling, value and representation.
  - 2. Point-to-Point Reports are to be submitted, reviewed and approved. Approved point-to-point records are to be uploaded to Facility Grid for the final commissioning records. Alternatively, point-to-point tests may be recorded on the associated PVT form if fields are available.
- E. Loop Tuning
  - 1. Controls PID loops all require individual tuning to verify correct response, minimal overshooting and zero hunting by the controls system. Loop tuning records list the final PID values as determined by the controls programmer.
  - 2. PID Loop Tuning Reports are to be submitted, reviewed and approved. Approved loop tuning records are to be uploaded to Facility Grid for the final commissioning records. Alternatively, loop tuning tests may be recorded on the associated PVT form if fields are available.

### 2.8 START-UP REPORTS

- A. Contractor(s) shall submit copies of all equipment start-up reports for every system to be commissioned. Start-up reports are to be completed as required by various equipment specifications. Start-up is to be performed by certified technicians, contractors or manufacturers as required. Start-up technician is to complete report which identifies checklist items, procedures and readings performed at start-up. Reports include the name and company of the start-up technician, contact information and date of activities.
- B. Start-up reports are to be submitted through the normal submittal procedures, reviewed by the design team and commissioning agents for approval. Reports are to be submitted within two weeks (14 days) of the start-up activity.
- C. The final approved start-up reports are to be uploaded to Facility Grid by the Construction Manager/General Contractor. Approved start-up reports are to be uploaded to facility grid within two weeks (14 days) of the approval by the design team via the submittal process. Reports are to be PDF files. PDF files are to be named using the following nomenclature:
  - 1. Start-Up Report – [System] – [Equipment Designation] – [YYYY-MM-DD].pdf

### 2.9 PREVENTATIVE MAINTENANCE PLAN

- A. Equipment and Systems are not to be utilized during construction for temporary means in order to support construction activities or other systems starting up. The Construction Manager/General Contractor shall plan for temporary equipment to perform such functions. Temporary equipment may include temporary power, water supplies, portable HVAC equipment, etc.
- B. In the event the Owner grants special permission to allow temporary operation of equipment or systems to support construction activities or the start-up of other systems or equipment, such permission must be delivered in writing to be included within the Project Records. The temporarily operating systems and equipment must be thoroughly maintained and maintenance records kept. The Construction Manager/General Contractor shall provide a Preventative

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Maintenance Plan for each System/Equipment to be energized for temporary purposes. The Preventative Maintenance Plan shall include the following at a minimum:

1. System/Equipment to be operated
2. Responsible Contracting Company who owns and will operate the system/equipment
3. Responsible Individual for that Company who is specifically responsible.
4. Dates for Temporary Use identifying the entire planned operational duration.
5. Operating Schedules and Modes of Operation to identify if the system/equipment is to be regularly started and stopped or if it will change modes based on time of day or temperatures, etc.
6. Temporary Protection means to protect the equipment and systems and keep them in Like-New conditions.
7. Observation plan detailing regular review of operating systems and equipment to ensure nothing has impacted systems or equipment and same are operating as prescribed under Operating Schedules and Modes of Operation above. It is recommended systems and equipment be observed on a daily basis. Personnel assigned to regularly review the systems and equipment shall be documented and logged as having done so per the approved plan.
8. Regular Maintenance Requirements, extracted directly from system/equipment O&M Manual. Referenced O&M to be included in the Preventative Maintenance Plan. Requirements will be listed on a Daily, Weekly, Monthly, Quarterly, Yearly, etc. basis. Examples include visual inspections, oil changes, filter changes, etc.
9. Maintenance Schedule identifying the first day of system/equipment start-up and based upon this, the actual dates for the Daily, Weekly, Monthly, Yearly, etc. when the required maintenance tasks are to take place.
10. Include Maintenance Record Forms in the Preventative Maintenance Plan. Maintenance Records document that every maintenance task has occurred. Maintenance Records must include a checklist for each Daily, Weekly, Monthly, Yearly, list of maintenance requirements. Any measurements or readings must be recorded on the Maintenance Record as required by the task list. The Maintenance Record must have a space for the Company Name, Individual Name and Date for who and when the maintenance was performed.
11. Include Warranty Plan within Preventative Maintenance Plan which identified the warranty requirements for the systems and equipment to be operated. The Warranty Plan must identify the start and end dates of the warranty such that the full duration of the required warranty coverage is provided beginning at the final acceptance of the project. The Warranty Plan intent is to demonstrate how the Manufacturer's Warranty will not begin until final acceptance, despite an early start-up or temporary utilization. Or how an extended Warranty is included to ensure the full duration of the warranty exists starting after final acceptance.
12. Full warranty start dates must occur upon final project acceptance. Any vendors or manufacturers who start their warranty upon the start-up of the equipment for use, whether temporary or not, must provide extended warranties such that the full contract warranty is provided upon final acceptance. Warranty plans, warranty start-dates and/or extended warranties must be formally submitted to the Commissioning Team prior to approval for temporary utilization or final acceptance.

### 2.10 PRE-VERIFICATION TESTS

- A. PVT's are identical copies of the Functional Performance Tests. PVT's are FPT versions created for the Contractor's use in pre-testing the various Commissioned Systems. Where FPT's include sections for spot-checking system components, PVT's will include full test sections for 100% component testing. On Facility Grid, Contractors will have access to complete the PVT's but will not have access to complete the FPT's.
- B. See Functional Performance Tests for more PVT content description.

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### 2.11 FUNCTIONAL PERFORMANCE TESTS

- A. Functional Performance Tests (FPT) shall be provided for every system included within the systems outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning. Systems may be split into several FPT's at the discretion of the Commissioning Agent to facilitate efficient testing.
- B. It is the contractor's responsibility to estimate the extent and depth of the FPT requirements, based upon the level of involvement required to test the entire system.
- C. Each system FPT shall consist of a multitude of operational procedures which shall encompass all operational procedures for which that system is required to be capable of performing per the contract documents. Each FPT is customized for each system according to the specifications, contract drawings and equipment submittals.
- D. It is the contractor's responsibility to estimate the extent and depth of the FTP requirements, based upon the level of involvement required to perform each individual sequence of operations. Each contractor shall be responsible for providing a cost associated with Functional Performance Testing based upon this extent and depth.
  1. Functional Performance Tests shall be composed of a very detailed series of step-by-step procedures required to be performed by the installing contractors in order to prove the sequence of operations has been properly met according to the construction documents.
  2. FPT's shall include functional test procedures for each operational piece of equipment within a system. Each piece of equipment shall be individually tested for correct operation and load capabilities according to the contract documents. These shall be tested by both the remote BAS control system as well as any localized controls. Local controls may range from a fully programmable control panel down to a simple disconnect switch. Equipment which has been adjusted by the TAB contractor shall be tested against the information provided by the TAB Contractor within the TAB Report. Certain parameters may be required for Functional Performance Testing which are not fully encompassed within the Test, Adjustment and Balance scope if these parameters are essential for verifying equipment operational characteristics or performance.
  3. Every sequence of operation shall be tested as identified within the contract documents. Various sequence requirements are outlined within the project specifications and several requirements are outlined within the contract drawings. Sequences tested shall verify equipment integration and overall system performance. Items identified during system testing include correct order of operations and system efficiencies. System sequence of operations testing shall test every sequence of operations for every case-scenario possible. Each sequence of operations shall be tested for each piece of redundant equipment. Each sequence of operations which has a reverse process shall be tested through the reverse process. Sequence of operations test shall encompass all controls devices as well as all major equipment.
  4. Each auxiliary system requirement shall be tested as identified within the contract documents. Various auxiliary requirements are outlined within the project specifications and several requirements are outlined within the contract drawings. Auxiliaries tested shall verify system alarms, notifications and operation of auxiliary equipment. Equipment failures shall be tested to verify system response. Sub-systems to large systems which have not been functionally tested elsewhere shall be tested, such as a refrigerant pump-out system to a chilled water system.
  5. Redundant Equipment – A Functional Performance Test shall be provided to test every piece of redundant equipment. However, all redundant equipment shall not necessarily be retested as part of the FPT's and witnessed by the Commissioning Agent. Rather, the Commissioning Agent will randomly select redundant equipment to be tested. See specification 019113 section 3.10-H for additional information regarding Functional Performance Testing of redundant equipment.

## SECTION 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS

### 2.12 TEST AND PROPRIETARY EQUIPMENT

- A. All industry standard test equipment required for performing the specified tests shall be determined by the Contractor as needed to complete the Controls Start-Up, Equipment Start-Up, Systems Start-Up, Pre-Verification Tests and Functional Performance Tests. Any proprietary vendor specific test equipment shall be provided by that vendor or manufacturer.
- B. Any portable or hand-held setup / calibration devices required to initialize the control system shall be made available by the Contractor to the Commissioning Team for PVT and FPT execution.
- C. The instrumentation provided by the contractor shall meet the following standards:
  - 1. Be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required.
  - 2. Be calibrated at the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument
  - 3. Be maintained in good repair and operating condition throughout the duration of use on this project.
  - 4. Be immediately replaced if dropped and/or damaged in any way during use on this project.
- D. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed.
- E. Proprietary test equipment (and software) needed for regular operation, settings adjustment, service and maintenance intended to be performed by the Owner's O&M Staff shall be included within the scope of this project to be turned over and become the property of the Owner upon completion of the project.

### PART 3 - EXECUTION

#### 3.1 COMMISSIONING PLAN AND KICK-OFF MEETING

- A. Each Contractor is to provide the contact information for their Commissioning Representatives. The Commissioning Agent will add each Commissioning Representative to the online Commissioning database Facility Grid. Some team members may have previously utilized Facility Grid and in their case will have existing login credentials. For those new to Facility Grid, new credentials will need to be set-up by each team member upon their first login attempt. RMF will confirm once every Contractor's Representative has setup their Facility Grid account.
- B. The Commissioning Agent will distribute the Draft Commissioning Plan to the Commissioning Team once these contacts are identified. The Plan will be distributed utilizing Facility Grid. The CxA will post the Plan to Facility and send notifications to the Commissioning Team which will include a link to the document.
- C. The Commissioning Kick-Off Meeting will be held and attended by all Contractors Commissioning Representatives involved in the commissioning process. The Draft Commissioning Plan will be reviewed at this meeting outlining the specific commissioning process for this project, the overall project schedule and scheduled commissioning activities and the names and contact information of each of the Commissioning Representatives. The



## **SECTION 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS**

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CxA will not print a copy of the Cx Plan for every attendee. Rather, each attendee is welcome to print their own copy and the CxA will review the Cx Plan via a presentation screen.

- D. After the Commissioning Kick-Off Meeting, the Commissioning Plan will be updated based upon the discussions at the Commissioning Kick-Off Meeting if any changes are required. The Final Commissioning Plan will be issued soon after the meeting.

### **3.2 CONSTRUCTION OBSERVATIONS**

- A. The Architect and System Design Professional(s) shall make standard construction inspection site visits as required by their respective contracts with the Owner. The Designers are the official inspectors of record for in-wall, above-ceiling and final inspections.
- B. The Commissioning Agent will additionally perform construction observations throughout the project construction phase. The Commissioning Agent will coordinate these site visits with the Construction Manager/General Contractor. Site visits will include progress reporting, observed means and methods, as well as observed deficiencies.
- C. The Construction Manager/General Contractor is responsible for notifying the Designers and Commissioning Agent of upcoming commissioning activities such that they may schedule their upcoming site visits to coincide with said activities. Activities include quality control tests, in-wall and above-ceiling inspections, start-ups, etc.
- D. The Commissioning Agent will provide a Report for each Site Visit which identifies what was observed as well as any deficiencies. Deficiencies will be listed on the associated Site Visit Report and logged on the Issues Log for tracking.

### **3.3 SYSTEMS AND EQUIPMENT START-UP**

- A. The Construction manager/General Contractor shall oversee, plan and schedule all system energization and start-up activities with continuous reporting and updating to the entire Commissioning Team.
- B. The CM/GC will provide a Systems and Equipment Start-Up Plan which details each activity from the first electrical energization to the final component start-up. See 019113 Section 2.7 – Systems and Equipment Start-Up Plan for plan content requirements.
- C. Systems and Equipment Start-Up Plan to be submitted for formal review a minimum of sixty (60) calendar days prior to the first anticipated energization or start-up activity. This allows for at least two (2) formal reviews before energization and start-up activities begin. Submission of a schedule which shows energization or start-up occurring within sixty (60) days shall be adequate reason for revision of this submittal.
- D. Starting one (1) week prior to the first scheduled energization activity, the Systems and Equipment Start-Up Plan is to be updated and distributed to the Commissioning Team. Upon the beginning of Energization and Start-Up activities, the Systems and Equipment Start-Up Plan shall be updated on weekly basis. Each activity and dependent activity must be updated accordingly. The CM/GC will continuously update the Systems and Equipment Start-Up Plan and distribute the updated plan to the Commissioning Team throughout the completion of energization and start-up.
- E. The Construction Manager/General Contractor shall oversee the energization of the electrical systems of the building and coordinate such with all equipment and system start-ups.

## SECTION 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS

Equipment and System start-ups cannot occur until the electrical system supporting their associated power are complete, tested and approved for energization by the Designers and any AHJ Inspections. Once the Designers and AHJ have inspected and approved the electrical systems for energization, they may be energized thus allowing equipment and systems start-up to commence. With a large building, energization will undoubtedly be staggered. Therefore, this energization is to be coordinated with the various pieces of equipment and systems such that associated parts and pieces may be successfully energized according to plan and schedule.

- F. The Construction Manager/General Contractor shall oversee the energization of the plumbing systems of the building and coordinate such with all equipment and system start-ups. The Plumbing Systems often support various hydronic Mechanical Systems and equipment such that those hydronics systems can only be energized to run continuously for tuning, adjustment or temporary operation if the associated plumbing system is energized and fully functional. Therefore, this energization is to be coordinated with the various pieces of equipment and systems such that associated parts and pieces may be successfully energized according to plan and schedule.
- G. The Construction Manager/General Contractor shall oversee the energization of the mechanical systems of the building and coordinate such with all equipment and system start-ups. The Mechanical Systems often support various Electrical and Telecommunication Systems and equipment such that they can only be energized to run continuously if air conditioning of sensitive equipment spaces is provided. Therefore, this energization is to be coordinated with the various pieces of equipment and systems such that associated parts and pieces may be successfully energized according to plan and schedule. Additionally, special approval is needed to energize these systems prior to Substantial Completion. See Specification 019113 Section 3.4 – Temporary Utilization for more information.
- H. Upon completion of each Energization and Start-Up Activity, the responsible Contractor shall formally submit through the General Contractor/Construction Manager a record of the activity. Equipment and System Start-Up Reports shall be submitted within fourteen (14) calendar days of the associated start-up activity execution.
- I. Approved Reports are to be posted to Facility Grid by the Construction Manager/General Contractor as PDF files within fourteen (14) calendar days of the submittal approval utilizing the following file naming convention where the date of the file is the date of the executed activity:
  1. [Report Type] – [System] – [Equipment Designation] – [YYYY-MM-DD].pdf

### 3.4 TEMPORARY UTILIZATION

- A. No new or final equipment or systems are to be utilized for Temporary means by the Construction Management, General Contractors or Subcontractors. Temporary utilization is generally not allowed and any temporary power, HVAC, plumbing, internet, etc. shall be provided as a temporary system by the Contractors. Temporary utilization of any new, permanent systems or equipment must be formally requested by the Contractors via the formal submittal process and must include a Preventative Maintenance Plan. See 2.10 – Preventative Maintenance Plan for plan content requirements.
- B. Perform regular observations of temporary operating systems and equipment. Document and log observations as prescribed in the approved Preventative Maintenance Plan with personnel performing observation, observations results and date of observations.
- C. Perform regular maintenance activities on temporary operating systems and equipment as prescribed by the approved Preventative Maintenance Plan. Document and log maintenance activities utilizing forms within the Plan.

## SECTION 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS

- D. Records must be maintained to demonstrate full compliance with the approved Preventative Maintenance Plan. Without full records for any or all components of a system, may result in deficiencies preventing acceptance of those systems or components.
- E. It is ultimately the contractors responsibility to turn over to the owner, equipment and systems in New condition. Any wear, tear or other damage to systems and equipment during the construction process, whether a result of temporary use, lack of maintenance or other, is the contractors responsibility to remedy.
- F. Full warranty start dates must occur upon final project acceptance. Any vendors or manufacturer's who start their warranty upon the start-up of the equipment for use, whether temporary or not, must provide extended warranties such that the full contract warranty is provided upon final acceptance. Warranty plans, warranty start-dates and/or extended warranties must be formally submitted to the Commissioning Team prior to approval for temporary utilization or final acceptance.

### 3.5 QUALITY CONTROL REPORTING

- A. The Construction Manager/General Contractor shall work with the various subcontractors to oversee, plan and schedule all field quality control tests with continuous reporting and updating to the entire Commissioning Team.
- B. The CM/GC will provide a Quality Control Plan which details each activity from the first electrical test to the final electrical component energization. See 019113 Section 2.4 – Quality Control Plan for plan content requirements.
- C. The CM/GC will ensure all Quality Control Reports are generated for every Quality Control Inspection and Test which details each activity. See 019113 Section 2.5 – Quality Control Reports for minimum report content requirements.
- D. Quality Control, Third-Party Test and Start-Up Reports are to be submitted to the entire Construction Team via the agreed upon submittal routing method. These reports are to be submitted to the Team within fourteen (14) calendar days of the execution of the associated activity. Similar tests are to be submitted individually. Similar reports may be grouped together and submitted as a package only upon the approval of the Commissioning Team. Every report is to be formally reviewed by the Designers and Commissioning Agent for approval.
- E. Approved Reports are to be posted to Facility Grid by the Construction Manager/General Contractor as PDF files within fourteen (14) calendar days of the submittal approval utilizing the following file naming convention where the date of the file is the date of the executed activity:
  1. [Report Type] – [System] – [Equipment Designation] – [YYYY-MM-DD].pdf

### 3.6 PRE-VERIFICATION TESTS

- A. Pre-Verification Tests (PVT's) shall be issued by the Commissioning Agent to the Commissioning Team. PVT's shall be submitted, reviewed and completed on the commissioning database website Facility Grid.
- B. Subcontractors, Vendors, Manufacturers and Third-Party Test Agencies complete the PVT's under the direction and coordination of the Construction Manager/General Contractor.
- C. PVT's are to be fully and successfully completed prior to scheduling FPT's. All issues discovered while performing a particular PVT are to be corrected such that the PVT can be

## SECTION 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS

successfully completed prior to scheduling the associated FPT. The Commissioning Team is to be given a minimum of seven (7) calendar days notice of the completion of the PVT for any given system prior to the scheduled start of the associated Functional Performance Test.

### 3.7 FUNCTIONAL PERFORMANCE TESTS

- A. Functional Performance Tests (FPT) shall be issued by the Commissioning Agent after the associated submittals have been reviewed and approved. FPTs will be distributed to the Commissioning Team via electronic website database called Facility Grid.
- B. FPT's shall not require an extension of the project schedule but shall be integrated into the original overall Master Project Schedule. FPT's require no additional installation work above and beyond the scope of the contract documents. FPT's generally include a repeat of quality control checks already required by the construction documents.
- C. FPT's may be reviewed and commented on by the Commissioning Team. Comments must be received within thirty (30) calendar days of the FPT being generated on Facility Grid. FPT's may be modified slightly during the execution of the PVT's. However, once FPT's have begun to be filled out by the Commissioning Agent, the FPT's will not be further revised. Any necessary changes to the FPT must be reported to the Commissioning Team a minimum of seven (7) calendar days prior to the scheduled beginning of the associated FPT. Changes must be minor enough to be effected within the seven (7) day period.
- D. Means and Methods – Upon the posting of each Functional Performance Test to Facility Grid, the contractor shall be responsible for reviewing all steps and procedures within, to verify each test is congruent to the applicable system as installed. The contractor is responsible for updating the Commissioning Team with any issues or discrepancies found with the Functional Performance Test. This includes means and methods. It is ultimately up to the contractor to determine the safest way to perform each test. Any devices, sequences or alarms thought to be “un-testable” must be reported to the Commissioning Team during the agreed upon FPT Review Period.
- E. Functional Performance Tests are to be executed by the installing contractors, vendors, manufacturers or third-party test agencies and witnessed by the Commissioning Agent. The entire Commissioning Team is also to be apprised of the test schedule with the option of witnessing testing. Functional Performance Testing is not to be executed by parties who are not responsible for the installations or have direct knowledge of the installations and operation of the system.
- F. Upon the beginning of FPT execution, changes or procedures not already corrected but not capable of testing will result in FPT failures, possible termination of FPT execution as determined by the Commissioning Team, project delays and retesting. Costs associated with any delays, retesting or other work resulting from such test failures will be directed to the party responsible for not bringing these issues to the Commissioning Team in advance. See specification 019113 section 1.6-D for additional information.
- G. Test Two Times – The contractor must account for performing each Functional Performance Test two (2) times. The Functional Performance Test is duplicated on Facility Grid. The version to be executed by the Contractors without witnessing by the Commissioning Team is called the Pre-Verification Test. These are identical to the Functional Performance Tests and must be completed by the Contractors prior to scheduling the Functional Performance Tests which is to be witnessed by the Commissioning Team. See 019113 Section 2.11 – Pre-Verification Tests

## SECTION 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS

- H. The contractor shall be responsible for testing every piece of equipment to verify correct operation via the PVT's. However, all redundant equipment shall not necessarily be retested as part of the FPT's and witnessed by the Commissioning Agent. Rather, the Commissioning Agent will randomly select redundant equipment to be tested at a test rate of twenty percent (20%), rounded up.
1. i.e. If there are twenty-one (21) pieces of equipment, four (4) pieces of equipment would be 19% and five (5) pieces would be 24%, since 19% is less than 20%, five (5) pieces of equipment would be tested. This is how the random redundant testing should be estimated.
  2. Equipment to be sampled shall be chosen at random by the Commissioning Agent, during functional testing. A failure of five percent (5%) or more of the randomly selected equipment shall indicate improper installation, start-up or tuning. This will result in the test being considered a failure.
  3. Upon failure of a system consisting of a random sampling, the full test will have to be repeated on a new random selection of equipment. Prior to retesting with the Commissioning Team, the entire collection of 100% of the equipment must be revised by the Contractors and a new, revised, updated PVT submitted. Upon receipt of the revised PVT, the FPT can once again be rescheduled.
  4. Upon failure of the same system twice, the random selection of the equipment will double (x2) to forty percent (40%). Upon failure of the same system three times, the random selection of the equipment triple (x3) to sixty percent (60%.) A fourth failure will require 100% of the system to be witnessed by the Commissioning Agent. The cost associated with this retesting including contractors and Commissioning Agents costs will be passed along to the responsible contractor. See specification 019113 section 1.6-D for additional information.

### 3.8 TAB VERIFICATION

- A. The Test, Adjustment and Balance (TAB) Contractor has several Quality Control Report requirements.
1. The TAB Contractor may be required to perform Duct Leakage testing.
  2. The TAB Contractor is required to provide a Qualifications Submittal.
  3. The TAB Contractor is required to provide a TAB Plan to identify their approach to the very specific systems within this project.
  4. The TAB Contractor is required to inspect the system installations and provide Inspection Reports prior to beginning actual field adjustments and measurements to ensure there are no deficiencies which will impair TAB from performing their work successfully.
- B. The Test, Adjustment and Balance Report is to be spot-checked by the Commissioning Agent. The TAB Contractor shall be required to repeat measurements selected by the Commissioning Agent to confirm the accuracy of the submitted report. See Specification 230800 – Commissioning of Mechanical Systems for details. TAB Verification shall be included within the scope of the Functional Performance Testing. See Specification 019113 – 3.8-H for details regarding redundant equipment spot-check tests.

### 3.9 INTEGRATED SYSTEMS TEST

- A. The Construction manager/General Contractor shall organize, plan and oversee the execution of an Integrated Systems Test (IST.) The IST is conducted by a full building power outage test, typically occurring at the primary service transformer. Often the utility company must accommodate the power disconnection. The Commissioning Team will agree on the power termination means and methods.

## SECTION 01 91 13 – GENERAL COMMISSIONING REQUIREMENTS

- B. The IST generally consists of verifying all of the building systems work together in harmony. During the power outage and restoration, every individual system is reviewed and analyzed for performance. The Commissioning Team will agree on participation requirements to verify each individual system component.
- C. The Integrated system Test is to be scheduled to occur after all other functional testing is complete and issues resolved. The IST is the final building functional test.

### 3.10 OPERATIONS AND MAINTENANCE MANUALS

- A. The Contractors will submit all O&M Manuals on a timely basis, individually within thirty (30) calendar days after the approval of the associated product and shop drawing submittals. O&M Manuals are to be formally submitted for review by the entire Commissioning Team.
- B. O&M's are to be retained and maintained by the Construction Manger/General Contractor and ultimately assembled into a full project record O&M collection. The final O&M collection is to be submitted for approval once every individual O&M has been reviewed and approved and the associated systems have been functionally tested such that the systems are reported to be accepted by the Designers and Commissioning Agent. The final O&M submission will include organized O&M's and associated table of contents, whether they are provided as hard copies or electronic copies.

### 3.11 EXCLUSIONS

- A. Means and methods – The Commissioning Agent is not responsible for construction means, methods, job safety, or any construction management functions on the job site.
- B. Hands-on work – The Commissioning Agent shall not perform any hands-on work or be otherwise responsible for the execution of any installation or test item. The contractors shall provide all services requiring tools or the use of tools to start-up, test, adjust, or otherwise bring equipment and systems into a fully operational state. The Commissioning Agent shall coordinate and observe these procedures (and may make minor adjustments), but shall not perform construction or technician services other than verification of testing, adjusting, balancing, and control functions.

### 3.12 PREREQUISITES TO SUBSTANTIAL COMPLETION

- A. All commissioning of Systems Included in Commissioning must be complete prior to Substantial Completion. Prerequisites include for all systems, but are not limited to:
  1. Completed and signed Quality Control and Start-Up Reports
  2. Final approved TAB Report
  3. Completion of all Functional Testing (with the exception of limited deferred testing.)
  4. Completed and approved Training of Owner personnel
  5. Submitted and approved final O&M Manual submission
  6. All identified deficiencies have been corrected as reported by the Designers, Commissioning Agents, Third-Party Test or Inspection Agencies and the Owner.
- B. Deferred Testing – Exceptions to this will be identified during the Acceptance Phase if any part of the Functional Testing cannot be conducted due to reasons outside of the Contractors control, such as weather. Additionally, some tests may be deferred due to occupancy requirements such as post occupancy electrical component thermal imaging.

## **SECTION 01 91 13 – GENERAL COMMISSIONING REQUIRMENTS**

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- C. The Owner's Project Manager will determine the date of Substantial Completion and Final Acceptance after reviewing the Commissioning Agent's recommendations.
- D. Commissioning activities are non-compensable and cannot be a cause for delay claims. Failure of the contractors to complete all work, including commissioning activities, in a timely manner resulting in overall project delays shall be the fault of the contractor.

**END OF SECTION 01 91 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Cast-in-place concrete and grout.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 15 19 - Anchorage to Concrete.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Concrete Institute (ACI):
    - a. 117, Specification for Tolerances for Concrete Construction and Materials.
    - b. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
    - c. 212.3R, Chemical Admixtures for Concrete.
    - d. 304R, Guide for Measuring, Mixing, Transporting, and Placing Concrete.
    - e. 304.2R, Placing Concrete by Pumping Methods.
    - f. 305.1, Hot Weather Concreting.
    - g. 306.1, Cold Weather Concreting.
    - h. 318, Building Code Requirements for Structural Concrete.
    - i. 347, Guide to Formwork for Concrete.
    - j. CT-13, Concrete Terminology.
  - 2. ASTM International (ASTM):
    - a. A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
    - b. A185, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
    - c. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
    - d. A1064, Standard Specification for Steel Wire and Welded Wire Replacement, Plain and Deformed, for Concrete.
    - e. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
    - f. C33, Standard Specification for Concrete Aggregates.
    - g. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
    - h. C94/C94M, Standard Specification for Ready-Mixed Concrete.
    - i. C138, Standard Method of Test for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
    - j. C143, Standard Test Method for Slump of Hydraulic Cement Concrete.
    - k. C150, Standard Specification for Portland Cement.
    - l. C172, Standard Practice for Sampling Freshly Mixed Concrete.
    - m. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
    - n. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
    - o. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
    - p. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
    - q. C494, Standard Specification for Chemical Admixtures for Concrete.



## **SECTION 03 00 05 - CONCRETE (CONDENSED FORM)**

- r. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
  - s. C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
  - t. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
  - u. D882, Standard Test Method for Tensile Properties of Thin Plastic Sheet.
  - v. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
  - w. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
  - x. D1709, Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
  - y. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - z. E96, Standard Test Methods for Water Vapor Transmission of Materials.
  - aa. E329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
3. Corps of Engineers (COE):
- a. CRD-C621, Standard Specification for Packaged, Dry, Hydraulic-Cement Grout (Nonshrink).
4. National Ready Mixed Concrete Association (NRMCA).
5. National Sanitation Foundation (NSF):
- a. 61, Drinking Water System Components - Health Effects.
- B. Quality Control:
- 1. Concrete testing agency:
    - a. Contractor to employ and pay for services of a testing laboratory to:
      - 1) Perform materials evaluation.
      - 2) Design concrete mixes.
    - b. Concrete testing agency to meet requirements of ASTM E329.
  - 2. Do not begin concrete production until proposed concrete mix design has been approved by Engineer.
    - a. Approval of concrete mix design by Engineer does not relieve Contractor of his responsibility to provide concrete that meets the requirements of this Specification.
  - 3. Adjust concrete mix designs when material characteristics, job conditions, weather, strength test results or other circumstances warrant.
    - a. Do not use revised concrete mixes until submitted to and approved by Engineer.
  - 4. Perform structural calculations as required to prove that all portions of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its own weight plus the loads placed thereon.
- C. Qualifications:
- 1. Ready mixed concrete batch plant certified by NRMCA.
  - 2. Formwork, shoring and reshoring for slabs and beams except where cast on ground to be designed by a professional engineer currently registered in the state where the Project is located.

### **1.3 DEFINITIONS**

- A. Per ACI CT-13 except as modified herein:
- 1. Concrete fill: Non-structural concrete.
  - 2. Concrete Testing Agency: Testing agency employed to perform materials evaluation, design of concrete mixes or testing of concrete placed during construction.

## **SECTION 03 00 05 - CONCRETE (CONDENSED FORM)**

3. Exposed concrete: Exposed to view after construction is complete.
4. Indicated: Indicated by Contract Documents.
5. Nonexposed concrete: Not exposed to view after construction is complete.
6. Required: Required by Contract Documents.
7. Specified strength: Specified compressive strength at 28 days.
8. Submitted: Submitted to Engineer.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
  1. Concrete mix designs proposed for use.
    - a. Concrete mix design submittal to include the following information:
      - 1) Sieve analysis and source of fine and coarse aggregates.
      - 2) Test for aggregate organic impurities.
      - 3) Test for deleterious aggregate per ASTM C1293.
      - 4) Proportioning of all materials.
      - 5) Type of cement with mill certificate for cement.
      - 6) Type of fly ash with certificate of conformance to specification requirements.
      - 7) Slump.
      - 8) Air content.
      - 9) Brand, type, ASTM designation, and quantity of each admixture proposed for use.
      - 10) 28-day cylinder compressive test results of trial mixes per ACI 318 and as indicated herein.
    2. Product technical data including:
      - a. Acknowledgement that products submitted meet requirements of standards referenced.
      - b. Manufacturer's installation instructions.
      - c. Manufacturers and types:
        - 1) Joint fillers.
        - 2) Curing agents.
        - 3) Chemical sealer.
        - 4) Bonding and patching mortar.
        - 5) Construction joint bonding adhesive.
        - 6) Nonshrink grout with cure/seal compound.
        - 7) Waterstops.
    3. Reinforcing steel:
      - a. Show grade, sizes, number, configuration, spacing, location and all fabrication and placement details.
      - b. In sufficient detail to permit installation of reinforcing without having to make reference to Contract Drawings.
      - c. Obtain approval of Shop Drawings by Engineer before fabrication.
      - d. Mill certificates.
    4. Scaled (minimum 1/8 inches per foot) drawings showing proposed locations of construction joints, control joints, expansion joints (as applicable) and joint dimensions.
    5. Strength test results of in place concrete including slump, air content and concrete temperature.
    6. Certifications:
      - a. Certification of standard deviation value in psi for ready mix plant supplying the concrete.
      - b. Certification that the material and sources submitted in the mix design will be used in the concrete for this project.
    7. Test reports:
      - a. Cement mill reports for all cement to be supplied.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Storage of Material:
  - 1. Cement and pozzolan:
    - a. Store in moistureproof, weathertight enclosures.
    - b. Do not use if caked or lumpy.
  - 2. Aggregate:
    - a. Store to prevent segregation and contamination with other sizes or foreign materials.
    - b. Obtain samples for testing from aggregates at point of batching.
    - c. Do not use frozen or partially frozen aggregates.
    - d. Do not use bottom 6 inches of stockpiles in contact with ground.
    - e. Allow sand to drain until moisture content is uniform prior to use.
  - 3. Admixtures:
    - a. Protect from contamination, evaporation, freezing, or damage.
    - b. Maintain within temperature range recommended by manufacturer.
    - c. Completely mix solutions and suspensions prior to use.
  - 4. Reinforcing steel: Support and store all rebars above ground.
  
- B. Delivery:
  - 1. Concrete:
    - a. Prepare a delivery ticket for each load for ready-mixed concrete.
    - b. Truck operator shall hand ticket to Owner's Representative at the time of delivery.
    - c. Ticket to show:
      - 1) Mix identification mark.
      - 2) Quantity delivered.
      - 3) Amount of each material in batch.
      - 4) Outdoor temp in the shade.
      - 5) Time at which cement was added.
      - 6) Numerical sequence of the delivery.
      - 7) Amount of water added.
  - 2. Reinforcing steel:
    - a. Ship to jobsite with attached plastic or metal tags with permanent mark numbers.
    - b. Mark numbers to match Shop Drawing mark number.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
  - 1. Nonshrink, nonmetallic grout:
    - a. Sika "SikaGrout 212."
    - b. Euclid Chemical "NS Grout."
    - c. Master Builders Solutions "Masterflow 713."
  - 2. Expansion joint fillers:
    - a. Permaglaze Co.
    - b. Rubatex Corp.
    - c. Williams Products, Inc.
  - 3. Waterstops, Preformed - Strip-Type:
    - a. Greenstreak (Hydrotite).
    - b. Adeka Ultra Seal (2010MN).
    - c. DeNeef (Swellseal Plus).

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4. Synthetic fibers.
  - a. GCP Applied Technologies, Inc.
  - b. Master Builders Solutions.
  - c. Euclid Chemical Company.
5. Form coating:
  - a. Richmond "Rich Cote."
  - b. Industrial Lubricants "Nox-Crete Form Coating."
6. Cementitious concrete coating:
  - a. Aquafin International.
  - b. Master Builders Solutions.
  - c. Euclid Chemical Company.
7. Chemical sealer:
  - a. L&M Construction Chemicals, Inc.
  - b. Euclid Chemical Company.
  - c. Dayton Superior.

**2.2 MATERIALS**

- A. Portland Cement: Conform to ASTM C150 Type I/II.
- B. Fly Ash:
  1. ASTM C618, Class F or Class C.
  2. Nonstaining.
    - a. Hardened concrete containing fly ash to be uniform light gray color.
  3. Maximum loss on ignition: 4 %.
  4. Compatible with other concrete ingredients.
  5. Obtain proposed fly ash from a source approved by the State Highway Department in the state where the Project is located for use in concrete for bridges.
- C. Admixtures:
  1. Air entraining admixtures: ASTM C260.
  2. Water reducing, retarding, and accelerating admixtures:
    - a. ASTM C494 Type A through E.
    - b. Conform to provisions of ACI 212.3R.
    - c. Do not use retarding or accelerating admixtures unless specifically approved in writing by Engineer and at no cost to Owner.
    - d. Follow manufacturer's instructions.
    - e. Use chloride free admixtures only.
  3. Maximum total water soluble chloride ion content contributed from all ingredients of concrete including water, aggregates, cementitious materials and admixtures by weight percent of cement:
    - a. 0.10 all concrete.
  4. Do not use calcium chloride.
  5. Pozzolanic admixtures: ASTM C618.
  6. Provide admixtures of same type, manufacturer and quantity as used in establishing required concrete proportions in the mix design.
- D. Water: Potable, clean, free of oils, acids and organic matter.
- E. Aggregates:
  1. Normal weight concrete: ASTM C33, except as modified below.
  2. Fine aggregate:
    - a. Clean natural sand.

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- b. No manufactured or artificial sand.
  - 3. Coarse aggregate:
    - a. Crushed rock, natural gravel, or other inert granular material.
    - b. Maximum amount of clay or shale particles: 1%.
  - 4. Gradation of coarse aggregate:
    - a. Lean concrete and concrete topping: Size #7.
    - b. All other concrete: Size #57 or #67.
- F. Concrete Grout:
  - 1. Nonshrink, nonmetallic grout:
    - a. Nonmetallic, noncorrosive, nonstaining, premixed with only water to be added.
    - b. Grout to produce a positive but controlled expansion.
    - c. Mass expansion not to be created by gas liberation.
    - d. Minimum compressive strength of nonshrink grout at 28 days: 6500 psi.
    - e. In accordance with COE CRD-C621.
  - 2. Epoxy grout:
    - a. 3-component epoxy resin system.
      - 1) Two liquid epoxy components.
      - 2) One inert aggregate filler component.
    - b. Each component packaged separately for mixing at jobsite.
- G. Reinforcing Steel:
  - 1. Reinforcing bars: ASTM A615, Grade 60.
  - 2. Welded wire reinforcement:
    - a. ASTM A185 or ASTM A1064.
    - b. Minimum yield strength: 60,000 psi.
  - 3. Column spirals: ASTM A82 or ASTM A1064.
- H. Forms:
  - 1. Prefabricated or job built.
  - 2. Wood forms:
    - a. 5/8 or 3/4 inches 5-ply structural plywood of concrete form grade.
    - b. Built-in-place or prefabricated type panel.
  - 3. Metal forms:
    - a. Metal forms may be used except for aluminum in contact with concrete.
    - b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.
  - 4. Chamfer strips: Clear white pine, surface against concrete planed.
- I. Form Ties:
  - 1. Commercially fabricated for use in form construction.
    - a. Field fabricated ties are unacceptable.
  - 2. Constructed so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete.
  - 3. 3/4 inches minimum to 1 inch maximum diameter cones on both ends.
  - 4. Embedded portion of ties to be not less than 1-1/2 inches from face of concrete after ends have been removed.
  - 5. Cone size:
    - a. 3/4 inches minimum to 2 1/2 inches maximum diameter cones on both ends.
    - b. Depth of cone not to exceed the concrete reinforcing cover.
  - 6. Form release: Nonstaining and shall not prevent bonding of future finishes to concrete surface.
- J. Chairs, Runners, Bolsters, Spacers, and Hangers:
  - 1. Stainless steel, epoxy coated, or plastic coated metal.

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- a. Plastic coated: Rebar support tips in contact with the forms only.
  
- K. Water Swelling Sealant:
  - 1. Compatible with strip-type waterstop.
  - 2. Single component, gun applied.
  - 3. Moisture cured.
  - 4. Minimum 70% volumetric expansion swelling capability.
  
- L. Chemical Floor Sealer:
  - 1. Colorless low VOC water-based solution containing acrylic copolymers.
    - a. ASTM C1315, Class B, minimum 30% solids.
  - 2. L&M Construction Chemicals Inc. Dress & Seal WB 30.
  
- M. Cementitious Concrete Coating:
  - 1. Polymer modified Portland cement based coating for concrete and masonry.
    - a. Waterproof.
    - b. Resistant to both positive and negative hydrostatic pressure.
    - c. Breathable.
  - 2. Master Builders Solutions "Masterseal 581 Thoroseal".
    - a. Color:
      - 1) Interior surfaces: Standard gray.
      - 2) Exterior surfaces: Custom color to match concrete surface.
      - 3) Texture: Fine.
  
- N. Membrane Curing Compound:
  - 1. ASTM C309, Type 1D, Class A or B.
  - 2. Fugitive dye shall dissipate over time and exposure.
  - 3. Curing compound shall not prevent bonding of any future coverings, coatings or finishes.
  
- O. Expansion Joint Filler:
  - 1. In contact with water or sewage:
    - a. Closed cell neoprene.
    - b. ASTM D1056, Class SC (oil resistant and medium swell) of 2 to 5 psi compression deflection (Grade SCE41).
  - 2. Exterior driveways, curbs and sidewalks:
    - a. Asphalt expansion joint filler.
    - b. ASTM D994.
  - 3. Other use:
    - a. Fiber expansion joint filler.
    - b. ASTM D1751.

### **2.3 CONCRETE MIXES**

- A. General:
  - 1. All concrete to be ready mixed concrete conforming to ASTM C94/C94M.
  - 2. Provide concrete of specified quality capable of being placed without segregation and, when cured, of developing all properties required.
  - 3. All concrete to be normal weight concrete.
  - 4. Provide pozzolan content for all cast-in-place construction.
  
- B. Strength:
  - 1. Provide specified strength and type of concrete for each use in structure(s) as follows:

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<u>TYPE</u>	<u>WEIGHT</u>	<u>SPECIFIED STRENGTH*</u>
Interior Slab-on-Grade (Thickness < 6")	Normal weight	3000 PSI
All other general use concrete	Normal weight	4000 PSI

\* Minimum 28-day compressive strength.

C. Air Entrainment:

1. Provide air entrainment in all concrete resulting in a total air content percent by volume as follows:

<u>MAX AGGREGATE SIZE</u>	<u>TOTAL AIR CONTENT PERCENT</u>
1 inches or 3/4 inches	6 ±1-1/2
<3/4 inches	6-1/2 ±1-1/2

2. Air content to be measured in accordance with ASTM C231, ASTM C173, or ASTM C138.

D. Slump - 4 inches maximum, 1 inch minimum:

1. Measured at point of discharge of the concrete into the concrete construction member.
2. 8 inches maximum after addition of superplasticizer (if used).
3. Concrete of lower than minimum slump may be used provided it can be properly placed and consolidated.
4. Pumped concrete:
  - a. Provide additional water at batch plant to allow for slump loss due to pumping.
  - b. Provide only enough additional water so that slump of concrete at discharge end of pump hose does not exceed maximum slump specified and the maximum specified water-cement ratio is not exceeded.
5. Slump may be adjusted in the field through the use of water reducers.
  - a. Coordinate dosage and mixing requirements with concrete supplier.
6. Determine slump per ASTM C143.

E. Selection of Proportions:

1. General:
  - a. Proportion ingredients to:
    - 1) Produce proper workability, durability, strength, and other required properties.
    - 2) Prevent segregation and collection of excessive free water on surface.
2. Minimum cement contents and maximum water cement ratios for concrete to be as follows:

<u>SPECIFIED STRENGTH</u>	<u>TARGET CEMENT, MAXIMUM AGGREGATE SIZE</u>			<u>MAXIMUM WATER CEMENT RATIO BY WEIGHT</u>
	<u>1/2 inches</u>	<u>3/4 inches</u>	<u>1 inches</u>	
4000	564	564	564	0.45

3. Fly ash:

- a. For cast-in-place concrete only, a maximum of 25% by weight of Portland cement content per cubic yard may be replaced with fly ash at rate of 1 pound fly ash for 1 pound of cement.
- b. When fly ash is used, the water to cementitious materials ratio shall not exceed the maximum value specified herein.

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4. Concrete mix proportioning methods for normal weight concrete:
  - a. Proportion mixture to provide desired characteristics using one of methods described below:
    - 1) Method 1 (Trial Mix):
      - a) Per ACI 318, Chapter 5, except as modified herein.
      - b) Air content within range specified above.
      - c) Record and report temperature of trial mixes.
      - d) Proportion trial mixes per ACI 211.1.
    - 2) Method 2 (Field Experience):
      - a) Per ACI 318, Chapter 5, except as modified herein:
      - b) Field test records must be acceptable to Engineer to use this method.
      - c) Test records shall represent materials, proportions and conditions similar to those specified.
  5. Required average strength to exceed the specified 28-day compressive strength by the amount determined or calculated in accordance with the requirements of Chapter 5 of ACI 318 using the standard deviation of the proposed concrete production facility.

### **PART 3 - EXECUTION**

#### **3.1 FORMING AND PLACING CONCRETE**

- A. Formwork:
  1. Contractor is responsible for design and erection of formwork.
  2. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation and position.
    - a. Allowable tolerances: As recommended in ACI 347.
  3. Provide slabs and beams of minimum indicated depth when sloping foundation base slabs or elevated floor slabs to drains.
    - a. For slabs on grade, slope top of subgrade to provide floor slabs of minimum uniform indicated depth.
    - b. Do not place floor drains through beams.
  4. Openings:
    - a. Provide openings in formwork to accommodate work of other trades.
    - b. Accurately place and securely support items built into forms.
  5. Chamfer strips: Place 3/4 inches chamfer strips in forms to produce 3/4 inches wide beveled edges on permanently exposed corners of members.
  6. Clean and adjust forms prior to concrete placement.
  7. Tighten forms to prevent mortar leakage.
  8. Coat form surfaces with form release agents prior to placing reinforcing bars in forms.
- B. Reinforcement:
  1. Position, support and secure reinforcement against displacement.
  2. Locate and support with chairs, runners, bolsters, spacers and hangers, as required.
  3. Set wire ties so ends do not touch forms and are directed into concrete, not toward exposed concrete surfaces.
  4. Lap splice lengths: ACI 318 Class B top bar tension splices unless indicated otherwise on the Drawings.
  5. Extend reinforcement to within 2 inches of concrete perimeter edges.
    - a. If perimeter edge is earth formed, extend reinforcement to within 3 inches of the edge.
  6. Minimum concrete protective covering for reinforcement: As shown on Drawings.
  7. Do not weld reinforcing bars.
  8. Welded wire reinforcement:
    - a. Install welded wire reinforcement in maximum practical sizes.



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- b. Splice sides and ends with a splice lap length measured between outermost cross wires of each fabric sheet not less than:
    - 1) One spacing of cross wires plus 2 inches.
    - 2) 1.5 x development length.
    - 3) 6 inches.
  - c. Development length: ACI 318 basic development length for the specified fabric yield strength.
- C. Construction, Expansion, and Contraction Joints:
- 1. Locate joints as indicated on Contract Drawings or as shown on approved Shop Drawings.
    - a. Where construction joint spacing shown on Drawings exceeds the joint spacing indicated in Paragraph below, submit proposed construction joint location in conformance with this Specification Section.
  - 2. Unplanned construction joints will not be allowed.
  - 3. Locate wall vertical construction joints at 30 feet maximum.
  - 4. Locate construction joints in floor slabs and foundation base slabs so that concrete placements are approximately square and do not exceed 4000 SQFT.
  - 5. Locate construction joints in columns and walls:
    - a. At the underside of beams, girders, haunches, drop panels, column capitals, and at floor panels.
    - b. Haunches, drop panels, and column capitals are considered part of the supported floor or roof and shall be placed monolithically therewith.
    - c. Column based need not be placed monolithically with the floor below.
  - 6. Install construction joints perpendicular to main reinforcement with all reinforcement continued across construction joints.
  - 7. At least 72 hours shall elapse between placing of adjoining concrete construction.
  - 8. Thoroughly clean and remove all laitance and loose and foreign particles from construction joints.
  - 9. Before new concrete is placed, dampen concrete surfaces.
  - 10. Slab Control Joints:
    - a. Submit jointing plan for Engineer review prior to concrete placement.
    - b. Maximum aspect ratio of joints shall not exceed 1.5:1.
    - c. Maximum joint spacing for 8" slab thickness = 15 FT.
    - d. Maximum joint spacing for 5" slab thickness = 12 FT.
- D. Embedments:
- 1. Set and build in anchorage devices and other embedded items required for other work that is attached to, or supported by concrete.
  - 2. See Specification Section 03 15 19 - Anchorage to Concrete.
  - 3. Use setting diagrams, templates and instructions for locating and setting.
- E. Waterstops - Preformed Strip Type:
- 1. Install in a bed of swelling sealant on a smooth surface of hardened concrete by use of nails, screws or other means as recommended by manufacturer to prevent movement of waterstop during placement of new concrete.
  - 2. Roughened joints shall be specially prepared during concrete placement to provide smooth surface for proper waterstop installation.
  - 3. Unless otherwise noted, use in joints against existing concrete and where indicated on Drawings.
- F. Placing Concrete:
- 1. Place concrete in compliance with ACI 304R and ACI 304.2R.
  - 2. Place in a continuous operation within planned joints or sections.
  - 3. Begin placement when work of other trades affecting concrete is completed.
  - 4. Place concrete by methods which prevent aggregate segregation.

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5. Do not allow concrete to free fall more than 4 feet.
  6. Where free fall of concrete will exceed 4 feet, place concrete by means of tremie pipe or chute.
- G. Consolidation: Consolidate all concrete using mechanical vibrators supplemented with hand rodding and tamping, so that concrete is worked around reinforcement and embedded items into all parts of forms.
- H. Protection:
1. Protect concrete from physical damage or reduced strength due to weather extremes.
  2. In cold weather comply with ACI 306.1 except as modified herein.
    - a. Do not place concrete on frozen ground or in contact with forms or reinforcing bars coated with frost, ice or snow.
    - b. Do not place heated concrete that is warmer than 80 degrees F.
    - c. If freezing temperatures are expected during curing, maintain the concrete temperature at or above 50 degrees F for seven days or 70 degrees F for 3 days.
    - d. Do not allow concrete to cool suddenly.
  3. In hot weather comply with ACI 305.1 except as modified herein.
    - a. At air temperature of 90 degrees F and above, keep concrete as cool as possible during placement and curing.
    - b. Do not allow concrete temperature to exceed 90 degrees F at placement.
    - c. Prevent plastic shrinkage cracking due to rapid evaporation of moisture.
    - d. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 pounds/SF/HR as determined from ACI 305.1, Figure 2.1.5.
- I. Curing:
1. Begin curing concrete as soon as free water has disappeared from exposed surfaces.
  2. Cure concrete by use of moisture retaining cover, burlap kept continuously wet or by membrane curing compound.
  3. Provide protection as required to prevent damage to concrete and to prevent moisture loss from concrete during curing period.
  4. Provide curing for minimum of seven days.
  5. Form materials left in place may be considered as curing materials for surfaces in contact with the form materials except in periods of hot weather.
  6. In hot weather follow curing procedures outlined in ACI 305.1.
  7. In cold weather follow curing procedures outlined in ACI 306.1.
  8. Curing vertical surfaces with a curing compound:
    - a. Cover vertical surfaces with a minimum of two coats of the curing compound.
    - b. Allow the preceding coat to completely dry prior to applying the next coat.
    - c. Apply the first coat of curing compound immediately after form removal.
    - d. Vertical surface at the time of receiving the first coat shall be damp with no free water on the surface.
    - e. A vertical surface is defined as any surface steeper than 1 vertical to 4 horizontal.
- J. Form Removal:
1. Remove forms after concrete has hardened sufficiently to resist damage from removal operations or lack of support.
  2. Where no reshoring is planned, leave forms and shoring used to support concrete until it has reached its specified 28-day compressive strength.

### **3.2 CONCRETE FINISHES**

- A. Tolerances:

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1. Class A: 1/8 inches in 10 feet.
  2. Class B: 1/4 inches in 10 feet.
- B. Surfaces Exposed to View:
1. Provide a smooth finish for exposed concrete surfaces and surfaces that are:
    - a. To be covered with a coating or covering material applied directly to concrete.
    - b. Scheduled for grout cleaned finish.
  2. Remove fins and projections, and patch voids, air pockets, and honeycomb areas with cement grout.
  3. Cementitious concrete coating:
    - a. Form facing material shall produce a smooth, hard, uniform texture.
      - 1) Use forms specified for surfaces exposed to view.
    - b. Prepare the surface in accordance with manufactures printed installation instructions.
    - c. Brush on coating to entire surface.
      - 1) As a mixing liquid for the coating, use bonding agent and water mixture as recommended by the manufacture.
      - 2) Apply two (2) coats at 2 pound/SQYD per coat.
    - d. When second coat is set, float to a uniform texture with a sponge coat.
    - e. Provide this finish at the following locations:
      - 1) Walls, columns, exposed to view.
- C. Surfaces Not Exposed to View:
1. Patch voids, air pockets and honeycomb areas with cement grout.
  2. Fill tie holes with nonshrink, nonmetallic grout.
- D. Slab Float Finish:
1. After concrete has been placed, consolidated, struck off, and leveled, do no further work until ready for floating.
  2. Do not use water to aid in finishing.
  3. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operation.
  4. During or after first floating, check planeness of entire surface with a 10 feet straightedge applied at not less than two different angles.
  5. Cut down all high spots and fill all low spots during this procedure to produce a surface within Class B tolerance throughout.
  6. Refloat slab immediately to a uniform sandy texture.
- E. Troweled Finish:
1. Float finish surface.
  2. Next power trowel, and finally hand trowel.
  3. Do not use water to aid in finishing.
  4. Produce a smooth surface which is relatively free of defects with first hand troweling.
  5. Perform additional trowelings by hand after surface has hardened sufficiently.
  6. Final trowel when a ringing sound is produced as trowel is moved over surface.
  7. Thoroughly consolidate surface by hand troweling.
  8. Leave finished surface essentially free of trowel marks, uniform in texture and appearance and plane to a Class A tolerance.
  9. On surfaces intended to support floor coverings remove any defects of sufficient magnitude that would show through floor covering by grinding.
- F. Broom Finish: Immediately after concrete has received a float finish as specified, give it a transverse scored texture by drawing a broom across surface.

**3.3 GROUT**

- A. Preparation:
  - 1. Nonshrinking, nonmetallic grout:
    - a. Clean concrete surface to receive grout.
    - b. Saturate concrete with water for 24 hours prior to grouting.
- B. Application:
  - 1. Nonshrinking, nonmetallic grout:
    - a. Mix in a mechanical mixer.
    - b. Use no more water than necessary to produce flowable grout.
    - c. Place in accordance with manufacturer's instructions.
    - d. Completely fill all spaces and cavities below the bottom of baseplates.
    - e. Provide forms where baseplates and bedplates do not confine grout.
    - f. Where exposed to view, finish grout edges smooth.
    - g. Except where a slope is indicated on Drawings, finish edges flush at the baseplate, bedplate, member, or piece of equipment.
    - h. Protect against rapid moisture loss by covering with wet rags or polyethylene sheets.
    - i. Wet cure grout for seven days, minimum.

**3.4 FIELD QUALITY CONTROL**

- A. See Specification Section 03 05 05 for additional information.
- B. Owner will employ and pay for services of a concrete testing laboratory to perform testing of concrete placed during construction.
  - 1. Contractor to cooperate with Owner in obtaining and testing samples.

**3.5 SCHEDULES**

- A. Form Types:
  - 1. Surfaces exposed to view:
    - a. Prefabricated or job-built wood forms.
    - b. Laid out in a regular and uniform pattern with long dimensions vertical and joints aligned.
    - c. Produce finished surfaces free from offsets, ridges, waves, and concave or convex areas.
    - d. Construct forms sufficiently tight to prevent leakage of mortar.
  - 2. Surfaces normally submerged or not normally exposed to view: Wood or steel forms sufficiently tight to prevent leakage of mortar.
  - 3. Other types of forms may be used:
    - a. For surfaces not restricted to plywood or lined forms.
    - b. As backing for form lining.
- B. Grout:
  - 1. Nonshrinking, nonmetallic grout: General use.
- C. Concrete:
  - 1. Normal weight concrete: All concrete.
  - 2. General use concrete: All other locations.
- D. Concrete Finishes:

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1. Slab finishes:
  - a. Use following finishes as applicable, unless otherwise indicated:
    - 1) Floated finish: Surfaces intended to receive roofing, concrete topping, lean concrete, concrete fill and waterproofing.
    - 2) Troweled finish: Interior floor slabs, exposed roof slabs and base slabs of structures, equipment bases, and column bases.
    - 3) Broom finish: Sidewalks, docks, concrete stairs, and ramps.

**END OF SECTION 03 00 05**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Contractor requirements for testing of concrete and grout.
  - 2. Definition of Owner provided testing.
  - 3. Acceptance criteria for concrete.
  - 4. Mortar, grout for masonry, and concrete masonry unit testing as required by Specification Section 04 05 13 and Specification Section 04 22 00.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 00 05 - Concrete.
  - 2. Section 04 05 13 - Cement and Lime Mortars.
  - 3. Section 04 22 00 - Concrete Masonry.

**1.2 RESPONSIBILITY AND PAYMENT**

- A. Owner will hire an independent Testing Agency/Service Provider to perform the following testing and inspection and provide test results to the Engineer and Contractor.
  - 1. Testing and inspection of concrete and grout produced for incorporation into the work during the construction of the Project for compliance with the Contract Documents.
  - 2. Additional testing or retesting of materials occasioned by their failure, by test or inspection, to meet requirements of the Contract Documents.
  - 3. Strength testing on concrete required by the Engineer or Special Inspector when the water-cement ratio exceeds the water-cement ratio of the typical test cylinders.
  - 4. In-place testing of concrete as may be required by Engineer when strength of structure is considered potentially deficient.
  - 5. Other testing services needed or required by Contractor such as field curing of test specimens and testing of additional specimens for determining when forms, form shoring or reshoring may re-removed.
  - 6. Owner will pay for services defined in Paragraph 1.2A.1.
  
- B. Hire a qualified testing agency to perform the following testing and provide test results to the Engineer.
  - 1. Testing of materials and mixes proposed by the Contractor for compliance with the Contract Documents and retesting in the event of changes.
  - 2. Additional testing and inspection required because of changes in materials or proportions requested by Contractor.
  - 3. Pay for services defined in Paragraphs 1.2B.1. and 1.2B.2.
  - 4. Reimburse Owner for testing services defined in Paragraphs 1.2A.2., 1.2A.3., 1.2A.4. and 1.2A.5.
  - 5. See Specification Section 01 42 00.
  
- C. Duties and Authorities of Testing Agency/Service Provider:
  - 1. Any Testing Agency/Service Provider or agencies and their representatives retained by Contractor or Owner for any reason are not authorized to revoke, alter, relax, enlarge, or release any requirement of Contract Documents, nor to reject, approve or accept any portion of the Work.

## **SECTION 03 05 05 - CONCRETE TESTING AND INSPECTION**

2. Testing Agency/Service Provider shall inform the Contractor and Engineer regarding acceptability of or deficiencies in the work including materials furnished and work performed by Contractor that fails to fulfill requirements of the Contract Documents.
3. Testing Agency to submit test reports and inspection reports to Engineer and Contractor immediately after they are performed.
  - a. All test reports to include exact location in the work at which batch represented by a test was deposited.
  - b. Reports of strength tests to include detailed information on storage and curing of specimens prior to testing.
4. Owner retains the responsibility for ultimate rejection or approval of any portion of the Work.

### **1.3 QUALITY ASSURANCE**

- A. Referenced Standards:
  1. American Concrete Institute (ACI):
    - a. 318, Building Code Requirements for Structural Concrete.
  2. ASTM International (ASTM):
    - a. ASTM Cement and Concrete Reference Laboratory (CCRL).
    - b. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
    - c. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
    - d. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
    - e. C94, Standard Specification for Ready-Mixed Concrete.
    - f. C143, Standard Test Method for Slump of Hydraulic-Cement Concrete.
    - g. C172, Standard Practice for Sampling Freshly Mixed Concrete.
    - h. C1019, Standard Test Method for Sampling and Testing Grout.
    - i. C1218, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
    - j. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- B. Qualifications:
  1. Contractor's Testing Agency:
    - a. Meeting requirements of ASTM E329 and ASTM C94.
    - b. Provide evidence of recent inspection by CCRL of NBS, and correction of deficiencies noted.
- C. Use of Testing Agency and approval by Engineer of proposed concrete mix design shall in no way relieve Contractor of responsibility to furnish materials and construction in full compliance with Contract Documents.

### **1.4 DEFINITIONS**

- A. Testing Agency/Service Provider: An independent professional testing/inspection firm or service hired by Contractor or by Owner to perform testing, inspection or analysis services as directed, and as provided in the Contract Documents.

### **1.5 SUBMITTALS**

- A. Shop Drawings:
  1. Product technical data including:

## **SECTION 03 05 05 - CONCRETE TESTING AND INSPECTION**

- a. Concrete materials and concrete mix designs proposed for use.
  - 1) Include results of all testing performed to qualify materials and to establish mix designs.
  - 2) Place no concrete until approval of mix designs has been received in writing.
  - 3) Submittal for each concrete mix design to include:
    - a) Sieve analysis and source of fine and coarse aggregates.
    - b) Test for aggregate organic impurities.
    - c) Proportioning of all materials.
    - d) Type of cement with mill certificate for the cement.
    - e) Brand, quantity and class of fly ash proposed for use along with other submittal data as required for fly ash by Specification Section 03 00 05.
    - f) Slump.
    - g) Brand, type and quantity of air entrainment and any other proposed admixtures.
    - h) Shrinkage test results.
    - i) Total water soluble chloride ion concentration in hardened concrete from all ingredients determined per ASTM C1218.
    - j) 28-day compression test results and any other data required by Specification Section 03 00 05 to establish concrete mix design.
2. Certifications:
  - a. Testing Agency qualifications.

### **PART 2 - PRODUCTS - (NOT USED)**

### **PART 3 - EXECUTION**

#### **3.1 TESTING SERVICES TO BE PERFORMED SERVICE PROVIDER/TESTING AGENCY**

- A. The following concrete testing will be performed by the Service Provider/Testing Agency:
  1. Concrete strength testing:
    - a. Secure concrete samples in accordance with ASTM C172.
      - 1) Obtain each sample from a different batch of concrete on a random basis, avoiding selection of test batch other than by a number selected at random before commencement of concrete placement.
    - b. For each strength test, mold and cure cylinders from each sample in accordance with ASTM C31.
      - 1) Record any deviations from requirements on test report.
      - 2) Cylinder size: Per ASTM C31.
        - a) 4 inches cylinders shall not be used for concrete mixes with maximum aggregate size larger than 1 inch.
        - b) Use the same size cylinder for all tests for each concrete mix.
      - 3) Quantity:
        - a) 6 inches diameter by 12 inches high: Five cylinders.
        - b) 4 inches diameter by 8 inches high: Six cylinders.
    - c. Field cure one cylinder for the seven day test.
      - 1) Laboratory cure the remaining.
    - d. Test cylinders in accordance with ASTM C39.
      - 1) 6 inches diameter cylinders:
        - a) Test two cylinders at 28 days for strength test result and the one field cured sample at seven days for information.
        - b) Hold remaining cylinder in reserve.
      - 2) 4 inches diameter cylinders:



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- a) Test three cylinders at 28 days for strength test result and the one field cured cylinder at seven days for information.
- b) Hold remaining cylinders in reserve.
- e. Strength test result:
  - 1) Average of strengths of two, 6 inches diameter cylinders or three, 4 inches diameter cylinders from the same sample tested at 28 days.
  - 2) If one cylinder in a test manifests evidence of improper sampling, molding, handling, curing, or testing, discard and test reserve cylinder(s); average strength of remaining cylinders shall be considered strength test result.
  - 3) Should all cylinders in any test show any of above defects, discard entire test.
- f. Frequency of tests:
  - 1) Concrete sand cement grout: One strength test for each 4 hour period of grout placement or fraction thereof.
    - a) Test grout in accordance with ASTM C1019.
  - 2) Concrete topping, concrete fill and lean concrete: One strength test for each 60 CUYD of each type of concrete or fraction thereof placed.
  - 3) All other concrete:
    - a) One strength test to be taken not less than once a day, nor less than once for each 60 cubic yards or fraction thereof placed in any one day.
    - b) Once for each 5000 square feet of slab or wall surface area placed each day
    - c) If total volume of concrete on Project is such that frequency of testing required in above paragraph will provide less than five strength tests for each concrete mix, tests shall then be made from at least five randomly selected batches or from each batch if fewer than five batches are provided.
- 2. Slump testing:
  - a. Determine slump of concrete sample for each strength test.
    - 1) Determine slump in accordance with ASTM C143.
  - b. If consistency of concrete appears to vary, the Engineer or Owner's Representative shall be authorized to require a slump test for each concrete truck.
    - 1) This practice shall continue until three consecutive batches are determined to be consistent and meet the slump requirements specified.
- 3. Air content testing: Determine air content of concrete sample for each strength test in accordance with ASTM C231.
- 4. In-place concrete testing (if required).

### **3.2 SPECIAL INSPECTIONS**

- A. See Section 01 45 33.
  - 1. Special Inspections listed are for the Contractor reference only and is not part of the Contract Documents.
  - 2. It is included to assist the Contractor in understanding the Owner-provided Services so that those services may be factored into the Contractor's pricing and schedule.
- B. Formwork Special Inspections:
  - 1. Shape, location, and dimensions.
    - a. Inspect in accordance with dimensions and details on Drawings.
    - b. Frequency: Inspect prior to each concrete pour.
- C. Reinforcing Special Inspections:
  - 1. Reinforcing size, spacing, lap length and concrete cover.
    - a. Inspect in accordance with Drawings and Specification.
    - b. Frequency: Inspect prior to each concrete pour.
  - 2. Reinforcing adhesive anchoring system:
    - a. Inspect in accordance with ICC-ES report.

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- b. Frequency:
    - 1) Inspect all adhesive anchors for the first 4 hours of installation.
    - 2) Inspect approximately 25% of adhesive anchors thereafter.
    - 3) Additional inspection will be required for different installer or if the quality of installation appears to vary.
  - 3. Mechanical splices:
    - a. Inspect in accordance with ICC-ES report.
    - b. Frequency:
      - 1) Inspect all mechanical splices prior to placing concrete.
      - 2) Inspect approximately 25% of mechanical splices thereafter.
      - 3) Additional inspection will be required for different installer or if the quality of installation appears to vary.
- D. Mixing, Placing, Jointing, and Curing Special Inspections:
- 1. Perform concrete tests per the requirements of this Specification Section.
  - 2. Verification of proper mix design.
    - a. Frequency: Periodically, prior to each concrete pour.
  - 3. Proper concrete placement techniques.
    - a. Inspect per requirements of Section 03 00 05.
    - b. Frequency: During each concrete pour.
  - 4. Proper curing temperature and techniques.
    - a. Inspect per requirements of Section 03 00 05.
    - b. Frequency: Periodically, but not less than every third day.
  - 5. Joints:
    - a. Inspect joints for proper joint type, dimensions, reinforcing, dowel alignment, surface preparation and location.
    - b. Frequency: Prior to each concrete pour.
  - 6. Waterstops:
    - a. Visually inspect waterstops for proper location, continuity, installation to prevent displacement, cleanliness and damage to waterstop.
    - b. Frequency:
      - 1) Prior to each concrete pour.
- E. Anchorage to Concrete Special Inspection:
- 1. Post installed anchors as required by the building code, ICC-ES Evaluation Reports, and as specified by the Engineer.
    - a. Frequency: Per ICC-ES Report.
  - 2. Cast-in-place concrete anchors, including anchor size, embedment, material and location.
    - a. Frequency: Prior to each concrete pour.

### **3.3 SAMPLING ASSISTANCE AND NOTIFICATION FOR OWNER**

- A. To facilitate testing and inspection, perform the following:
  - 1. Furnish any necessary labor to assist Testing Agency in obtaining and handling samples at site.
  - 2. Provide and maintain for sole use of Testing Agency adequate facilities for safe storage and proper curing of test specimens on site for first 24 hours as required by ASTM C31.
  - 3. Take samples at point of placement into concrete member.
- B. Notify Engineer and Owner's Testing Agency sufficiently in advance of operations (minimum of 24 hours) to allow for assignment of personnel and for scheduled completion of quality tests.

**3.4 ACCEPTANCE**

- A. Completed concrete work which meets applicable requirements will be accepted without qualification.
- B. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance will be accepted without qualification.
- C. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Contract Documents.
  - 1. In this event, modifications may be required to assure that concrete work complies with requirements.
  - 2. Modifications, as directed by Engineer, to be made at no additional cost to Owner.
- D. Dimensional Tolerances:
  - 1. Formed surfaces resulting in concrete outlines smaller than permitted by tolerances shall be considered potentially deficient in strength and subject to modifications required by Engineer.
  - 2. Formed surfaces resulting in concrete outlines larger than permitted by tolerances may be rejected and excess material subject to removal.
    - a. If removal of excess material is permitted, accomplish in such a manner as to maintain strength of section and to meet all other applicable requirements of function and appearance.
  - 3. Concrete members cast in wrong location may be rejected if strength, appearance or function of structure is adversely affected or misplaced items interfere with other construction.
  - 4. Inaccurately formed concrete surfaces exceeding limits of tolerances and which are exposed to view, may be rejected.
    - a. Repair or remove and replace if required.
  - 5. Finished slabs exceeding tolerances may be required to be repaired provided that strength or appearance is not adversely affected.
    - a. High spots may be removed with a grinder, low spots filled with a patching compound, or other remedial measures performed as permitted or required.
- E. Appearance:
  - 1. Concrete surfaces exposed to view with defects which, in opinion of Engineer, adversely affect appearance as required by specified finish shall be repaired by approved methods.
  - 2. Concrete not exposed to view is not subject to rejection for defective appearance unless, in the opinion of the Engineer, the defects impair the long-term strength or function of the member.
- F. High Water-Cement Ratio:
  - 1. Concrete with water in excess of the specified maximum water-cement ratio will be rejected.
  - 2. Remove and replace concrete with high water-cement ratio or make other corrections as directed by Engineer.
- G. Strength of Structure:
  - 1. Strength of structure in place will be considered potentially deficient if it fails to comply with any requirements which control strength of structure, including but not necessarily limited to following:
    - a. Low concrete strength:
      - 1) Test results for standard molded and cured test cylinders to be evaluated separately for each mix design.

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- a) Such evaluation shall be valid only if tests have been conducted in accordance with specified quality standards.
  - b) For evaluation of potential strength and uniformity, each mix design shall be represented by at least three strength tests.
  - c) A strength test shall be the average of two, 6 inches diameter cylinders or three, 4 inches diameter cylinders from the same sample tested at 28 days.
- 2) Acceptance:
- a) Strength level of each specified compressive strength shall be considered satisfactory if both of the following requirements are met:
    - (1) Average of all sets of three consecutive strength tests equal or exceed the required specified 28 day compressive strength.
    - (2) No individual strength test falls below the required specified 28 day compressive strength by more than 500 psi.
  - b. Reinforcing steel size, configuration, quantity, strength, position, or arrangement at variance with requirements in Specification Section 03 00 05 or requirements of the Contract Drawings or approved Shop Drawings.
  - c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.
  - d. Curing time and procedure not meeting requirements of this Specification Section.
  - e. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
  - f. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
  - g. Concrete defects such as voids, honeycomb, cold joints, spalling, cracking, etc., likely to result in deficient strength or durability.
2. Structural analysis and/or additional testing may be required when strength of structure is considered potentially deficient.
3. In-place testing of concrete may be required when strength of concrete in place is considered potentially deficient.
- a. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer to determine relative strengths at various locations in the structure or for selecting areas to be cored.
    - 1) Such tests shall not be used as a basis for acceptance or rejection.
  - b. Core tests:
    - 1) Where required, test cores will be obtained in accordance with ASTM C42.
      - a) If concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 degrees F, relative humidity less than 60%) for seven days before test then test dry.
      - b) If concrete in structure will be wet or subjected to high moisture atmosphere under service conditions, test cores after immersion in water for at least 40 hours and test wet.
      - c) Testing wet or dry to be determined by Engineer.
    - 2) Three representative cores may be taken from each member or area of concrete in place that is considered potentially deficient.
      - a) Location of cores shall be determined by Engineer so as least to impair strength of structure.
      - b) If, before testing, one or more of cores shows evidence of having been damaged subsequent to or during removal from structure, damaged core shall be replaced.
    - 3) Concrete in area represented by a core test will be considered adequate if average strength of three cores is equal to at least 85% of specified strength and no single core is less than 75% of specified strength.
    - 4) Fill core holes with non-shrink grout and finish to match surrounding surface when exposed in a finished area.

## **SECTION 03 05 05 - CONCRETE TESTING AND INSPECTION**

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4. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm safety of structure, load tests may be required and their results evaluated in accordance with ACI 318, Chapter 20.
5. Correct or replace concrete work judged inadequate by structural analysis or by results of core tests or load tests with additional construction, as directed by Engineer, at Contractor's expense.
6. Contractor to pay all costs incurred in providing additional testing and/or structural analysis required.

**END OF SECTION 03 05 05**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Requirements for anchorages in concrete, including: cast-in-place anchor bolts, anchor rods, reinforcing anchorage adhesive, and post-installed concrete anchors required for the Project but not specified elsewhere in the Contract Documents.
  2. Delegated design requirements for concrete anchors not expressly shown or indicated on the Drawings or elsewhere in the Contract Documents, including, but not limited to, anchorages in concrete for the following structural and nonstructural components:
    - a. Structural members and accessories.
    - b. Metal, wood, and plastic fabrications.
    - c. Architectural Work, including building components, finishes, specials, facility equipment and conveying equipment, furnishings, and special construction Work.
    - d. Mechanical and electrical Work, including process-mechanical Work, site and infrastructure Work, electrical Work, communications Work, electronic safety and security systems Work, and others.
    - e. Fire suppression, plumbing, and HVAC Work.
    - f. Other components requiring anchorages to concrete.
- B. Related Requirements: Include but are not necessarily limited to:
1. Section 01 81 10 - Wind and Seismic Criteria
  2. Section 03 05 05 - Concrete Testing and Inspection.

**1.2 REFERENCES**

- A. Definitions and Terminology:
1. This provision presents definitions and terminology, which have the meanings indicated in this provision, applied to the singular or plural thereof, and without regard to use of initial capital letters.
    - a. Adhesive Anchors:
      - 1) Post-installed anchors developing their strength primarily from chemical bond between the concrete and the anchor.
      - 2) Includes anchors using acrylics, epoxy and other similar adhesives.
    - b. Anchor Bolt: Any cast-in-place anchorage that is made of a headed (i.e. bolt) material.
    - c. Anchor Rod: Any cast-in-place or post-installed anchorage made from unheaded, threaded, rod or deformed bar material.
    - d. Concrete Anchor: Generic term for either an anchor bolt or an anchor rod.
    - e. Galvanizing: Hot-dip galvanizing in accordance with ASTM A123, ASTM A153 or ASTM F2329 with minimum coating of 2.0 ounces of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by reference standard.
    - f. Hardware: As defined in ASTM A153.
    - g. MPII: Manufacturer's printed installation instructions.
    - h. Mechanical Anchors:
      - 1) Post-installed anchors developing their strength from attachment other than thru adhesives or chemical bond to concrete.
      - 2) Includes expansion anchors, expansion sleeve, screw anchors, undercut anchors, specialty inserts and other similar types of anchorages.
      - 3) Drop-in anchors and other similar non-ICC ES approved anchors are unacceptable.

## **SECTION 03 15 19 - ANCHORAGE TO CONCRETE**

- i. Post-Installed Anchor: Adhesive or mechanical anchor installed into previously placed and adequately cured concrete.
  
- B. Reference Standards:
  - 1. American Concrete Institute (ACI):
    - a. 318, Building Code Requirements for Structural Concrete and Commentary.
  - 2. American Concrete Institute/Concrete Reinforcing Steel Institute (ACI-CRSI):
    - a. Adhesive Anchor Installation Certification Program: Adhesive Anchor Installer.
  - 3. American Institute of Steel Construction (AISC):
    - a. 303, Code of Standard Practice for Steel Buildings and Bridges.
    - b. 355.2, Seismic Testing of Post-Installed Concrete and Masonry Anchors in Cracked Concrete.
    - c. 355.4, Qualification of Post-Installed Adhesive Anchors in Concrete.
  - 4. ASTM International (ASTM):
    - a. A36, Standard Specification for Carbon Structural Steel.
    - b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
    - c. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - d. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    - e. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
    - f. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
    - g. A563, Standard Specification for Carbon and Alloy Steel Nuts.
    - h. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
    - i. F436, Standard Specification for Hardened Steel Washers.
    - j. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
    - k. F594, Standard Specification for Stainless Steel Nuts.
    - l. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
    - m. F2329, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
  - 5. International Code Council Evaluation Service (ICC-ES):
    - a. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
    - b. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

### **1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Comply with coordination requirements in Division 01 specifications.
  
- B. Pre-Design Conference:
  - 1. Pre-design conference for anchorages to concrete (where such anchorages are delegated design Work) is not required.

### **1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements:
  - 1. Code-required Special Instructions:
    - a. Special Inspection is required in accordance with the building code for all concrete anchorages.

## SECTION 03 15 19 - ANCHORAGE TO CONCRETE

- b. Notify the Special Inspector that an inspection is required prior to concrete placement (or during post-installed anchorage installation).
  - c. See the "Field Quality Control" Article in "Part 3 – Execution" of this Section for additional requirements.
- B. Qualifications:
- 1. Delegated Design Professional:
    - a. Delegated design professional's qualifications and responsibilities shall be in accordance with Division 01 specifications.
  - 2. Installer:
    - a. Installer for post-installed anchors shall be trained by the manufacturer or certified by a training program approved by the Engineer.
    - b. Installer for adhesive anchors installed in horizontal, upward incline, or overhead applications shall be certified by ACI-CRSI Adhesive Anchor Installation Certification Program.

### 1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
- 1. Shop Drawings:
    - a. Submit schedule (table or listing) of types, sizes (diameter, length, embedment length), material, finish, and proposed manufacturers of anchorages to concrete to be provided. Apportion by Project-specific application (for example, "Anchorages for cooling water pumps in basement") and indicate where anchorages are fully-designed by Engineer and those for which final design was prepared by delegated design professional.
    - b. Engineer's approval of such Shop Drawing will be only for anchorages fully designed by Engineer. For anchorages for which final design is by delegated design professional, include on such Shop Drawing delegated design professional's approval stamp.
  - 2. Product Data: Submit as Action Submittals product data for anchorages to concrete fully designed by Engineer. For anchorages to concrete for which final design is by delegated design professional, submit as Informational Submittals bearing approval stamp of delegated design professional.
    - a. Manufacturer's express, written acknowledgement that proposed items comply with referenced standards indicated in this Section and, as applicable, by delegated design professional.
    - b. Manufacturer published data and information for each anchor.
      - 1) Clearly indicate items that are proposed for the Work. Neatly strike out or obscure materials and products not proposed.
    - c. Manufacturer's published installation instructions and instructions for code-required special inspections and tests.
    - d. Post-Installed Anchors: In addition, submit for each post-installed anchor system current ICC-ES report, indicating the following:
      - 1) Manufacturer's certification that anchors comply with requirements indicated in the Contract Documents.
      - 2) Performance data indicating that anchor is approved by its manufacturer for use in cracked concrete.
      - 3) Seismic design categories for which anchor system is approved by ICC-ES report.
    - e. Anchorage layout drawings and details:
      - 1) Drawings showing location, configuration, spacing and edge distance.
  - 3. Delegated Design Professional's Instruments of Service Submittals: Submit, in accordance with this Section and Division 01 specifications, for each anchorage to concrete for which final design is by delegated design professional:
    - a. Certification of compliance, in accordance with Division 01 specifications. Indicate design tension and shear loads used for anchor design.



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- b. Delegated design professional's drawings.
  - c. Delegated design professional's specifications, if any, when prepared by delegated design professional.
  - d. Post-Installed Anchors (for which final design is by delegated design professional):  
Submittal shall also include the following for post-installed anchors for which final design was by delegated design professional:
    - 1) Show diameter, embedment depth and edge distance of each anchor.
    - 2) Indicate compliance with ACI 318 Chapter 17.
    - 3) Type of post-installed anchor system used.
      - a) Provide manufacturer's ICC-ES report for the following:
        - (1) Mechanical anchorage per ICC-ES AC193.
        - (2) Adhesive anchorage per ICC-ES AC308.
4. Samples:
- a. Submit representative Samples of anchorages to concrete, when requested by Engineer. Engineer's approval of Samples will be for type and finish only.
- B. Informational Submittals: Submit the following:
- 1. Shop Drawings and Product Data Approved by Delegated Design Professional:
    - a. Submit with delegated design professional's approval stamp those Shop Drawings and product data Submittals indicated in this Article but for which final design was performed by delegated design professional.
  - 2. Calculations by Delegated Design Professional:
    - a. Submit sealed and signed calculations for sizing and determining embedment length of anchorages to concrete not fully designed by Engineer.
    - b. Post-Installed Anchors Designed by Delegated Design Professional: In addition, also submit design calculations:
      - 1) Indicate design load to each anchor.
      - 2) When design load is not indicated on the Drawings, include calculations to develop anchor forces based on performance and design criteria indicated in this Section.
  - 3. Supplier's Instructions:
    - a. Submit manufacturer's published instructions for installation.
  - 4. Field Quality Control Submittals:
    - a. Submit written results of required field quality control activities indicated in this Section.
  - 5. Reports of Supplier's Visits to Site:
    - a. Submit each written report of visit to the Site by Supplier's factory trained representative and delegated design professional. For each, indicate date and time of visit, purpose of visit, observations made, decisions made, problems encountered, and other pertinent information.
  - 6. Qualifications Statements:
    - a. Delegated design professional.
    - b. Each installer.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS – ALL ANCHORAGES**

- A. Materials – General:
- 1. This Article applies to all anchorages to concrete, regardless of whether fully designed by Engineer or delegated design professional. Requirements for delegated designs are in the following Article.
  - 2. Additional requirements for anchorages fully designed by Engineer are indicated in the Article following requirements for delegated design anchorages.

## **SECTION 03 15 19 - ANCHORAGE TO CONCRETE**

3. For structural applications, do not use powder actuated fasteners and other types of bolts or fasteners not specified in this Section unless approved by Engineer or otherwise required by the Contract Documents.
- B. Description:
1. Provide anchorages to concrete, of the types shown or indicated, to secure to concrete materials, equipment, and appurtenances installed as part of the Work.
  2. Locations where anchorages are required are generally shown or indicated on the Drawings. Where not shown or indicated on the Drawings provide anchorages or the types required for materials, equipment, and systems where such materials, equipment, and systems are shown on the Drawings.
  3. Anchorages required include those for materials, equipment, and systems shown on the structural Drawings and Drawing other than the structural Drawings.
  4. Design loads for concrete anchorages are shown or indicated on the Drawings for anchorages where design responsibility is delegated to Contractor's delegated design professional. For such anchorages, embedment depths are not shown or indicated.
- C. Cast-in-place Concrete Anchors:
1. Buildings, non-building structures, and equipment, unless otherwise specified:
    - a. ASTM F1554, Grade 36 or Grade 55 with weldability supplement S1 for galvanized threaded rods.
    - b. ASTM A307, Grade A for galvanized headed bolts.
  2. All other cast-in-place concrete anchors:
    - a. Stainless steel with matching nut and washer.
    - b. Submerged application: ASTM F593, Type 316, minimum yield strength of 45,000 psi.
    - c. Non-submerged application: ASTM F593, Type 304 or Type 316, minimum yield strength of 45,000 psi.
- D. Post-Installed Mechanical and Adhesive Concrete Anchors:
1. Non-submerged application: ASTM F593, Type 304 or Type 316, minimum yield strength of 45,000 psi with matching nut and washer.
  2. Post-installed anchors and related materials shall be listed by ICC-ES or Engineer-approved equivalent.
- E. Reinforcing: Comply with Section 03 –00 05.
- F. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 psi and a minimum tensile strength of 60,000 psi.
- G. Deformed Bar Anchors: ASTM A496 with minimum yield strength of 70,000 psi and a minimum tensile strength of 80,000 psi.
- H. Washers:
1. ASTM F436 unless indicated otherwise, finish to match bolt.
  2. When stainless steel anchorage is provided for cast-in-place anchorages, provide washers of the same material and alloy as in the associated anchorage.
  3. Plate washers: Minimum 1/2 inch thick fabricated ASTM A36 square plates as required.
  4. Comply with manufacturer's written instructions for all post-installed anchorages.
- I. Nuts:
1. ASTM A563 for cast-in-place anchorages.
  2. When stainless steel anchorages are provided for cast-in-place anchorages, nuts shall comply with ASTM F594 and shall match material and alloy of the associated anchorage.
  3. Follow manufacturer's requirements if using post-installed anchorage.

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- J. Galvanizing Repair Paint:
  - 1. High zinc dust content paint for regalvanizing welds and abrasions.
  - 2. ASTM A780.
  - 3. Zinc content: Minimum 92 percent in dry film.
  - 4. Products and Manufacturers: "ZRC Cold Galvanizing", by ZRC; or "High Performance Zinc Spray", by Clearco; or equal.
  
- K. Dissimilar Materials Protection: Comply with Division 09 specifications.

### **2.2 DELEGATED DESIGN ANCHORAGES TO CONCRETE**

- A. Manufacturers:
  - 1. Post-installed anchor systems for indicated manufacturers are acceptable only when a current ICC-ES evaluation report is furnished as a Submittal and the subject anchorage system is approved by delegated design professional.
    - a. Hilti.
    - b. Dewalt.
    - c. Simpson Strong-Tie.
    - d. Or equal.
  
- B. Description: Perform delegated design for anchorages when one or more of the following applies:
  - 1. Design load for concrete anchorage is shown or indicated on the Drawings and anchorage embedment depth is not shown or indicated.
  - 2. When specifically required by the Contract Documents.
  - 3. When an anchorage is necessary but is not shown or indicated on the Drawings.
  - 4. Anchorages shown on the Drawings other than the structural Drawings.
  
- C. Performance and Design Criteria for Delegated Design Anchorages:
  - 1. Determine design loads, including wind and seismic loads, in accordance with applicable building code and other Laws and Regulations.
  - 2. For anchorage of equipment and non-structural components, use actual dead load and operating loads obtained by Contractor or delegated design professional from manufacturer. Design loads shall include operating conditions when equipment or element of the Work is in operation, dynamic loads, and other loads as appropriate or required by the building code or other Laws or Regulations.
  - 3. Design assuming cracked concrete.

### **2.3 ANCHORAGES FULLY DESIGNED BY ENGINEER**

- A. When size, length, and details of anchorage are shown or indicated on the structural Drawings, such anchorages are considered as fully designed by Engineer and delegated design of such anchorage is not required.
  
- B. Manufacturers:
  - 1. For post-installed anchor systems regardless of whether proposed manufacturer is indicated below, furnish as Submittal current evaluation agency report and anchor system is certified by ICC-ES for cracked concrete conditions.
  - 2. Mechanical Anchors:
    - a. Hilti:
      - 1) Kwik Bolt TZ (ICC-ES ESR-1917).
    - b. Dewalt:

## **SECTION 03 15 19 - ANCHORAGE TO CONCRETE**

- 1) Power-Stud+ SD1 (ICC-ES ESR-2818).
- c. Simpson Strong-Tie:
  - 1) Strong-Bolt 2 (ICC-ES ESR-3037).
- d. Or equal.
3. Adhesive Anchors for Concrete:
  - a. Hilti:
    - 1) HIT RE 500 V3 (ICC ESR-3814).
    - 2) HIT-HY 200 V3 (ICC-ES ESR-4868).
  - b. Dewalt:
    - 1) PURE110+ (ICC-ES ESR-3298).
  - c. Simpson Strong-Tie:
    - 1) SET-3G (ICC ES 4057)
  - d. Or equal.
4. Screw Anchors for Concrete:
  - a. Hilti:
    - 1) Kwik HUS-EZ Screw (ICC-ES ESR-3027).
  - b. Dewalt:
    - 1) Screw-Bolt+ (ICC-ES ESR-3889).
  - c. Simpson Strong-Tie:
    - 1) Titen HD (ICC-ES ESR-2713).
  - d. Or equal.
5. Requests, if any, for Engineer's approval of "or-equals" or substitutes shall indicate proposed anchor has at least the same tension and shear strength as the associated anchorage products indicated by name in this Article.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. For cast-in-place concrete anchorages, allow adequate time for proper installation, inspection, and observation prior to placing concrete.
- B. Prior to installation, inspect and verify areas and conditions under which concrete anchorages will be installed.
  1. Notify Engineer of conditions detrimental to proper and timely completion of the Work.
  2. Do not proceed with the Work until unsatisfactory conditions are properly remedied.

#### **3.2 INSTALLATION**

- A. Installation Requirements - General:
  1. Install items in accordance with the Contract Documents, manufacturer's written instructions, and Laws and Regulations. Where such requirements conflict, obtain interpretation or clarification from Architect prior to commencing the associated Work.
  2. Perform the following unless shown or indicated otherwise:
    - a. Provide stainless steel anchorages for connecting aluminum and steel members to concrete and masonry. Provide dissimilar materials protection in accordance with Division 09 specifications.
    - b. Provide washers for all anchorages.
    - c. Where exposed, extend threaded anchorage a maximum of 0.75 inch and a minimum of 0.5 inch above top of fully-engaged nut. If anchorage is cut off to required maximum height, dress the threads to allow nuts to be removed without damage to nuts.

## **SECTION 03 15 19 - ANCHORAGE TO CONCRETE**

3. Tightening of nuts: Do the following after nuts are snug-tightened down:
    - a. Upset anchorage threads to prevent nuts from backing off. Provide double nut or lock nut in lieu of upset threads for items that may require future removal.
    - b. For cast-in-place anchorages (excluding post-installed anchorages), tighten nuts an additional 1/8 turn beyond snug tight to prevent nuts from backing off.
    - c. When two nuts are used per concrete anchor above the base plate, tighten top nut an additional 1/8 turn to "lock" the two nuts together.
    - d. For post-installed anchorages, comply with MPII.
  4. Secure architectural components to avoid aesthetic distortion and to avoid overstressing fasteners from expansion, contraction, or installation.
- B. Cast-in-Place Anchorages:
1. Provide where anchor rods or anchor bolts are indicated on the Drawings, unless another anchor type is approved by Engineer.
  2. Provide concrete anchorages as shown on the Drawings or as required to secure the Work to concrete.
  3. Tie cast-in-place anchorage in position to embedded reinforcing steel using wire.
  4. Tack welding of anchorage is prohibited.
  5. Chase threads as required and coat projected portion of carbon steel anchors and nut threads with a heavy coat of clean grease after concrete has cured.
  6. Anchorage location Tolerance: in accordance with AISC 303.
  7. Provide steel or durable wood templates for all column and equipment anchorages. Place templates above top of concrete; do not impede proper concrete placement and consolidation.
- C. Mechanical Anchorages:
1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.
  2. Do not use where subjected to vibration.
  3. May be used in overhead applications.
  4. Contact Engineer for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.
- D. Post-installed Anchorages:
1. For post-installed anchors, comply with MPII regarding hole diameter and depth required to fully develop the tensile strength of anchor or reinforcing bar.
  2. Use hammer drills to create holes.
  3. Properly clean out holes in accordance with the associated ICC-ES report using non-metallic, fiber bristle brush and compressed air, or as otherwise necessary to remove all loose material from each hole prior to installing anchor in the presence of Special Inspector.
  4. Adhesive Anchorages:
    - a. Provide only where specifically indicated on the Drawings or when approved for use by Engineer.
    - b. May be provided where subjected to vibration or at buried or submerged locations.
    - c. Do not install for overhead applications or sustained tension loading conditions such as utility hangers.
    - d. Install adhesive anchors in concrete aged not less than 21 days.
- E. Finishes:
1. Coat aluminum surfaces in contact with dissimilar materials in accordance with Division 09 specifications.
  2. Repair of damaged galvanized surfaces:
    - a. Prepare damaged surfaces by abrasive blasting or power sanding.
    - b. Repair damaged galvanized surfaces in accordance with ASTM A780.

## **SECTION 03 15 19 - ANCHORAGE TO CONCRETE**

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- c. Apply galvanizing repair paint to not less than 6 mils dry film thickness in accordance with galvanizing repair material manufacturer's instructions and ASTM A780.
- F. Ensure that embedded items are protected from damage and are not filled in with concrete or related materials.

### **3.3 FIELD QUALITY CONTROL**

- A. Field Tests and Inspections:
  - 1. Special Inspections: Comply with Section 01 45 33 - Code-Required Special Inspections and Procedures.
  - 2. Comply with Section 03 05 05 - Concrete Testing and Inspection.
  - 3. Tests and inspections of anchorages shall comply with ACI 355.2 and/or ACI 355.4 as applicable.
  - 4. Owner reserves the right to inspect and test completed anchorages at a minimum of 25 to 100 percent of provided anchorages.
- B. Supplier's services:
  - 1. Post-installed anchor manufacturer's representative shall demonstrate and observe the proper installation procedures for the post-installed anchors.
- C. Defective Work:
  - 1. Anchorages that do not successfully pass required field tests and inspections or that are otherwise deemed defective by Engineer shall be remedied, in accordance with the Contract Documents, at no cost to Owner.

### **3.4 CLEANING**

- A. After concrete has been placed, remove protection and clean all anchorage of all concrete, dirt, and other foreign matter.
- B. Provide surface acceptable to receive field applied paint coatings when specified in Division 09 specifications.

**END OF SECTION 03 15 19**

## **SECTION 03 54 16 - HYDRAULIC CEMENT UNDERLAYMENT**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings and to assist in floor leveling and flattening.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans indicating substrates, locations, and average depths of underlayment based on survey of substrate conditions.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.

#### **1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

#### **1.5 FIELD CONDITIONS**

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.
  - 1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F.

### **PART 2 - PRODUCTS**

#### **2.1 HYDRAULIC CEMENT UNDERLAYMENTS**

- A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch and that can be feathered at edges to match adjacent floor elevations.
  - 1. Cement Binder: ASTM C 150/C 150M, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C 219.
  - 2. Compressive Strength: Not less than 4000 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer.

## **SECTION 03 54 16 - HYDRAULIC CEMENT UNDERLAYMENT**

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.
- C. Water: Potable and at a temperature of not more than 70 deg F.
- D. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.
- E. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for conditions affecting performance of the Work.
- B. Proceed with application only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. General: Prepare and clean substrate according to manufacturer's written instructions.
  1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
  2. Fill substrate voids to prevent underlayment from leaking.
- B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.
  1. Moisture Testing: Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
- C. Adhesion Tests: After substrate preparation, test substrate for adhesion with underlayment according to manufacturer's written instructions.

#### **3.3 APPLICATION**

- A. General: Mix and apply underlayment components according to manufacturer's written instructions.
  1. Close areas to traffic during underlayment application and for time period after application recommended in writing by manufacturer.
  2. Coordinate application of components to provide optimum adhesion to substrate and between coats.
  3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Apply underlayment to produce uniform, level surface.
  1. Apply a final layer without aggregate to product surface.



## **SECTION 03 54 16 - HYDRAULIC CEMENT UNDERLAYMENT**

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- 2. Feather edges to match adjacent floor elevations.
- D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during application and curing processes.
- E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.
- F. Apply surface sealer at rate recommended by manufacturer.
- G. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

### **3.4 PROTECTION**

- A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

**END OF SECTION 03 54 16**

**SECTION 03 54 16 - HYDRAULIC CEMENT UNDERLAYMENT**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Masonry mortar.
  - 2. Masonry grout.
  - 3. Integral water repellent admixture.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 04 22 00 - Concrete Masonry.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. C143/C143M, Standard Test Method for Slump of Hydraulic-Cement Concrete.
    - b. C144, Standard Specification for Aggregate for Masonry Mortar.
    - c. C150/C150M, Standard Specification for Portland Cement.
    - d. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
    - e. C270, Standard Specification for Mortar for Unit Masonry.
    - f. C404, Standard Specification for Aggregates for Masonry Grout.
    - g. C476, Standard Specification for Grout for Masonry.
    - h. C1019, Standard Test Method for Sampling and Testing Grout.
    - i. C1093, Standard Practice for Accreditation of Testing Agencies for Masonry.
    - j. C1384, Standard Specification for Admixtures for Masonry Mortars.
  - 2. The Masonry Society (TMS):
    - a. 602, Specification for Masonry Structures.
  
- B. Qualifications:
  - 1. Preconstruction Testing Laboratory shall be an independent agency qualified in accordance with ASTM C1093 for performing the testing indicated.
    - a. Testing Laboratory shall have a minimum of 10 years of experience in the testing of mortar and grout.
    - b. Technician conducting tests shall have minimum of five years of experience in the testing of mortar and grout.
  
- C. Mock-Ups:
  - 1. Provide mortar and grout for mock-up specified in Specification Section 04 22 00.

**1.3 DEFINITIONS**

- A. Coarse grout and fine grout are defined by the aggregate size used in accordance with ASTM C476.
  
- B. Coarse aggregate and fine aggregate are defined in ASTM C404, Table 1.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. General:
      - 1) Product data for cementitious materials.
      - 2) Source or producer of aggregates and gradation.
      - 3) Integral water repellent manufacturer's dosage rate.
    - c. Proposed mortar mix design:
    - d. Proposed masonry grout mix design.
  - 2. Test results:
    - a. Preconstruction mortar test results.
    - b. Preconstruction masonry grout test results.
- B. Informational Submittals:
  - 1. Qualifications of testing lab and technician.
  - 2. Test results and inspection reports per Specification Section 01 45 33.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Store cementitious materials on elevated platforms, under cover, and in a dry location.
  - 1. Do not use cementitious materials that have become damp.
- B. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- C. Deliver preblended, dry mixes in moisture-resistant containers.
  - 1. Store preblended, dry mixes in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Portland Cement:
  - 1. ASTM C150/C150M, Type I or II.
  - 2. No air entrainment.
  - 3. Natural color.
  - 4. Maximum percent of alkalis: 0.60 in accordance with ASTM C150/C150M, Table 2.
- B. Hydrated Lime:
  - 1. ASTM C207, Type S.
  - 2. Type SA not acceptable.
  - 3. Lime substitutes are not acceptable.
- C. Mortar Aggregate: ASTM C144, free of gypsum.
- D. Grout Aggregate: ASTM C404.
- E. Water: Potable.

## **SECTION 04 05 13 - MASONRY MORTAR AND GROUT**

- F. Integral Water Repellent Admixture:
  - 1. Liquid polymeric admixture: ASTM C1384.
  - 2. Verify compatibility with liquid water repellent admixture being used in the fabrication of concrete masonry units.

### **2.2 MIXES**

- A. Mortar and grout shall comply with TMS 602 and building code.
- B. Type "S" mortar shall be used:
  - 1. Comply with ASTM C270, Table No. 1, Cement-Lime Mortar.
    - a. Do not use masonry cement or mortar cement.
    - b. No fly ash additives will be accepted.
  - 2. Mix materials minimum of three minutes and maximum of five minutes.
  - 3. Adjust consistency to satisfaction of mason.
  - 4. Do not use admixtures unless otherwise indicated.
  - 5. Provide integral water repellent admixture in mortar used for:
    - a. Exterior concrete masonry work.
    - b. Interior concrete masonry work in wet areas.
  - 6. Do not use integral water repellent admixture in mortar for brick.
- C. Masonry Grout:
  - 1. ASTM C476.
    - a. Minimum 28-day compressive strength: 2,000 psi.
    - b. Slump: 8 to 11 inches.
  - 2. Mix 5 minutes minimum.
  - 3. No admixtures allowed.
  - 4. At Contractor's option, premixed or preblended grout meeting the above minimum requirements may be used.

### **2.3 SOURCE QUALITY CONTROL**

- A. Perform preconstruction laboratory tests on proposed masonry mortar and grout prior to start of masonry work.
  - 1. Perform tests far enough in advance so that any necessary retesting can be accomplished before masonry construction begins.
    - a. Test mortar per ASTM C270.
    - b. Test grout per ASTM C1019.
- B. Source Limitations for Mortar Materials:
  - 1. Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions and TMS 602.

## **SECTION 04 05 13 - MASONRY MORTAR AND GROUT**

### **B. Mortar:**

1. If standard gray mortar begins to stiffen, it may be retempered by adding water and remixing [unless prohibited by water repellent admixture manufacturer].
  - a. Standard gray mortar shall not be retempered more than one time.
2. All mortar must be used within 2-1/2 hours maximum after initial mixing per TMS 602.
3. Engineer reserves right to alter mix design based on initial rate of absorption of masonry units.
4. Set [Prefaced masonry] [Glazed structural clay tile] using type S mortar.
  - a. Rake mortar from joint as recommended by the unit manufacturer.
  - b. Tuckpoint raked joints [and scored joints] using pointing grout.
    - 1) Install pointing grout in accordance with ANSI A108.10 and masonry unit manufacturer's published instructions.
    - 2) Use polymer modified sanded pointing grout for joints in:
      - a) Exterior masonry.
      - b) Interior dry areas.
    - 3) Use epoxy pointing grout for joints in interior areas subject to exposure to corrosive or caustic chemicals.

### **C. Masonry Grout:**

1. Use grout within 1-1/2 hours maximum after initial mixing.
2. Use no grout after it has begun to set.
3. Do not retemper grout after initial mixing.
4. Place grout in lifts not exceeding 4 feet.
5. Use coarse grout in spaces with least dimension over 2 inches.
6. Consolidate all grout while installing.
  - a. Consolidate grout pours 12 inches or less in height by mechanical vibration or by puddling.
  - b. Consolidate grout pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.

## **3.2 FIELD QUALITY CONTROL**

### **A. Masonry Mortar and Grout Testing and Inspection:**

1. Testing and inspection services will be provided by the Owner's special masonry inspector.
  - a. Do not include in the bid price the cost of these services.
2. Testing and inspection shall include, but is not limited to:
  - a. Observe proportions of site-prepared mortar and grout.
  - b. Observe grout space prior to grouting.
  - c. Grout compressive strength sampling, testing and reporting per ASTM C1019.
    - 1) One strength test shall be the average of three specimens from the same sample, tested at 28 days.
  - d. Grout slump test sampling, testing, and reporting per ASTM C143/C143M.
  - e. Frequency of sampling: One sample (three specimens) collected each grouting operation during masonry construction.
3. Reporting: Special inspector to submit test results and inspection reports per Specification Section 01 45 33.

**END OF SECTION 04 05 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Concrete masonry construction (CMU), including:
    - a. Standard concrete masonry.
    - b. Pre-colored masonry.
    - c. Split-face masonry.
    - d. Precast concrete lintels.
  - 2. Integral water repellent admixture.
  - 3. Masonry special inspection.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 00 05 - Concrete.
  - 2. Section 04 05 13 - Masonry Mortar and Grout.
  - 3. Section 07 21 00 - Building Insulation.
  - 4. Section 07 92 00 - Joint Sealants.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. C33, Standard Specification for Concrete Aggregates.
    - b. C55, Standard Specification for Concrete Building Brick.
    - c. C90, Standard Specification for Loadbearing Concrete Masonry Units.
    - d. C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
    - e. C426, Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.
    - f. C1357, Standard Test Methods for Evaluating Masonry Bond Strength.
    - g. E514, Standard Test Method for Water Penetration and Leakage Through Masonry.
  - 2. National Concrete Masonry Association (NCMA):
    - a. TEK 2-3A, Architectural Concrete Masonry Units.
    - b. TEK 3-4B, Bracing Concrete Masonry Walls During Construction.
    - c. TEK 8-2A, Removal of Stains from Concrete Masonry.
    - d. TEK 8-3A, Control and Removal of Efflorescence.
  - 3. The Masonry Society (TMS):
    - a. 602, Specification for Masonry Structures.
  
- B. Concrete masonry unit manufacturer shall be licensed or qualified, in writing, by manufacturer of integral water repellent admixture to produce masonry units containing manufacturer's admixture.
  - 1. Concrete masonry unit manufacturer shall have a minimum of five years experience producing masonry units containing manufacturer's admixture.
  
- C. All masonry units of any one particular type, color or face style shall be from the same production run.
  - 1. Special shapes shall be factory fabricated unless noted otherwise.

**1.3 DEFINITIONS**

- A. Definitions to be in accordance with Standard Unit Nomenclature Table 1, NCMA TEK 2-3A.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Manufacturer's information on aggregate and cement type used in manufacture.
    - b. Data sheet on each type of masonry unit, including:
      - 1) Pre-colored masonry.
      - 2) Split-face masonry.
  - 2. Drawings:
    - a. Scaled (minimum 1/8 inches per foot) plans showing proposed locations of masonry control joints.
    - b. Wall elevations and sections, indicating special shapes, shape part numbers, applicable dimensions.
    - c. Detail drawings for:
      - 1) Precast concrete lintels.
        - a) Show profiles, cross-sections, reinforcement and steel components.
  - 3. Certifications:
    - a. Certification that concrete masonry units meet or exceed requirements of standards referenced.
    - b. Certification that fire-resistive rated units meet the requirements of the building code.
    - c. Certification that integral water repellent admixture will not affect the use of coloring processes or alter the actual colors of factory colored masonry units.
    - d. Data sheets on integral water repellent admixture being used in masonry unit manufacturing.
    - e. Technical bulletins on cleaning masonry containing integral water repellent.
    - f. Certification of integral water repellent admixture dosage rates from concrete masonry unit producer.
    - g. Concrete masonry producer shall certify that integral liquid water repellent admixture has been provided at dosage rate recommended by admixture manufacturer for use in exterior wall construction.
  - 4. Qualifications of testing lab and technician.
  - 5. Test results for all masonry testing.
- B. Samples:
  - 1. Concrete Masonry Finish Samples: Manufacturer's complete offering of colors and textures for each type of masonry specified.
    - a. Minimum 3 inches SQ samples for initial selection.
    - b. Provide two, 8 inches SQ samples if each type of masonry selected for final approval.
    - c. Samples of standard gray masonry will not be required.
- C. Informational Submittals:

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver units on pallets with tight covers or deliver in cubes and store on dunnage.
- B. Protect units from damage.



- C. Inspect units upon delivery for damage, to assure color match with [mock-up] or approved samples, dimensional quality, and trueness of unit.
  - 1. Remove damaged or otherwise unacceptable units from the Project Site.
- D. Store units in accordance with manufacturer's recommendations.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Standard masonry units:
    - a. Any manufacturer capable of meeting the requirements of this Specification Section.
  - 2. Integral water repellent admixture:
    - a. GCP Applied Technologies, Inc.
    - b. ACM Chemistries, Inc.

### **2.2 MATERIALS**

- A. Cement: Type I or II Portland, ASTM C150.
- B. Aggregate: ASTM C33.
- C. Reinforcing Bars: Refer to Specification Section 03 00 05.
- D. Mortar: Refer to Specification Section 04 05 13.
- E. Masonry Grout: Refer to Specification Section 04 05 13.
- F. Masonry Accessories: Refer to Specification Section 04 05 23.
- G. Insulation: Refer to Specification Section 07 21 00.
- H. Sealants: Refer to Specification Section 07 92 00.
- I. Integral Concrete Masonry Water Repellent:
  - 1. Liquid polymeric admixture.
  - 2. GCP Applied Technologies, Inc., "DRY-BLOCK".

### **2.3 MANUFACTURED UNITS**

- A. General:
  - 1. Fire resistive units: Fabricate to meet the building code.
  - 2. Fabricated in the manufacturing plant.
  - 3. Provide square corners unless noted otherwise.
- B. Concrete Masonry Units:
  - 1. Modular units: ASTM C90.
    - a. Medium weight units: 105 pound/CUFT to less than 125 pound/CUFT.

- b. Light weight units are not acceptable.
  2. Concrete bricks:
    - a. Structural units: ASTM C55.
      - 1) Same material, texture and density as modular units.
  3. Color:
    - a. Interior units: Standard gray.
    - b. Exposed exterior units: Precolored, [\_\_\_\_\_].
  4. Design compressive strength:  $f'm = 2,000$  PSI minimum.
    - a. Determine in accordance with TMS 602.
      - 1) Unit strength method, sampled and tested in accordance with ASTM C140.
  5. Provide masonry units manufactured with integral water repellent admixture for the following exposures:
    - a. Exterior veneer.
    - b. Exterior single-wythe construction.
    - c. Exterior composite wall construction.
    - d. Interior areas defined as wet and/or corrosive.
      - 1) See Specification Section 07 92 00 for definition of wet and/or corrosive areas.
  6. Special shapes and faces:
    - a. Corner units.
      - 1) Corner units used in veneer wythe shall have a finished return leg one-half the length of a standard modular stretcher unit.
      - 2) Corner units shall maintain regular modular masonry coursing.
    - b. Finished end units.
    - c. Other special shapes as indicated on Drawings or necessary to maintain coursing.
- C. Precast concrete lintels:
  1. Concrete: See Specification Section 03 00 05.
  2. Reinforcing: See Specification Section 03 00 05.
  3. Embedded steel components: Galvanized.
    - a. See Specification Section 05 50 00.

## **2.4 PERFORMANCE AND DESIGN REQUIREMENTS**

- A. Integral Concrete Masonry Water Repellent:
  1. Water permeance of masonry: Capable of achieving a Class E Rating when evaluated using ASTM E514 with the test extended to 72 hours, using the rating criteria specified in ASTM E514.
  2. Flexural bond strength of masonry: An increase of 10%, minimum, in masonry flexural bond strength shall occur as a result of adding integral water-repellent concrete masonry and mortar admixtures when compared to a control (containing no admixtures) concrete masonry and mortar tested in accordance with ASTM C1357.
  3. Compressive strength validation shall be per unit strength method.
  4. Drying shrinkage of masonry: Maximum 5% increase in drying shrinkage of the concrete masonry units shall occur as a result of adding integral water repellent concrete masonry admixture when compared to a control (containing no admixtures) concrete masonry when tested in accordance with ASTM C426.
  5. Grout shear bond strength: Maximum 5% decrease in grout shear bond strength shall occur as a result of adding integral water repellent admixture to the concrete masonry units when compared to a control (containing no admixtures).

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Verify that anchors and flashings are correct.
- B. Lay out walls in advance for uniform and accurate spacing of bond patterns and joints.
  - 1. Properly locate openings, movement type joints, returns, and offsets [weep joints and weep vents].

**3.2 INSTALLATION**

- A. General:
  - 1. Build in flashing, reinforcing, [reglets,] [weepers,] [weep vents] and related accessory items.
    - a. See Specification Section 04 05 23 for installation of accessory items.
  - 2. Perform all cutting using masonry saw blades.
  - 3. Drill holes using masonry drill bits or core drill.
    - a. Holes made by chipping unit will not be accepted.
  - 4. Install field units in running bond, unless noted otherwise.
    - a. Provide special coursing where indicated on the Drawings.
  - 5. Cut as required to maintain bond pattern.
  - 6. Use solid units where cutting or laying would expose holes and as noted on Drawings.
  - 7. Avoid use of less than half size units, whenever possible.
  - 8. Do not use chipped, cracked, spalled, stained or imperfect units exposed in finish work.
  - 9. Provide units of uniform color, within the range demonstrated on the approved mock-up.
  - 10. Do not wet concrete masonry units.
  - 11. Build chases and recesses as indicated and required for work of other trades.
    - a. Provide not less than 8 inches of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses unless detailed otherwise on the Drawings.
  - 12. In fire-resistive rated wall construction, install fire resistive units in accordance with the building code.
- B. Concrete Masonry Units:
  - 1. Grout solid all cells containing steel reinforcing and as indicated on Drawings.
    - a. Refer to Specification Section 04 05 13 for grouting.
- C. Laying and Tooling:
  - 1. Lay masonry units with completely filled bed and head joints.
    - a. Provide full mortar bed on all block cross webs and completely fill head joints.
      - 1) Do not slush head joints.
      - 2) Protect cells requiring grout fill from mortar droppings.
      - 3) Omit mortar from head joint at weep joint opening.
  - 2. Maintain nominal 3/8 inches joint widths.
    - a. Cut joints flush where concealed [and where veneer plaster coating is required].
    - b. Tool exposed joints concave.
    - c. Compress mortar in below ground joints and in joints concealed by insulation in cavity wall construction.
    - d. Provide wider joints where noted on Drawings.
      - 1) In no case shall any mortar joint be more than 3/4 inches wide.

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- e. Where masonry sits on top of steel support omit the mortar joint on top of the support and sit masonry directly on top of the thru wall flashing or the steel support member unless a mortar joint is required to maintain coursing.
  3. During tooling of joints, enlarge any voids or holes [except weeps], and completely fill with mortar.
  4. Point-up all joints at corners, openings, and adjacent work to provide neat, uniform appearance.
  5. Remove masonry disturbed after laying.
    - a. Clean and relay in fresh mortar.
    - b. Do not pound units to fit.
    - c. If adjustments are required, remove units, clean, and reset in fresh mortar.
  6. Where work is stopped and later resumed, rack back 1/2 masonry unit length in each course.
    - a. Remove loose units and mortar prior to laying fresh masonry.
  7. As work progresses, build in items indicated on Drawings and specified.
    - a. Fill in solidly with mortar around built-in items.
    - b. Where built-in items are to be embedded in cores of hollow masonry units, place grout screen in joint below and fill core solid with mortar.
- D. Control Joints and Sealants:
1. Provide vertical expansion, control and isolation joints where indicated on Drawings.
  2. Where not indicated on Drawings, submit proposed control joint locations in accordance with the following requirements:
    - a. Provide control joints at maximum [24] feet OC.
    - b. Provide at all T intersections.
    - c. Locate joints so as to allow lintels and bond beams above and below openings to extend beyond the opening as indicated on the Drawings without control joints thru the lintel or bond beam.
  3. Rake out mortar in joint.
  4. Refer to Specification Section 07 92 00 for sealant installation requirements.
    - a. Seal control and expansion joints.
- E. Tolerances:
1. Maximum variation from plumb in vertical lines and surfaces of columns, walls, and arises:
    - a. 1/4 inches in 10 feet.
    - b. 3/8 inches in a story height not to exceed 20 feet.
    - c. 1/2 inches in 40 feet or more.
  2. Maximum variation from plumb for external corners, expansion joints, and other conspicuous lines:
    - a. 1/4 inches in any story or 20 feet maximum.
    - b. 1/2 inches in 40 feet or more.
  3. Maximum variation from level of grades for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
    - a. 1/4 inches in any bay or 20 feet.
    - b. 1/2 inches in 40 feet or more.
  4. Maximum variation from plan location of related portions of columns, walls, and partitions:
    - a. 1/2 inches in any bay or 20 feet.
    - b. 3/4 inches in 40 feet or more.
  5. Maximum variation in cross-sectional dimensions of columns and thicknesses of walls from dimensions shown on Drawings:
    - a. Minus 1/4 inches.
    - b. Plus 1/2 inches.
  6. Maximum variation in mortar joint width:
    - a. Bed joints: 3/32 inches in 10 feet.
    - b. Head joints:

- 1) Minus 1/8 inches.
  - 2) Plus 1/8 inches.
- F. Protect against weather when work is not in progress.
1. During inclement weather conditions, cover top of walls with translucent waterproof membrane.
- G. Protect against cold/hot weather.

### **3.3 FIELD QUALITY CONTROL**

- A. Bracing Concrete Masonry Walls During Construction:
1. At a minimum, provide bracing in accordance with NCMA TEK 3-4B.
  2. Contractor is responsible for adequately bracing all masonry during construction.
- B. Remove and replace loose, stained, damaged and other unacceptable units as directed by Engineer.
1. Provide new units to match.
  2. Install in fresh mortar.
  3. Point to eliminate evidence of replacement.
- C. Special Masonry Inspection:
1. Masonry inspection services will be provided during the following construction activities:
    - a. Cost of masonry inspection services will be paid by Owner.
    - b. During laying of units:
      - 1) During the first day of the masonry construction, inspect proportions of site prepared mortar, construction of mortar joints, location of all reinforcing and connectors, size and location of structural elements, type, size and location of anchors, protection of masonry during cold weather.
      - 2) Inspection to be continuous the first full day of masonry construction which requires special inspection.
        - a) Thereafter, a minimum of 3 hours every third day of construction until the concrete masonry work is complete.
      - 3) Inspection while laying masonry units may be made concurrently with other inspection duties provided all inspection duties are adequately performed.
      - 4) When deficiencies are found, additional inspection shall be provided as required until deficiencies have been corrected.
      - 5) If masonry crews change, an additional full day of inspection is required during the first day the new crew is on-site.
    - c. Placement of reinforcing steel:
      - 1) Verification of all reinforcing including size, grade, lap lengths, and type.
      - 2) Inspection may be periodic as required to verify all reinforcing.
      - 3) Inspector to be present during the concrete pour in which any dowels connecting concrete to masonry are cast.
        - a) Inspector to verify proper location of dowels.
    - d. Prior to each grouting operation, verify that grout space is clean, reinforcing is clean and connectors are properly placed, proportions of site-prepared grout are correct and mortar joints have been properly constructed.
      - 1) Inspection may be periodic as required to verify proper grout space.
    - e. Verify compliance with building code and Specifications continuously during all grouting operations.

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- f. Provide special inspection in accordance with the [building code Table 1704.5.1] [building code Table 1704.5.3] [TMS 602 Level [A][B][C] Quality Assurance] including observation of masonry work for conformance to the Contract Documents:
  - 1) Provide inspection reports to the Engineer, Building Official and Owner.
    - a) Notify Contractor of discrepancies for correction.
    - b) Notify Engineer, Building Official and Owner, in writing, when discrepancies have been satisfactorily corrected.
  - 2) Submit final signed report stating that work requiring special inspection was, to the best of the inspector's knowledge, in conformance to the Contract Documents and the applicable workmanship provisions of the building code.

### **3.4 CLEANING**

- A. Clean concrete masonry as the wall is being constructed using fiber brushes, wooden paddles and scrapers.
  - 1. Do not use metal tools or wire brushes.
  - 2. No acid-based cleaning solutions shall be used unless approved in writing by Engineer.
- B. Remove dirt and stains in accordance NCMA TEK 8-2A.
- C. Remove primary efflorescence in accordance with NCMA TEK 8-3A.

**END OF SECTION 04 22 00**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Clay face brick.
  - 2. Mortar.
  - 3. Ties and anchors.
  - 4. Embedded flashing.
  - 5. Miscellaneous masonry accessories.
- B. Products Installed but not Furnished under This Section:
  - 1. Steel lintels in masonry veneer.
  - 2. Steel shelf angles for supporting masonry veneer.
- C. Related Requirements:
  - 1. Section 07 62 00 "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
  - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
  - 2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:
  - 1. Clay face brick, in the form of straps of five or more bricks.
  - 2. Weep holes/vents.

**1.4 INFORMATIONAL SUBMITTALS**

- A. List of Materials: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.
  - 1. Submittal is for information only. Receipt of list does not constitute approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.
- B. Material Certificates: For each type and size of the following:
  - 1. Masonry units.
    - a. Include data on material properties, material test reports substantiating compliance with requirements.

- b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
    - c. For exposed brick, include test report for efflorescence according to ASTM C67.
  - 2. Cementitious materials. Include name of manufacturer, brand name, and type.
  - 3. Mortar admixtures.
  - 4. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
  - 5. Anchors, ties, and metal accessories.
- C. Mix Designs: For each type of mortar. Include description of type and proportions of ingredients.
- 1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
- D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

**1.5 QUALITY ASSURANCE**

- A. Testing Agency: Qualified in accordance with ASTM C1093 for testing indicated.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- C. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

**1.7 FIELD CONDITIONS**

- A. Protection of Masonry: During construction, cover tops of veneer, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down face of veneer, and hold cover securely in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry. Immediately remove grout, mortar, and soil that come in contact with masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.



- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

**2.2 UNIT MASONRY, GENERAL**

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects will be exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

**2.3 BRICK**

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
  - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
  - 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
  - 4. Provide special shapes for applications where required.
- B. Clay Face Brick: Palmetto – .75 Greystone Wirecut.

**2.4 MORTAR MATERIALS**

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
  - 1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Aggregate for Mortar: ASTM C144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  - 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
- E. Mortar Color: Adams; # 4201.
- F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C494/C494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation.
    - b. Euclid Chemical Company (The); an RPM company.
    - c. GCP Applied Technologies Inc.

**2.5 TIES AND ANCHORS**

- A. General: Ties and anchors shall extend at least 1-1/2 inches into veneer but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
  - 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
  - 2. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with
- C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
  - 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire.
  - 2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel wire.
- D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
  - 1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.105-inch-thick, steel sheet, galvanized after fabrication or 0.109-inch-thick, stainless-steel sheet.

2. Tie Section: Triangular-shaped wire tie made from 0.187-inch- diameter, hot-dip galvanized steel or stainless-steel wire
- E. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist a 100-lbf load in both tension and compression perpendicular to plane of wall without deforming or developing play in excess of 1/16 inch.
  2. Fabricate sheet metal anchor sections and other sheet metal parts from 0.105-inch-thick steel sheet, galvanized after fabrication or 0.109-inch-thick, stainless-steel sheet.
  3. Fabricate wire ties from 0.187-inch- diameter, hot-dip galvanized steel or stainless-steel wire unless otherwise indicated.
  4. Fabricate wire connector sections from 0.187-inch- diameter, hot-dip galvanized steel or stainless-steel wire.
  5. Masonry-Veneer Anchors; Single-Barrel Screw: Self-drilling, single-barrel screw designed to receive wire tie. Screw has a smooth barrel the same thickness as insulation with factory-installed gasketed washer to seal at face of insulation and sheathing and a coating to reduce thermal conductivity.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Heckmann Building Products, Inc.
      - 2) Hohmann & Barnard, Inc.
      - 3) PROSOCO, Inc.
      - 4) Rodenhouse Inc.
      - 5) Wire-Bond.
  6. Masonry-Veneer Anchors; Single-Barrel Screw with Double-Pintle Wingnut: Self-drilling, single-barrel screw with thermally resistant wingnut head designed to receive double-pintle wire tie. Screw has a smooth barrel the same thickness as insulation with factory-installed gasketed washer to seal at face of insulation and sheathing and a coating to reduce thermal conductivity.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Heckmann Building Products, Inc.
      - 2) Hohmann & Barnard, Inc.
  7. Stainless Steel Drill Screws for Wood Studs: ASTM C954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads; either made from Type 410 stainless steel or made with a carbon-steel drill point and 300 Series stainless steel shank.

## **2.6 EMBEDDED FLASHING MATERIALS**

- A. Masonry Veneer Flashing and End Dams:
1. General:
    - a. 0.0188-inch thick, stainless steel.
    - b. Fabricate one brick high x one brick deep plus width of cavity.
      - 1) File all cuts in metal flashing.
  2. Veneer Flashing:
    - a. Lintel or Shelf Angle:
      - 1) Length to be ½-inch less than length of lintel or shelf angle adjusted to the closest head joint including weeps.
    - b. Sill Flashing:
      - 1) Length to be ½-inch less than the masonry sill opening including weeps.
  3. Formed End Dams.
    - a. Fabricate each mirrored end dam 8-inches long x one brick high x one brick deep plus width of cavity.

- b. Fold rear and side material to create drainage pan.
  - c. Solder all joints.
- B. Drip Edge:
  - 1. Factory formed, cold and drawn and annealed of 2B or 2D, 0.0188-inch thick (26 gage) stainless flashing.
  - 2. Provide hemmed drip edge.
  - 3. Constructed wide enough to bridge the length of the horizontal leg of the lintel or shelf angle.
- C. Flexible Flashing: Use the following unless otherwise indicated:
  - 1. Provide 0.010 thick self-adhering stainless-steel core with one uncoated (bare) stainless steel face (outward facing) with a butyl block co-polymer adhesive (inward facing).
  - 2. Where flashing extends to face of masonry, self-adhering stainless-steel sheet is held back approximately 1/2 inch from face of brick.
  - 3. Provide preformed 26-gauge stainless-steel metal drip edges and end dams, extended at least 3 inches into wall and up the jambs and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
  - 4. Apply self-adhering stainless-steel sheet to stainless steel drip edge and preformed stainless steel end dams.
  - 5. Manufacture to be York 304 Multi-Flash and Flash-Vent flashing.
- D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- E. Termination Bars for Flexible Flashing: Stainless-steel bars 0.075 inch by 1 inch.

**2.7 MISCELLANEOUS MASONRY ACCESSORIES**

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.
- B. Weep/Vent Products: Use the following unless otherwise indicated:
  - 1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Advanced Building Products Inc.
      - 2) Heckmann Building Products, Inc.
      - 3) Hohmann & Barnard, Inc.
      - 4) Wire-Bond.
- C. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advanced Building Products Inc.
    - b. CavClear/Archovations, Inc.
    - c. Heckmann Building Products, Inc.
    - d. Hohmann & Barnard, Inc.
    - e. Mortar Net Solutions.

- f. Wire-Bond.
- 2. Configuration: Provide one of the following:
  - a. Strips, full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.
  - b. Strips, not less than 1-1/2 inches thick and 10 inches high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.

**2.8 MASONRY CLEANERS**

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Diedrich Technologies, Inc.; a Hohmann & Barnard company.
    - b. EaCo Chem, Inc.
    - c. PROSOCO, Inc.

**2.9 MORTAR MIXES**

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
  - 1. Do not use calcium chloride in mortar or grout.
  - 2. Use masonry cement or mortar cement mortar unless otherwise indicated.
  - 3. For exterior masonry, use masonry cement or mortar cement mortar.
  - 4. For reinforced masonry, use masonry cement or mortar cement mortar.
  - 5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Use Type S unless another type is indicated.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION, GENERAL**

- A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.
- D. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested according to ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

**3.3 TOLERANCES**

- A. Dimensions and Locations of Elements:
  - 1. For dimensions in cross section or elevation, do not vary by more than plus 1/2 inch or minus 1/4 inch.
  - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch.
  - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2-inch total.
- B. Lines and Levels:
  - 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
  - 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 3. For vertical lines and surfaces, do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
  - 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
  - 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
  - 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
  - 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
- C. Joints:
  - 1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
  - 2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
  - 3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.

4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

### **3.4 LAYING MASONRY WALLS**

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
  1. Provide soldier where indicated.
  2. Provide herringbone pattern where indicated.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

### **3.5 MORTAR BEDDING AND JOINTING**

- A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- B. Lay hollow brick and CMUs with face shells fully bedded in mortar and with head joints of depth equal to bed joints. At starting course, fully bed entire units, including area under cells.
  1. At anchors and ties, fully bed units and fill cells with mortar as needed to fully embed anchors and ties in mortar.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
  1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.

### **3.6 ANCHORED MASONRY VENEERS**

- A. Anchor masonry veneers to wall framing and concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
  1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
  2. Embed tie sections connector sections and continuous wire in masonry joints.

3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  4. Space anchors as indicated.
- B. Provide not less than 1 inch of airspace between back of masonry veneer and face of insulation.
1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

### **3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE**

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete to comply with the following:
1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
  2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
  3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

### **3.8 EXPANSION JOINTS**

- A. General: Install expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form expansion joints as follows:
1. Build flanges of factory-fabricated, expansion-joint units into masonry.
  2. Build in compressible joint fillers where indicated.
  3. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 07 92 00 "Joint Sealants."

### **3.9 LINTELS**

- A. Install steel lintels where indicated.
- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

### **3.10 FLASHING, WEEP HOLES, AND VENTS**

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.



2. Extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under air barrier, lapping at least 4 inches.
  3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
  4. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
  5. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07 92 00 "Joint Sealants" for application indicated.
  6. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install weep holes in veneers in head joints of first course of masonry immediately above embedded flashing.
1. Use specified weep/vent products to form weep holes.
  2. Use wicking material to form weep holes above flashing under brick sills. Turn wicking down at lip of sill to be as inconspicuous as possible.
  3. Space weep holes 24 inches o.c. unless otherwise indicated.
- E. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- F. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.
1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

### **3.11 REPAIRING, POINTING, AND CLEANING**

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

## **SECTION 04 26 13 - MASONRY VENEER**

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3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean stone trim to comply with stone supplier's written instructions.

### **3.12 MASONRY WASTE DISPOSAL**

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be recycled, and other masonry waste, and legally dispose of off Owner's property.

**END OF SECTION 04 26 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Structural steel, including the fabrication and erection of support and bracing members, including connections.
  - 2. Connection detail design as required.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 15 19 - Anchorage to Concrete.
  - 2. Division 09 - Finishes.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Institute of Steel Construction (AISC):
    - a. 303, Code of Standard Practice for Steel Buildings and Bridges.
    - b. 360, Specifications for Structural Steel Buildings.
    - c. Quality Certification Program for Fabricators.
  - 2. American Society of Mechanical Engineers (ASME):
    - a. B18.21.1, Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series).
  - 3. ASTM International (ASTM):
    - a. A2, Standard Specification for Carbon Steel Girder Rails of Plain, Grooved, and Guard Types.
    - b. A6/A6M, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
    - c. A36/A36M, Standard Specification for Carbon Structural Steel.
    - d. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    - e. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
    - f. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - g. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    - h. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
    - i. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
    - j. A563, Standard Specification for Carbon and Alloy Steel Nuts.
    - k. A992/A992M, Standard Specification for Structural Steel Shapes.
    - l. A1064/A1064M, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
    - m. F436, Standard Specification for Hardened Steel Washers.
    - n. F959, Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
    - o. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

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- p. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
  - 4. American Welding Society (AWS):
    - a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
    - b. A5.5/A5.5M, Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding.
    - c. A5.17/A5.17M, Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
    - d. A5.18/A5.18M, Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding.
    - e. A5.20/A5.20M, Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
    - f. A5.23/A5.23M, Specification for Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding.
    - g. A5.28/A5.28M, Specification for Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding.
    - h. A5.29/A5.29M, Specification for Low-Alloy Steel Electrodes for Flux Cored Arc Welding.
    - i. D1.1/D1.1M, Structural Welding Code - Steel.
      - 1) Steel stud connectors and their installation to comply with requirements of AWS D1.1/D1.1M.
  - 5. National Institute of Steel Detailing (NISD).
  - 6. Research Council on Structural Connections (RCSC):
    - a. Specification for Structural Joints Using High-Strength Bolts.
- B. Qualifications:
- 1. Steel fabricator:
    - a. Minimum of 10 years of experience in fabrication of structural steel and participate in the AISC Certification program and is designated an AISC Certified Plant, Category BU (formally known as STD), SBR at time of bid.
    - b. Fabricator plant quality control and inspection program: Meet requirements of the building code and/or be an Approved Fabricator.
    - c. Plants that are not an Approved Fabricator may be acceptable, provided:
      - 1) Plant meets all remaining qualifications.
      - 2) Contractor reimburses the Owner the cost of required Special Inspection services.
  - 2. Steel erector:
    - a. Minimum of 10 years of experience in erection of structural steel similar in the scope of this project or certified as CSE under the AISC Quality Certification Program.
    - b. With an active and enforced quality assurance program in place, as described in the applicable Codes.
  - 3. Qualify welding procedures and welding operators in accordance with AWS.

### 1.3 DEFINITIONS

- A. Owner: May mean the Owner's Designated Representative for Construction as defined by the AISC 303.
- B. Galvanizing: Hot-dipped galvanizing per ASTM A153/A153M and/or ASTM A123/A123M with minimum coating of 2.0 oz of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by aforementioned standards.
- C. Approved Fabricator: Approved by the Building Official to perform the building code required Special Inspections.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Detailed supplemental specification relating to load indicator washers or high-strength bolts.
      - 1) Alternate design for Engineer approval (submitted at Contractor's option if desired by Contractor for use).
    - d. Source and certification of quality for high-strength bolts, nuts and washers.
  - 2. Fabrication and/or layout drawings:
    - a. Prepare Shop Drawings under NISD Quality Procedures Program certification.
    - b. Complete Shop Drawings for all of the work showing clearly all pieces, sizes, dimensions, details, connections materials and shop coatings.
      - 1) All Shop Drawings must be checked and signed "approved" before submittal.
      - 2) Show all cuts, copes, and holes.
      - 3) Indicate all shop and field bolts.
      - 4) Indicate all shop and field welds using AWS symbols.
      - 5) Be reviewed and sealed by a Professional Engineer retained by Contractor to verify conformance with design criteria stipulated in the Contract Documents.
        - a) Note connection capacity or design load next to each connection.
    - c. Prepare complete erection drawings showing the location and marks of all pieces.
      - 1) Copies of up-to-date erection drawings shall accompany the Shop Drawings.
      - 2) Use match marks on the erection drawings to indicate the sheet number on which each particular member is detailed.
    - d. Correct any incorrect or unacceptable material or fabrication due to incorrect detailing, shop work, or erection, without additional charge.
  - 3. Certifications:
    - a. Certificates of compliance with standards specified for all major components and fasteners incorporated into work.
    - b. Copies of current welding certificates for each welder assigned to perform welding indicating compliance with testing specified by AWS.
    - c. Welder qualification data and prequalified procedures.
    - d. Special Inspections reports.
    - e. Source Quality Control Documentation, including certificate of compliance stating that the work performed in the fabrication shop was done in accordance with the approved construction documents.
      - 1) Certification is required only if the fabricator is fabricator approved by the Building Official.
  - 4. Test reports:
    - a. Certified copies of mill tests.
    - b. Manufacturer's load test and temperature sensitivity data for post-installed anchor bolts.
    - c. Test reports for all structural steel work.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Handle and store steel members above ground on skids or other supports.
  - 1. Keep free of dirt and other foreign material and protect against corrosion.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. High-strength bolts:
    - a. Portland Bolt and Manufacturing Company.
    - b. Lewis Bolt & Nut Company.
    - c. Nucor Fasteners.
    - d. St. Louis Screw and Bolt Company.
  - 2. Load indicator washers for high-strength bolts:
    - a. Portland Bolt and Manufacturing Company.
    - b. Mid-South Bolt and Screw Co., Inc.
    - c. J and M Turner, Inc.
  - 3. Alternate design high-strength bolts:
    - a. T. C. Bolt Corporation.
    - b. Constrution Fastener Systems Division of Bristol Machine Company.
    - c. LeJuene Bolt Co.
  - 4. Headed studs and deformed bar anchors:
    - a. Nelson Stud Welding Division, TRW, Inc.
    - b. Stud Welding Products, Inc.
  - 5. Mechanical anchor bolts:
    - a. See Section 03 15 19.
  - 6. Adhesive anchors bolts:
    - a. See Section 03 15 19.
  - 7. Anchor bolt sleeves:
    - a. Sinco/Wilson.

**2.2 MATERIALS**

- A. Steel, Structural Shapes and Plate (unless noted otherwise on Drawings):
  - 1. All W-shapes and WT-shapes: ASTM A992/A992M.
  - 2. All other plates, bars and rolled shapes: ASTM A36/A36M.
  - 3. Column Base Plates: ASTM A572 (Fy=50).
- B. Pipe: ASTM A53/A53M, Grade B (Type E or S) (Fy=35).
- C. Hollow Structural Sections (HSS):
  - 1. Round: ASTM A501, Grade C (Fy=50).
  - 2. Square or rectangular: ASTM A500/A500M, Grade C(Fy=50).
- D. High-Strength Bolts, Nuts and Washers:
  - 1. ASTM F3125, Grade A325 or Grade A490 with ASTM A563 nuts:
  - 2. High-strength bolts:
    - a. Provide two ASTM F436 washers for all bolts.
    - b. Provide beveled washers at connections of sloped/tapered sections.
  - 3. High-strength bolts with compressible washer type direct tension indicators (DTI), ASTM F959.
    - a. Provide at Contractor's option and subject to approval of Engineer.
  - 4. Alternate high-strength design: Provide at Contractor's option and subject to approval of Engineer.

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- E. Bolts, Non-high Strength: ASTM A307, Grade A.
- F. Threaded Rod: ASTM F1554, Grade 36.
- G. Washers, Plain (for Non-high Strength Bolts): ASME B18.22.1, Type B.
- H. Welding Electrodes:
  - 1. Shielded metal arc: AWS A5.1/A5.1M or AWS A5.5/A5.5M, E70XX or E801X-X.
  - 2. Submerged arc: AWS A5.17/A5.17M or AWS A5.23/A5.23M, F7XX-EXXX or F8XX-EXXX-XX.
  - 3. Gas metal arc: AWS A5.18/A5.18M, E70S-X or E70U-1 or AWS A5.28/A5.28M, ER80S-XX, E80C-XXX.
  - 4. Flux cored arc: AWS A5.20/A5.20M, E7XT-X (except 2, 3, 10, GS), AWS A5.29/A5.29M, E7XT-X or E8XTX-X, E8XTX-XM.
- I. Anchor Rods and Bolts:
  - 1. See Section 03 15 19.
- J. Headed Studs and Deformed Bar Anchors:
  - 1. Headed studs:
    - a. ASTM A108, complying with AWS D1.1/D1.1M, Section 7, Type B; minimum yield strength 50,000 psi, minimum tensile strength 60,000 psi.
    - b. Uniform diameter.
    - c. Heads: Concentric and normal to shaft.
    - d. Weld end: Chamfered and solid flux.
  - 2. Deformed bar anchor:
    - a. ASTM A1064/A1064M, complying with AWS D1.1/D1.1M, Section 7, Type C.
    - b. Minimum yield strength: 70,000 psi.
    - c. Minimum tensile strength: 80,000 psi.
    - d. Straight, unless indicated otherwise.
    - e. Solid flux.
  - 3. After welding, remove ceramic ferrules and maintain free from any substance which would interfere with function, or prevent bonding to concrete.
- K. Nonshrink Grout: See Specification Section 03 00 05.
- L. Crane Rails:
  - 1. Controlled-cooled, open-hearth carbon steel ASCE (American Society of Civil Engineers) rails per ASTM A2, Class A, #1 rails, unless noted otherwise, of size and weight indicated.
    - a. Furnish rails with milled tight end joints suitable for crane service, with standard drilling, removable end stops and all related accessories required, including:
      - 1) Joint bars: Match rail section and properties, drilled to match rail drilling.
      - 2) Joint bar bolts and nuts: High strength.
      - 3) Hardened washer: ASTM F436 for bar bolts.
      - 4) Except as indicated otherwise, two-bolt type fixed or floating rail clamps to suit the conditions, of forged or pressed steel, complete with Grade A325 bolts, reversible fillers, and self-locking nut or nut and lock washer.
- M. Mechanical and Adhesive Anchor Bolts for Fastening to Concrete:
  - 1. See Specification Section 03 15 19.

**2.3 FABRICATION**

- A. Comply with requirements of applicable building code and AISC 360 with modifications and additional requirements specified herein.
  - 1. Identify high-strength steel material in fabricated members in accordance with ASTM A6/A6M.
  
- B. Minimize the amount of field welding.
  - 1. Shop assemble components into largest size possible commensurate with transportation and handling limitations.
  - 2. Shop connections: Bolted with high-strength bolts or welded.
  
- C. Connection Details:
  - 1. Connections not fully detailed on Drawings shall be designed by a Professional Engineer registered in the State of North Carolina, retained by Contractor, based on requirements of Contract Documents.
  - 2. Where beam reactions are shown on Drawings, design beam connection to support specified loads.
  - 3. Where indicated on the Drawings, design beam connections for the axial load or transfer forces indicated in addition to the shear value indicated above.
  - 4. Design bracing connections for loads indicated on the Drawings.
  - 5. Design girt connections for required lateral wind and/or seismic horizontal load acting either inward or outward in addition to vertical load due to panel and girt weight.
  - 6. Provide as a minimum, two, 3/4 inches diameter, high-strength bolts for all bolted connections unless otherwise specified.
  - 7. Provide bearing type connections for all bolted connections, unless otherwise noted or required to be slip-critical by the RCSC Specification for Structural Joints Using High-Strength Bolts.
  - 8. One-sided or other types of eccentric connections not indicated will not be permitted without prior approval.
  
- D. Provide bearing type connections for all bolted connections, unless otherwise noted.
  
- E. Field Connections:
  - 1. Provide bolts for all field connections except where shown otherwise on the Drawings.
  - 2. Use high-strength bolts unless shown or specified otherwise.
  - 3. Use of high-strength bolts: Conform to RCSC Specification for Structural Joints Using High-Strength Bolts.
  - 4. Unfinished bolts may be used for attaching stair treads to stringers.
  - 5. If structural steel details (field welds versus shop welds, etc.) shown on design Drawings are not compatible with selected erection procedures, submit proposed modifications for review.
  - 6. Connections to structural steel provided by others: Provide all connectors and coordinate location of bolt holes to match connection holes in steel provided by others.
  
- F. Accurately mill column end bearing surfaces to true plane.
  
- G. Fabricate and erect beams with non-specified camber in accordance with AISC 360, Chapter L1.
  
- H. Cut, drill, or punch holes at right angles to surface of metal.
  - 1. Do not make or enlarge holes by burning.
  - 2. Make holes clean cut, without torn or ragged edges.



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3. Remove outside burrs resulting from drilling or reaming operations with tool making 1/16 IN bevel.
  4. Provide holes in members to permit connection of work of other trades or contractors.
- I. Make allowance for draw in all cross bracing to provide small amount of initial tension in members.
- J. Make splices only where indicated or where approved.
- K. Wall Girts:
1. Extend past columns and miter ends unless noted otherwise.
  2. Connect girts to each other at corners unless noted otherwise.
- L. Cope at 45 degrees, corners of stiffener plates at junction of member flanges with webs.
- M. Flame cut bevels for welds, provided such cutting is done automatically.
1. Leave free of burrs and slag by grinding or planing the cut edges.
- N. Grind smooth all rough welds and sharp steel edges shall be ground to approximately 1/8 inches radius.
- O. Tolerances (unless noted otherwise on Drawings):
1. When material received from the mill does not satisfy ASTM A6/A6M tolerances for camber, profile, flatness or sweep, Contractor is permitted to perform corrective work by the use of controlled heating, and mechanical straightening, subject to the limitations of the AISC 360.
  2. Fabrication tolerance:
    - a. Member length:
      - 1) Both ends finished for contact bearing: 1/32 inches.
      - 2) Framing members: 30 feet or less: 1/16 inches Over 30 feet: 1/8 inches.
    - b. Member straightness:
      - 1) Compression members: 1/1000 of axial length between points laterally supported.
      - 2) Non-compression members: ASTM A6/A6M tolerance for wide flange shapes.
    - c. Specified member camber (except compression members):
      - 1) 50 feet or less: -0/+1/2 inches.
      - 2) Over 50 feet: -0/+1/2 inches (+1/8 inches per 10 feet over 50 feet).
      - 3) Members received from mill with 75% of specified camber require no further cambering.
      - 4) Fabricate beams/trusses without specified camber so after erection, camber is upward.
      - 5) Measure camber in fabrication shop in unstressed condition.
    - d. Use filler plates at bolted splices to take up depth deviation.
      - 1) At welded joints, adjust weld profile to conform to variation in depth.
      - 2) Slope weld surface per AWS requirements.
    - e. Free finished members from twists, bends and open joints.
      - 1) Sharp kinks, bends and deviation from the above tolerances are cause for rejection of material.

### 2.4 WELDING

- A. Comply with AWS D1.1/D1.1M, and other requirements indicated herein, for all welding, techniques of welding employed, appearance and quality of welds, and methods used to correct defective work.
1. Qualify joint welding procedures or test in accordance with AWS qualification procedures.

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- B. Test and qualify welders, welding operators and tackers in compliance with AWS D1.1/D1.1M for position and type of welding to which they will be assigned.
  - 1. Conduct tests in presence of approved testing agency.
  - 2. Certification within previous 12 months will be acceptable, provided samples of the welder's work are satisfactory.
- C. Before Starting Welding:
  - 1. Carefully plumb and align members in compliance with specified requirements.
  - 2. Fully tighten all bolts.
  - 3. Comply with AWS D1.1/D1.1M, Section 5 for assembly and surface preparation.
  - 4. Preheat base metal to temperature stated in AWS D1.1/D1.1M.
    - a. When no preheat temperature is given in AWS D1.1/D1.1M and base metal is below 50 degrees F, preheat base metal to at least 70 degrees F.
    - b. Maintain temperature during welding.
    - c. Preheat surface of all base metal within distance from point of welding equal to thickness of thicker part being welded or 3 inches, whichever is greater, to specified preheat temperature.
    - d. Maintain this temperature during welding.
  - 5. Mark welds with an identifying mark unique to each welder.
- D. Make flange welds before making web welds.
- E. Where groove welds have back-up plates, make first three passes with 1/8 inches round electrodes.
  - 1. Use backup plates in accordance with AWS D1.1/D1.1M, extending minimum of 1 inch either side of joint.
- F. Flame cut edges of stiffener plates at shop or field butt weld.
  - 1. Do not shear.
- G. Grind flush web fillets at webs notched to receive backup plates for flange groove welds.
- H. Low Hydrogen Electrodes: Dry and store electrodes in compliance with AWS D1.1/D1.1M.
- I. Do not perform welding when ambient temperature is lower than 0 degrees F or where surfaces are wet or exposed to rain, snow, or high wind, or when welders are exposed to inclement conditions.
- J. Headed Studs and Deformed Bar Anchors:
  - 1. Automatically end welded in accordance with the AWS D1.1/D1.1M and manufacturer's recommendations.
  - 2. Fillet welding of headed studs and deformed bar anchors is not allowed unless approved by Engineer.
- K. Test in-place studs in accordance with requirements of AWS D1.1/D1.1M to ensure satisfactory welding of studs to members.
  - 1. Replace studs failing this test.
- L. When headed stud-type shear connectors are to be applied, clean top surface of members to receive studs in shop to remove oil, scale, rust, dirt, and other materials injurious to satisfactory welding.
  - 1. Do not shop paint or galvanize metal surfaces to receive field applied studs.

**2.5 SHOP COATING**

- A. Refer to Division 09 specifications and coordinate shop primer, surface preparation and coating with field applied primers and coatings where specified.
- B. Provide suitable methods of handling and transporting painted steel to avoid damage to coating.
- C. Do not coat following surfaces:
  - 1. Machined surfaces, surfaces adjacent to field welds, and surfaces fully embedded in concrete.
  - 2. All other members for which no coating is specified.
  - 3. Contact surfaces at bolted slip-critical connections, unless surface condition conforms to the RCSC Specification for Structural Joints Using High-Strength Bolts, Part 3.2.2.
- D. Clean thoroughly all surfaces not coated before shipping.
  - 1. Remove loose mill scale, rust, dirt, oil and grease.
  - 2. Protect machined surfaces.

**2.6 SOURCE QUALITY CONTROL**

- A. Special Inspection and Testing:
  - 1. See Specification Section 01 45 33.
  - 2. If the fabricator is not an Approved Fabricator, Owner will employ the services of an independent testing agency to inspect and test structural steel shop work for compliance with Specifications.
    - a. Contractor provides sufficient notification and access so inspection and testing can be accomplished.
  - 3. Contractor responsible for testing to qualify shop welders and as needed for Contractor's own quality control to ensure compliance with Contract Documents.
- B. Approved Fabricator or Testing Agency Responsibilities:
  - 1. Inspect shop and field welding in accordance with AWS D1.1/D1.1M, Section 6 including the following non-destructive testing:
    - a. Visually inspect all welds.
    - b. In addition to visual inspection, test 50% of full penetration welds and 20% of fillet welds with liquid dye penetrant.
    - c. Test 20% of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.
  - 2. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
    - a. Verify proper pretension for slip-critical bolted connection only.
    - b. Verify direct tension indicator gaps for slip-critical bolted connection only.
  - 3. Inspect stud welding in accordance with AWS D1.1/D1.1M, Section 7.8.
  - 4. Prepare and submit inspection and test reports to Engineer.

**2.7 GENERAL**

- A. Contractor is solely responsible for safety.
  - 1. Construction means and methods and sequencing of work is the prerogative of the Contractor.

## **SECTION 05 12 00 - STRUCTURAL STEEL**

2. Take into consideration that full structural capacity of many structural members is not realized until structural assembly is complete; e.g., until slabs, decks, bracing or rigid connections are installed.
  3. Partially complete structural members shall not be loaded without an investigation by the Contractor.
  4. Until all elements of the permanent structure and lateral bracing system are complete, provide temporary bracing designed, furnished, and installed by the Contractor for the partially complete structure.
- B. Adequate temporary bracing to provide safety, stability and to resist all loads to which the partially complete structure may be subjected, including wind, construction activities, and operation of equipment, is the responsibility of the Contractor.
1. Use temporary guys, braces, shoring, connections, etc., necessary to maintain the structural framing plumb and in proper alignment until permanent connections are made, the succeeding work is in place, and temporary work is no longer necessary.
  2. Use temporary guys, bracing, shoring, and other work to prevent injury or damage to adjacent work or construction from stresses due to erection procedures and operation of erection equipment, construction loads, and wind.
  3. Design of the temporary bracing system and consideration of the sequence and schedule of placement of such elements and effects of loads imposed on the structural steel members by partially or completely installed work, including work of all other trades, is the Contractor's responsibility.
    - a. If not obvious from experience or from the Drawings, confer with the Engineer to identify those structural steel elements that must be complete before the temporary bracing system is removed.
  4. Remove and dispose of all temporary work and facilities off-site.
- C. Examine work-in-place on which specified work is in any way dependent to ensure that conditions are satisfactory for the installation of the work.
1. Report defects in work-in-place which may influence satisfactory completion of the work.
  2. Absence of such notification will be construed as acceptance of work-in-place.
- D. Field Measurement:
1. Take field measurements as necessary to verify or supplement dimensions indicated on the Drawings.
  2. Contractor is responsible for the accurate fit of the work.
- E. Check the elevations of all finished footings or foundations and the location and alignment of all anchor bolts before starting erection.
1. Notify Engineer of any errors or deviations found by such checking.

### **PART 3 - EXECUTION**

#### **3.1 ERECTION**

- A. Framing member location tolerances after erection shall not exceed the framing tolerances listed in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
- B. Erect plumb and level; introduce temporary bracing required to support erection loads.
- C. Use light drifting necessary to draw holes together.
  1. Drifting to match unfair holes is not allowed.

## SECTION 05 12 00 - STRUCTURAL STEEL

- D. Welding:
  - 1. Conform to AWS D1.1/D1.1M and requirements of this Specification Section.
  - 2. Join two (2) sections of steel of different ASTM designations using welding techniques in accordance with a qualified AWS D1.1/D1.1M procedure.
- E. Shore existing members when unbolting of common connections is required.
  - 1. Use new bolts for rebolting connections.
- F. Clean stored material of all foreign matter accumulated during erection period.
- G. Clean bearing and contact surfaces before assembly.
- H. Set beam and column base and bearing plates accurately, as indicated, on nonshrink grout.
  - 1. Set and anchor each base plate to proper line and elevation.
  - 2. Use metal wedges, shims or setting nuts as required and tighten anchor bolts.
    - a. Use same metal as base plate.
    - b. Cut off protrusions of wedges and shims flush with edge of base plate.
  - 3. Fill sleeves around anchor bolts with nonshrink grout.
  - 4. Pack grout solidly between bottom of plate and bearing surface.
  - 5. Refer to Specification Section 03 00 05 for nonshrink grout requirements.
- I. Cast-in-place Anchor Bolts:
  - 1. See Specification Section 03 15 19.
- J. Install high strength bolts with hardened washers.
  - 1. Install and tighten in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 8.
  - 2. Coordinate installation with inspection.
    - a. Do not start installation until coordination with Testing Agency is complete.
  - 3. Bearing-type connections: High-strength bolts shall be tightened to snug-tight condition.
  - 4. Slip-critical connections:
    - a. Perform calibration testing for all methods of installation of high-strength bolts in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts, Section 8.2.
    - b. Turn-of-nut tightening:
      - 1) Inspector shall observe the pre-installation verification testing.
      - 2) Subsequently, ensure by routine observation that the bolting crew properly rotates the turned element relative to the unturned element by the amount specified.
      - 3) Alternatively, when fastener assemblies are match-marked after the initial fitup of the joint but prior to pretensioning, visual inspection after pretensioning is permitted in lieu of routine observation.
    - c. Calibrated wrench tightening: Calibrate on a daily basis.
    - d. Direct tension indicator tightening: If previously approved by Engineer.
    - e. Installation of alternate design bolts: If previously approved by Engineer.
  - 5. In the event any bolt in a connection is found to be defective, check and retighten all bolts in the connection.
- K. Do not use gas cutting to correct fabrication errors.
  - 1. In case members do not fit or holes do not match, ream out the holes and insert the next larger size bolt.
    - a. Drill new holes if the connections require new holes.
    - b. Make no such corrections without prior approval of the Engineer.
  - 2. Burning of holes is not permitted.

## SECTION 05 12 00 - STRUCTURAL STEEL

- L. Prior to making field connections to existing structural steel, remove completely all paint from existing steel which will be in contact with new steel and new welds.
- M. Tighten and leave in place erection bolts used in welded construction.
- N. Provide beveled washers to give full bearing to bolt head or nut where bolts are to be used on surfaces having slopes greater than 1 in 20 with a plane normal to bolt axis.
- O. After bolts are tightened, upset threads of non-high strength bolts and anchor bolts to prevent nuts from backing off.
- P. Crane Runways:
  - 1. Erect crane runways complete with columns, beams, girders, bracing, crane rails, crane stops, and other required components as indicated.
  - 2. Stagger crane rail joints with respect to each other on opposite sides of the runway and do not coincide with crane girder joints.
  - 3. Center crane rails on top of crane girders and secure to girders with tight clamps and/or floating clamps as appropriate; provide clamps in pairs spaced not over 3 feet on-center along rail length, with each clamp secured with two high-strength bolts and self-locking nuts (or nuts and lock washers), with reversible fillers used at each clamp to allow for alignment.
    - a. Do not use hook bolt type clamps.
  - 4. Tolerances:
    - a. Center-to-center of crane rails: Not exceed plus or minus 1/4 inches from indicated dimension.
    - b. Crane rail horizontal misalignment: Not exceed 1/4 inches per 50 feet of runway with a maximum of 1/2 inches total deviation.
    - c. Vertical misalignment between crane rails and along a crane rail measured at centerlines of columns: Not to exceed 1/4 inches per 50 feet of runway with a maximum of 1/2 inches total deviation.
  - 5. Tight-fitting joints between rail sections and install so top of crane rails are flush at all joints.
  - 6. Secure the joints with joint bars on each side of rail, bolted together through rail with high-strength bolts, nuts and spring washers.
- Q. After Erection:
  - 1. Grind smooth all sharp surface irregularities resulting from field cutting or welding.
  - 2. Power tool clean welds, bolts, washers and abrasions to shop coat removing all rust and foreign matter.
- R. Mechanical Anchor Bolts and Adhesive Anchor Bolts:
  - 1. See Specification Section 03 15 19.

### 3.2 FIELD QUALITY CONTROL

- A. Special Inspection and Testing:
  - 1. See Specification Section 01 45 33.
  - 2. Special Inspection to be in accordance with the building code.
  - 3. Special Inspection is required for:
    - a. Material verification of high-strength bolts, nuts, and washers.
      - 1) Frequency: All high-strength bolts, prior to being covered up or substantial completion.
    - b. Inspection of high-strength boltings:
      - 1) Frequency:
        - a) All high-strength bolts, prior to being covered up or substantial completion.

## **SECTION 05 12 00 - STRUCTURAL STEEL**

- b) Pretensioned and slip-critical joints using turn-of-nut without match marking or calibrated wrench methods of installation require continuous inspection.
  - c. Material verification of structural steel.
    - 1) Frequency: Prior to being covered up or substantial completion,
  - d. Material verification of weld filler materials.
    - 1) Frequency:
      - a) Prior to welding on site.
      - b) Randomly thereafter.
  - e. Inspection of welding.
    - 1) Frequency:
      - a) Visually inspect all welds.
      - b) In addition to visual inspection, test 50% of full penetration welds and 20% of fillet welds with liquid dye penetrant or magnetic particle.
      - c) Test 20% of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.
  - f. Inspect structural steel which has been erected.
    - 1) Frequency: Prior to members being covered up or substantial completion.
  - g. Inspect stud welding in accordance with AWS D1.1/D1.1M, Section 7.8.
- B. Erected Framing Tolerance, unless noted otherwise on the Drawings:
- 1. Do not exceed cumulative effect of rolling, fabrication and erection tolerance for overall finished dimensions.
  - 2. Erection tolerances are defined relative to member working points and working lines as follows:
    - a. Actual centerline of top flange or surface at each end for horizontal members.
    - b. Actual center of member at each end for all other members.
    - c. Other points may be used, providing they are based on these definitions.
    - d. Working line is straight line connecting member working points.
  - 3. Tolerances on position and alignment are as specified in the Code, unless otherwise modified.
    - a. Provide "adjustable items" such as lintels, wall supports, curb angles, window mullions and similar members with adjustable connections to supporting structural framing.
  - 4. Certification by steel erector:
    - a. Certify the location of erected structural steel is acceptable for plumbness, level and aligned within tolerances specified.
    - b. Provide certification upon completion of any part of work.
    - c. Provide certification prior to start of work by other trades that may be supported; attach to structural steel work.

### **3.3 CLEANING AND REPAIR OF SHOP PRIMER PAINT**

- A. After erection, clean all steel of mud or other foreign materials, and repair any damage.
  - 1. Touchup coatings to comply with Division 09 specifications.

**END OF SECTION 05 12 00**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Manufactured open-web steel joists and joist accessories.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 01 45 33 - Special Inspections and Testing Program.
  - 2. Section 05 12 00 - Structural Steel.
  - 3. Section 05 30 00 - Metal Decking.
  - 4. Division 09 - Finishes.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Institute of Steel Construction (AISC):
    - a. 360, Specifications for Structural Steel Buildings (referred to herein as AISC Specification).
  - 2. ASTM International (ASTM):
    - a. A36, Standard Specification for Carbon Structural Steel.
    - b. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
    - c. A563, Standard Specification for Carbon and Alloy Steel Nuts.
    - d. F436, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
    - e. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
  - 3. American Welding Society (AWS):
    - a. D1.1, Structural Welding Code - Steel.
  - 4. Corps of Engineers (COE):
    - a. CRD-C621, Standard Specification for Packaged, Dry, Hydraulic-Cement Grout (Nonshrink).
  - 5. Steel Joist Institute (SJI):
    - a. Recommended Code of Standard Practice for Steel Joists and Joist Girders.
    - b. Standard Specification for Open Web Steel Joists, K-Series (ANSI SJI-K-1.1).
    - c. Standard Specification for Longspan Steel Joists LH-Series and Deep Longspan Steel Joists DLH-Series (ANSI SJI-LH-DLH-1.1).
    - d. Standard Specification for Joist Girders (ANSI SJI-JG-1.1).
    - e. Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders:
      - 1) Standard Load Table Open Web Steel Joists, K-Series.
      - 2) Standard Load Table Longspan Steel Joists, LH-Series.
      - 3) Standard Load Table Deep Longspan Steel Joists, DLH-Series.
  
- B. Qualifications:
  - 1. Manufacturer: Member of SJI.
    - a. Structural design calculations and details of manufactured joists shall be prepared by a qualified professional engineer retained by the manufacturer and registered in the state where the project is located.



2. Qualification of welding work:
  - a. Qualify welding processes, operations, and operators in accordance with requirements of AWS D1.1.
  - b. Welding operators to have been qualified during the 12-month period prior to commencement of welding.

### **1.3 SUBMITTALS**

- A. Shop Drawings:
  1. Fabrication and/or layout drawings, signed by a professional engineer:
    - a. Detailed Shop Drawings showing size and layout of each joist unit, bridging, connections, and accessories. Include mark, number, type, location, and spacing of joists and bridging.
    - b. Show joining splice and connection to other work details.
    - c. Provide templates or location drawings for installation of anchor bolts.
    - d. Provide details of bridging, method of attachment to joists, and joist end anchorage and other details required for joist installation. Indicate beveled end plates for joist roof pitch where required.
    - e. Show shop-applied coatings.
    - f. Shop Drawings shall not be reproductions of the Contract Drawings.
  2. Product technical data including:
    - a. Joist manufacturer's load tables, Standard Specifications and installation instructions for each type of joist and its accessories. Include product data describing materials, shop coating, bridging, and accessories.
  3. Certifications:
    - a. Manufacturer's certification that steel joists and accessories comply with specified requirements.
    - b. Manufacturer member of SJI.
    - c. Joist material, shop welding and testing, manufacturing and shop inspection and testing are in accordance with SJI requirements.

### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store and handle steel joists as recommended by SJI.
  1. Exercise care to avoid damage to joists.
- B. Store joists clear of soil on platforms, skids or other durable supports.
  1. Protect joists after delivery to prevent rust and deterioration.
- C. Provide anchor bolts and other items to be embedded in concrete or masonry, with templates as required, in time for incorporation into the work.

## **PART 2 - PRODUCTS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Nucor Corporation Vulcraft Divisions.
  2. CANAM Steel Corporation.
  3. Socar Incorporated.

**2.2 MATERIALS**

- A. Steel: Comply with SJI and AISC Specifications for joist series indicated.
- B. High-Strength Bolts, Nuts and Washers:
  - 1. Bolts: ASTM F3125, Grade A325 or Grade A490 as required, heavy hexagon structural bolts.
  - 2. Nuts: ASTM A563.
  - 3. Washers (hardened): ASTM F436.
- C. Bolts and Nuts, Unfinished: ASTM A307, Grade A, regular hexagon type, low carbon steel, with carbon steel washers.

**2.3 STEEL JOISTS**

- A. Design of steel joists proposed shall have been checked by the SJI and found to conform to the standard specifications and load tables.
- B. Design and fabricate joists and accessories in accordance with SJI Specifications and as follows:
  - 1. Make shop connections and splices using either arc or resistance welding.
    - a. Do not shop bolt connections.
  - 2. Design and fabricate for maximum deflection of 1/360 of clear span under design live load.
  - 3. Shop holes, field holes, and enlargement of holes will not be permitted unless approved by Engineer.
  - 4. Fabricate bearing ends to provide following minimum bearing unless a longer bearing length is indicated on the Contract Documents.

	<u>K SERIES</u>	<u>LH AND DLH SERIES</u>	<u>JOIST GIRDERS</u>
On masonry or concrete:	4 inches min	6 inches min	6 inches min
On steel:	2-1/2 inches min	4 inches min	4 inches min

- 5. With steel angle tops and bottom chord members.
- C. Special or Concentrated Loads:
  - 1. Where special or concentrated loads are indicated or required by other trades, reinforce joist and develop details as necessary for support of such loads.
  - 2. Design connections to resist uplift loads per building code, unless otherwise specified.
  - 3. Submit written certification that the joists requiring special loads have been designed, fabricated, and are capable of supporting the required design loadings.
    - a. Written certification to be signed and sealed by a registered professional Structural Engineer.
    - b. Submit certification along with the Shop Drawings for the joist(s).
- D. Sloped joists shall have bearing ends that are flush to supporting element.
- E. Provide extended bottom chords where indicated.
  - 1. Comply with SJI and AISC requirements and load tables.

- F. Provide extended top chords where indicated.
  - 1. Comply with SJI and AISC requirements and load tables.
- G. Provide ceiling extensions in areas having ceilings attached directly to joist bottom chord.
  - 1. Provide either an extended bottom chord or a separate unit of sufficient strength to support ceiling construction.
  - 2. Extend ends to within 1/2 inches of wall surface.
- H. Provide nailers bolted to top chord where indicated.
- I. Prepare and paint steel joists and accessories in compliance with Division 09 specifications.
- J. Comply with SJI Specifications:
  - 1. Joist designations indicated on the Drawing are minimum requirements; increase as required to comply with design requirements specified.
  - 2. Wherever possible, increased joists shall have the same depth as joist indicated on Drawings.
  - 3. Where necessary to increase joist depths to meet design requirements, coordinate all project changes required due to the increased depth.
  - 4. Make all required joist revisions at no additional cost to Owner.

## **2.4 SOURCE QUALITY CONTROL**

- A. Engineer reserves right to inspect joists or manufacturer's shop during joist fabrication.
- B. Identify each joist type, size and manufacturer.
  - 1. Provide tagging or other suitable (permanent) means.
  - 2. Maintain identification continuously.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Examine areas and conditions under which steel joists are to be installed for conditions detrimental to proper and timely completion of work.
- B. Do not proceed with work until unsatisfactory conditions have been corrected.
- C. Do not start placement of steel joists until supporting work is in place and secured.
- D. Joists will be subject to rejection if:
  - 1. Joists do not comply with requirements of SJI and AISC Specifications and requirements herein.
  - 2. Joists are improperly manufactured, welded, painted or installed.
  - 3. Joists are damaged so that strength is impaired.
  - 4. Joists are not installed as indicated on Drawings.
  - 5. Chords are not installed straight within a tolerance of plus or minus 0.0028 times the length of the joist or the distance between points of lateral support.

**3.2 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
  - 1. Where not specifically indicated otherwise, place and secure steel joists in accordance with SJI and AISC Specifications and as herein specified.
  
- B. Splice any joist delivered to the site in more than one piece.
  
- C. Do not overload joists.
  - 1. Note: Joists may not be stable or able to carry design loads until bridging and deck is fully installed.
  - 2. Contractor is solely responsible for safety, construction methods and sequencing of the Work.
  - 3. Do not install joists damaged so that strength is impaired.
  
- D. Place joists on supporting work, adjust and align in accurate location and spacing before permanently fastening.
  - 1. Provide end bearing and anchorages to secure all joists to supporting members or walls in accordance with SJI Specifications, unless otherwise indicated.
  - 2. When joists are misfabricated and do not bear flush on supporting member or wall, take corrective measures to ensure full bearing.
    - a. Provide steel shims as required for uniform flush bearing.
  
- E. Field weld joists to supporting steel framework in accordance with SJI, AISC and AWS Specifications for type of joists used.
  - 1. Coordinate welding sequence and procedure with placing of joists.
  - 2. Observe any special welding requirements on erection drawings.
  
- F. Bearing on Masonry or Concrete Bearing Surfaces:
  - 1. Secure joists resting on masonry or concrete bearing surfaces by bedding in mortar and anchoring to masonry or concrete construction as specified in SJI Specifications for type of steel joist used.
    - a. Masonry or concrete required to support joists to have reach required 28-day compressive strength prior to placing joists thereon.
    - b. Area under joist bearing shall be solidly filled with grout.
  - 2. Furnish anchor bolts or steel bearing plates to be built into concrete and masonry construction.
    - a. Furnish templates as may be necessary for accurate location of anchors. Steel bearing plates to conform to ASTM A36.
  - 3. Bedding mortar:
    - a. Sand cement grout:
      - 1) Approximately 3 parts sand, 1 part Portland cement, 6 plus/minus 1% entrained air and water to produce a slump which allows grout to completely fill required areas and surround adjacent reinforcing.
      - 2) Minimum 28-day compressive strength: 3000 psi.
    - b. Non-shrink grout complying with COE CRD-C621.
  
- G. Provide type, size, spacing, and attachment of bridging in accord with SJI and AISC Specifications, where not specifically indicated otherwise, except as modified herein.
  - 1. Clearly specify bridging on erection drawings.
  - 2. Provide diagonal type bridging unless otherwise noted.
  - 3. Do not use sag rods as substitute for bridging.
  
- H. Install bridging completely, immediately after erection, and before any loads are applied.

1. Anchor ends of bridging lines at top and bottom chords of each joist and where terminating at walls or beams.
  2. Provide bridging connections at top and bottom chords capable of safely resisting a force specified by SJI Specifications for open web, long span, deep long span joists, and joist girders respectively.
  3. Where five rows of bridging are required in spans over 40 feet, laterally brace each joist before erecting next joist or applying loads.
  4. Do not release hoisting cables before installing center row of diagonal bridging and anchoring bridging line to prevent lateral movement.
  5. During construction period, Contractor is responsible for any loads placed on joists.
    - a. Contractor's attention is directed the fact that joists may be unstable and cannot carry their design load until steel deck and bridging are completely installed.
- I. Remove or repair damaged joists or other work, to satisfaction of Engineer at no additional expense to Owner.
- J. After installation, touch up paint or field paint as specified in Division 09 specifications.

### **3.3 FIELD QUALITY CONTROL**

- A. Special Inspection and Testing:
1. See Section 01 45 33.
  2. Special Inspection is required for:
    - a. Visually inspect joists, bridging, anchorages, and connections which have been erected.
    - b. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
      - 1) Verify direct tension indicator gaps.

**END OF SECTION 05 21 00**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Manufactured roof decking.
  
- B. Related Requirements: Include but are not necessarily limited to:
  - 1. Section 01 45 33 - Special Inspections and Testing Program.
  - 2. Section 05 21 00 - Steel Joists.
  - 3. Division 09 - Finishes.

**1.2 REFERENCES**

- A. Reference Standards:
  - 1. American Iron and Steel Institute (AISI):
    - a. S100, Specification for the Design of Cold-Formed Steel Structural Members.
  - 2. ASTM International (ASTM):
    - a. A36/A36M, Standard Specification for Carbon Structural Steel.
    - b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
    - c. A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
    - d. A1008/A1008M, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
    - e. C1513, Standard Specification for Steel Tapping Screws for Cold Formed Steel Framing Connections.
    - f. D746, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
    - g. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
  - 3. American Welding Society (AWS):
    - a. D1.1/D1.1M, Structural Welding Code - Steel.
    - b. D1.3/D1.3M, Structural Welding Code - Sheet Steel.
  - 4. Steel Deck Institute (SDI):
    - a. 31, Design Manual for Composite Decks, Form Decks and Roof Decks.
  - 5. Underwriters Laboratories, Inc. (UL):
    - a. UL Fire Resistance Directory.

**1.3 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Decking Manufacturer:
    - a. Manufacturer shall possess current, valid, full membership in SDI; associate membership is unacceptable. Submit to Engineer documentation of such membership.
    - b. When decking is not specified on the Drawings, structural system design of manufactured decking shall be prepared by qualified professional engineer, employed by or retained by decking manufacturer. When such services are required, submit to

Engineer evidence of current, valid license and registration in the same jurisdiction as the Site.

2. Welders:
  - a. Qualify welding processes, operations, and personnel in accordance with AWS D1.1 and AWS D1.3, for decking manufacturing and welding at the Site.
  - b. Welders shall be qualified, as indicated in the paragraph immediately above, during the 12-month period preceding commencement of welding for the Work and be experienced in welding light-gage metal.
  - c. Promptly submit documentation of qualifications when requested by Engineer.

#### **1.4 SUBMITTALS**

A. Action Submittals: Submit the following:

1. Shop Drawings:
  - a. Complete framing and erection plans and details.
  - b. Location, length, type, cross section, thickness, and markings of metal decking units.
  - c. Size and location of each opening in decking and conditions requiring closure panels and supplementary framing. Show and indicate necessary accessories and reinforcing.
  - d. Sequence and procedure to be followed for erecting, fastening, and securing decking. Engineer's approval or commenting on Shop Drawings does not in any way reduce or mitigate Contractor's responsibility for means, methods, procedures, techniques, and sequences of construction or for safety and protection measures incident thereto.
  - e. Show and indicate units and surfaces to receive shop-applied finishing, as applicable.
  - f. Details and gages of accessories and miscellaneous items, showing sump pans, cant strips, ridge and valley plates, closure and filler strips and insulation supports.
  - g. Fasteners and welding details for installation, including size, spacing, type, and location of fasteners necessary and required to secure decking.
  - h. Recommended welding rod size, type, burn-off rate, and welder setting for deck thickness to be joined. Engineer's approval or comments on Shop Drawings showing or indicating such information in no way reduces or modifies Contractor's obligations for construction means, methods, sequences, procedures, and techniques and safety and protection measures incident thereto.
  - i. Define welds by indicating standard AWS welding symbols.
  - j. Shop Drawings shall not be developed from or reproductions of the Drawings prepared by Engineer.
2. Product Data:
  - a. Manufacturer's specifications and published catalog data for:
    - 1) Welds and welding procedure.
    - 2) Galvanizing repair paint.
    - 3) Screws.
    - 4) Powder actuated fasteners.
    - 5) Joint sealing compound.
  - b. Manufacturer's load tables for decking to be provided, including:
    - 1) Allowable gravity load for metal roof decking.
    - 2) Allowable diaphragm shear values for metal roof deck.
    - 3) Allowable metal decking superimposed load.

B. Informational Submittals: Submit the following:

1. Certifications:
  - a. Manufacturer's certification that metal decking provided complies with specified requirements, including:
    - 1) Deck material, manufacturing, and shop testing and inspection are in accordance with SDI requirements.
2. Supplier's Instructions:

- a. Manufacturer's written instructions for storing, handling, and installing materials furnished.
- 3. Test and Evaluation Reports:
  - a. Powder driven fastener ICC-ES Evaluation Report(s).
- 4. Source Quality Control Submittals:
  - a. Manufacturer's certified test and mill reports for actual materials furnished.
- 5. Qualifications Statements:
  - a. Evidence of manufacturer's current, valid SDI membership.
  - b. Welder qualifications and certifications, when requested by Engineer.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery and Handling:
  - 1. Comply with the Contract Documents, SDI requirements and recommendations, and decking manufacturer's written instructions.
- B. Storage:
  - 1. Comply with the Contract Documents, SDI requirements and recommendations, and decking manufacturer's written instructions.
  - 2. Store metal decking off the ground, entirely covered by waterproof covering, with one end elevated for drainage. Properly vent waterproof covering to avoid condensation.
  - 3. Prevent corrosion, deterioration, and accumulation of foreign matter.
  - 4. Prevent formation of "white rust" on surfaces with galvanized finish.
  - 5. Do not overload supporting members.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. 1.5-inch deep metal roof decking:
    - a. Vulcraft.
    - b. Verco Decking.
    - c. New Millennium Building Systems.
    - d. DACS.

**2.2 METAL ROOF DECKING**

- A. Design of the metal decking shall be checked by decking manufacturer's professional engineer and found by such professional engineer to comply with SDI's standard specifications and load tables.
  - 1. Allowable superimposed live uniform loading per square foot for metal roof decking provided for spans shown or indicated shall equal or exceed allowable superimposed live uniform load per square foot for same spans as indicated in SDI's tables.
  - 2. Maximum Deflection: Less than 1/240 of span under live load.
- B. Provide decking configurations complying with SDI 31 and as shown and indicated.
  - 1. Painted Decking: ASTM A1008, shop-applied.
  - 2. Galvanized Decking: ASTM A653 G60 zinc coating.



C. Metal Roof Decking, 1-1/2 Inch Deep:

1. Wide Rib Deck: Ribs spaced approximately 6 inches on centers; width of rib opening at top surface maximum 2.5 inches; width of bottom rib surface minimum 1.75 inches.

**2.3 FABRICATION**

A. Standard Deck Profiles:

<u>DEPTH</u>	<u>TYPE (Vulcraft designations, UNO)</u>	<u>RIB SPACING</u>	<u>TOP SURFACE MAXIMUM RIB OPENING</u>	<u>MINIMUM BOTTOM OF RIB WIDTH</u>
1-1/2 inches	Roof Deck - Wide Rib ('1.5BI')	6 inches	2-5/8IN	1-5/8 inches

\* Indicates produced by DACS

B. Minimum Deck Thickness:

1. Where gage of metal is indicated, provide the not less than uncoated thickness required by SDI.
  - a. Delivered thickness of uncoated steel: Not less than 95 percent of the stated thickness.
2. Use steel with minimum yield stress of 33 ksi.
3. Comply with deflection limits, especially when proposing steel with greater strength than required in this provision.

C. Fabrication:

1. Fabricate decking units in lengths to span three or more support spacings with flush, telescoped or nested end laps not less than 2 inches.
  - a. End laps shall occur on supporting members.
  - b. Provide decking units with overlapping male and female type side laps or joints to provide positive vertical and lateral alignment of adjacent decking units.

**2.4 ACCESSORIES**

A. Metal Closures:

1. Form to configuration required for tight-fitting closures at open ends and sides of decking.
2. Minimum thickness before galvanizing: 0.0358-inch (20-gage).

B. Ridge and Valley Plates:

1. Minimum Width: 4.5 inches.
2. Bend to provide tight-fitting closure with deck units.
3. Provide plates in 10-foot length where possible.
4. Minimum thickness before galvanizing: 0.0747-inch (14-gage).

C. Welding Washers:

1. 16-gage bent steel plate with 3/8-inch or as required by weld size center hole.
2. Provide at all deck units thinner than 22-gage.

D. Filler Sheet:

1. Flat or formed 20-gage galvanized steel.

E. Roof Sump Pans:

1. Provide roof sump pans at locations shown.

## SECTION 05 30 00 - METAL DECKING

2. Fabricate each from single piece of galvanized sheet steel with level bottom and sloping sides to direct water flow to drain.
  3. Provide sump pans of adequate size to receive roof drains with bearing flanges not less than three inches wide.
  4. Recess pans not less than 1.5 inches below roof deck surface, unless otherwise shown or indicated or required by deck configuration.
  5. Minimum thickness before galvanizing: 0.0747-inch (14-gage).
- F. Cant Strips:
1. Provide bend cant strips to form 45-degree slope not less than five inches wide, with top and bottom flanges not less than three inches wide.
  2. Minimum thickness before galvanizing: 0.0358-inch (20-gage).
- G. Insulation Supports:
1. Provide insulation supports that do not impair quality or finish of decking.
- H. Venting:
1. Provide slotted openings in bottom flutes in accordance with manufacturer's standards.
- I. Metal Pour Stops:
1. Provide and form to configuration required for mortar-tight closures at open sides and ends of decking.
- J. Primer Paint:
1. Unless otherwise required in the Contract Documents, provide decking manufacturer's baked-on, rust-inhibitive paint, factory-applied to chemically cleaned and phosphate treated metal surfaces.
  2. Paint is not required for galvanized surfaces, unless otherwise indicated.
- K. Galvanized coating for metal decking accessories: Comply with ASTM A653 (or equivalent) G60 zinc coating.
- L. Galvanizing Repair Materials:
1. Galvanized repair paint shall be in accordance with Division 09 specifications.
- M. Screws:
1. Self-drilling, self-tapping, no. 12 size minimum, hex washer head metal screws.
  2. Protected carbon steel, Hilti S-MD KF, or equal.
    - a. Kwik-Cote finish.
    - b. ASTM C1513 or equal.
- N. Powder Actuated Mechanical Fasteners:
1. Material: AISI 1070 modified.
  2. Hardness: Minimum Rockwell Hardness C 54.5.
  3. Strength: Minimum tensile strength 285 ksi; minimum shear strength 175 ksi.
  4. Design and Manufacture: Knurled shank with forged ballistic point. Manufacturing process shall ensure steel ductility and prevent development of hydrogen embrittlement.
  5. Washers:
    - a. For Steel bar Joist Framing: Minimum 12 mm (0.472-inch) steel washers.
    - b. For Structural Steel Framing: Minimum 15 mm (0.591inch) steel washers.
  6. Corrosion Resistance:
    - a. For steel roof decks with waterproofing membrane: Five-micron zinc electroplated in accordance with ASTM B633 SC1 Type III.

- b. For exposed steel roof decks: Minimum AISI 304 stainless steel sealing caps with bonded neoprene washer shall be provided over each fastener.
- 7. Design Requirements:
  - a. ICC-ES AC43 or SDI method for diaphragm shear strength and stiffness.
  - b. FM wind uplift resistance.
  - c. UL fire classification.
- 8. Products and Manufacturers:
  - a. For use with steel bar joist and light structural steel framing supports with top chord or flange thickness 1/8-inch to 3/8-inch:
    - 1) Hilti X-HSN24 (1/8-inch up to and including 3/8-inch).
    - 2) Or equal.
  - b. For use with structural steel framing supports with top flange thickness 1/4-inch or thicker:
    - 1) Hilti X-ENP-19 L15 (1/4-inch or thicker).
    - 2) Or equal.
- O. Miscellaneous Steel Shapes:
  - 1. Comply with ASTM A36.
- P. Sheet Metal Accessories:
  - 1. Provide of same material and finish as decking panels.
- Q. Flexible Closure Strips for Decking:
  - 1. Vulcanized, closed cell expanded chloroprene elastomer, complying with ASTM D1056, Grade SCE 41.
  - 2. Brittleness Temperature: -40 degrees F, ASTM D746.
  - 3. Flammability Resistance: Self-extinguishing.
  - 4. Provide with adhesive in accordance with manufacturer/s written instructions.
  - 5. Ensure complete closure in the Work.

## **2.5 SOURCE QUALITY CONTROL**

- A. Tests and Inspections:
  - 1. Before shipping materials from the shop or fabrication facility to the Site or offsite storage, perform manufacturer's or fabricator's ordinary inspections, testing, and other source quality control activities.
  - 2. Do not ship materials that are damaged or otherwise defective.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Examination:
  - 1. Examine areas and conditions under which metal decking will be installed for conditions detrimental to proper and timely completion of the Work.
  - 2. Do not proceed with the Work until unsatisfactory conditions are remedied.
- B. Do not start installing metal decking until supporting Work is in place and properly secured.

**3.2 INSTALLATION**

A. Installation – General:

1. Install decking in accordance with the Contract Documents, SDI requirements and recommendations, decking manufacturer's written instructions and approved Submittals. In event of conflict among such requirements, obtain Engineer's written interpretation or clarification before proceeding with the associated Work.
2. Loading During Handling and Installation:
  - a. Do not overload supporting structural members or architectural elements.
  - b. Until entire assembly is substantially complete, structural elements may be unstable or incapable of supporting loads required by code or design loads indicated in the Contract Documents.
  - c. Locate deck bundles to prevent overloading of structure.
  - d. Ensure decking construction loads are less than recommendation of SDI 31, except where adequate temporary supports are provided.
3. Provide decking manufacturer's standard accessories as needed to complete decking Work installation.
4. Install each decking unit on supporting structural frame, adjust to final position and accurately align with ends properly bearing on supporting members.
5. Interlock decking units at sides without stretching, contracting, or deforming.
6. Install deck units flat and square and secure to framing without warp or excessive deflection.
7. Install decking units in accurate and close alignment for entire length of run and with close alignment of flutes of one unit with those of abutting unit.
8. Refer to requirements, below in this Article, applicable to all decking, including:
  - a. Cutting, fitting, and openings.
  - b. Temporary supports.
  - c. Welding – general.
  - d. Fastening (mechanical and welding).
  - e. Pour stops for concrete.
  - f. Accessories.

B. Roof Decking:

1. Install roof decking units and accessories as required, in accordance with SDI 31.
2. Lap roof deck units at ends not less than 2 inches.
3. Refer to requirements, below in this Article, for roof decking provisions on:
  - a. Insulation supports.
  - b. End closures.
  - c. Ridge and valley plates.
  - d. Roof sump pans.
  - e. Cant strips.
  - f. Others.

C. Cutting, Fitting, and Openings:

1. Cut and fit deck units and accessories around other construction projecting through or adjacent to decking.
2. Make cutting and fitting neat, square, and trim.
3. Cut decking by mechanical means, not by burning.
4. Neatly and accurately install reinforcing at openings, except:
  - a. Circular openings less than six-inch diameter.
  - b. Rectangular openings having no side dimension greater than 6 inches.
5. Reinforcing at Openings:
  - a. Reinforce openings that are not framed between 6 inches and 1 foot with 20-gage flat steel sheet, 1-foot greater in each dimension than opening.

- b. Provide sheeting around opening. Fusion-weld to top surface of deck at each corner and midway along each side.
  
- D. Field Welding – General:
  - 1. Plug weld sizes indicated are effective fusion diameter of welds.
  - 2. Weld metal shall penetrate all layers of deck material and have good fusion to supporting members.
  - 3. Do not burn through deck.
  
- E. Fastening (Mechanical and Welded):
  - 1. Prevent over-torquing of screw fasteners by using a tool with depth-limiting nosepiece and clutch.
  - 2. Fastening of 1.5-inch Deep Metal Roof Deck:
    - a. Unless otherwise shown or indicated, secure decking units to supporting frame and side laps as follows:
      - 1) Fasten edge ribs of panels at each support.
      - 2) At interior supports and at ends of deck, use:
        - a) For 2-foot wide deck: Three, 5/8-inch round plug welds per deck unit.
        - b) For 2.5-foot and 3-foot wide deck: Four, 5/8-inch round plug welds per deck unit.
        - c) Install 20-gage and thinner deck with welding washers at all specified weld locations.
      - 3) At perimeter supports, provide 5/8-inch round plug welds at 1-foot on centers.
        - a) At side laps, provide no. 12 hex-head screws at 1.5 feet on centers.
  - 3. Fastening of Three-inch Deep Metal Roof Deck:
    - a. Unless otherwise shown or indicated, secure decking units to supporting frame and side laps as follows:
      - 1) Fasten edge ribs of panels at each support.
      - 2) At interior supports and at ends of deck provide:
        - a) Four, 5/8-inch round plug welds per decking unit (2-foot unit).
        - b) Install 20-gage and thinner deck with welding washers at specified weld locations.
      - 3) At perimeter supports 5/8-inch round plug welds at 1-foot on centers.
      - 4) At side laps, provide no. 12 hex-head screws at 1.5 feet on centers.
  
- F. Insulation Supports:
  - 1. Provide insulation supports as necessary and required.
  - 2. Provide insulation supports where top surface of roof decking does not extend as necessary and required to completely support roof insulation.
  - 3. Weld insulation supports into position.
  
- G. Closure Strips:
  - 1. Provide metal closure Strips at open, uncovered ends and edges of roof decking, and in voids between deck and other construction.
  - 2. Weld closure strips into position to provide complete decking.
  - 3. Flexible Closure Strips:
    - a. Provide flexible closure strips lieu of metal closures, at Contractor's option and when approved by Engineer, wherever use will ensure complete closure.
    - b. Provide with elastomeric type adhesive in accordance with written directions and recommendations of manufacturers of closure strips and adhesives.
  
- H. Ridge and Valley Plates:
  - 1. Provide weld ridge and valley plates at top surface of roof decking.
  - 2. Lap end joints not less than three inches with laps in direction of water flow.

- I. Roof Sump Pans:
  - 1. Provide over openings in roof decking.
  - 2. Weld to top deck surface. Space welds at not more than 1-foot on center with not less than one weld at each corner and each side midway between each corner.
  - 3. Cut opening in bottom of roof sump to accommodate drain size shown or indicated.
  
- J. Cant Strips:
  - 1. Provide cant strips welded to top surface of roof decking at 1-foot on centers.
  - 2. Lap end joints not less than 3 inches.
  
- K. Accessors:
  - 1. Provide metal accessories to close all openings and gaps between decking and other construction, at objects projecting through decking, at locations where decking changes direction, and at open ends of deck units where deck units terminate.
  - 2. Weld into position to provide a complete installation.
  
- L. Pour Stops:
  - 1. Provide pour stops continuous around decking perimeter.
  - 2. Locate so that slab terminates beyond perimeter support centerline distance indicated on the Drawings.
  - 3. Weld into position adequately to resist forces due to placement and finishing of concrete and in accordance with manufacturer's written recommendations.
  
- M. Cleaning and Touch-Up:
  - 1. After installation, remove surplus materials and debris from decking surfaces.
  - 2. Field-repair shop-painted surface in accordance with paint or coating manufacturer's written instructions and applicable provisions of the Contract Documents.
  - 3. Repair damaged galvanized surfaces in accordance with Division 09 specifications.

**3.3 FIELD QUALITY CONTROL**

- A. Code-Required Special Inspection:
  - 1. Comply with Section 01 45 33 - Code-Required Special Inspections and Procedures.
  - 2. Special inspection is required for:
    - a. Verifying proper decking materials and layout.
      - 1) Frequency: Prior to attaching decking to structure.
    - b. Verifying proper weld filler materials, screws, powder actuated mechanical fasteners, weld testing and fastener spacing.
      - 1) Frequency:
        - a) First four hours during the first day of decking attachment; and
        - b) Inspection prior to covering decking Work with concrete, insulation, or other materials.
    - c. Weld Testing:
      - 1) Perform the following test in special inspector's presence on first deck panel installed:
        - a) Place one end of decking panel over perimeter support and attach only to that support with two welds as specified six inches apart.
        - b) Move opposite end of decking panel in plane parallel to span of decking panel until shear distress is observed or apparent in weld.
        - c) Provide welds of sufficient quality to cause local distortions in decking panel around welds and show good perimeter contact between welds and decking panel.

## **SECTION 05 30 00 - METAL DECKING**

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- d) When results of test are satisfactory and approved by special inspector, install remaining decking using same weld rod size and type, welding amperage setting, and procedures used in the tested deck.
  - e) Weld test shall be performed for each metal deck welder.
  - 2) Visually inspect remainder of welds.
    - a) When, in special inspector's opinion, one or more welds are defective or of insufficient quality, provide additional, acceptable weld adjacent to rejected weld.
    - b) Provide new weld on sound, unburned decking sufficient distance from rejected weld.
- B. Defective Work:
- 1. Metal decking Work will be deemed defective Work and will be rejected by Engineer when it:
    - a. Do not comply with SDI requirements and recommendations.
    - b. Does not comply with the Contract Documents.
    - c. Is improperly: manufactured, finished, and installed.
    - d. Is damaged resulting in impaired strength, defacing, or inappropriate appearance.
  - 2. Remedy defective Work in accordance with the Contract Documents. Replace damaged decking with new decking in accordance with the Contract Documents
  - 3. Remove and replace decking that:
    - a. Is structurally weak or unsound.
    - b. Has burn holes due to improper welding; or
    - c. Is deemed defective Work by Engineer (unless Engineer expressly allows repair or other remedy).

**END OF SECTION 05 30 00**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish labor, materials, tools, equipment, and services for Cold-Formed Metal Framing in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

**1.2 QUALITY ASSURANCE**

- A. ASTM International (ASTM):
  - 1. ASTM A1003 Standard Specification for Steel Sheet, Carbon, Metallic- and – Nonmetallic-Coated for Cold-Formed Framing Members.
  - 2. ASTM C1007 Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories
- B. American Iron and Steel Institute (AISI):
  - 1. AISI S200 Series North American Standards for Cold-Formed Steel Framing.
- C. Provide Cold-Formed Metal Framing engineered to support dead, live, and lateral (wind or seismic) loads indicated.
  - 1. Comply with Division 01 specifications.
  - 2. Include headers and reinforcing members around openings.
  - 3. Required details defining method of fastening throughout system and attachments to supporting primary structure included in engineering requirement.
  - 4. Design cold-formed metal framing to accommodate building drift.

**1.3 SUBMITTALS**

- A. Product Data:
  - 1. For each type of material and accessory.
- B. Shop Drawings:
  - 1. Complete building elevations defining framing member sizes, locations, and connection details.
    - a. Show openings, edges and support conditions field verified and coordinated with respect to location, physical requirements of items to be installed in or on exterior wall system.
- C. Project Information:
  - 1. Structural calculations for Cold Formed Metal Framing indicating design conforms to specified design criteria, sealed by the Specialty Structural Engineer.
    - a. Submit concurrent with Shop Drawings.



**SECTION 05 40 00 - COLD-FORMED METAL FRAMING**

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Cold-Formed Metal Framing:
  - 1. Base:
    - a. ClarkDietrich Building Systems
  - 2. Optional:
    - a. Telling Industries
    - b. California Expanded Metal Products Co.
    - c. Custom Stud Inc.
    - d. Marino\WARE
    - e. MBA Metal Framing
    - f. MRI Steel Framing LLC
    - g. The Steel Network
- B. Galvanizing Repair Coating:
  - 1. Base:
    - a. Tnemec
  - 2. Optional:
    - a. ZRC Worldwide
    - b. Sherwin Williams
- C. Other manufacturers desiring approval comply with Section 01 61 00.

**2.2 DESIGN CRITERIA**

- A. Design Cold-Formed Metal Framing to satisfy requirements of applicable building codes as locally amended, but not less than loads shown in contract documents.
  - 1. Design Exterior Soffits similarly.
  - 2. Include anticipated dead and live with lateral, wind or seismic, loads where details indicate cladding, soffits or equipment weights are carried by stud wall system.
- B. Limit lateral deflection of stud wall system due to wind or seismic as follows:

<b>Maximum Allowable Deflection</b>	
<b>Exterior Finish Material</b>	<b>Deflection Limit</b>
Marble, Granite and other Stone Veneers	L/720
Brick and Concrete Masonry Veneers	L/600
Portland Cement Plaster (Stucco)	L/360
Manufactured Stone Veneer, Adhered Stone Veneer, Thin Brick, Tile and similar Mortar-Set finishes.	L/360
Metal Panels, Curtain Walls, and other flexible wall finishes.	L/240

- C. Select stud gauge and spacing as required for strength and to limit deflection due to applied loads.
  - 1. Utilize properties of metal stud only.

## SECTION 05 40 00 - COLD-FORMED METAL FRAMING

2. Do not include contributions provided by wallboard or sheathing.
3. Design connections such that anticipated structural movements will not adversely affect system or cladding supported by system
  - a. Allow for vertical beam deflections of span/360.
  - b. Allow for lateral interstory drift of story height/400.
4. Design framing system to resist gravity loads and wind uplift at soffits.

### 2.3 MATERIALS

- A. Exterior Studs:
  1. 33 ksi steel studs, runner channels and track, bracing, and accessories.
    - a. Revise thickness and minimum requirements if 50 ksi steel is used.
  2. Coatings:
    - a. G60 galvanized
    - b. A60 ZF180, AZ50 AZ150, or GF30 ZGF90 EQ coatings.
  3. Stud depth:
    - a. As indicated on Drawings.
  4. Span:
    - a. As indicated on Drawings.
  5. Stud spacing:
    - a. Use closer spacing as needed to satisfy load deflection criteria.
    - b. 12 inches OC minimum.
    - c. 16 inches OC maximum.
  6. Stud, runner, and track thickness:
    - a. Minimum: 43 mils (18 GA).
    - b. Increase member thickness where needed to satisfy loading and deflection criteria.
  7. Deep-leg runner flange:
    - a. Minimum: 2 inches.
  8. Headers:
    - a. C-shapes used to form header beams
    - b. Web depths and stiffened flanges as required.
    - c. Thickness: As determined by engineering calculations for specific opening.
  9. Runner fasteners:
    - a. Power driven fasteners.
    - b. Minimum 190 pound shear and bearing.
- B. Galvanizing Repair Coating:
  1. Tnemec Series 94-H20 Hydro-Zinc.
  2. ZRC Worldwide, Galvilite 221.
  3. Sherwin Williams Zinc Clad III HS 100.
- C. Wood Sheathing:
  1. See Division 06 specifications.
- D. Gypsum Sheathing:
  1. See Division 06 specifications.
- E. Exterior Joint Sealants:
  1. See Section 07 92 13.
- F. Metal Blocking:
  1. C-shaped modified track runners.
    - a. Roll-form from corrosion-resistant galvanized steel.

## **SECTION 05 40 00 - COLD-FORMED METAL FRAMING**

- b. Conform to ASTM C645.
2. Galvanized: ASTM A653, G40.
3. Backing height: 6 inches minimum.
4. Flange width: 1-1/4 inches minimum.
5. Thickness: 33 mil (20 GA) minimum.
6. Base product: Notched Track by Clark Dietrich.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrate for suitability to accept work.
- B. Start of work constitutes acceptance of substrate and responsibility for performance.

#### **3.2 ERECTION**

- A. Studs and Runners:
  1. Align outside deep leg runner track accurately according to exterior wall layout.
  2. Fasten 12 inches OC, or as needed to satisfy design criteria.
  3. Position studs vertically in inside deep leg runners at required spacing.
  4. Install minimum of two (2) studs each side of openings; use more if required to meet loadings.
  5. Anchorage:
    - a. Top:
      - 1) Allow 3/4 inches clearance between top of inside deep leg runner and outside deep leg runner.
      - 2) Do not fasten inside deep leg runner to outside deep leg runner.
      - 3) Fasten studs to inside deep leg runner.
    - b. Bottom:
      - 1) Anchor each stud at bottom to runners with two, 3/8 inches minimum, type S-12 pan head screws.
  6. Where stud design is outside edge of floor slab, provide galvanized connectors designed for loading requirements and allow individual floor movement without affecting integrity of stud system.
  7. Shop weld assemblies as required to meet design requirements.
  8. Touch-up burned off or abraded galvanizing with galvanizing repair coating.
- B. Openings:
  1. Install header, jamb, and sill framing system per approved engineering documents
- C. Coordinate installation of wall blocking used to support wall-supported items with installation of Cold-Formed Metal Framing.

#### **3.3 PROTECTION**

- A. Protect erected wall and openings with temporary covers until finish, roofing, flashing, and windows are installed.

**SECTION 05 40 00 - COLD-FORMED METAL FRAMING**

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**END OF SECTION 05 40 00**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Metal downspout boots.
  - 2. Miscellaneous framing and supports.
  - 3. Cane detection zones.
  - 4. Miscellaneous steel trim.
  
- B. Products furnished, but not installed, under this Section include the following:
  - 1. Loose steel lintels.
  - 2. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.
  - 3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

**1.2 COORDINATION**

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.
  
- B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Fasteners.
  - 2. Shop primers.
  - 3. Metal downspout boots.
  
- B. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
  - 1. Miscellaneous framing and supports for applications where framing and supports are not specified in other Sections.
  - 2. Structural-steel door frames.
  - 3. Cane detection zones.
  - 4. Metal downspout boots.
  - 5. Miscellaneous steel trim including steel angle corner guards.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Mill Certificates: Signed by stainless steel manufacturers, certifying that products furnished comply with requirements.
  
- B. Welding certificates.

## **SECTION 05 50 00 - METAL FABRICATIONS**

- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Research Reports: For post-installed anchors.

### **1.5 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following welding codes:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

### **1.6 FIELD CONDITIONS**

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

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design ladders.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### **2.2 METALS**

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Cast Iron: Either gray iron, ASTM A48/A48M, or malleable iron, ASTM A47/A47M, unless otherwise indicated.

### **2.3 FASTENERS**

- A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.
- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A307, Grade A; with hex nuts, ASTM A563; and, where indicated, flat washers.

## SECTION 05 50 00 - METAL FABRICATIONS

- C. High-Strength Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 3, heavy-hex steel structural bolts; ASTM A563, Grade DH3, heavy-hex carbon-steel nuts; and where indicated, flat washers.
- D. Stainless Steel Bolts and Nuts: Regular hexagon-head annealed stainless steel bolts, ASTM F593; with hex nuts, ASTM F594; and, where indicated, flat washers; Alloy Group 1.
- E. Anchor Bolts: ASTM F1554, Grade 36, of dimensions indicated; with nuts, ASTM A563; and, where indicated, flat washers.
  - 1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.
- F. Anchors, General: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing in accordance with ASTM E488/E488M, conducted by a qualified independent testing agency.
- G. Cast-in-Place Anchors in Concrete: Either threaded or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A47/A47M malleable iron or ASTM A27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F2329/F2329M.
- H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
  - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
  - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.
- I. Refer to specification section 03 15 19 for additional information.

### 2.4 MISCELLANEOUS MATERIALS

- A. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- E. Shrinkage-Resistant Grout: Factory-packaged, nonmetallic, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- F. Concrete: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained concrete with a minimum 28-day compressive strength of 3000 psi.

**2.5 FABRICATION, GENERAL**

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
- J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

**2.6 STRUCTURAL-STEEL DOOR FRAMES**

- A. Fabricate structural-steel door frames from steel shapes, plates, and bars of size and to dimensions indicated, fully welded together, with 5/8-by-1-1/2-inch steel channel stops, unless otherwise indicated. Plug-weld built-up members and continuously weld exposed joints. Secure removable stops to frame with countersunk machine screws, uniformly spaced at not more than 10 inches o.c. Reinforce frames and drill and tap as necessary to accept finish hardware.
  - 1. Provide with integrally welded steel strap anchors for securing door frames into adjoining concrete or masonry.
- B. Extend bottom of frames to floor elevation indicated with steel angle clips welded to frames for anchoring frame to floor with expansion shields and bolts.



- C. Galvanize and prime exterior steel frames.
- D. Prime exterior steel frames with zinc-rich primer.

**2.7 CANE DETECTION ZONES.**

- A. Fabricate from steel / iron pipe or tube sections in stairwells around standpipes or other protrusion for a cane sweep zone.
- B. Prime with zinc-rich primer. Field Paint.

**2.8 METAL DOWNSPOUT BOOTS**

- A. Source Limitations: Obtain downspout boots from single source from single manufacturer.
- B. Provide downspout boots made from cast iron in heights indicated with inlets of size and shape to suit downspouts. Provide units with flanges and holes for countersunk anchor bolts.
  - 1. Outlet: As indicated.
- C. Prime cast-iron downspout boots with zinc-rich primer.

**2.9 MISCELLANEOUS STEEL TRIM**

- A. Unless otherwise indicated, fabricate units, including corner guards, from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
- B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
  - 1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
- C. Galvanize and prime exterior miscellaneous steel trim.
- D. Prime exterior miscellaneous steel trim with zinc-rich primer.

**2.10 GENERAL FINISH REQUIREMENTS**

- A. Finish metal fabrications after assembly.
- B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

**2.11 STEEL AND IRON FINISHES**

- A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A153/A153M for steel and iron hardware and with ASTM A123/A123M for other steel and iron products.
  - 1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

## SECTION 05 50 00 - METAL FABRICATIONS

- B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean galvanized surfaces of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.
- C. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
  - 1. Shop prime with zinc-rich primer.
- D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
  - 1. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
  - 1. Cast Aluminum: Heavy coat of bituminous paint.
  - 2. Extruded Aluminum: Two coats of clear lacquer.

#### 3.2 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

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

## **SECTION 05 50 00 - METAL FABRICATIONS**

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

### **3.3 CANE DETECTION ZONES.**

- A. Install and anchor protection for "Protrusion Limits" and / or "Cane sweep zone" is defined as 0" to 27" above the finished floor. See ICCI A 117.1-2009; paragraph 307.2 for additional information.
- B. Provide cane detection at all standpipes.
- C. Provide cane detection on the underside of all stairs when vertical clearance under stairs is reduced under 80"

### **3.4 INSTALLATION OF METAL DOWNSPOUT BOOTS**

- A. Anchor metal downspout boots to concrete or masonry construction to comply with manufacturer's written instructions.
- B. Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

### **3.5 INSTALLATION OF MISCELLANEOUS STEEL TRIM**

- A. Anchor to concrete construction to comply with manufacturer's written instructions.

### **3.6 REPAIRS**

- A. Touchup Painting:
  - 1. Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
    - a. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

**END OF SECTION 05 50 00**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Preassembled steel stairs with concrete-filled treads.
  - 2. Steel tube railings attached to metal stairs.
  - 3. Steel tube handrails attached to walls adjacent to metal stairs.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For metal pan stairs.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design stairs and railings.
- B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Uniform Load: 100 lbf/sq. ft.
  - 2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
  - 3. Uniform and concentrated loads need not be assumed to act concurrently.
  - 4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
- C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
    - b. Infill load and other loads need not be assumed to act concurrently.

**2.2 METALS**

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing for Railings: ASTM A 500/A 500M (cold formed) or ASTM A 513/A 513M.

## SECTION 05 51 13 - METAL PAN STAIRS

1. Provide galvanized finish for exterior installations and where indicated.
- C. Steel Pipe for Railings: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
  1. Provide galvanized finish for exterior installations and where indicated.
- D. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.
- E. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.
- F. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- G. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- H. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- I. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.
- J. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

### 2.3 ABRASIVE NOSINGS

- A. Cast-Metal Units: Cast aluminum, with an integral abrasive, as-cast finish consisting of aluminum oxide, silicon carbide, or a combination of both designed specifically for tiled stair installations. Fabricate units in lengths necessary to accurately fit openings or conditions.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Ecoglo, Inc.; M4.125-N30 Tile Stair Nosing or a comparable product by one of the following:
    - a. American Safety Tread Co., Inc.
    - b. Balco; a CSW Industrials Company.
    - c. Barry Pattern & Foundry Co., Inc.
    - d. Safe-T-Metal Company, Inc.
    - e. TrueNorth Steel.
    - f. Wooster Products Inc.
  2. Color to be M4170.125 Black.

### 2.4 FASTENERS

- A. Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

### 2.5 MISCELLANEOUS MATERIALS

- A. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

## SECTION 05 51 13 - METAL PAN STAIRS

- C. Concrete Materials and Properties: Comply with requirements in Section 03 30 00 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
- D. Welded Wire Reinforcement: ASTM A 185/A 185M, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated.

### 2.6 FABRICATION, GENERAL

- A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.
  - 1. Join components by welding unless otherwise indicated.
  - 2. Use connections that maintain structural value of joined pieces.
- B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- E. Weld connections to comply with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Weld exposed corners and seams continuously unless otherwise indicated.
  - 5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed weld with spatter removed.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.

### 2.7 STEEL-FRAMED STAIRS

- A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," Commercial Class, unless more stringent requirements are indicated.
- B. Stair Framing:
  - 1. Fabricate stringers of steel plates or channels.
    - a. Provide closures for exposed ends of channel stringers.
  - 2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements unless noted otherwise.
  - 3. Weld stringers to headers; weld framing members to stringers and headers.
  - 4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below. Locate hanger rods and struts

## SECTION 05 51 13 - METAL PAN STAIRS

where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

- C. Metal Pan Stairs: Form risers, subread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.

### 2.8 STAIR RAILINGS

- A. Steel Tube Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.
  1. Rails and Posts: 1-5/8-inch- diameter top and bottom rails and 1-1/2-inch- square posts unless noted otherwise.
  2. Picket Infill: 1/2-inch- square pickets spaced less than 4 inches clear unless noted otherwise.
  3. Intermediate Rails Infill: 1-5/8-inch- diameter intermediate rails spaced less than 12 inches clear unless noted otherwise.
- B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed weld with spatter removed as shown in NAAMM AMP 521.
- C. Form changes in direction of railings by bending.
- D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- E. Close exposed ends of railing members with prefabricated end fittings.
- F. Provide wall returns at ends of wall-mounted handrails.
- G. Connect posts to stair framing by direct welding.
- H. Gates: Form gates from steel tube of same size and shape as top rails, with infill to match guards. Provide with cam-type, self-closing hinges for fastening to wall and overlapping stop with rubber bumper to prevent gate from opening in direction opposite egress.
- I. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work.

### 2.9 FINISHES

- A. Finish metal stairs after assembly.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."



- C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

**PART 3 - EXECUTION**

**3.1 INSTALLING METAL PAN STAIRS**

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.
- B. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
- C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints.
- D. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.
- E. Place and finish concrete fill for treads and platforms to comply with Section 03 30 00 "Cast-in-Place Concrete."
  - 1. Install abrasive nosings with anchors fully embedded in concrete.
  - 2. Center nosings on tread width.

**3.2 INSTALLING RAILINGS**

- A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:
  - 1. Anchor posts to steel by welding to steel supporting members.
  - 2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with postinstalled anchors and bolts.
- B. Attach handrails to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets to building construction as required to comply with performance requirements.
- C. Install railing gates level, plumb, and secure for full opening without interference.
  - 1. Attach hardware using tamper-resistant or concealed means.
  - 2. Adjust hardware for smooth operation.

**3.3 ADJUSTING AND CLEANING**

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

**END OF SECTION 05 51 13**

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## **SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. Section Includes:
  - 1. Wood blocking and nailers.
  - 2. Plywood backing panels.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Evaluation Reports: For the following, from ICC-ES:
  - 1. Preservative-treated wood.

#### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

### **PART 2 - PRODUCTS**

#### **2.1 WOOD PRODUCTS, GENERAL**

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent unless otherwise indicated.

## **SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY**

### **2.2 WOOD-PRESERVATIVE-TREATED MATERIALS**

- A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
  - 3. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
  - 4. Wood floor plates that are installed over concrete slabs-on-grade.

### **2.3 MISCELLANEOUS LUMBER**

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
  - 3. Rooftop equipment bases and support curbs.
  - 4. Grounds.
- B. Dimension Lumber Items: Construction or No. 2 grade lumber.
- C. Concealed Boards: 15 percent maximum moisture content.

### **2.4 PLYWOOD BACKING PANELS**

- A. Equipment Backing Panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

### **2.5 FASTENERS**

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.

## **SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY**

- C. Screws for Fastening to Metal Framing: ASTM C 954, length as recommended by screw manufacturer for material being fastened.
- D. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION, GENERAL**

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.
- D. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- G. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.
- I. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- J. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
  - 2. ICC-ES evaluation report for fastener.
- K. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

## **SECTION 06 10 53 - MISCELLANEOUS ROUGH CARPENTRY**

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### **3.2 WOOD BLOCKING AND NAILER INSTALLATION**

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

### **3.3 PROTECTION**

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

**END OF SECTION 06 10 53**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Wall sheathing.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of process and factory-fabricated product.
- B. Samples:
  - 1. Fasteners: Four (4) of each type used, labeled appropriately, in required length for each application.

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer of air-barrier and water-resistant glass-mat gypsum sheathing.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

**PART 2 - PRODUCTS**

**2.1 WALL SHEATHING**

- A. Glass-Mat Gypsum Sheathing: ASTM C1177/C1177M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. CertainTeed Gypsum.
    - c. Continental Building Products, LLC.
    - d. Georgia-Pacific Gypsum LLC.
    - e. National Gypsum Company.
    - f. USG Corporation.
  - 2. Type and Thickness: As indicated.

- B. Glass Fiber Mat Faced, Polyisocyanurate-Foam Sheathing: ASTM C1289, Type II, Class 2, rigid, cellular, polyisocyanurate thermal insulation. Foam-plastic core and facings are to have a flame-spread index of 25 or less when tested individually.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Atlas Molded Products, a division of Atlas Roofing Corporation.
    - b. Carlisle Coatings & Waterproofing Inc.
    - c. Elevate; Holcim Building Envelope.
    - d. Hunter Panels; a Carlisle company.
    - e. Rmax, A Business Unit of Sika Corporation.
    - f. The Dow Chemical Company.
  - 2. Thickness: As indicated.

**2.2 FASTENERS**

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. For roof and wall sheathing, provide fasteners of Type 304 stainless steel.

**2.3 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS**

- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.
  - 1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.
- B. Sheathing Tape for Foam-Plastic Sheathing: Pressure-sensitive plastic tape recommended by sheathing manufacturer for sealing joints and penetrations in sheathing.

**PART 3 - EXECUTION**

**3.1 INSTALLATION, GENERAL**

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in the ICC's International Building Code.
  - 2. ICC-ES evaluation report for fastener.
- D. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.



**3.2 GYPSUM SHEATHING INSTALLATION**

- A. Comply with GA-253 and with manufacturer's written instructions.
  - 1. Fasten gypsum sheathing to wood framing with nails or screws.
  - 2. Fasten gypsum sheathing to cold-formed metal framing with screws.
  - 3. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
  - 4. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
  
- B. Seal sheathing joints according to sheathing manufacturer's written instructions.
  - 1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
  - 2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

**3.3 INSTALLATION OF FOAM-PLASTIC SHEATHING**

- A. Comply with manufacturer's written instructions.
  
- B. Foam-Plastic Wall Sheathing: Install vapor-relief strips or equivalent for permitting escape of moisture vapor that otherwise would be trapped in stud cavity behind sheathing.
  
- C. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

**END OF SECTION 06 16 00**

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# **SECTION 06 41 16 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

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

### **1.2 PREINSTALLATION MEETINGS**

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

### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Include plans, elevations, sections, and attachment details.
- C. Samples: For each exposed product and for each color and texture specified.

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Research reports.
- B. Field quality control reports.

### **1.5 QUALITY ASSURANCE**

- A. Manufacturer's Qualifications: Employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Manufacturer of products.

## **PART 2 - PRODUCTS**

### **2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS**

- A. Quality Standard: Unless otherwise indicated, comply with the ANSI/AWI 0641 - Architectural Wood Casework Standard for grades of cabinets indicated for construction, finishes, and the ANSI/AWI 0620 – AWI Standards for Finish Carpentry/installation, and other requirements.
  - 1. Structural Grade: Duty Level 3.
  - 2. Aesthetic Grade: Premium.

## **SECTION 06 41 16 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS**

- B. Type of Construction: Frameless.
- C. Door and Drawer-Front Style: Flush overlay.
  - 1. Reveal Dimension: As indicated.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
  - 1. Refer to finish legend for basis of design and equal manufacturers.
- E. Laminate Cladding for Exposed Surfaces:
  - 1. Horizontal Surfaces: Grade HGS.
  - 2. Vertical Surfaces: Grade VGS.
  - 3. Edges: Grade VGS.
- F. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
  - 1. Join subfronts, backs, and sides with glued dovetail joints.
- H. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
  - 1. As indicated.
- I. Dust Panels: 1/4-inch plywood above compartments and drawers where drawer locking systems are indicated.

### **2.2 WOOD MATERIALS**

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
  - 1. Wood Moisture Content: 5 to 10 percent.
- B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.
  - 1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
  - 2. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.
  - 3. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

### **2.3 CABINET HARDWARE AND ACCESSORIES**

- A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
- B. Center to Center Handle Pulls: Back mounted, solid metal, Miseno Brushed Satin Nickel, 6-5/16 inches long, square profile.
- C. Adjustable Shelf Standards and Supports: ANSI/BHMA A156.9, B04071; with shelf rests, B04081.

## **SECTION 06 41 16 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS**

- D. Drawer Slides: BHMA A156.9; B05091.
  - 1. Grade 1 and Grade 2: Side mounted.
    - a. Type: Full extension.
    - b. Material: Zinc-plated steel with polymer rollers.
  - 2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
  - 3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
  - 4. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
  - 5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
  - 6. For computer keyboard shelves, provide Grade 1.
  - 7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-100.
- E. Door Locks: BHMA A156.11, E07121.
- F. Drawer Locks: BHMA A156.11, E07041.
- G. Door and Drawer Silencers: BHMA A156.16, B05091.
- H. Grommets for Cable Passage: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage.
  - 1. Subject to compliance with the requirements, provide OG Series by Doug Mockett & Company, Inc.
  - 2. Color: Architect to select from manufacturers full range of colors.
- I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
  - 1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
- J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

### **2.4 MISCELLANEOUS MATERIALS**

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesive for Bonding Plastic Laminate: As per the AWS; Ed 2.

### **2.5 FABRICATION**

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

## **SECTION 06 41 16 - PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS**

- B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.
- B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

#### **3.2 INSTALLATION**

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use finishing screws for exposed fastening, countersunk and filled flush with woodwork.
  - 1. Use filler matching finish of items being installed.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. All adjustable shelving standards are to be mortised.
  - 2. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

#### **3.3 ADJUSTING AND CLEANING**

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

**END OF SECTION 06 41 16**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Plastic sheet paneling.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

**1.3 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight 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 PLASTIC SHEET PANELING**

- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D5319.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. As indicated.
  - 2. Surface-Burning Characteristics: As follows when tested by a qualified testing agency in accordance with ASTM E84. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.
  - 3. Nominal Thickness: Not less than 0.09 inch.
  - 4. Surface Finish: As selected by Architect from manufacturer's full range.
  - 5. Color: As selected by Architect from manufacturer's full range.

**2.2 ACCESSORIES**

- A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
  - 1. Color: As indicated.
- B. Adhesive: As recommended by plastic paneling manufacturer.

- C. Sealant: Mildew-resistant, single-component, neutral-curing or acid-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 92 00 "Joint Sealants."

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.
- B. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.
- C. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 inches wide.
  - 1. Mark plumb lines on substrate at trim accessory locations for accurate installation.
  - 2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

**3.3 INSTALLATION**

- A. Install plastic paneling according to manufacturer's written instructions.
- B. Install panels in a full spread of adhesive. Install trim accessories with adhesive.
- C. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.
- D. Maintain uniform space between panels and wall fixtures. Fill space with sealant.
- E. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 06 64 00



## **SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes self-adhering modified bituminous sheet waterproofing.

#### **1.2 PREINSTALLATION MEETINGS**

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

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions. Provide information regarding compatibility of self-adhering modified bituminous sheet waterproofing products and hot-applied rubberized asphalt waterproofing

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Sample warranties.

#### **1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained.

#### **1.6 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
  1. Warranty Period: Three years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING**

- A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56mils of rubberized asphalt laminated on one side to a 4-mil- thick, polyethylene-film reinforcement, and with release liner on adhesive side.
- B. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil-thick, polyethylene-film

## **SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING**

reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Carlisle Coatings & Waterproofing Inc.
  - b. GCP Applied Technologies Inc. (formerly Grace Construction Products).
  - c. Henry Company.
2. Physical Properties:
  - a. Tensile Strength, Membrane: 250 psi minimum; ASTM D 412, Die C, modified.
  - b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
  - c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970/D 1970M.
  - d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836/C 836M.
  - e. Puncture Resistance: 40 lbf minimum; ASTM E 154/E 154M.
  - f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
  - g. Water Vapor Permeance: 0.05 perm maximum; ASTM E 96/E 96M, Water Method.
  - h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D 5385.

### **2.2 AUXILIARY MATERIALS**

- A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
  1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid waterborne primer recommended for substrate by sheet-waterproofing material manufacturer.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.
- F. Protection Course: Extruded-polystyrene board insulation, unfaced, ASTM C 578, Type X, 1/2 inch thick unless otherwise indicated.

### **PART 3 - EXECUTION**

#### **3.1 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION**

- A. Prepare surfaces and install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.
- B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

## **SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING**

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.
- E. Seal edges of sheet-waterproofing terminations with mastic.
- F. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.
- G. Immediately install protection course with butted joints over waterproofing membrane.
  1. Molded-sheet drainage panels may be used in place of a separate protection course to vertical applications when approved by waterproofing manufacturer and installed immediately.

### **3.2 PROTECTION, REPAIR, AND CLEANING**

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

**END OF SECTION 07 13 26**

**SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Glass-fiber blanket.
  - 2. Loose-fill insulation.
  - 3. Sill Sealer.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For the following:
  - 1. Glass-fiber blanket insulation.
  - 2. Loose-fill insulation.
  - 3. Sill Sealer.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Installer's Certification: Listing type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope.
  - 1. For blown-in or sprayed fiberglass indicate initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed.
  - 2. Sign, date, and post the certification in a conspicuous location on Project site.
- B. Product Test Reports: For each product, for tests performed by a qualified testing agency.

**PART 2 - PRODUCTS**

**2.1 GLASS-FIBER BLANKET**

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. Knauf Insulation.
    - d. Owens Corning.

**2.2 SILL SEALER:**

- A. Closed-cell neoprene foam, 1/4 inchthick, selected from manufacturer's standard widths to suit width of sill members indicated.

**2.3 LOOSE-FILL INSULATION**

- A. Glass-Fiber Loose-Fill Insulation: ASTM C764, Type I for pneumatic application or Type II for poured application; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.

**2.4 ACCESSORIES**

- A. Insulation for Miscellaneous Voids:
  - 1. Glass-Fiber Insulation: ASTM C 764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E 84.
  - 2. Spray Polyurethane Foam Insulation: ASTM C 1029, Type II, closed cell, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
- B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.
- C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

**PART 3 - EXECUTION**

**3.1 INSTALLATION, GENERAL**

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

**3.2 SILL SEALER**

- A. Install sill sealer between the foundation wall/slab-on-grade and the sill plate corrugated side face down with all end joints butted, not overlapped.

**3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION**

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

## **SECTION 07 21 00 - THERMAL INSULATION**

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2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

### **3.4 PROTECTION**

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

**END OF SECTION 07 21 00**

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**PART 1 - GENERAL**

**1.1 DESCRIPTION OF WORK**

- A. Work Included in This Section:
  - 1. Sheet materials to form a vapor retarder for the following construction:
    - a. Below grade.

**1.2 SUBMITTALS**

- A. Submit the following:
  - 1. Samples of vapor retarder and tape recommended by the manufacturer for total vapor retarder/barrier system.
  - 2. Installation Details including edge of slab, splices, pipe and structural steel penetrations.
  - 3. Details for repairing damaged areas and holes.
- B. Samples for Verification: For each type of vapor retarder and approved tape indicated.
  - 1. Sample Size: 11 by 8-1/2 inches.

**1.3 QUALITY ASSURANCE**

- A. Source:
  - 1. Products for use on this Project shall be of one manufacturer unless noted specifically otherwise herein.
- B. Regulatory Requirements:
  - 1. Use only polyolefin materials that are resistant to deterioration and that are tested in accordance with ASTM E 154.
  - 2. Slabs: ASTM E 1745; Class A.

**PART 2 - PRODUCTS**

**2.1 SHEET MATERIALS**

- A. Below Grade:
  - 1. Slab-on-grade vapor retarder is based on yellow, extruded, single ply, 15-mil polyolefin membrane as manufactured by StegoWrap.
  - 2. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
    - a. Black co-extruded 15 mil polyethylene membrane.
      - 1) Manufacturer shall be Reef Industries; Griffolyn 15 mil.
    - b. Black, polyethylene; minimum of 15 mils thick.
      - 1) Manufacturer shall be Raven Industries (VaporBlock 15).
    - c. Orange, extruded, single ply, 15-mil polyolefin membrane.
      - 1) Manufacturer shall be Fortifiber (Moistop Ultra A).
- B. Adhesive for Vapor Retarder:

## **SECTION 07 26 16 – BELOW GRADE VAPOR RETARDER**

1. Product recommended by vapor-retarder manufacturer and with demonstrated capability to bond vapor retarder securely to substrates indicated.
- C. Pipe Boot:
  1. Manufacturer's adjustable pipe boot or as constructed from the vapor retarder material as required by the manufacturer.
- D. Metal Termination Bars:
  1. Aluminum bars, approximately 1 by 1/8 inch, predrilled at 9-inch centers.

### **PART 3 - EXECUTION**

#### **3.1 CONDITION OF SURFACES**

- A. Verify substrate materials are dry and clean.
- B. Remove loose or foreign matter, which might impair installation.

#### **3.2 INSTALLATION**

- A. Below Grade:
  1. Installation shall be in accordance with manufacturer's instructions ASTM E 1643, and ACI 504.
  2. Level and tamp or roll base for slabs on grade.
  3. Place vapor retarder sheeting with the longest dimension parallel with the direction of the pour.
  4. Lap joints minimum of 6 inches and seal with tape.
    - a. Seal all four sides.
    - b. Seal around all penetrations.
  5. Turn up retarder at edges of all slabs to the top of the slab.
  6. Seal edges of vapor retarder terminations with termination bar and sealant.
  7. Install tested pre-manufactured pipe boot or field manufactured connections on all penetrations through the vapor retarder.
  8. No penetration of the vapor retarder is allowed except for reinforcing steel and permanent utilities.
  9. Repair damaged areas by cutting patches of vapor retarder, overlapping damaged area 6 inches and taping all four sides with tape.

#### **3.3 PROTECTION**

- A. Protect installed vapor retarder from damage due to harmful weather exposures, physical abuse and other causes.
- B. Provide temporary coverings or enclosures where vapor retarder are subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

### **END OF SECTION 07 26 16**

## **SECTION 07 27 26 - FLUID-APPLIED MEMBRANE AIR BARRIERS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Low-build air barriers, vapor permeable.

#### **1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review air-barrier requirements and installation, special details, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.
  - 1. Low-build air barriers, vapor permeable.
- B. Shop Drawings: For air-barrier assemblies.
  - 1. Show locations and extent of air-barrier materials, accessories, and assemblies specific to Project conditions.
  - 2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
  - 3. Include details of interfaces with other materials that form part of air barrier.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- 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.

#### **1.5 QUALITY ASSURANCE**

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

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

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

## **SECTION 07 27 26 - FLUID-APPLIED MEMBRANE AIR BARRIERS**

- B. Protect stored materials from direct sunlight.

### **1.7 FIELD CONDITIONS**

- A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended in writing 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 SOURCE LIMITATIONS**

- A. Obtain primary air-barrier materials and air-barrier accessories from single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Air-Barrier Performance: Air-barrier assembly and seals with adjacent construction to be capable of performing as a continuous air barrier. Air-barrier assemblies to 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., when tested in accordance with ASTM E2357.
- C. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. pressure difference; ASTM E2178.
- D. Ultimate Elongation: Minimum 200 percent; ASTM D412, Die C.
- E. Adhesion to Substrate: Minimum 30 lbf/sq. in. when tested in accordance with ASTM D4541.
- F. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
- G. UV Resistance: Can be exposed to sunlight for 60 days in accordance with manufacturer's written instructions.

### **2.3 LOW-BUILD AIR BARRIERS, VAPOR PERMEABLE**

- A. Low-Build, Vapor-Permeable Air Barrier: Synthetic polymer material with an installed dry film thickness, according to manufacturer's written instructions, of 6 to 15 mils over smooth, void-free substrates.
  - 1. Manufacturers: Basis of Design: Subject to compliance with requirements, provide Barritech VP as manufactured by Carlisle or by one of the following:
    - a. Master Builders Solutions; brand of MBCC Group.
    - b. Master Wall Inc.
    - c. PROSOCO, Inc.
    - d. Pecora Corporation.
    - e. Polyguard Products, Inc.

## **SECTION 07 27 26 - FLUID-APPLIED MEMBRANE AIR BARRIERS**

- f. Soprema, Inc.
  - g. Sto Corp.
  - h. The Dow Chemical Company.
  - i. W. R. Meadows, Inc.
2. Vapor Permeance: Minimum 14 perms; ASTM E96/E96M, Procedure B, Water Method.

### **2.4 ACCESSORY MATERIALS**

- A. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.
- B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.
- C. Stainless Steel Sheet: ASTM A240/A240M, Type 304, 0.0187 inch thick, and Series 300 stainless steel fasteners.
- D. Preformed Silicone 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GE Construction Sealants; Momentive Performance Materials Inc.
    - b. PROSOCO, Inc.
    - c. Pecora Corporation.
    - d. The Dow Chemical Company.
    - e. Tremco Incorporated.

## **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.
  2. Verify that substrates have cured and aged for minimum time recommended in writing by air-barrier manufacturer.
  3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method in accordance with ASTM D4263.
  4. Verify that masonry joints are flush and completely filled with mortar.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## **SECTION 07 27 26 - FLUID-APPLIED MEMBRANE AIR BARRIERS**

### **3.2 SURFACE PREPARATION**

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate in accordance with manufacturer's written instructions and details. 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. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching material.
- E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
- F. 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.
- G. 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.
- H. Bridge isolation joints and discontinuous wall-to-wall, deck-to-wall, and deck-to-deck joints with air-barrier accessory material that accommodates joint movement in accordance with manufacturer's written instructions and details.

### **3.3 INSTALLATION OF ACCESSORIES**

- A. Install accessory materials in accordance with air-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.
  - 1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
  - 2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
  - 3. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 4. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
- B. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.
- C. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.
- D. 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.

## **SECTION 07 27 26 - FLUID-APPLIED MEMBRANE AIR BARRIERS**

- E. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames, with not less than 1 inch of full contact.
  - 1. Transition Strip: Roll firmly to enhance adhesion.
- F. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.
- G. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.
- H. Seal top of through-wall flashings to air barrier with an additional 6-inch-wide, transition strip.
- I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.
- J. 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 beyond repaired areas in strip direction.

### **3.4 INSTALLATION OF PRIMARY AIR-BARRIER MATERIAL**

- A. Apply air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier in accordance with air-barrier manufacturer's written instructions and details. Apply air-barrier material within manufacturer's recommended application temperature ranges.
  - 1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
  - 2. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.
  - 3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.
- B. Low-Build Air Barriers: Apply continuous unbroken air-barrier material to substrates according to the following thickness. Apply an increased thickness of air-barrier material in full contact around protrusions such as masonry ties.
  - 1. Vapor-Permeable, Low-Build Air Barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, applied in two equal coats. Apply additional material as needed to achieve void- and pinhole-free surface, but do not exceed thickness on which required vapor permeability is based.
- C. Do not cover air barrier until it has been tested and inspected by testing agency.
- D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

### **3.5 FIELD QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Air barriers will be considered defective if they do not pass tests and inspections.

## **SECTION 07 27 26 - FLUID-APPLIED MEMBRANE AIR BARRIERS**

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1. Apply additional air-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
  2. Remove and replace deficient air-barrier components for retesting as specified above.
- C. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
- D. Prepare test and inspection reports.

### **3.6 CLEANING AND PROTECTION**

- A. Protect air-barrier system from damage during application and remainder of construction period, in accordance with manufacturer's written instructions.
1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended in writing by manufacturer. If exposed to these conditions for longer than recommended, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed materials in accordance with 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 in writing by manufacturer of affected construction.
- C. Remove masking materials after installation.

**END OF SECTION 07 27 26**



**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Foamed-insulation-core metal wall panels.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- C. Samples: For each type of metal panel indicated.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product test reports.
- B. Warranties: Samples of special warranties.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**1.6 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

## **SECTION 07 42 13 - INSULATED METAL WALL PANELS**

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing in accordance with ASTM E72:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
  - 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
  
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested in accordance with ASTM E283 at the following test-pressure difference:
  - 1. Maximum 0.0002 cfm/sq. ft. at static air pressure difference of 1.57 lbf/sq. ft.
  - 2. Maximum 0.0009 cfm/sq. ft. at static-air-pressure difference of 6.24 lbf/sq. ft.
  - 3. Maximum 0.01 cfm/sq. ft. at static-air-pressure difference of 20 lbf/sq. ft.
  
- C. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E331 at the following test-pressure difference:
  - 1. ASTM E 331: No uncontrolled water penetration at a static pressure of 20 lbf/sq. ft.
  - 2. ASTM E 331 Modified (2-hour duration): No uncontrolled water penetration at a static pressure of 6.24 lbf/sq. ft.
  
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
  
- E. Fire-Test-Response Characteristics: Provide metal wall panels and system components with the following fire-test-response characteristics, as determined by testing identical panels and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.
  - 1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E119.
  - 2. Radiant Heat Exposure: No ignition when tested in accordance with NFPA 268.
  - 3. Potential Heat: Acceptable level when tested in accordance with NFPA 259.
  - 4. Surface-Burning Characteristics: Provide wall panels with a flame-spread index of 25 or less and a smoke-developed index of 450 or less, per ASTM E84.

#### **2.2 FOAMED-INSULATION-CORE METAL WALL PANELS**

- A. General: Provide factory-formed and -assembled metal wall panels fabricated from two metal facing sheets and insulation core foamed in place during fabrication, and with joints between panels designed to form weathertight seals. Include accessories required for weathertight installation.
  - 1. Insulation Core: Modified isocyanurate or polyurethane foam using a non-CFC blowing agent, with maximum flame-spread and smoke-developed indexes of 25 and 450, respectively.
    - a. Closed-Cell Content: 90 percent when tested in accordance with ASTM D6226.
    - b. Density: 2.0 to 2.6 lb/cu. ft. when tested in accordance with ASTM D1622.
    - c. Compressive Strength: Minimum 20 psi when tested in accordance with ASTM D1621.

## SECTION 07 42 13 - INSULATED METAL WALL PANELS

- d. Shear Strength: 26 psi when tested in accordance with ASTM C273/C273M.
- B. Concealed-Fastener, Foamed-Insulation-Core Metal Wall Panels: Formed with tongue-and-groove panel edges; designed for sequential installation by interlocking panel edges and mechanically attaching panels to supports using concealed clips or fasteners.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Metl-Span; a Nucor Brand; CF Mesa Insulated Metal Wall Panel or a comparable product by one of the following:
    - a. CENTRIA, a Nucor Brand.
    - b. Kingspan Insulated Panels, Inc.
    - c. MBCI; Cornerstone Building Brands.
  2. Metallic-Coated Steel Sheet: Facings of zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Exterior Face Sheet: 26-gauge Light Mesa with embossed surface.
    - b. Interior Face Sheet: 26-gauge thickness, with smooth embossed surface Mesa or Light Mesa profile.
    - c. Exterior Finish: Two-coat fluoropolymer.
      - 1) Color: Polar White.
    - d. Interior Finish: Siliconized polyester.
      - 1) Color: Polar White.
  3. Panel Coverage: 42 inches nominal.
  4. Thermal-Resistance Value (R-Value): R-21 in accordance with ASTM C1363.

### 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated.
1. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
  2. Provide complete metal panel assemblies incorporating trim, copings, fasciae, gutters and downspouts, and miscellaneous flashings. Provide required fasteners, closure strips, and sealants as indicated in manufacturer's written instructions.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
  2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

## **SECTION 07 42 13 - INSULATED METAL WALL PANELS**

- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
  - 2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
  - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.

### **2.4 FABRICATION**

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

### **2.5 FINISHES**

- A. Panels and Accessories:
  - 1. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  - 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages in accordance with ASTM C754 and metal panel manufacturer's written recommendations.

## **SECTION 07 42 13 - INSULATED METAL WALL PANELS**

### **3.2 INSTALLATION OF INSULATION-CORE METAL WALL PANELS**

- A. General: Apply continuous ribbon of sealant to panel joint on concealed side of insulated metal wall panels as vapor seal; apply sealant to panel joint on exposed side of panels for weather seal.
  - 1. Fasten foamed-insulation-core metal wall panels to supports with fasteners at each lapped joint at location and spacing and with fasteners recommended by manufacturer.
  - 2. Apply panels and associated items true to line for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
  - 3. Provide metal-backed washers under heads of exposed fasteners on weather side of insulated metal wall panels.
  - 4. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
  - 5. Provide sealant tape at lapped joints of insulated metal wall panels and between panels and protruding equipment, vents, and accessories.
  - 6. Apply a continuous ribbon of sealant tape to panel side laps and elsewhere as needed to make panels weathertight.
- B. Foamed-Insulation-Core Metal Wall Panels: Fasten metal wall panels to supports with concealed clips at each joint at location and spacing and with fasteners recommended by manufacturer. Fully engage tongue and groove of adjacent panels.
  - 1. Install clips to supports with self-tapping fasteners.
- C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
- D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level. Install work with laps, joints, and seams that are permanently watertight.

### **3.3 CLEANING**

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

**END OF SECTION 07 42 13**

**SECTION 07 42 13 - INSULATED METAL WALL PANELS**

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## **SECTION 07 42 14 - METAL COMPOSITE MATERIAL WALL PANELS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Metal composite material (MCM) panels.

#### **1.2 PREINSTALLATION MEETINGS**

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

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel, system, and accessory.
  - 1. Metal composite material (MCM) panels.
- B. Shop Drawings:
  - 1. Include fabrication and installation layouts of MCM system; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, accessories, and special details.
  - 2. Accessories: Include details of flashing, trim, and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.
  - 3. Provide signed and sealed drawings, by a qualified design professional in Project jurisdiction, of MCM system showing compliance with performance requirements and design criteria identified for this Project.
- C. Samples for Initial Selection: For each type of MCM panel indicated, with factory-applied color finishes.
  - 1. Size: Manufacturers' standard size.
  - 2. Include Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of MCM panel and MCM system required, with factory-applied color finishes.
  - 1. MCM Panel: Two samples, 12 inches long by actual panel width. Include fasteners, closures, and other MCM panel accessories. Submit custom color samples in paint manufacturer's standard size.

#### **1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Product Test Reports: For each product, tests performed by a qualified testing agency.
  - 1. MCM Manufacturer's Material Test Reports: Certified test reports showing compliance with specific performance or third-party listing documenting compliance to comparable code sections IBC 1407.14 and IBC 1703.5.
  - 2. MCM System Fabricator's Certified System Tests Reports: Certified system test reports showing system compliance with specific performance or third-party listing documenting

## **SECTION 07 42 14 - METAL COMPOSITE MATERIAL WALL PANELS**

compliance code section. Base performance requirements on MCM system type provided.

- a. Dry System: Tested to AAMA 501.
- C. Sample Warranties: For special warranties.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For MCM panels.
- B. Warranty Documentation:
  - 1. Manufacturers' special warranties.
  - 2. Installer's special warranties.

### **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Minimum 5 years' experience.
- B. Fabricator Qualifications: Approved by MCM panel manufacturer or Certified MCM fabricator by the Metal Construction Association.
- C. Installer Qualifications: Fabricator of MCM system.

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver components, MCM panels, and other manufactured items so as not to be damaged or deformed. Package MCM panels for protection during transportation and handling.
- B. Unload, store, and erect MCM panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack MCM panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store MCM panels to ensure dryness, with positive slope for drainage of water. Do not store MCM panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on MCM panels during installation.

### **1.8 FIELD CONDITIONS**

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of MCM panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

### **1.9 COORDINATION**

- A. Coordinate MCM panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.



## **SECTION 07 42 14 - METAL COMPOSITE MATERIAL WALL PANELS**

### **1.10 WARRANTY**

- A. Panel Integrity Warranty: Manufacturer agrees to repair or replace components of MCM panels that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including rupturing, cracking, or puncturing.
    - b. Deterioration of metals and other materials beyond normal weathering.
  - 2. Warranty Period: Five years from date of Substantial Completion.
- B. Panel Finish Warranty: Manufacturer agrees to repair finish or replace MCM panels that show 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 in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - 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. Structural Performance: MCM systems to withstand the effects of the following loads, based on testing in accordance with ASTM E330/E330M:
  - 1. Wind Loads: As indicated on Drawings.
  - 2. Other Design Loads: As indicated on Drawings.
  - 3. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested in accordance with ASTM E283/E283M at the following test-pressure difference:
  - 1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E331 at the following test-pressure difference:
  - 1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- D. Water Penetration under Dynamic Pressure: No water penetration when tested in accordance with AAMA 501.1 at the following test pressure:
  - 1. Test Pressure: 6.24 psf.
- E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### **2.2 METAL COMPOSITE MATERIAL (MCM) WALL PANELS**

- A. Metal Composite Material (MCM) Wall Panels: Provide MCM panels fabricated from two metal facings bonded to a solid, extruded thermoplastic core.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide ALUCOBOND; 3A Composites USA, Inc ; ALUCOBOND PLUS. or a comparable product by one of the following:
    - a. ALPOLIC Materials; Mitsubishi Chemical Composites.

## **SECTION 07 42 14 - METAL COMPOSITE MATERIAL WALL PANELS**

- b. Arconic.
  2. Core: PE.
  3. Panel Thickness: 0.157 inch.
  4. Bond Strength: 22.5 in-lb/in. when tested for bond integrity in accordance with ASTM D1781.
  5. Fire Performance: Flame-spread index less than 75 and smoke-developed index less than 450, in accordance with ASTM E84 or UL 723.
- B. MCM Panel Materials:
  1. Aluminum-Faced Panels: ASTM B209/B209M alloy as standard with manufacturer, temper as required to suit finish and forming operations with 0.032-inch- thick, aluminum sheet facings.
    - a. Exterior Finish: Two-coat fluoropolymer.
      - 1) Color: Dusty Charcoal II.
  2. Peel Strength: 22.5 in-lb/in. when tested for bond integrity in accordance with ASTM D1781.
- C. System Panel Depth: 2 inches.
- D. Attachment Assembly Components: Formed from material compatible with panel facing.
- E. Labeling: Comply with labeling requirement of applicable building code.

### **2.3 ACCESSORIES**

- A. Metal Subframing and Furring: ASTM C955 cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of MCM system.
- B. System Accessories: Provide components required for a complete, weathertight wall system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of MCM panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as MCM panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent MCM panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Use gasketed or approved coated fasteners between dissimilar metals.
  1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- E. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in MCM panels and remain weathertight; and as recommended in writing by MCM system manufacturer.

## **SECTION 07 42 14 - METAL COMPOSITE MATERIAL WALL PANELS**

### **2.4 FABRICATION**

- A. Fabricate and finish MCM panels at the factory, by panel manufacturer's standard procedures and processes, as necessary to fulfill indicated panel performance requirements demonstrated by laboratory testing.
- B. Shop-fabricate MCM systems and accessories by fabricator's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with requirements of MCM panel manufacturer, of indicated system profiles, and with dimensional and structural requirements.
  - 1. Fabricate panels to dimensions indicated on Drawings based on an assumed design temperature of 70 deg F. Allow for ambient temperature range at time of fabrication.
  - 2. Formed MCM panel lines, breaks, and angles to be sharp and straight, with surfaces free from warp or buckle.
  - 3. Fabricate panels with sharply cut edges and no displacement of face sheet or protrusion of core.
  - 4. Fabricated Panel Tolerances: Shop-fabricate panels to sizes and joint configurations indicated on Drawings.
    - a. Width: Plus or minus 0.079 inch at 70 deg F.
    - b. Length: Plus or minus 0.079 inch at 70 deg F.
    - c. Squareness: Plus or minus 0.079 inch at 70 deg F.
  - 5. Fabricate MCM panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
  - 6. Attach routed-and-turned panel flanges to perimeter extrusions or panel clips with manufacturer's standard fasteners.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
  - 1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
  - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
  - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams.
  - 4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
  - 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
  - 6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal manufacturer.
    - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal manufacturer for application, but not less than thickness of metal being secured.

### **2.5 FINISHES**

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **SECTION 07 42 14 - METAL COMPOSITE MATERIAL WALL PANELS**

- C. Coil-Coated Metal Finish:
  - 1. PVDF Fluoropolymer: AAMA 2605, two-coat fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, MCM system supports, and other conditions affecting performance of the Work.
  - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by MCM system manufacturer.
  - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by MCM system manufacturer.
- B. Examine roughing-in for components and assemblies penetrating MCM system to verify actual locations of penetrations relative to seam locations of MCM panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 MCM PANEL INSTALLATION**

- A. General: Install MCM panels in accordance with Fabricator's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor MCM panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 1. Shim or otherwise plumb substrates receiving MCM panels.
  - 2. Flash and seal MCM panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by MCM panels are installed.
  - 3. Install screw fasteners in predrilled holes.
  - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
  - 5. Install flashing and trim as MCM panel work proceeds.
  - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  - 7. Align bottoms of MCM panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
  - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.
- B. Fasteners:
  - 1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
- C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by MCM panel manufacturer.

## **SECTION 07 42 14 - METAL COMPOSITE MATERIAL WALL PANELS**

- D. Attachment Assembly, General: Install attachment assembly required to support MCM wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.
1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.
- E. Panel Installation: Attach MCM wall panels to supports at locations, spacings, and with fasteners recommended by Fabricator to achieve performance requirements specified.
1. PER Installation: Install using Fabricator's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach MCM wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.
    - a. Track-Support Installation: Install support assembly at locations, spacings, and with fasteners recommended by Fabricator. Use Fabricator's standard horizontal tracks and vertical tracks or drain channels that provide support and secondary drainage assembly, draining to the exterior at horizontal joints through drain tube. Attach MCM wall panels to tracks by interlocking panel edges with Fabricator's standard "T" clips.
    - b. Panel Installation:
      - 1) Attach routed-and-turned flanges of wall panels to perimeter extrusions with Fabricator's standard fasteners.
      - 2) Install wall panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
    - c. Joint Sealing: Seal all joints in accordance with AAMA 508. Do not apply sealants to joints unless indicated.
- F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install components required for a complete MCM panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by MCM panel Fabricator; or, if not indicated, provide types recommended in writing by MCM system Fabricator.
- G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, or SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
  2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

### **3.3 ERECTION TOLERANCES**

- A. Site Verifications of Conditions:

## **SECTION 07 42 14 - METAL COMPOSITE MATERIAL WALL PANELS**

1. Verify conditions of substrate previously installed under other Sections are acceptable for the MCM system installation. Provide documentation indicating detrimental conditions to the MCM system performance.
2. Once conditions are verified, MCM system installation tolerances are as follows:
  - a. Shim and align MCM wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### **3.4 INSTALLATION TOLERANCES**

- A. Shim and align MCM panels within installed tolerance of 1/4 inch in 20 ft., non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### **3.5 CLEANING**

- A. Remove temporary protective coverings and strippable films as MCM panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, clean finished surfaces as recommended by MCM panel manufacturer. Maintain in a clean condition during construction.
- B. After installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

### **3.6 PROTECTION**

- A. Replace MCM panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION 07 42 14**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
1. Adhered polyvinyl chloride (PVC) roofing system – two types.
  2. Substrate board.
  3. Accessory roofing materials.
  4. Roof insulation.
  5. Snow guards.
  6. Insulation accessories and cover board.
  7. Walkways.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
1. Polyvinyl chloride (PVC) roofing system.
  2. Accessory roofing materials.
  3. Substrate board.
  4. Roof insulation.
  5. Insulation accessories and cover board.
  6. Walkways.
  7. For insulation and roof system component fasteners, include copy of SPRI's Directory of Roof Assemblies listing.
- B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:
1. Layout and thickness of insulation.
  2. Base flashings and membrane terminations.
  3. Flashing details at penetrations.
  4. Tapered insulation thickness and slopes.
  5. Roof plan showing orientation of steel roof deck and orientation of roof membrane, fastening spacings, and patterns for mechanically fastened roofing system.
  6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
  7. Tie-in with air barrier.
- C. Delegated Design Submittals: For snow guards, include analysis reports signed and sealed by the qualified professional engineer responsible for their preparation.
1. Include calculation of number and location of snow guards.
- D. Samples: For the following products:
1. Roof membrane and flashing, of color required.
  2. Walkway pads or rolls, of color required.
- E. Wind Uplift Resistance Submittal: For roofing system, indicating compliance with wind uplift performance requirements.

## **SECTION 07 54 19 - POLYVINYL-CHLORIDE (PVC) ROOFING**

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Manufacturer Certificates:
  - 1. Performance Requirement Certificate: Signed by roof membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
    - a. Submit evidence of compliance with performance requirements.
  - 2. Special Warranty Certificate: Signed by roof membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.
- B. Product Test Reports: For roof membrane and insulation, tests performed by independent qualified testing agency indicating compliance with specified requirements.
- C. Qualification Data: For professional engineer's experience with providing delegated design engineering services of the kind indicated, including documentation that the engineer is licensed in the state in which the Project is located.
- D. Product Test Reports: For each type of snow guard, for tests performed by a qualified testing agency, indicating load at failure of attachment to roof system identical to roof system used on this Project.
- E. Research reports.
- F. Field Test Reports:
  - 1. Fastener-pullout test results and manufacturer's revised requirements for fastener patterns.
- G. Field quality-control reports.
- H. Sample warranties.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

### **1.6 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Installers: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

### **1.7 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
  - 1. Special warranty includes roof membrane, base flashings, roof insulation, fasteners, cover boards, substrate board, and other components of roofing system.
  - 2. Warranty Period: 20 years from date of Substantial Completion.
- B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of



## **SECTION 07 54 19 - POLYVINYL-CHLORIDE (PVC) ROOFING**

roofing system such as roof membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, and walkway products, for the following warranty period:

1. Warranty Period: Two years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Accelerated Weathering: Roof membrane to withstand 2000 hours of exposure when tested according to ASTM G152, ASTM G154, or ASTM G155.
- B. Impact Resistance: Roof membrane to resist impact damage when tested according to ASTM D3746, ASTM D4272.
- C. Material Compatibility: Roofing materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roof membrane manufacturer based on testing and field experience.
- D. Wind Uplift Resistance: As indicated.
- E. SPRI's Directory of Roof Assemblies Listing: Roof membrane, base flashings, and component materials comply with requirements in FM Approvals 4450 or FM Approvals 4470 as part of a roofing system, and are listed in SPRI's Directory of Roof Assemblies for roof assembly identical for that specified for this Project.
- F. Exterior Fire-Test Exposure: ASTM E108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

#### **2.2 POLYVINYL CHLORIDE (PVC) ROOFING WITH SIMULATED METAL ROOFING SYSTEM**

- A. PVC Sheet Type III, Fabric Backed: ASTM D4434/D4434M, fabric reinforced and fabric backed.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Décor Roof Systems as manufactured by Sarnafil or comparable product by one of the following:
    - a. Duro-Last Roofing, Inc.
    - b. Elevate; Holcim Building Envelope.
    - c. Flex Membrane International Corp.
    - d. GAF.
    - e. Johns Manville; a Berkshire Hathaway company.
    - f. Soprema, Inc.
    - g. Versico Roofing Systems; Carlisle Construction Materials.
  2. Membrane Thickness: 60 mils.
  3. Exposed Face Color:
    - a. Flat roof: White.
    - b. Sloped roof: Light gray for Simulated standing seam.

#### **2.3 POLYVINYL CHLORIDE (PVC) ROOFING**

- A. PVC Sheet Type III, Fabric Backed: ASTM D4434/D4434M, fabric reinforced and fabric backed.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide adhered Roof Systems as manufactured by Sarnafil or comparable product by one of the following:

## SECTION 07 54 19 - POLYVINYL-CHLORIDE (PVC) ROOFING

- a. Duro-Last Roofing, Inc.
  - b. Elevate; Holcim Building Envelope.
  - c. Flex Membrane International Corp.
  - d. GAF.
  - e. Johns Manville; a Berkshire Hathaway company.
  - f. Soprema, Inc.
  - g. Carlisle Syntec; Carlisle Construction Materials.
2. Membrane Thickness: 60 mils.
  3. Exposed Face Color:
    - a. Flat roof: White.

### 2.4 ACCESSORY ROOFING MATERIALS

- A. General: Accessory materials recommended by roofing system manufacturer for intended use and compatible with other roofing components.
- B. Snow Guards: Alpine snow guards in matching membrane colors.
- C. Sheet Flashing: Manufacturer's standard compatible sheet flashing of same material, type, reinforcement, thickness, and color as PVC sheet.
- D. Prefabricated Pipe Flashings: As recommended by roof membrane manufacturer.
- E. Bonding Adhesive: Manufacturer's standard, water based.
- F. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- G. Low-Rise, Urethane, Fabric-Backed Membrane Adhesive: Roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.
- H. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel bars, approximately 1 by 1/8 inch thick; with anchors.
- I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing components to substrate, and acceptable to roofing system manufacturer.
- J. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

### 2.5 SUBSTRATE BOARD

- A. Glass-Mat Gypsum Roof Substrate Board: ASTM C1177/C1177M, water-resistant gypsum board.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed; SAINT-GOBAIN.
    - b. Georgia-Pacific Gypsum LLC.

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- c. Gold Bond Building Products, LLC provided by National Gypsum Company.
  - d. USG Corporation.
  2. Thickness: Type X, 5/8 inch.
  3. Surface Finish: Factory primed.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate board to roof deck.

### **2.6 ROOF INSULATION**

- A. Polyisocyanurate Board Insulation: ASTM C1289, Type II, Class 2, Grade 2, felt or glass-fiber mat facer on both major surfaces.
1. Basis-of-Design Product: Subject to compliance with requirements, provide product approved by the roof membrane manufacture.
  2. Thickness:
    - a. Base Layer: 1-1/2 inches.

### **2.7 INSULATION ACCESSORIES AND COVER BOARD**

- A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.
- B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:
1. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
- C. Fiber-Reinforced Gypsum Roof Board: ASTM C1278/C1278M, cellulosic-fiber reinforced, water-resistant gypsum board.
1. Thickness: 5/8 inch.

### **2.8 WALKWAYS**

- A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.
1. Size: Approximately 36 by 60 inches.
  2. Color: Contrasting with roof membrane.

## **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.

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### **3.2 PREPARATION**

- A. Perform fastener-pullout tests according to roof system manufacturer's written instructions.
  - 1. Submit test result within 24 hours of performing tests.
    - a. Include manufacturer's requirements for any revision to previously submitted fastener patterns required to achieve specified wind uplift requirements.

### **3.3 INSTALLATION OF ROOFING, GENERAL**

- A. Install roofing system according to roofing system manufacturer's written instructions and SPRI's Directory of Roof Assemblies listed roof assembly requirements.
- B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### **3.4 INSTALLATION OF SUBSTRATE BOARD**

- A. Install substrate board with long joints in continuous straight lines, with end joints staggered not less than 24 inches in adjacent rows with adhesive.
  - 1. At steel roof decks, install substrate board at right angle to flutes of deck.
    - a. Locate end joints over crests of steel roof deck.
  - 2. Tightly butt substrate boards together.
  - 3. Cut substrate board to fit tight around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  - 4. Fasten substrate board to top flanges of steel deck according to recommendations in SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity and FM Global Property Loss Prevention Data Sheet 1-29.
  - 5. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

### **3.5 INSTALLATION OF INSULATION**

- A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at end of workday.
- B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.
- C. Installation Over Metal Decking:
  - 1. Install base layer of insulation with end joints staggered not less than 12 inches in adjacent rows and with long joints continuous at right angle to flutes of decking.
    - a. Locate end joints over crests of decking.
    - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
    - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
    - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
      - 1) Trim insulation so that water flow is unrestricted.
    - e. Fill gaps exceeding 1/4 inch with insulation.
    - f. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

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- 1) Fasten insulation according to requirements in SPRI's Directory of Roof Assemblies for specified Wind Uplift Load Capacity.
  - 2) Fasten insulation to resist specified uplift pressure at corners, perimeter, and field of roof.
2. Install upper layers of insulation and tapered insulation with joints of each layer offset not less than 12 inches from previous layer of insulation.
- a. Staggered end joints within each layer not less than 24 inches in adjacent rows.
  - b. Trim insulation neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  - c. Make joints between adjacent insulation boards not more than 1/4 inch in width.
  - d. At internal roof drains, slope insulation to create a square drain sump with each side equal to the diameter of the drain bowl plus 24 inches.
  - e. Trim insulation so that water flow is unrestricted.
  - f. Fill gaps exceeding 1/4 inch with insulation.
  - g. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.
  - h. Adhere each layer of insulation to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity as follows:
    - 1) Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

### **3.6 INSTALLATION OF COVER BOARDS**

- A. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction.
1. Trim cover board neatly to fit around penetrations and projections, and to fit tight to intersecting sloping roof decks.
  2. At internal roof drains, conform to slope of drain sump.
    - a. Trim cover board so that water flow is unrestricted.
  3. Cut and fit cover board tight to nailers, projections, and penetrations.
  4. Adhere cover board to substrate using adhesive according to SPRI's Directory of Roof Assemblies listed roof assembly requirements for specified Wind Uplift Load Capacity as follows:
    - a. Set cover board in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
    - b. Set cover board in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

### **3.7 INSTALLATION OF ADHERED ROOF MEMBRANE**

- A. Adhere roof membrane over area to receive roofing according to roofing system manufacturer's written instructions.
- B. Unroll roof membrane and allow to relax before installing.
- C. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- D. Bonding Adhesive: Apply to substrate and underside of roof membrane at rate required by manufacturer, and allow to partially dry before installing roof membrane. Do not apply to splice area of roof membrane.

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- E. Fabric-Backed Roof Membrane Adhesive: Apply to substrate at rate required by manufacturer, and install fabric-backed roof membrane.
- F. In addition to adhering, mechanically fasten roof membrane securely at terminations, penetrations, and perimeter of roofing.
- G. Apply roof membrane with side laps shingled with slope of roof deck where possible.
- H. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roof membrane and sheet flashings to ensure a watertight seam installation.
  - 1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roof membrane and sheet flashings.
  - 2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
  - 3. Repair tears, voids, and lapped seams in roof membrane that do not comply with requirements.
- I. Spread sealant bed over deck-drain flange at roof drains, and securely seal roof membrane in place with clamping ring.

### **3.8 INSTALLATION OF BASE FLASHING**

- A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.
- B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.
- E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

### **3.9 INSTALLATION OF WALKWAYS**

- A. Flexible Walkways: Install walkway products according to manufacturer's written instructions.
  - 1. Install flexible walkways at the following locations:
    - a. Locations indicated on Drawings.
    - b. As required by roof membrane manufacturer's warranty requirements.
  - 2. Provide 6-inch clearance between adjoining pads.
  - 3. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

### **3.10 INSTALLATION OF SNOW GUARDS**

- A. Install snow guards as per manufacture recommendations.
  - 1. Space rows as recommended by manufacturer.

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### **3.11 PROTECTING AND CLEANING**

- A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing system for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.
- B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

**END OF SECTION 07 54 19**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Manufactured reglets with counterflashing.
  - 2. Formed roof-drainage sheet metal fabrications.
  - 3. Formed low-slope roof sheet metal fabrications.
  - 4. Formed wall sheet metal fabrications.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each of the following
  - 1. Underlayment materials.
  - 2. Elastomeric sealant.
  - 3. Butyl sealant.
  - 4. Epoxy seam sealer.
- 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 roof-penetration flashing.
  - 9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
  - 10. Include details of special conditions.
  - 11. Include details of connections to adjoining work.
- C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product Certificates: For each type of coping and roof edge flashing that is ANSI/SPRI/FM 4435/ES-1 tested.

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- B. Evaluation Reports: For copings and roof edge flashing, from an agency acceptable to authority having jurisdiction showing compliance with ANSI/SPRI/FM 4435/ES-1.
- C. Sample warranty.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance data.
- B. Special warranty.

### **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.
  - 1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested, shop is to be listed as able to fabricate required details as tested and approved.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to 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 are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### **2.2 SHEET METALS**

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Stainless Steel Sheet: ASTM A240/A240M, Type 304, dead soft, fully annealed; with smooth, flat surface.
  - 1. Finish: ASTM A480/A480M, No. 2D (dull, cold rolled).

**2.3 UNDERLAYMENT MATERIALS**

- A. Self-Adhering, High-Temperature Sheet Underlayment: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer in accordance with underlayment manufacturer's written instructions.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ATAS International, Inc.
    - b. Carlisle WIP Products; a brand of Carlisle Construction Materials.
    - c. GCP Applied Technologies Inc.
    - d. Henry Company; a Carlisle company.
    - e. Owens Corning.
    - f. Polyglass U.S.A., Inc.
    - g. Protecto Wrap Company.
    - h. SDP Advanced Polymer Products Inc.
  - 2. Low-Temperature Flexibility: ASTM D1970/D1970M; passes after testing at minus 20 deg F or lower.

**2.4 MISCELLANEOUS MATERIALS**

- A. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
  - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength stainless-steel rivets suitable for metal being fastened.
  - 2. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.
- B. Solder:
  - 1. For Stainless Steel: ASTM B32, Grade Sn60 or Grade Sn96, with acid flux of type recommended by stainless steel sheet manufacturer.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane or silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.
- G. Reglets: Units of type, material, and profile required, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated with factory-mitered and -welded corners and junctions and.
  - 1. Material: Stainless steel, 0.0188 inch thick.

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2. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
3. Accessories:
  - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
  - b. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.

### 2.5 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
  1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
  2. 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.
  3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
  4. 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.
  5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
  1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
  2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams:
  1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

### 2.6 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12-foot-long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings; and form with 2-inch-high, end dams. Fabricate from the following materials:

## **SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM**

1. Stainless Steel: 0.0156 inch thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:
  1. Stainless Steel: 0.0156 inch thick.
- C. Wall Expansion-Joint Cover: Fabricate from the following materials:
  1. Stainless Steel: 0.0188 inch thick.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION OF UNDERLAYMENT**

- A. Self-Adhering, High-Temperature Sheet Underlayment:
  1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
  2. Prime substrate if recommended by underlayment manufacturer.
  3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
  4. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses.
  5. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller.
  6. Roll laps and edges with roller.
  7. Cover underlayment within 14 days.

#### **3.2 INSTALLATION, GENERAL**

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
  1. Install fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder.
  3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
  4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
  5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
  6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
  8. Do not field cut sheet metal flashing and trim by torch.
- 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 stainless steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.

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2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
  1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
  2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
  3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
  1. Use sealant-filled joints unless otherwise indicated.
    - a. Form joints to completely conceal sealant.
    - b. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
    - c. Adjust setting proportionately for installation at higher ambient temperatures.
      - 1) Do not install sealant-type joints at temperatures below 40 deg F.
  2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."
- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
  1. Pretin edges of sheets with solder to width of 1-1/2 inches; however, reduce pretinning where pretinned surface would show in completed Work.
  2. Do not use torches for soldering.
  3. Heat surfaces to receive solder, and flow solder into joint.
    - a. Fill joint completely.
    - b. Completely remove flux and spatter from exposed surfaces.
  4. Stainless Steel Soldering:
    - a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
    - b. Promptly remove acid-flux residue from metal after tinning and soldering.
    - c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

### 3.3 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

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### **3.4 INSTALLATION TOLERANCES**

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### **3.5 CLEANING**

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

### **3.6 PROTECTION**

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. 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, as determined by Architect.

**END OF SECTION 07 62 00**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Manufactured units for the following applications:
  1. Copings.
  2. Roof-edge drainage systems.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

- A. Product data.
- B. Shop Drawings: For roof specialties.
  1. Plans, expansion-joint locations, keyed details, and attachments to other work. Distinguish between factory pre-manufactured- and field-assembled installation.
  2. Details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
  3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
  4. Details of termination points and assemblies, including fixed points.
  5. Details of special conditions.
- C. Samples: For each type of roof specialty indicated with factory-applied color finishes.

**1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**1.5 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A qualified manufacturer offering products that are ANSI/SPRI/FM 4435/ES-1 tested to specified design pressure.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.
- B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

**1.7 FIELD CONDITIONS**

- A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

**1.8 COORDINATION**

- A. Coordinate roof specialties with roofing system, exterior wall system, air barrier, flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, weathertight, secure, and noncorrosive installation.
  - 1. Performance Coordination: Coordinate with the Work of roofing and exterior wall Sections to ensure that roof specialties provided under the Work of this Section meet or exceed specified roofing and exterior wall design performance requirements.
- B. Confirm and coordinate compatibility of materials and comply with warranty requirements of roofing system manufacturer.
- C. Coordinate roof specialties layout and seams with sizes and locations of joints and seams in adjacent materials.

**1.9 WARRANTY**

- A. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
    - 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 Performance: Roof specialties to withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
- B. SPRI Wind Design Standard: Manufacture and install copings tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressures:
  - 1. Design Pressure: As indicated on Drawings.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

**2.2 COPINGS**

- A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 ft., concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Hickman; an MTL Company; Leak-Tite Coping or a comparable product by one of the following:
    - a. ATAS International, Inc.
    - b. Englert, Inc.
    - c. Metal-Era, Inc.
    - d. OMG Roofing Products; a Division of OMG, Inc.
    - e. PAC-CLAD; Petersen; a Carlisle company.
    - f. SAF Perimeter Systems Division.
  - 2. Formed Aluminum Coping Caps: Aluminum sheet, 0.050 inch thick.
    - a. Surface: Smooth, flat finish.
    - b. Finish: Two-coat fluoropolymer.
    - c. Color: Custom color to match adjacent metal panel wall.
  - 3. Corners: Factory mitered and continuously welded.
  - 4. Coping-Cap Attachment Method: Face leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.
    - a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches wide, with integral cleats.

**2.3 ROOF-EDGE DRAINAGE SYSTEMS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide SAF (Southern Aluminum Finishing Company, Inc.); style indicated or a comparable product by one of the following:
  - 1. ATAS International, Inc.
  - 2. Architectural Products Company.
  - 3. Cheney Flashing Company.
  - 4. Drexel Metals.
  - 5. Metal-Era, Inc.
  - 6. OMG Roofing Products; a Division of OMG, Inc.
- B. Gutters: Manufactured in uniform section lengths not exceeding 12 ft., with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
  - 1. Metallic-Coated Steel Sheet: Nominal 0.034-inch thickness.
  - 2. Corners: Factory mitered and soldered.
  - 3. Gutter Supports: Manufacturer's standard supports as selected by Architect with finish matching the gutters.
- C. Downspouts: Plain square complete with machine-crimped elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
  - 1. Metallic-Coated Steel Sheet: Nominal 0.034-inch thickness.
  - 2. Size: As indicated on Drawings.
- D. Finishes:
  - 1. Metallic-Coated Steel: Two-coat fluoropolymer.
    - a. Color: As selected by Architect from manufacturer's full range.

**2.4 SHEET METAL MATERIALS**

- A. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with minimum ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with minimum ASTM A792/A792M, Class AZ50 coating designation; structural quality..
  - 1. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight in color coat.
- B. Aluminum Sheet: ASTM B209/B209M, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
  - 1. Exposed Coil-Coated Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    - a. Two-Coat Fluoropolymer Finish: AAMA 2605. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight in color coat.
  - 2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

**2.5 MISCELLANEOUS MATERIALS**

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Fasteners: Roof specialty manufacturer's recommended fasteners, designed to meet performance requirements, suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
  - 1. Fasteners for Metallic-Coated Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel in accordance with ASTM A153/A153M or ASTM F2329/F2329M.
  - 2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  - 3. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
- C. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.
- D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane or silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.
- E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

**2.6 GENERAL FINISH REQUIREMENTS**

- A. Comply with NAAMM/NOMMA AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
- B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.
- C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION, GENERAL**

- A. Install roof specialties in accordance with manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.
  - 1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
  - 2. Provide uniform, neat seams with minimum exposure of solder and sealant.
  - 3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
  - 4. Torch cutting of roof specialties is not permitted.
  - 5. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer's written installation instructions.
  - 1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
  - 2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.
- C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
  - 1. Space movement joints at a maximum of 12 ft. with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.

2. 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.
- D. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
- E. Seal concealed joints with butyl sealant as required by roof specialty manufacturer.
- F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

### **3.3 INSTALLATION OF COPINGS**

- A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.
- B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.
  1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

### **3.4 INSTALLATION OF ROOF-EDGE DRAINAGE SYSTEMS**

- A. Install components to produce a complete roof-edge drainage system in accordance with manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
- B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches apart. Attach ends with rivets and solder to make watertight. Slope to downspouts.
  1. Install gutter with expansion joints at locations indicated but not exceeding 50 ft. apart. Install expansion-joint caps.
- C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.
  1. Provide elbows at base of downspouts at grade to direct water away from building.
  2. Connect downspouts to underground drainage system indicated.

### **3.5 CLEANING AND PROTECTION**

- A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing in accordance with ASTM A780/A780M.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

## **SECTION 07 71 00 - ROOF SPECIALTIES**

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- D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures, as determined by Architect.

**END OF SECTION 07 71 00**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes: Sprayed fire-resistive materials.

**1.2 DEFINITIONS**

- A. SFRM: Sprayed fire-resistive materials.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

**1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Framing plans or schedules, or both, indicating the following:
  - 1. Extent of applied fire protection for each construction and fire-resistance rating.
  - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
  - 3. Minimum applied fire protection material thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
  - 4. Treatment of sprayed fire-resistive material after application.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard dimensions in size.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: For each type of applied fire protection material for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Research Reports: For each type of applied fire protection material, from an agency acceptable to authorities having jurisdiction.
- C. Qualification Statements: For Installer.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by applied fire protection material manufacturer as experienced and with sufficient trained staff to install manufacturer's products in accordance with specified requirements.

**1.7 FIELD CONDITIONS**

- A. Environmental Limitations: Do not apply applied fire protection when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fire protection, providing complete air exchanges in accordance with manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fire protection dries thoroughly.

**PART 2 - PRODUCTS**

**2.1 SOURCE LIMITATIONS**

- A. Obtain applied fire protection from single source.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Assemblies: Provide applied fire protection, including auxiliary materials, in accordance with requirements of each fire-resistance design and manufacturer's written instructions.
- B. Fire-Resistance Design: Indicated on Drawings, tested in accordance with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- C. Asbestos: Provide products containing no detectable asbestos.

**2.3 SPRAYED FIRE-RESISTIVE MATERIALS**

- A. Sprayed Fire-Resistive Material: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and conveyed in a dry state and mixed with atomized water at place of application.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Per the UL Design.
  - 2. Dry Density: 15 lb/cu. Ft. for minimum average and individual densities regardless of density indicated in referenced fire-resistive design, or greater if required attaining fire-resistance ratings indicated, per ASTM E605.
  - 3. Thickness: As required for fire-resistance design indicated, measured in accordance with requirements of fire-resistance design or ASTM E605/E605M, whichever is thicker, but not less than 0.375 inch.
  - 4. Combustion Characteristics: ASTM E136.
  - 5. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 6. Compressive Strength: Minimum 10 lbf/sq. in. in accordance with ASTM E761/E761M.
  - 7. Corrosion Resistance: No evidence of corrosion in accordance with ASTM E937/E937M.
  - 8. Deflection: No cracking, spalling, or delamination in accordance with ASTM E759/E759.
  - 9. Effect of Impact on Bonding: No cracking, spalling, or delamination in accordance with ASTM E760/E760M.

## **SECTION 07 81 00 - APPLIED FIRE PROTECTION**

10. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours in accordance with ASTM E859/E859M.
11. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G21 or rating of 10 in accordance with ASTM D3274 when tested in accordance with ASTM D3273.
12. Finish: As selected by Architect from manufacturer's standard finishes.

### **2.4 AUXILIARY MATERIALS**

- A. Provide auxiliary materials that are compatible with sprayed fire-resistive material and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved in writing by sprayed fire-resistive material manufacturer and complying with one or both of the following requirements or as tested by UL (CGJM):
  1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
  2. Primer's bond strength in required fire-resistance design complies with specified bond strength for sprayed fire-resistive material and with requirements in UL's "Product iQ" online directory or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests in accordance with ASTM E736/E736M.
- C. Sealer: Transparent-drying, water-dispersible, tinted protective coating recommended in writing by sprayed fire-resistive material manufacturer for each fire-resistance design.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Isolatek International.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and in accordance with each fire-resistance design.
  1. Verify that substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of applied fire protection with substrates under conditions of normal use or fire exposure.
  2. Verify that objects penetrating applied fire protection, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
  3. Verify that substrates receiving applied fire protection are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fire protection application.
- B. Verify that roof construction, installation of rooftop HVAC equipment, and other related work are complete before beginning Work.
- C. Verify that UL listed primer, CGJM, has been installed.
- D. Conduct tests in accordance with sprayed fire-resistive material manufacturer's written instructions to verify that substrates are free of substances capable of interfering with bond.

## **SECTION 07 81 00 - APPLIED FIRE PROTECTION**

- 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 PREPARATION**

- A. Cover other work subject to damage from fallout or overspray of applied fire protection materials during application.
- B. Clean substrates of substances that could impair bond of applied fire protection.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by sprayed fire-resistive material manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive applied fire protection.

### **3.3 APPLICATION**

- A. Construct applied fire protection assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting applied fire protection Work.
- B. Comply with sprayed fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fire protection; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fire protection with other construction to minimize need to cut or remove applied fire protection.
  - 1. Do not begin applying fire protection until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
  - 2. Defer installing ducts, piping, and other items that would interfere with applying fire protection until application of fire protection is completed.
- D. Metal Decks:
  - 1. Do not apply fire protection to underside of metal deck substrates until concrete topping, if any, is completed.
  - 2. Do not apply fire protection to underside of metal roof deck until roofing is completed; prohibit roof traffic during application and drying of fire protection.
- E. Install auxiliary materials as required, as detailed, and in accordance with fire-resistance design and sprayed fire-resistive material manufacturer's written instructions for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by sprayed fire-resistive material manufacturer.
- F. Spray apply fire protection to maximum extent possible. After the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by sprayed fire-resistive material manufacturer.
- G. Extend applied fire protection in full thickness over entire area of each substrate to be protected.

## **SECTION 07 81 00 - APPLIED FIRE PROTECTION**

- H. Install body of applied fire protection in a single course unless otherwise recommended in writing by sprayed fire-resistive material manufacturer.
- I. Where sealers are used, apply products that are tinted to differentiate them from applied fire protection over which they are applied.
- J. Provide a uniform finish complying with description indicated for each type of applied fire protection material and matching approved finish.
- K. Cure applied fire protection in accordance with sprayed fire-resistive material manufacturer's written instructions.
- L. Do not install enclosing or concealing construction until after applied fire protection has been inspected, tested, and corrections have been made to deficient applications.

### **3.4 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Test and inspect as required by the IBC, Subsection 17 05 .15, "Sprayed Fire-Resistant Materials."
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fire protection for the next area until test results for previously completed applications of fire protection show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Applied fire protection will be considered defective if it does not pass tests and inspections.
  - 1. Remove and replace applied fire protection that does not pass tests and inspections, and retest.
  - 2. Apply additional applied fire protection, in accordance with manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

### **3.5 CLEANING**

- A. Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

### **3.6 PROTECTION**

- A. Protect applied fire protection from damage resulting from construction operations or other causes in accordance with manufacturer's and Installer's written instructions, so applied fire protection is without damage or deterioration at time of Substantial Completion.

### **3.7 REPAIRS**

- A. As installation of other adjacent construction proceeds, inspect applied fire protection and repair damaged areas due to work of other trades before concealing it with other construction.

## **SECTION 07 81 00 - APPLIED FIRE PROTECTION**

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- B. Repair applied fire protection using same method and materials as original installation or using manufacturer's recommended trowel-applied repair product.

**END OF SECTION 07 81 00**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

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

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product test reports.

**1.5 CLOSEOUT SUBMITTALS**

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

**1.6 QUALITY ASSURANCE**

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

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics:
  - 1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
  - 2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
    - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

- 1) UL in its "Fire Resistance Directory."

## **2.2 PENETRATION FIRESTOPPING SYSTEMS**

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. 3M Fire Protection Products.
    - b. Hilti, Inc.; CFS-DID.
    - c. Specified Technologies, Inc.
- B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
  2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
  3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
  1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.



## **SECTION 07 84 13 - PENETRATION FIRESTOPPING**

- D. Install fill materials by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

### **3.2 IDENTIFICATION**

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.
  - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
  - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Designation of applicable testing and inspecting agency.
  - 4. Date of installation.
  - 5. Manufacturer's name.
  - 6. Installer's name.

### **3.3 FIELD QUALITY CONTROL**

- A. Owner may engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

**END OF SECTION 07 84 13**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Joints in or between fire-resistance-rated constructions.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

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

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product test reports.

**1.5 CLOSEOUT SUBMITTALS**

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

**1.6 QUALITY ASSURANCE**

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

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

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

**2.2 JOINT FIRESTOPPING SYSTEMS**

- A. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
- B. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.
  - 1. Products: Subject to compliance with requirements, provide products from same manufacturer as in Section 07 84 13.
  - 2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.
- C. Exposed Joint Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.
- D. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install elastomeric fill materials and to maintain ratings required. Use only components specified by joint firestopping system manufacturer and approved by the qualified testing agency for conditions indicated.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.
- B. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- C. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.
- D. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:
  - 1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
  - 2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.
  - 3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

**3.2 IDENTIFICATION**

- A. Joint Identification: Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-

adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

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

**3.3 FIELD QUALITY CONTROL**

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

**END OF SECTION 07 84 43**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Silicone joint sealants.
  - 2. Mildew-resistant joint sealants.
  - 3. Latex joint sealants.

**1.2 ACTION SUBMITTALS**

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

**1.3 INFORMATIONAL SUBMITTALS**

- A. Product test reports.
- B. Field-adhesion-test reports.

**1.4 QUALITY ASSURANCE**

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

**1.5 WARRANTY**

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

**PART 2 - PRODUCTS**

**2.1 JOINT SEALANTS, GENERAL**

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

**2.2 SILICONE JOINT SEALANTS**

- A. Mildew-Resistant Silicone Joint Sealant: ASTM C 920.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Building Systems.
    - b. Dow Corning Corporation.
    - c. GE Advanced Materials - Silicones.
    - d. May National Associates, Inc.
    - e. Pecora Corporation.
    - f. Polymeric Systems, Inc.
    - g. Sika Corporation; Construction Products Division.
    - h. Tremco Incorporated.
  - 2. Type: Single component (S).
  - 3. Grade: nonsag (NS).
  - 4. Class: 25.
  - 5. Uses Related to Exposure: Nontraffic (NT).
- B. Mildew-Resistant Silicone Joint Sealant: ASTM C 920.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the same manufacturer as above.
  - 2. Type: Single component (S) or multicomponent (M).
  - 3. Grade: Pourable (P) or nonsag (NS).
  - 4. Class: 25.
  - 5. Uses Related to Exposure: Traffic (T).
- C. Acid-Curing Silicone Joint Sealant: ASTM C 920.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the same manufacturer as above.
  - 2. Type: Single component (S).
  - 3. Grade: nonsag (NS).
  - 4. Class: 25.
  - 5. Uses Related to Exposure: Nontraffic (NT).

**2.3 LATEX JOINT SEALANTS**

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Building Systems.
    - b. Bostik, Inc.
    - c. May National Associates, Inc.
    - d. Pecora Corporation.
    - e. Tremco Incorporated.



**2.4 JOINT-SEALANT BACKING**

- A. 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.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

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

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove laitance and form-release agents from concrete.
  - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

**3.2 INSTALLATION OF JOINT SEALANTS**

- A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

## SECTION 07 92 00 - JOINT SEALANTS

1. Place sealants so they directly contact and fully wet joint substrates.
  2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

### 3.3 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.

### 3.4 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.5 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
    - a. Construction joints in cast-in-place concrete.
    - b. Joints between plant-precast architectural concrete units.
    - c. Control and expansion joints in unit masonry.
    - d. Joints in exterior insulation and finish systems.
    - e. Joints between metal panels.
    - f. Joints between different materials listed above.
    - g. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
    - h. Control and expansion joints in ceilings and other overhead surfaces.
    - i. Other joints as indicated.
  2. Joint Sealant: Silicone.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints of exterior openings where indicated.
    - c. Tile control and expansion joints.
    - d. Vertical joints on exposed surfaces of walls and partitions.
    - e. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
    - f. Other joints as indicated.
  2. Joint Sealant: Latex.

## **SECTION 07 92 00 - JOINT SEALANTS**

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3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
  1. Joint Sealant Location:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Tile control and expansion joints where indicated.
    - c. Other joints as indicated.
  2. Joint Sealant: Silicone.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

**END OF SECTION 07 92 00**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Preformed, foam joint seals for roof, walls and ceilings.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. The Contractor is responsible to coordinate and schedule all trades and ensure that all subcontractors understand their responsibilities in relation to expansion joints and that their work cannot impede anticipated structural movement at the expansion joints, or compromise the achievement of watertightness or life safety at expansion joints in any way.

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Preformed, foam joint seals.
- B. Shop Drawings: For all expansion joints.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Include details of splices, block-out requirement, attachments to other work, intersections, transitions, fittings, method of field assembly, and location and size of each field splice.
  - 3. Provide isometric drawings of intersections, terminations, changes in joint direction or planes, and transition to other expansion joint systems depicting how components interconnect with each other and adjacent construction to allow movement and achieve waterproof continuity.
- C. Expansion Joint Schedule: Prepared by or under the supervision of the supplier. Include the following information in tabular form:
  - 1. Manufacturer and model number for each expansion joint cover assembly.
  - 2. Expansion joint cover assembly location cross-referenced to Drawings.
  - 3. Nominal, minimum, and maximum joint width.
  - 4. Movement direction.
  - 5. Materials, colors, and finishes.
- D. Samples for Initial Selection: Color sheets, showing specified colors for each type of exposed preformed joint seal.
- E. Samples for Verification: Actual samples of each type and color of exposed preformed joint seal.
  - 1. Size: 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint seals.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Test and Evaluation Reports:

1. Product Test Reports: For each preformed joint seal, for tests performed by qualified testing agency.

B. Sample warranties.

**1.5 WARRANTY**

A. Special Installer's Warranty: Installer agrees to repair or replace preformed joint seals that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish preformed joint seals to repair or replace those that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 SOURCE LIMITATIONS**

A. For preformed joint seals, obtain joint seal from single source with resources to provide products of consistent quality in appearance and physical properties.

**2.2 EXPANSION JOINTS**

A. Roof Expansion Joints (REJ-1A): Roof Joint (Roof to Roof & Roof to Wall):

1. Basis-of-Design for roof expansion joint: Subject to compliance with requirements, provide EMSEAL Joint Systems, Ltd., RoofJoint or a comparable product by one of the following:

- a. MM Systems Corporation.
- b. Nystrom, Inc.
- c. Watson Bowman Acme Corp.

2. Joint Seal Color: Reflective White to match adjacent flat roof.

B. Roof-to-wall expansion joint (REJ-1B): Roof Joint (Roof to Roof & Roof to Wall).

1. Basis-of-Design for roof expansion joint: Subject to compliance with requirements, provide EMSEAL Joint Systems, Ltd., RoofJoint or a comparable product by one of the following:

- a. MM Systems Corporation.
- b. Nystrom, Inc.
- c. Watson Bowman Acme Corp.

2. Joint Seal Color: Reflective Black/Gray to match adjacent sloped roof.

C. Wall Expansion Joint (WEJ-1A): Wall Joint (Ext. Wall to Ext. Wall & Int. Wall to Int. Wall); subject to compliance with requirements, provide EMSEAL Joint Systems, Ltd; Seismic Colorseal or a comparable product by one of the following:

- a. MM Systems Corporation.
- b. Nystrom, Inc.
- c. Watson Bowman Acme Corp.

2. Design Criteria:

a. Nominal Joint Width: As indicated on Drawings.

3. Joint Seal Color: Limestone/Natural Stone to match adjacent brick.

- D. Wall Expansion Joint (WEJ-1B): Wall Joint (Ext. Wall to Ext. Wall & Int. Wall to Int. Wall); subject to compliance with requirements, provide EMSEAL Joint Systems, Ltd; Seismic Colorseal or a comparable product by one of the following:
  - a. MM Systems Corporation.
  - b. Nystrom, Inc.
  - c. Watson Bowman Acme Corp.
- 2. Design Criteria:
  - a. Nominal Joint Width: As indicated on Drawings.
- 3. Joint Seal Color: White to match adjacent metal panels and/or interior walls.
  
- E. Wall Expansion Joint (WEJ-2) Wall Joint (Int. Wall to Int. Wall): For the interior walls; subject to compliance with requirements, provide EMSEAL Joint Systems, Ltd; Migutec FN 50/20 or a comparable product by one of the following:
  - a. MM Systems Corporation.
  - b. Nystrom, Inc.
  - c. Watson Bowman Acme Corp.
- 2. Design Criteria:
  - a. Nominal Joint Width: As indicated on Drawings.
- 3. Joint Seal Color: Light grey or white to match walls.
  
- F. Ceiling Expansion Joint (CEJ-1): For Ceiling Joint (Ceiling to Ceiling): Subject to compliance with requirements, provide EMSEAL Joint Systems, Ltd., Migutec FN 50/20 or a comparable product by one of the following:
  - a. MM Systems Corporation.
  - b. Nystrom, Inc.
  - c. Watson Bowman Acme Corp.
- 2. Design Criteria:
  - a. Nominal Joint Width: As indicated on Drawings.
- 3. Joint Seal Color: -Light grey or white to match walls and soffit.

**2.3 MISCELLANEOUS MATERIALS**

- A. Primer: Material recommended by preformed joint seal manufacturer for joint substrates indicated.
  
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to preformed joint seal manufacturer, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces, and formulated to promote best adhesion to joint substrates.
  
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with preformed joint seals and surfaces adjacent to joints.
  
- D. Sealant for Adhering Extruded-Silicone Joint Seals: Silicone adhesive sealant recommended by extruded-silicone joint seal manufacturer.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine joints indicated to receive preformed joint seals, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting preformed joint seal performance.
- 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 preformed joint seals to comply with preformed joint seal manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of preformed joint seal, including dust, paints (except for permanent protective coatings tested and approved for seal adhesion and compatibility by seal manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimal bond with preformed joint seals. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.
  - 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 seals.
- B. Joint Priming: Prime joint substrates where recommended by preformed joint seal manufacturer or as indicated by tests or prior experience. Apply primer to comply with joint seal manufacturer's written instructions. Confine primers to areas of joint seal bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of adhesive or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove smears. Remove tape immediately after tooling without disturbing joint seal.

**3.3 INSTALLATION OF JOINT SEALS**

- A. Install all expansion joint products as per manufacturer's written instructions.
- B. General: Comply with preformed joint seal manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
  - 1. Install each length of seal immediately after removing protective wrapping.
  - 2. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.
  - 3. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.
  - 4. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.



## **SECTION 07 95 00 - EXPANSION CONTROL**

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- C. Transitions to Other Expansion-Control Joint Assemblies: Coordinate installation of roof expansion joints with exterior wall expansion-control joint assemblies to result in watertight performance. Install factory-fabricated units at transitions between roof expansion joints and exterior expansion-control joint systems.
- D. Splices: Splice roof expansion joints to provide continuous, uninterrupted, and waterproof joints.

### **3.4 PROTECTION**

- A. Protect preformed joint seals from damage resulting from construction operations or other causes so seals are without deterioration or damage at time of Substantial Completion.
- B. Cut out, remove, and repair damaged or deteriorated seals so repaired areas are indistinguishable from original work.

**END OF SECTION 07 91 00**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes hollow-metal work.
- B. Coordinate all openings with Low-voltage and Security Consultant.

**1.2 COORDINATION**

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, core descriptions, and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door type.
  - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of anchorages, joints, field splices, and connections.
  - 7. Details of accessories.
  - 8. Details of moldings, removable stops, and glazing.
  - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Coordination Drawings:
  - 1. Shall be prepared indicating conduit size and routing of the low voltage and security systems:
    - a. Drawings shall be produced in 1/4-inch scale for affected door frames.
    - b. Indicate where sequencing and coordination of installations are of importance to the efficient flow of the work.
- D. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.
  - 1. Coordinate the actual conduit size and routing of the low voltage and security systems with the frame and lock manufacturer.
  - 2. Coordinate with final Door Hardware Schedule.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency.

## **SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES**

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amweld International, LLC.
  - 2. Ceco Door; ASSA ABLOY.
  - 3. Curries Company; ASSA ABLOY.
  - 4. Fleming Door Products Ltd.; Assa Abloy Group Company.
  - 5. Mesker Door Inc.
  - 6. Pioneer Industries.
  - 7. Republic Doors and Frames.
  - 8. Steelcraft; an Allegion brand.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.
- C. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than 0.40 deg Btu/F x h x sq. ft. when tested in accordance with ASTM C1363 or ASTM E1423.

### **2.3 INTERIOR DOORS AND FRAMES**

- A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.

## **SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES**

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:
  - a. Type: As indicated in the Door and Frame Schedule.
  - b. Thickness: 1-3/4 inches.
  - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
  - d. Edge Construction: For interior; Model 1, Full Flush.
  - e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
3. Frames:
  - a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
  - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
  - c. Construction: Full profile welded.
4. Accessible Door Frames: Provide where indicated.
5. Exposed Finish: Prime.

### **2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES**

- A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.
  1. Physical Performance: Level B according to SDI A250.4.
  2. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.042 inch, with minimum A40 coating.
    - d. Edge Construction: Model 2, Seamless.
    - e. Core: Manufacturer's standard polystyrene, polyurethane, or polyisocyanurate core at manufacturer's discretion to meet energy code requirements.
      - 1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
  3. Frames:
    - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
    - b. Construction: Full profile welded.
  4. Exposed Finish: Prime.

### **2.5 BORROWED LITES**

- A. Hollow-metal frames of uncoated steel sheet, minimum thickness of 0.042 inch.
- B. Construction: Full profile welded.

### **2.6 FRAME ANCHORS**

- A. Jamb Anchors:

## **SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES**

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
  2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
  3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
  2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

### **2.7 MATERIALS**

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- H. Glazing: Comply with requirements in Section 08 80 00 "Glazing."
- I. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

### **2.8 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.

## **SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES**

- B. Hollow-Metal Doors:
1. Fire Door Cores: As required to provide fire-protection ratings indicated.
  2. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.
  3. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
  4. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
  5. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
  6. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
  5. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
      - 1) Two anchors per jamb up to 60 inches high.
      - 2) Three anchors per jamb from 60 to 90 inches high.
      - 3) Four anchors per jamb from 90 to 120 inches high.
      - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
    - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Three anchors per jamb up to 60 inches high.
      - 2) Four anchors per jamb from 60 to 90 inches high.
      - 3) Five anchors per jamb from 90 to 96 inches high.
      - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
    - c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
  6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

## **SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES**

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
  2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  4. Provide loose stops and moldings on inside of hollow-metal work.
  5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

### **2.9 STEEL FINISHES**

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

### **2.10 ACCESSORIES**

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

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



## SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

### 3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-rated openings, install frames according to NFPA 80.
    - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - c. Install frames with removable stops located on secure side of opening.
    - d. Install door silencers in frames before grouting.
    - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
  - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
  - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
  - 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
  - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  - 7. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
  - 8. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Accessible Door Frames: Provide at all locations for intrusion and access control.
- D. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
  - 1. Non-Fire-Rated Steel Doors:
    - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
    - c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
    - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.
  - 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

## **SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES**

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- E. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.
  - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

### **3.4 ADJUSTING AND CLEANING**

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
- F. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

**END OF SECTION 08 11 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Solid-core five-ply flush wood veneer-faced doors for transparent factory finish.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Solid-core five-ply flush wood veneer-faced doors and transom panels for transparent finish.
- B. Product Data Submittals: For each product, including the following:
  - 1. Door core materials and construction.
  - 2. Door edge construction.
  - 3. Door face type and characteristics.
- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:
  - 1. Door schedule indicating door location, type, size, and swing.
  - 2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
  - 3. Details of frame for each frame type, including dimensions and profile.
  - 4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
  - 5. Dimensions and locations of blocking for hardware attachment.
  - 6. Dimensions and locations of mortises and holes for hardware.
  - 7. Clearances and undercuts.
  - 8. Requirements for veneer matching.
  - 9. Doors to be factory finished and application requirements.
- D. Samples for Verification:
  - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
  - 2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.

**1.4 CLOSEOUT SUBMITTALS**

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.

## **SECTION 08 14 16 - FLUSH WOOD DOORS**

- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

### **1.5 FIELD CONDITIONS**

- A. Environmental Limitations:
  - 1. Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of construction period.
  - 2. Do not deliver or install doors until building is enclosed and weathertight, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 43 and 70 percent during remainder of construction period.

### **1.6 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Delamination of veneer.
    - b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
    - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
  - 2. Warranty also includes installation and finishing that may be required due to repair or replacement of defective doors.
  - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

## **PART 2 - PRODUCTS**

### **2.1 SOURCE LIMITATIONS**

- A. Obtain flush wood doors from single manufacturer.

### **2.2 FLUSH WOOD DOORS, GENERAL**

- A. Quality Standard: In addition to requirements specified, comply with AWI/AWMAC/WI's "Architectural Woodwork Standards."
  - 1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with the Contract Documents in addition to those of the referenced quality standard.

### **2.3 SOLID-CORE FIVE-PLY FLUSH WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH**

- A. Interior Doors, Solid-Core Five-Ply Veneer-Faced (PC-5):
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Masonite Architectural; Aspiro Series or a comparable product by one of the following:
    - a. Lambton Doors.
    - b. Oshkosh Door Company.

## SECTION 08 14 16 - FLUSH WOOD DOORS

- c. VT Industries, Inc.
- d. Wilsonart LLC.
2. Performance Grade: ANSI/WDMA I.S. 1A Heavy Duty.
3. Architectural Woodwork Standards Quality Grade: Custom.
4. Faces: Single-ply wood veneer not less than 1/50 inch thick.
  - a. Species: White Birch.
  - b. Cut: Plain sliced (flat sliced).
  - c. Match between Veneer Leaves: Slip match.
  - d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
  - e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
  - f. Room Match:
    - 1) Match door faces within each separate room or area of building.
    - 2) Corridor-door faces do not need to match where they are separated by 10 feet or more.
5. Exposed Vertical and Top Edges: Same species as faces or a compatible species - Architectural Woodwork Standards edge Type A.
6. Core for Non-Fire-Rated Doors:
  - a. ANSI A208.1, Grade LD-2 particleboard.
    - 1) Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
    - 2) Provide doors with glued-wood-stave or WDMA I.S. 10 structural-composite-lumber cores instead of particleboard cores for doors scheduled to receive exit devices.
  - b. Glued wood stave.
  - c. WDMA I.S. 10 structural composite lumber.
7. Construction: Five plies, hot-pressed bonded (vertical and horizontal edging is bonded to core), with entire unit abrasive planed before veneering.

### 2.4 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated.
  1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
  2. Comply with NFPA 80 requirements for doors.
- B. Factory machine doors for hardware that is not surface applied.
  1. Locate hardware to comply with DHI-WDHS-3.
  2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
  3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
  4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.
- C. Openings: Factory cut and trim openings through doors.
  1. Light Openings: Trim openings with moldings of material and profile indicated.
  2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 "Glazing."

### 2.5 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.

## SECTION 08 14 16 - FLUSH WOOD DOORS

1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  2. Finish faces, all four edges, edges of cutouts, and mortises.
  3. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
1. Architectural Woodwork Standards Grade: Custom.
    - a. System-5, Varnish, Conversion.
  2. Staining: Coco Bean.
  3. Sheen: Satin.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Hardware: For installation, see Section 08 71 00 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Install frames level, plumb, true, and straight.
1. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
  2. Anchor frames to anchors or blocking built in or directly attached to substrates.
    - a. Secure with countersunk, concealed fasteners and blind nailing.
    - b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
      - 1) For factory-finished items, use filler matching finish of items being installed.
  3. Install doors and frames in accordance with NFPA 80.
- D. Job-Fitted Doors:
1. Align and fit doors in frames with uniform clearances and bevels as indicated below.
    - a. Do not trim stiles and rails in excess of limits set by manufacturer.
  2. Machine doors for hardware.
  3. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  4. Clearances:
    - a. Provide 1/8 inch at heads, jambs, and between pairs of doors.
    - b. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated on Drawings.

## **SECTION 08 14 16 - FLUSH WOOD DOORS**

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- c. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
- 5. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
- E. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- F. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

### **3.3 ADJUSTING**

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

**END OF SECTION 08 14 16**

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## **SECTION 08 31 13 - ACCESS DOORS AND FRAMES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes access doors and frames for walls and ceilings.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For each type of access door and frame and for each finish specified.

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Rated Access Doors and Frames: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, according to NFPA 252 or UL 10B.

#### **2.2 ACCESS DOORS AND FRAMES**

- A. Flush Access Doors with Exposed Flanges:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - b. Karp Associates, Inc.
    - c. Larsens Manufacturing Company.
    - d. Milcor; Commercial Products Group of Hart & Cooley, Inc.
  - 2. Description: Face of door flush with frame, with exposed flange and concealed hinge.
  - 3. Locations: Wall and ceiling.
  - 4. Uncoated Steel Sheet for Door and Frame: Nominal 0.060 inch, 16 gage, factory primed.
  - 5. Latch and Lock: Cam latch, screwdriver operated.

#### **2.3 FIRE-RATED ACCESS DOORS AND FRAMES**

- A. Fire-Rated, Flush Access Doors with Exposed Flanges:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. JL Industries, Inc.; a division of the Activar Construction Products Group.
    - b. Karp Associates, Inc.
    - c. Larsens Manufacturing Company.
    - d. Milcor; Commercial Products Group of Hart & Cooley, Inc.
  - 2. Description: Door face flush with frame, with a core of mineral-fiber insulation enclosed in sheet metal; with exposed flange, self-closing door, and concealed hinge.
  - 3. Locations: Wall and ceiling.
  - 4. Fire-Resistance Rating: Not less than that indicated that of adjacent construction.

## **SECTION 08 31 13 - ACCESS DOORS AND FRAMES**

5. Uncoated Steel Sheet for Door: Nominal 0.036 inch, 20 gage, factory primed.
6. Frame Material: Same material, thickness, and finish as door.
7. Latch and Lock: Self-latching door hardware, operated by key with interior release.

### **2.4 MATERIALS**

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- C. Frame Anchors: Same material as door face.
- D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

### **2.5 FABRICATION**

- A. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- B. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish mounting holes, attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- C. Latch and Lock Hardware:
  1. Quantity: Furnish number of latches and locks required to hold doors tightly closed.
  2. Keys: Furnish two keys per lock and key all locks alike.

### **2.6 FINISHES**

- A. Painted Finishes: Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
  1. Factory Primed: Apply manufacturer's standard, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Adjust doors and hardware, after installation, for proper operation.

## **END OF SECTION 08 31 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Counter door assemblies.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type and size of coiling counter door and accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
- C. Samples: For each exposed product and for each color and texture specified.

**1.3 CLOSEOUT SUBMITTALS**

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

**1.4 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Source Limitations: Obtain overhead coiling doors, overhead sectional doors and coiling counter doors from single source from single manufacturer.

**2.2 COUNTER DOOR ASSEMBLY (DOOR 120W)**

- A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.

## **SECTION 08 33 13 - COILING COUNTER DOORS**

1. Basis-of-Design Product: Subject to compliance with requirements, provide Overhead Door Corporation; Series 650 or a comparable product by one of the following:
  - a. ACME Rolling Doors.
  - b. ASTA America; Janus International Group.
  - c. Alpine Overhead Doors, Inc.
  - d. Alumatec Pacific Products.
  - e. Amarr; an ASSA ABLOY Group company.
  - f. C.H.I. Overhead Doors, Inc.
  - g. City Gates USA.
  - h. Clopay Building Products.
  - i. Cookson; a CornellCookson company.
  - j. Cornell; a CornellCookson company.
  - k. Lawrence Roll-Up Doors, Inc.
  - l. McKeon Door Company.
  - m. Metro Door LLC.
  - n. Wayne Dalton; a division of Overhead Door Corporation.
  - o. Woodfold Manufacturing, Inc.
  
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000.
  
- C. Door Curtain Material: Galvanized steel.
  
- D. Door Curtain Slats: Interlocking flat profile slats.
  
- E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated hot-dip galvanized steel or and finished to match door.
  
- F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
  
- G. Hood: Match curtain material and finish.
  1. Mounting: As indicated on Drawings.
  
- H. Sill Configuration: No sill.
  
- I. Locking Devices: Equip door with slide bolt for padlock and chain lock keeper.
  
- J. Manual Door Operators:
  1. General: Equip door with manual door operator by door manufacturer.
  2. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.
  
- K. Door Finish:
  1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
  2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

### **2.3 DOOR CURTAIN MATERIALS AND FABRICATION**

- A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness

## SECTION 08 33 13 - COILING COUNTER DOORS

and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

### 2.4 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that project beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.

### 2.5 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

### 2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **SECTION 08 33 13 - COILING COUNTER DOORS**

### **2.7 STEEL AND GALVANIZED-STEEL FINISHES**

- A. Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.
  - 1. Color to be selected from manufacturer's standard colors.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrate areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION, GENERAL**

- A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

#### **3.3 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

#### **3.4 ADJUSTING**

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.

#### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

**END OF SECTION 08 33 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Insulated overhead coiling service doors.
  - 2. Un-insulated overhead coiling service doors.
  - 3. Both manual and electric operators.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type and size of overhead coiling door and accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
  - 5. Include diagrams for power, signal, and control wiring.
- C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.
  - 1. Include similar Samples of accessories involving color selection.
- D. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:
  - 1. Curtain slats.
  - 2. Bottom bar with sensor edge.
  - 3. Guides.
  - 4. Brackets.
  - 5. Hood.
  - 6. Locking device(s).
  - 7. Include similar Samples of accessories involving color selection.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Sample Warranty: For special warranty.

**1.4 CLOSEOUT SUBMITTALS**

- A. Special warranty.
- B. Maintenance Data: For overhead coiling doors to include in maintenance manuals.
- C. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
  - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

**1.6 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of doors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Source Limitations: Obtain overhead coiling doors, overhead sectional doors and coiling counter doors from single source from single manufacturer.
  - 1. Obtain operators and controls from overhead coiling-door manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.
- B. Structural Performance, Exterior Doors: Capable of withstanding the following design wind loads:
  - 1. Design Wind Load: As indicated on Drawings.
  - 2. Testing: According to ASTM E330/E330M or DASMA 108 for garage doors and complying with acceptance criteria of DASMA 108.
  - 3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
  - 4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.
- C. Windborne-Debris Impact Resistance: Provide impact-protective overhead coiling doors that pass ASTM E1886 missile-impact and cyclic-pressure tests according to ASTM E1996 for Wind Zone 1 or DASMA 115 for basic protection.
  - 1. Large-Missile Test: For overhead coiling doors located within 30 ft. of grade.



**2.3 INSULATED DOOR ASSEMBLY (DOOR 120Z)**

- A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Overhead Door Corporation; Series 625 or a comparable product by one of the following:
    - a. ACME Rolling Doors.
    - b. ASTA America; Janus International Group.
    - c. Advanced Door Technologies.
    - d. Alpine Overhead Doors, Inc.
    - e. Alumatec Pacific Products.
    - f. Amarr; an ASSA ABLOY Group company.
    - g. C.H.I. Overhead Doors, Inc.
    - h. City Gates USA.
    - i. Clopay Building Products.
    - j. Cookson; a CornellCookson company.
    - k. Cornell; a CornellCookson company.
    - l. Dynamic Closures Corporation.
    - m. Hormann High Performance Doors.
    - n. Lawrence Roll-Up Doors, Inc.
    - o. McKeon Door Company.
    - p. Metro Door LLC.
    - q. Raynor Garage Doors.
    - r. Southwestern Rolling Steel Door Co.
    - s. Wayne Dalton; a division of Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
  - 1. Include tamperproof cycle counter.
- C. Air Infiltration: Maximum rate of 0.4 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E283 or DASMA 105.
- D. Insulated Door Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.
- E. Insulated Door Assembly U-Factor: 0.90 Btu/deg F x h x sq. ft.
- F. Door Curtain Material: Galvanized steel.
- G. Door Curtain Slats: Flat profile slats.
  - 1. Insulated-Slat Interior Facing: Metal.
  - 2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.
- H. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.
- I. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- J. Hood: Match curtain material and finish.
  - 1. Shape: As indicated.
  - 2. Mounting: As indicated on Drawings.
- K. Electric Door Operator:
  - 1. Commercial Rolling Door and Grille Operator: Model RSX Commercial Standard Duty Door Operator.

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2. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
  3. Operator Location: As indicated on Drawings.
  4. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
  5. Motor Exposure: Interior.
  6. Motor Electrical Characteristics:
    - a. Horsepower: As indicated.
    - b. Voltage: As indicated.
  7. Emergency Manual Operation: Chain type.
  8. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar or pneumatic sensor edge on bottom bar.
    - a. Sensor Edge Bulb Color: Black.
  9. Control Station(s): Interior mounted.
- L. Door Finish:
1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
  2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

### 2.4 UN-INSULATED DOOR ASSEMBLY (DOOR 152Y)

- A. Service Door: Overhead coiling door formed with curtain of interlocking metal slats.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Overhead Door Corporation; Series 620 or a comparable product by one of the following:
    - a. ACME Rolling Doors.
    - b. ASTA America; Janus International Group.
    - c. Advanced Door Technologies.
    - d. Alpine Overhead Doors, Inc.
    - e. Alumatec Pacific Products.
    - f. Amarr; an ASSA ABLOY Group company.
    - g. C.H.I. Overhead Doors, Inc.
    - h. City Gates USA.
    - i. Clopay Building Products.
    - j. Cookson; a CornellCookson company.
    - k. Cornell; a CornellCookson company.
    - l. Dynamic Closures Corporation.
    - m. Hormann High Performance Doors.
    - n. Lawrence Roll-Up Doors, Inc.
    - o. McKeon Door Company.
    - p. Metro Door LLC.
    - q. Raynor Garage Doors.
    - r. Southwestern Rolling Steel Door Co.
    - s. Wayne Dalton; a division of Overhead Door Corporation.
- B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
1. Include tamperproof cycle counter.
- C. Door Curtain Material: Galvanized steel.
- D. Door Curtain Slats: Flat profile slats.

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- E. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.
- F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.
- G. Hood: Match curtain material and finish.
  - 1. Shape: As indicated.
  - 2. Mounting: As indicated on Drawings.
- H. Locking Devices: Equip door with slide bolt for padlock and chain lock keeper.
- I. Manual Door Operators:
  - 1. General: Equip door with manual door operator by door manufacturer.
  - 2. Chain-Hoist Operator: Consisting of endless steel hand chain, chain-pocket wheel and guard, and gear-reduction unit with a maximum 25-lbf force for door operation. Provide alloy-steel hand chain with chain holder secured to operator guide.
- J. Door Finish:
  - 1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
  - 2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

### 2.5 MATERIALS, GENERAL

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.6 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
  - 1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural-steel sheet; complying with ASTM A653/A653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
  - 2. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E84 or UL 723. Enclose insulation completely within slat faces.
  - 3. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.
- B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

**2.7 HOODS**

- A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that project beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.
  - 1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized-steel sheet with G90 zinc coating, complying with ASTM A653/A653M.

**2.8 LOCKING DEVICES**

- A. Slide Bolt: For manual operators, fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.
- B. Chain Lock Keeper: Suitable for padlock.
- C. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

**2.9 CURTAIN ACCESSORIES**

- A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.
  - 1. At door head, use 1/8-inch-thick, replaceable, continuous-sheet baffle secured to inside of hood or field-installed on the header.
  - 2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch-thick seals of flexible vinyl, rubber, or neoprene.

**2.10 COUNTERBALANCE MECHANISM**

- A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.
- C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.
- D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

## SECTION 08 33 23 - OVERHEAD COILING DOORS

### 2.11 ELECTRIC DOOR OPERATORS

- A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
  - 1. Commercial Rolling Door and Grille Operator: Model RSX Commercial Standard Duty Door Operator.
  - 2. Comply with NFPA 70.
  - 3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.
- B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.
- C. Door Operator Location(s): Operator location indicated for each door.
  - 1. Manufacturer's standard.
- D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.
  - 1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
    - a. Motor Size: ½ hp with field selectable voltage.
    - b. Electrical Characteristics:
      - 1) Phase: 3 phase.
      - 2) Volts: As indicated.
  - 2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
  - 3. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
- E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
- F. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.
  - 1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
  - 2. Pneumatic Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device.
- G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."
  - 1. Interior-Mounted Units: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
- H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

## **SECTION 08 33 23 - OVERHEAD COILING DOORS**

- I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

### **2.12 GENERAL FINISH REQUIREMENTS**

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

### **2.13 STEEL AND GALVANIZED-STEEL FINISHES**

- A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Examine locations of electrical connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION, GENERAL**

- A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.
- B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.
- C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with the accessibility standard.
- D. Power-Operated Doors: Install according to UL 325.

## **SECTION 08 33 23 - OVERHEAD COILING DOORS**

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### **3.3 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. After electrical circuitry has been energized, operate doors to confirm proper motor rotation and door performance.
  - 3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

### **3.4 ADJUSTING**

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
  - 1. Adjust exterior doors and components to be weather resistant.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust seals to provide tight fit around entire perimeter.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

**END OF SECTION 08 33 23**

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**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Sectional-door assemblies.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type and size of sectional door and accessory.
  - 1. Include construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
  - 2. For power-operated doors, include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
- B. Shop Drawings: For each installation and for components not dimensioned or detailed in manufacturer's product data.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Include details of equipment assemblies. Indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
  - 3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
  - 4. Include diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.
- D. Samples for Initial Selection: For units with factory-applied finishes.
  - 1. Include Samples of accessories involving color selection.
- E. Samples for Verification: For each type of exposed finish and for each color and texture required on the following components, in manufacturer's standard sizes:
  - 1. Glazing.
  - 2. Metal for door sections.
  - 3. Hardware.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Sample Warranties: For manufacturer's warranty and finish warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For sectional doors to include in maintenance manuals.
- B. Manufacturer's warranty.
- C. Finish warranty.

**1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.
  - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.
- B. Regulatory Requirements: Comply with provisions in the U.S. Department of Justice's "2010 ADA Standards for Accessible Design" and ICC A117.1 applicable to sectional doors.

**1.7 WARRANTY**

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Failure of components or operators before reaching required number of operation cycles.
    - c. Faulty operation of hardware.
    - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
    - e. Delamination of exterior or interior facing materials.
  - 2. Warranty Period: Two years from date of Substantial Completion.
- B. Finish Warranty: Manufacturer agrees to repair or replace components that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS, GENERAL**

- A. Source Limitations: Obtain overhead coiling doors, overhead sectional doors and coiling counter doors from single source from single manufacturer.
  - 1. Obtain operators and controls from sectional door manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. General Performance: Provide sectional doors that comply with performance requirements specified without failure from defective manufacture, fabrication, installation, or other defects in construction.

- B. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.
  - 1. Design Wind Load: As indicated on Drawings.
  - 2. Testing: In accordance with ASTM E330/E330M or DASMA 108 for garage doors and complying with DASMA 108 acceptance criteria.
  - 3. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components.
    - a. Deflection of door sections in horizontal position (open) shall not exceed 1/120 of door width.
    - b. Deflection of horizontal track assembly shall not exceed 1/240 of door height.
  - 4. Operability under Wind Load: Design sectional doors to remain operable under design wind load, acting inward and outward.

**2.3 SECTIONAL-DOOR ASSEMBLY**

- A. Steel Sectional Door: Provide sectional door formed with hinged sections and fabricated so that finished door assembly is rigid and aligned with tight hairline joints; free of warp, twist, and deformation; and complies with requirements in DASMA 102.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Overhead Door Corporation; Thermacore Model 596 or a comparable product by one of the following:
    - a. Amarr; an ASSA ABLOY Group company.
    - b. Arm-R-Lite Manufacturing Co., Inc.
    - c. BP - Glass Garage Doors & Entry Systems, Inc.
    - d. C.H.I. Overhead Doors, Inc.
    - e. Clopay Building Products.
    - f. Fimbel Architectural Doors.
    - g. Haas Door; a Nofziger Company.
    - h. Hörmann LLC.
    - i. Martin Door Manufacturing.
    - j. Raynor Garage Doors.
    - k. Rite-Hite Holding Corporation.
    - l. Wayne Dalton; a division of Overhead Door Corporation.
    - m. Windsor Door.
- B. Operation Cycles: Door components and operators capable of operating for not less than 50,000 operation cycles. One operation cycle is complete when door is opened from closed position to the open position and returned to closed position.
- C. Air Infiltration: Maximum rate of 0.8 cfm/sq. ft. at 25mph when tested in accordance with ASTM E283 or DASMA 105.
- D. Thermal Values: R-value of 17.40; U-value of 0.057.
- E. Steel Door Sections: ASTM A653/A653M, zinc-coated (galvanized), cold-rolled, commercial steel sheet with G90 zinc coating.
  - 1. Door-Section Thickness: 2 inches.
  - 2. Section Faces:
    - a. Thermal-Break Construction: Provide sections with continuous thermal-break construction separating the exterior and interior faces of door.
    - b. Exterior Face: Fabricated from single sheets, not more than 24 inches high; with horizontal meeting edges rolled to continuous, interlocking, keyed, rabbeted, shiplap, or tongue-in-groove, weather- and pinch-resistant seals and reinforcing flange return.
      - 1) Steel Sheet Thickness: 0.040-inch nominal coated thickness.
      - 2) Surface: Flush, textured.

## SECTION 08 36 13 - SECTIONAL DOORS

- c. Interior Face: Enclose insulation completely within steel exterior facing and interior facing material, with no exposed insulation. Provide the following interior-facing material:
    - 1) Zinc-Coated (Galvanized) Steel Sheet: With minimum nominal coated thickness of dimension recommended in writing by manufacturer to comply with performance requirements.
  - 3. End Stiles: 16 gauge with thermal break.
  - 4. Section Reinforcing: Horizontal and diagonal reinforcement as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place.
    - a. Bottom Section: Reinforce section with a continuous channel or angle conforming to bottom-section profile.
    - b. Hardware Locations: Provide reinforcement for hardware attachment.
  - 5. Thermal Insulation: CFC-free and HCFC-free polyurethane, fully encapsulated.
- F. Track: Manufacturer's standard, galvanized-steel, standard-lift track system. Provide complete system including brackets, bracing, and reinforcement to ensure rigid support of ball-bearing roller guides.
- 1. Material: Galvanized steel, ASTM A653/A653M, minimum G60 zinc coating.
  - 2. Size: As recommended in writing by manufacturer for door size, weight, track configuration and door clearances indicated on Drawings.
  - 3. Track Reinforcement and Supports: Provide galvanized-steel members to support track without sag, sway, and vibration during opening and closing of doors. Slot vertical sections of track spaced 2 inches apart for door-drop safety device.
    - a. Vertical Track: Incline vertical track to ensure weathertight closure at jambs. Provide continuous angle attached to track and wall.
    - b. Horizontal Track: Provide continuous reinforcing angle from curve in track to end of track, attached to track and supported at points by laterally braced attachments to overhead structural members.
- G. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom top and jambs of door. Provide combination bottom weatherseal and sensor edge for bottom seal.
- H. Windows: Manufacturer's standard window units of shape and size and in locations indicated on Drawings. Set glazing in vinyl, rubber, or neoprene glazing channel. Provide removable stops of same material as door-section frames. Provide the following glazing:
- 1. Insulating Glass Units: Manufacturers' standard unit with tempered glass lites complying with ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (clear), Quality-Q3.
- I. Hardware: Heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless steel, or other corrosion-resistant fasteners, to suit door type.
- 1. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch nominal coated thickness at each end stile and at each intermediate stile, in accordance with manufacturer's written recommendations for door size.
    - a. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is impossible.
    - b. Provide double-end hinges where required for doors more than 16 ft. wide unless otherwise recommended by door manufacturer in writing.
  - 2. Rollers: Heavy-duty rollers with steel ball bearings in case-hardened steel races, mounted to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Match roller-tire diameter to track width.
    - a. Roller-Tire Material: Manufacturer's standard.

## SECTION 08 36 13 - SECTIONAL DOORS

3. Push/Pull Handles: Equip each door with galvanized-steel lifting handles on each side of door, finished to match door.
- J. Locking Device:
1. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.
- K. Counterbalance Mechanism:
1. Torsion Spring: Adjustable-tension torsion springs complying with requirements of DASMA 102 for number of operation cycles indicated, mounted on torsion shaft.
  2. Cable Drums and Shaft for Doors: Cast-aluminum cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised.
    - a. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft.
    - b. Provide one additional midpoint bracket for shafts up to 16 ft. long and two additional brackets at one-third points to support shafts more than 16 ft. long unless closer spacing is recommended in writing by door manufacturer.
  3. Cables: Galvanized-steel, multistrand, lifting cables with cable safety factor of at least 5 to 1.
  4. Cable Safety Device: Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if lifting cable breaks.
  5. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.
  6. Bumper: Provide spring bumper at each horizontal track to cushion door at end of opening operation.
- L. Electric Door Operator: Electric door operator assembly of size and capacity recommended by door manufacturer for door and operation cycles specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
1. Commercial Rolling Door and Grille Operator: Model RSX Commercial Standard Duty Door Operator.
  2. Comply with NFPA 70.
  3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24 V ac or dc.
  4. Safety: Listed in accordance with UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 ft. or lower.
  5. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
  6. Operator Type: Manufacturer's standard for door requirements.
  7. Motor: Reversible-type with controller (disconnect switch) for interior, clean, and dry motor exposure. Use adjustable motor-mounting bases for belt-driven operators.
    - a. Motor Size: ½ hp with field selectable voltage.
    - b. Electrical Characteristics:
      - 1) Phase: 3 phase.
      - 2) Volts: As indicated.
  8. Limit Switches: Equip motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.
  9. Obstruction Detection: Automatic external entrapment protection consisting of automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
    - a. Unmonitored Entrapment Protection: Pneumatic sensor edge, black, located within weatherseal mounted to bottom bar.

10. Control Station: Surface mounted, three-position (open, close, and stop) control.
    - a. Operation: Push button.
    - b. Interior-Mounted Unit: Full-guarded, surface-mounted, standard-duty, weatherproof-type, NEMA ICS 6, Type 4 enclosure.
  11. Emergency Manual Operation: Push pull handles designed so required force for door operation does not exceed 25 lbf.
  12. Emergency Operation Disconnect Device: Hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
  13. Motor Removal: Design operator so motor can be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.
- M. Metal Finish: Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.
1. Finish: Pre-finished roll coated steel.
    - a. Color and Gloss: Dark grey.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

- A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; in accordance with manufacturer's written instructions.
- B. Tracks:
  1. Fasten vertical track assembly to opening jambs and framing with fasteners spaced not more than 24 inches apart.
  2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
- C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.
- D. Power-Operated Doors: Install automatic garage doors openers in accordance with UL 325.

#### **3.3 STARTUP SERVICES**

- A. Engage a factory-authorized service representative to perform startup service.

## **SECTION 08 36 13 - SECTIONAL DOORS**

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1. Complete installation and startup checks in accordance with manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

### **3.4 ADJUSTING**

- A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.
- B. Lubricate bearings and sliding parts as recommended by manufacturer.
- C. Adjust doors and seals to provide weather-resistant fit around entire perimeter.
- D. Touchup Painting Galvanized Material: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A780/A780M.

### **3.5 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain sectional doors.

**END OF SECTION 08 36 13**

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# **SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Aluminum storefront framing.
  - 2. Aluminum-framed entrance door systems.
- B. Coordinate all openings with Low-voltage and Security Consultant.

### **1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
- B. Coordinate all openings with security

### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
  - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  - 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing.
    - e. Flashing and drainage.
  - 3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
  - 4. Include point-to-point wiring diagrams showing the following:
    - a. Power requirements for each electrically operated door hardware.
    - b. Location and types of switches, signal device, conduit sizes, and number and size of wires.
- C. Samples: For each exposed finish required.
- D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

### **1.4 INFORMATIONAL SUBMITTALS**

- A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

## **SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

- B. Product test reports.
- C. Field quality-control reports.
- D. Sample warranties.

### **1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

### **1.6 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

### **1.7 WARRANTY**

- A. Special Assembly Warranty: Installer agrees to repair or replace components of glazed aluminum curtain wall that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

### **2.2 PERFORMANCE REQUIREMENTS – EXTERIOR SYSTEMS**

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

## **SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.
- B. Structural Loads:
1. Wind Loads: As indicated on Drawings.
  2. Other Design Loads: As indicated on Drawings.
- C. Deflection of Framing Members: At design wind pressure, as follows:
1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
  2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.
    - a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.
- D. Structural: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
  2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
  3. Test Durations: As required by design wind velocity, but not less than 10 seconds.
- E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Fixed Framing and Glass Area:
    - a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.2PSF.
- F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. The test specimen shall be tested in accordance with ASTM E 331.
  2. There shall be no leakage at a minimum static air pressure differential of 8psf as defined in AAMA 501.
  3. There shall be no leakage at a minimum static air pressure differential of 8psf as defined in AAMA 501 with option Air Air/Vapor Barrier Tie-in.
  4. There shall be no leakage at a minimum static air pressure differential of 10psf as defined in AAMA 501 with optional sill flashing.
- G. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.47 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
  2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.35 as determined according to NFRC 200.
- H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## **SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

### **2.3 SOURCE LIMITATIONS**

- A. Obtain all components of storefront system, including framing sun control and accessories, from single manufacturer.

### **2.4 FRAMING SYSTEMS – INTERIOR**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Company, Inc., Tri-fab 451 Storefront system or comparable product by one and only one of the following:
  - 1. EFCO Corporation.
  - 2. Kawneer Company, Inc.; Arconic Corporation.
  - 3. OldCastle Building Envelope (OBE).
  - 4. Tubelite Inc.
  - 5. U.S. Aluminum; C.R. Laurence Co., Inc.; CRH Americas, Inc.
  - 6. YKK.
- B. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  - 1. Construction: Thermally improved.
  - 2. Glazing System: Retained mechanically with gaskets on four sides.
  - 3. Glazing Plane: Center.
  - 4. Size: 2" x 4.5-inches.
- C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  - 2. Reinforce members as required to receive fastener threads.
  - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- E. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
  - 1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### **2.5 ENTRANCE DOOR SYSTEMS – EXTERIOR**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Company, Inc., Aluminum Entrance Type 350 in conjunction with Trifab VersaGlaze 451T for door entrance system with insulated glazing.
- B. Exterior Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
  - 1. Door Construction: 1-3/4-inch overall thickness with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
  - 2. Performance: Thermal.

## **SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

3. Glazing Stops and Gaskets: Manufacturer's standard, snap-on, extruded-aluminum stops and preformed gaskets.
  - a. Provide non-removable glazing stops on outside of door.

### **2.6 ENTRANCE DOOR SYSTEMS – INTERIOR**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer Company, Inc., Type 350 Door entrance system with single glazing.
- B. Interior Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
  1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
  2. Performance: Non-thermal.
  3. Door Design: Match exterior doors.
  4. Glazing Stops and Gaskets: Manufacturer's standard, snap-on, extruded-aluminum stops and preformed gaskets.
    - a. Provide non-removable glazing stops on outside of door.

### **2.7 ENTRANCE DOOR HARDWARE**

- A. Entrance Door Hardware: As specified.

### **2.8 GLAZING**

- A. Glazing: As indicated.
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.
- C. Glazing Sealants: As recommended by manufacturer.

### **2.9 MATERIALS**

- A. Sheet and Plate: ASTM B 209.
- B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
- C. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
- D. Structural Profiles: ASTM B 308/B 308M.
- E. Steel Reinforcement (As Required for Design):
  1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.
  4. Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and

## **SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

### **2.10 FABRICATION**

- A. Form or extrude aluminum shapes before finishing.
- B. Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Physical and thermal isolation of glazing from framing members.
  - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 5. Provisions for field replacement of glazing from exterior.
  - 6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
- D. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
- E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.
- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

### **2.11 ALUMINUM FINISHES - EXTERIOR**

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

### **2.12 ALUMINUM FINISHES - INTERIOR**

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General:
  - 1. Comply with manufacturer's written instructions.
  - 2. Do not install damaged components.
  - 3. Fit joints to produce hairline joints free of burrs and distortion.
  - 4. Rigidly secure nonmovement joints.
  - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

## **SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
  1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
  2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.
- D. Install components plumb and true in alignment with established lines and grades.
- E. Install glazing.
- F. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
  1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.

**END OF SECTION 084113**

**SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes requirements for translucent panel system as shown and specified herein.

**1.2 WORK INCLUDED**

- A. Design, engineer, manufacture, and installation of translucent panel system.
- B. All anchors, brackets, and hardware attachments necessary to complete the specified structural assembly, weatherability, and water-tightness performance requirements. All flashing up to but not penetrating adjoining work are also required as part of the system and shall be included.
- C. Trained and factory authorized labor and supervision to complete the entire panel installation.

**1.3 QUALITY ASSURANCE**

- A. The glazing panels must be evaluated and listed by recognized building code evaluation organization: International Council Evaluation Service Inc (ICC-ES).
- B. Materials and products shall be manufactured by a company continuously and regularly employed in the manufacturing, engineering, and designing, stocking and building of unitized translucent panels for a period of at least ten (10) years.
- C. Erection shall be by an installer who has been in the business of erecting similar material for at least five (5) consecutive years and can show evidence of satisfactory completion of projects of similar size, scope, and type.
- D. The manufacturer shall be responsible for the configuration and fabrication of the complete panel system, in accordance with the requirements of this specification.

**1.4 SUBMITTALS**

- A. Submit Shop drawings and color samples in accordance with Section 01 33 00.
- B. Manufacturer shall submit written guarantee accompanied by substantiating data, stating that the products to be furnished are in accordance with or exceed these specifications.
- C. Manufacturer shall submit full warranty and sales terms and conditions for verification of compliance with the requirements of this specification.
- D. For glazing assemblies to comply with performance requirements and design criteria, include analysis data signed and sealed by a professional engineer licensed in the state of the project's location.
- E. The manufacturer shall submit certified test reports made by an independent organization.

## SECTION 08 45 13 - TRANSLUCENT PANEL SYSTEM

### 1.5 MAINTENANCE DATA

- A. The manufacturer shall provide recommended maintenance procedures, schedule of maintenance and materials required or recommended for maintenance.
- B. Submit installer certificate signed by installer, certifying compliance with project qualification requirements.

### 1.6 WARRANTY

- A. Provide a single source translucent panel systems manufacturer warranty against defective materials and fabrication. Submit manufacturer's written warranty agreeing to repair failures in materials within one (1) year from date of delivery.
- B. Provide the following single source translucent Panel manufacturer glazing warranties. Third party warranties shall not be acceptable. All warranties shall be maintained without any system maintenance requirements of the owner's responsibility. The expected humidity of the enclosed space shall not affect warranty length.
  - 1. Provide a lifetime warranty for both interior and exterior glazing covering:
    - a. Delamination of the glazing from the internal structure.
    - b. Fiberbloom; development of a rough exterior surface.
    - c. Provide a ten (10) warranty on the interior glazing covering:
      - 1) Change in light transmission of no more than 6% per ASTM D-1003.
      - 2) Color stability: interior glazing shall not change color more than 6 CIE Units DELTA E by ASTM D-2244.
    - d. Provide a ten (10) year warranty on the exterior glazing covering:
      - 1) Change in light transmission of no more than 6% per ASTM D-1003.
      - 2) Color stability: exterior glazing shall not change color more than 6 CIE Units DELTA E by ASTM D-2244.
  - 2. In addition, submit installer's written warranty agreeing to repair installation workmanship, defects and leaks within one year from date of delivery.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE

- A. Reports shall verify that the material will meet all performance requirements of this specification. Previously completed reports will be acceptable if they are indicative of the products used on this project. Test reports required are:
  - 1. Self-Ignition Temperature (ASTM 1929-3).
  - 2. Burning Extent (ASTM D-635).
  - 3. Smoke Density (ASTM E-84).
  - 4. Interior Flame Spread (ASTM E-84).
  - 5. Color Difference (ASTM D-2244).
  - 6. Tests on a weathered glazing after approximately 10 years of actual exposure in Florida field conditions. Test shall include:
    - a. Uniform Static Air Pressure (ASTM E-330).
    - b. Impact Loading (ASTM E-695).
    - c. Cyclic Static Air Pressure and Missile Impact Level D (ASTM 1886 & E-1996).
  - 7. Weather evaluation before and after exposure to 300°F for 25 minutes. Include light transmission and color change (ASTM E-1175 and ASTM D-2244, respectively).
  - 8. Insulation U-Value for Center of Glazing (ASTM C1363).

## **SECTION 08 45 13 - TRANSLUCENT PANEL SYSTEM**

9. Insulation U-Value for System, glazing and aluminum framing (NFRC 100 and 700 Certification).
10. Visible Light Transmission (VT) (ASTM E-972 and NFRC 202).
11. Solar Heat Gain Coefficient (SHGC) based on tests or calculations per methodology and procedure given in the NFRC/Calorimeter Standard.
12. Water Penetration (ASTM E-331).
13. Structural Performance by Uniform Load (ASTM E-330).
14. Cyclic static air pressure and Missile Impact Level D for exterior windows and curtain walls (ASTM 1886 & E-1996).
15. Haze for glare measurement (ASTM D-1003).
16. ICC Evaluation Service Report (ICC-ESR) for compliance with IBC Building Code.
17. OSHA Fall through protection for the skylight scope

### **2.2 MANUFACTURERS**

- A. Brand name manufacturers of materials and products identified are provided to the bidder to convey the general style, type, character and quality of product desired.
  1. Establish an acceptable range for items of equal or equivalent design.
  2. They do not restrict selections to a specific brand, make, manufacturer or specific name.
  3. Equivalent products shall be acceptable.
- B. Manufacturers
  1. UniQuad Translucent Window / Skylight– pre-fabricated, pre-assembled glazing system as manufactured by Kingspan Light + Air | CPI Daylighting or from one of a comparable system.

### **2.3 TRANSLUCENT PANEL PERFORMANCE AND APPEARANCE**

- A. Glazing construction for longevity and resistance to buckling and pressure
  1. Translucent glazing must be constructed of tight cell sizes not exceeding 0.18". Wide cells of size greater than 0.18" shall not be acceptable.
- B. Translucent double panel assemblies
  1. Design, engineer, manufacture, and installation of translucent panel system.
    - a. An assembly of two independent insulated glazing panels in one integrated assembly, incorporated into a complete aluminum frame system that has been tested and warranted by the manufacturer as a single source system.
    - b. Design shall provide for the replacement of the exterior glazing, independently of the interior glazing without exposing the building's interior or compromising the weather tightness of interfering with the normal working functions of the building.
    - c. Single panel glazing systems are not acceptable.
  2. Overall glazing assembly thickness shall be a minimum 2.75", with two glazing panels and concealed interlocking connector.
    - a. Thickness of the exterior and interior glazing shall be minimum 8mm thick each.
- C. Thermal and Solar Performance
  1. To ensure Energy Code compliance, product U-Values must be listed in the NFRC Product Directory and have a Certified Product Directory (CPD) number.
    - a. Basis of Design CPD Number: UQTW
  2. Center of glazing U-Value per NFRC 100: Maximum .23.
  3. System U-Value per NFRC 100 and 700: Maximum .30.
  4. Visible Light Transmission – Center of Glass (VT%) 18% Per ASTM E-972 and NFRC 202.

## SECTION 08 45 13 - TRANSLUCENT PANEL SYSTEM

5. Solar Heat Gain Coefficient -Center of glass (SHGC) 0.28 per NFRC 201.
  6. Haze measurement minimum of 90% per ASTM D-1003.
  7. Standard exterior glazing color: White
  8. Standard interior glazing color: Clear
- D. Translucent Glazing Joint System
1. Water penetration: no water penetration of the glazing joint connection length at test pressure of 6.24 PSF per ASTM E-331.
  2. Air Infiltration: pass requirements of NFRC 400 at 1.57 PSF and 6.24 PSF.
  3. Air Exfiltration: pass requirements of NFRC 400 at 1.57 PSF and 6.24 PSF.
  4. Free movement of the glazing shall be allowed to occur without damage to the weather tightness of the completed system.
  5. The glazing joint shall comply with the deflection limitation of IBC Table 1604.3 for exterior walls with flexible finishes – L/120 per IBC.
- E. Flammability
1. Exterior Glazing
    - a. Class CC1 fire rating classification per ASTM D-635.
    - b. Class A interior flame spread per ASTM E-84
    - c. Flame spread no greater than zero (0) and smoke density no greater than 110 per ASTM E-84.
    - d. Minimum self-ignition temperature of 1120° per ASTM 1929.
  2. Interior Glazing
    - a. Class CC1 fire rating classification per ASTM D-635.
    - b. Class A interior flame spread per ASTM E-84
    - c. Flame spread no greater than zero (0) and smoke density no greater than 110 per ASTM E-84.
    - d. Minimum self-ignition temperature of 1120° per ASTM 1929.
- F. Impact Resistance
1. Minimum Impact loading of 500 ft. lbs. per ASTM E-695.
  2. Must comply with standard specification for performance of exterior glazing or curtain walls when impacted by windborne debris at level D and after cyclic wind loading at the specified design load (ASTM E1996-02).
- G. Weatherability
1. The light transmission shall not decrease more than 6% as measured by ASTM D-1003 over 10 years, or after exposure to temperature of 300° for 25 minutes (thermal aging performance standard).
  2. The weathering performance should be justified by successful testing of the glazing's performance after exposure to actual Florida weather conditions for approximately 10 years in comparison to a new glazing assembly. This performance must be demonstrated by providing independent lab test reports for the exposed and a new panel assembly for the following tests; test results must show that there is no deterioration in performance for the 10 year's exposed panels versus new:
    - a. Uniform static air pressure per ASTM E-330 at negative load of -105 PSF and positive load of 130 PSF.
    - b. Impact loading of 500 ft.lbs. per ASTM E-695.
    - c. Cyclic static air pressure at 65 PSF and impact lever D per ASTM 1886 and ASTM E-1996.
  3. Glazing must be manufactured with a permanent, co-extruded ultra-violet protective layer. Post-applied coatings or films of dissimilar materials that need to be maintained are unacceptable.
  4. Glazing shall not become readily detached when exposed to temperatures of 300°F and 0°F for 25 minutes.

## **SECTION 08 45 13 - TRANSLUCENT PANEL SYSTEM**

5. Thermal aging – the interior and exterior glazing shall not change color in excess of 0.75 Delta E per ASTM D-2244 and shall not darken more than 0.3 units Delta L per ASTM D-2244 and shall allow no cracking or crazing when exposed to 300°F for 25 minutes.
6. Glazing shall be factory sealed to restrict dirt ingress.

### **2.4 METAL FRAME STRUCTURE**

- A. Design criteria shall be per S-1 structural notes page and ASCE-7 requirements
- B. The wall light framing is designed to be self-supporting between the support constructions.
  1. The deflection of the system framing members in a direction normal to the plane of the glazing, when subjected to a uniform load deflection, shall not exceed L/120 for vertical application and L/60 for skylight applications for the unsupported span per IBC Table 1604.3.
  2. All adjacent and support construction must support the transfer of all loads included horizontal and vertical, exerted by the system.
  3. Design or structural engineering services for the supporting structure or building components in not included in the translucent panel scope of this section
- C. Water penetration:
  1. The translucent panel system shall allow no water penetration at a minimum differential static pressure of 6.24 PSF per AAMA 501 pressure difference recommendations and as demonstrated by prior testing of typical framing sample per ASTM E-331.
- D. Water test of metal frame structure shall be conducted according to procedures in AAMA 501.2.

### **2.5 METAL MATERIALS**

- A. Extruded aluminum shall be ANSI/ASTM B-221; 6063-T6 or 6005-T5.
- B. Flashing:
  1. 5005 H34 Aluminum .040" thick.
  2. Sheet metal sill flashings are to be furnished shop formed to profile - when lengths exceed 10ft, provide in nominal 10ft lengths. Field trimming of the flashing and field forming the ends is necessary to suit as-built conditions. Sheet metal ends are to overlap at least 6in to 8in, set in a full bed of sealant and riveted if required.
- C. All fasteners for aluminum framing to be stainless steel or cadmium plated steel, excluding the final fasteners to the building.

### **2.6 FINISH**

- A. Aluminum Finishes:
  1. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

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## SECTION 08 45 13 - TRANSLUCENT PANEL SYSTEM

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. General contractor to verify when structural support is ready to receive all work in the section and to convene a pre-installation conference at least one week prior to commencing work of this section. Attendance required of the general contractor, translucent Panel installer and all parties affecting and effected by the work of this section.
- B. All submitted opening sizes, dimensions and tolerances are to be field verified by the general contractor unless otherwise stipulated.
- C. Installer shall examine area of installation to verify readiness of site conditions. Notify the general contractor about any defects requiring correction. Do not work until conditions are satisfactory.

#### 3.2 INSTALLATION

- A. Install components in strict accordance with manufacturer's instructions an approved shop drawing. Use proper fasteners, caulking and hardware for material attachments as specified.
- B. Use methods of attachment to structure allowing sufficient adjustment to accommodate tolerances.
- C. Remove all protective coverings on panels immediately after installation.

#### 3.3 CLEANING

- A. Follow manufacturer's instructions when washing down exposed panel surfaces using a solution of mild detergent in warm water that is applied with soft, cleaning wiping cloths. Always test a small area before applying to an entire area.
- B. Follow strict panel manufacturer guidelines when removing foreign substances from panel surfaces requiring mineral spirits or any solvents that are acceptable for use. Always test a small sample to validate compliance before applying to the entire glazing surface.
- C. Installer shall leave glazing system clean at completion of installation. Final cleaning is by others upon completion of project, following manufacturer's cleaning instructions.

**END OF SECTION 08 45 13**

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SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 Section "Alternates" for alternates affecting this section.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
  - a. "Metal Doors and Frames"
  - b. "Flush Wood Doors"
  - c. "Interior Aluminum Doors and Frames"
  - d. "Aluminum-Framed Entrances and Storefronts"
6. Division 09 sections for touchup, finishing or refinishing of existing openings modified by this section.
7. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
8. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL, ULC

1. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

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### C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 101 – Life Safety Code

### D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

## 1.03 SUBMITTALS

### A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
  - a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.
  - b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
  - c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

### B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
  - a. Wiring Diagrams: For power, signal, and control wiring and including:
    - 1) Details of interface of electrified door hardware and building safety and security systems.
    - 2) Schematic diagram of systems that interface with electrified door hardware.
    - 3) Point-to-point wiring.
    - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
  - a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
4. Door Hardware Schedule:



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- a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
- b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
- c. Indicate complete designations of each item required for each opening, include:
  - 1) Door Index: door number, heading number, and Architect's hardware set number.
  - 2) Quantity, type, style, function, size, and finish of each hardware item.
  - 3) Name and manufacturer of each item.
  - 4) Fastenings and other pertinent information.
  - 5) Location of each hardware set cross-referenced to indications on Drawings.
  - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
  - 7) Mounting locations for hardware.
  - 8) Door and frame sizes and materials.
  - 9) Degree of door swing and handing.
  - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

### 5. Key Schedule:

- a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
- b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
- c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
- d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
- e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
- f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

### C. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data:
  - a. Include warranties for specified door hardware.

### D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
  - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
  - b. Catalog pages for each product.
  - c. Final approved hardware schedule edited to reflect conditions as installed.

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- d. Final keying schedule
- e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
- f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

### E. Inspection and Testing:

1. Submit written reports to the Owner and Authority Having Jurisdiction (AHJ) of the results of functional testing and inspection for:
  - a. required egress door assemblies, in compliance with NFPA 101.

## 1.04 QUALITY ASSURANCE

### A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
  - a. For door hardware: DHI certified AHC or DHC.
  - b. Can provide installation and technical data to Architect and other related subcontractors.
  - c. Can inspect and verify components are in working order upon completion of installation.
  - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

### B. Certifications:

1. Electrified Door Hardware
  - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
2. Accessibility Requirements:
  - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This

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project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

### C. Pre-Installation Meetings

#### 1. Keying Conference

- a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
  - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
  - 2) Preliminary key system schematic diagram.
  - 3) Requirements for key control system.
  - 4) Requirements for access control.
  - 5) Address for delivery of keys.

#### 2. Pre-installation Conference

- a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
- b. Inspect and discuss preparatory work performed by other trades.
- c. Inspect and discuss electrical roughing-in for electrified door hardware.
- d. Review sequence of operation for each type of electrified door hardware.
- e. Review required testing, inspecting, and certifying procedures.
- f. Review questions or concerns related to proper installation and adjustment of door hardware.

#### 3. Electrified Hardware Coordination Conference:

- a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

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### 1.06 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop 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. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

### 1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
  - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
  - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    - a. Mechanical Warranty
      - 1) Locks
        - a) 3 years
      - 2) Exit Devices
        - a) 3 years
      - 3) Closers
        - a) 30 years
    - b. Electrical Warranty
      - 1) Locks
        - a) 1 year
      - 2) Exit Devices
        - a) 1 year

### 1.08 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected

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to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance in section 01 25 00.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

### 2.02 MATERIALS

#### A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
  2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
  3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.
- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.
1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

#### C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

### 2.03 HINGES

#### A. Manufacturers and Products:

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1. Scheduled Manufacturer and Product:
    - a. Ives 5BB series
  2. Acceptable Manufacturers and Products:
    - a. Hager BB1191/1279 series
    - b. Best FBB series
- B. Requirements:
1. Provide hinges conforming to ANSI/BHMA A156.1.
  2. Provide five knuckle, ball bearing hinges.
  3. Provide hinge weights and sizes as specified in hardware sets.
  4. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
  5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
  6. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
    - a. Steel Hinges: Steel pins
    - b. Non-Ferrous Hinges: Stainless steel pins
    - c. Out-Swinging Exterior Doors: Non-removable pins
    - d. Out-Swinging Interior Lockable Doors: Non-removable pins
    - e. Interior Non-lockable Doors: Non-rising pins
  7. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

### 2.04 CONTINUOUS HINGES

- A. Manufacturers:
1. Scheduled Manufacturer:
    - a. Ives
  2. Acceptable Manufacturers:
    - a. Select
    - b. ABH
- B. Requirements:
1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
  2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
  3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
  4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
  5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.

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6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

### 2.05 ELECTRIC POWER TRANSFER

#### A. Manufacturers:

1. Scheduled Manufacturer and Product:
  - a. Von Duprin EPT-10
2. Acceptable Manufacturers and Products:
  - a. ABH PT1000
  - b. Security Door Controls PTM

#### B. Requirements:

1. Provide power transfer with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
2. Locate electric power transfer per manufacturer's template and UL requirements, unless interference with operation of door or other hardware items.

### 2.06 FLUSH BOLTS

#### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Burns
  - b. DCI

#### B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

### 2.07 COORDINATORS

#### A. Manufacturers:

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1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Burns
  - b. DCI

### B. Requirements:

1. Where pairs of doors are equipped with automatic flush bolts, an astragal, or other hardware that requires synchronized closing of the doors, provide bar-type coordinating device, surface applied to underside of stop at frame head.
2. Provide filler bar of correct length for unit to span entire width of opening, and appropriate brackets for parallel arm door closers, surface vertical rod exit device strikes, or other stop mounted hardware. Factory-prepared coordinators for vertical rod devices as specified.

## 2.08 MORTISE LOCKS

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Schlage L9000 series
2. Acceptable Manufacturers and Products:
  - a. Accurate 9000/9100 series
  - b. Corbin-Russwin ML2000 series

### B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-inch x 1/2 inch with 180-degree visibility. Provide messages color-coded with full text and/or symbols, as scheduled, for easy visibility.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.
5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches. Provide motor based electrified locksets that comply with the following requirements:
  - a. Universal input voltage – single chassis accepts 12 or 24VDC to allow for changes in the field without changing lock chassis.
  - b. Fail Safe/Fail Secure – changing mode between electrically locked (fail safe) and electrically unlocked (fail secure) is field selectable without opening the lock case



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- c. Low maximum current draw – maximum 0.4 amps to allow for multiple locks on a single power supply.
  - d. Low holding current – maximum 0.01 amps to produce minimal heat, eliminate “hot levers” in electrically locked applications, and to provide reliable operation in wood doors that provide minimal ventilation and air flow.
  - e. Connections – provide quick-connect Molex system standard.
8. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
- a. Lever Design: 03A.

### 2.09 EXIT DEVICES

#### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Von Duprin 98/35A series
2. Acceptable Manufacturers and Products:
  - a. Detex Advantex series
  - b. Precision APEX 2000 series

#### B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer’s approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide electrified options as scheduled.
14. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.
15. Special Options:

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- a. SI: Provide dogging indicators for visible indication of dogging status.

### 2.10 POWER SUPPLIES

#### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Schlage/Von Duprin PS900 Series
2. Acceptable Manufacturers and Products:
  - a. Dynalock 5000 series
  - b. Security Door Controls 600 series

#### B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
  - a. 12/24 VDC Output, field selectable.
  - b. Class 2 Rated power limited output.
  - c. Universal 120-240 VAC input.
  - d. Low voltage DC, regulated and filtered.
  - e. Polarized connector for distribution boards.
  - f. Fused primary input.
  - g. AC input and DC output monitoring circuit w/LED indicators.
  - h. Cover mounted AC Input indication.
  - i. Tested and certified to meet UL294.
  - j. NEMA 1 enclosure.
  - k. Hinged cover w/lock down screws.
  - l. High voltage protective cover.

### 2.11 CYLINDERS

#### A. Manufacturers:

1. Scheduled Manufacturer and Product:
  - a. Medeco, to match Owner's standard
2. Acceptable Manufacturers and Products:
  - a. No Substitute

#### B. Requirements:

1. Provide cylinders for locking devices, whether called out in hardware sets or not.

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2. Provide conventional (non-IC) cylinders to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

### 2.12 KEYING

#### A. Scheduled System:

##### 1. Existing factory registered system:

- a. Provide cylinders keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

#### B. Requirements:

##### 1. Construction Keying:

- a. Temporary Construction Cylinder Keying.
  - 1) Provide construction cores that permit voiding construction keys without cylinder removal, furnished in accordance with the following requirements.
    - a) Split Key or Lost Ball Construction Keying System.
    - b) 3 construction control keys, and extractor tools or keys as required to void construction keying.
    - c) 12 construction change (day) keys.
  - 2) Owner or Owner's Representative will void operation of temporary construction keys.

##### 2. Permanent Keying:

- a. Provide permanent cylinders keyed by the manufacturer according to the following key system.
  - 1) Master Keying system as directed by the Owner.
- b. Forward biting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders involved at no additional cost to Owner.
- c. Provide keys with the following features:
  - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
  - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
- d. Identification:
  - 1) Mark permanent cylinders and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
  - 2) Identification stamping provisions must be approved by the Architect and Owner.
  - 3) Stamp cylinders and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
  - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
  - 5) Forward permanent cylinders to Owner, separately from keys, by means as directed by Owner.

- e. Quantity: Furnish in the following quantities.

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- 1) Change (Day) Keys: 3 per cylinder.
- 2) Master Keys: 6.

### 2.13 KEY CONTROL SYSTEM

#### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Telkee
2. Acceptable Manufacturers:
  - a. HPC
  - b. Lund

#### B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
  - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
  - b. Provide hinged-panel type cabinet for wall mounting.

### 2.14 DOOR CLOSERS

#### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. LCN 4040XP series
2. Acceptable Manufacturers and Products:
  - a. Corbin-Russwin DC8000 series
  - b. Sargent 281 series

#### B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.

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6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

### 2.15 DOOR TRIM

#### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives.
2. Acceptable Manufacturers:
  - a. Trimco
  - b. Burns

#### B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

### 2.16 PROTECTION PLATES

#### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Burns
  - b. Trimco

#### B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Provide protection plates with countersunk screw holes.
3. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
4. At fire rated doors, provide protection plates over 16 inches high with UL label.

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### 2.17 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

#### A. Manufacturers:

##### 1. Scheduled Manufacturers:

a. Glynn-Johnson

##### 2. Acceptable Manufacturers:

a. Rixson

b. ABH

#### B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
2. Provide friction type at doors without closer and positive type at doors with closer.

### 2.18 DOOR STOPS AND HOLDERS

#### A. Manufacturers:

##### 1. Scheduled Manufacturer:

a. Ives

##### 2. Acceptable Manufacturers:

a. Trimco

b. Burns

#### B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

### 2.19 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

#### A. Manufacturers:

##### 1. Scheduled Manufacturer:

a. Zero International

##### 2. Acceptable Manufacturers:

a. National Guard

b. Reese

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### B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
3. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

## 2.20 SILENCERS

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Steelcraft
  - b. Republic

### B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

## 2.21 DOOR POSITION SWITCHES

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Schlage
2. Acceptable Manufacturers:
  - a. GE-Interlogix
  - b. Sentrol

### B. Requirements:

1. Provide recessed or surface mounted type door position switches as specified.
2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

## 2.22 LATCH PROTECTORS

### A. Manufacturers:

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1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Burns
  - b. Trimco

B. Provide stainless steel latch protectors of type required to function with specified lock.

### 2.23 COAT HOOKS

- A. Manufacturers:
1. Scheduled Manufacturer:
    - a. Ives
  2. Acceptable Manufacturers:
    - a. Burns
    - b. Trimco

B. Provide coat hooks as specified.

### 2.24 FINISHES

- A. Finish: Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Prior to installation of hardware, 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. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.



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### 3.02 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  - 2. Custom Steel Doors and Frames: HMMA 831.
  - 3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
  - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
  - 1. Conduit, junction boxes and wire pulls.
  - 2. Connections to and from power supplies to electrified hardware.
  - 3. Connections to fire/smoke alarm system and smoke evacuation system.
  - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
  - 5. Connections to panel interface modules, controllers, and gateways.
  - 6. Testing and labeling wires with Architect's opening number.
- J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- L. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- M. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

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- N. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- O. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- P. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- Q. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

### 3.03 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.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

### 3.04 CLEANING AND PROTECTION

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

### 3.05 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

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HARDWARE GROUP NO. 01

Provide each RU door(s) with the following:

QTY	DESCRIPTION NOTE	CATALOG NUMBER HARDWARE BY DOOR SUPPLIER	FINISH	MFR
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HARDWARE GROUP NO. 02

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA PASSAGE SET	L9010 03A	626	SCH
1	EA WALL STOP	WS406/407CVX	630	IVE
3	EA SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 03

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA PASSAGE SET	L9010 03A	626	SCH
1	EA OH STOP	450S	630	GLY
3	EA SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 04

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA OFFICE/ENTRY LOCK	L9050L 03A 09-544	626	SCH
1	EA MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA WALL STOP	WS406/407CVX	630	IVE
3	EA SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 04.1

Provide each SGL door(s) with the following:

QTY	DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA OFFICE/ENTRY LOCK	L9050L 03A 09-544	626	SCH
1	EA MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA WALL STOP	WS406/407CVX	630	IVE
3	EA SILENCER	SR64	GRY	IVE

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HARDWARE GROUP NO. 05

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050L 03A 09-544	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	COAT AND HAT HOOK	507	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 06

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	OFFICE/ENTRY LOCK	L9050L 03A 09-544	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	545A	A	ZER

HARDWARE GROUP NO. 07

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080L 03A	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 08

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	OFFICE/ENTRY LOCK	L9050L 03A 09-544	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
2	EA	WALL STOP	WS406/407CVX	630	IVE
2	EA	SILENCER	SR64	GRY	IVE

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HARDWARE GROUP NO. 09

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	L9040 03A OS-OCC	626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	SINGLE HOOK	507B	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 09.1

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	L9040 03A OS-OCC	626	SCH
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	SINGLE HOOK	507B	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 10

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	OFFICE/ENTRY LOCK	L9050L 03A 09-544	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	SURFACE CLOSER	4040XP CUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	545A	A	ZER

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HARDWARE GROUP NO. 11

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM LOCK	L9080L 03A	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER

HARDWARE GROUP NO. 12

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	DBL CYL STORE W/DB	L9466L 03A	626	SCH
2	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER

HARDWARE GROUP NO. 13

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	CONST LATCHING BOLT	FB51P 24"	630	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	STOREROOM LOCK	L9080L 03A	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	COORDINATOR	COR X FL	US26D	IVE
2	EA	SURFACE CLOSER	4040XP SHCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	MEETING STILE	383AA	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER

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HARDWARE GROUP NO. 13.1

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	STOREROOM LOCK	L9080L 03A	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	COORDINATOR	COR X FL	US26D	IVE
2	EA	SURFACE CLOSER	4040XP SHCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	MEETING STILE	383AA	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER

HARDWARE GROUP NO. 14

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	PANIC HARDWARE	LD-98-EO	626	VON
1	EA	PANIC HARDWARE	LD-98-NL	626	VON
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	RIM CYLINDER	AS REQUIRED	626	MED
2	EA	SURFACE CLOSER	4040XP SHCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER

HARDWARE GROUP NO. 15

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 6" X 16"	630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

Operational Description: Doors normally closed and unlocked. Push/pull operation.

CITY OF CONCORD FLEET SERVICES FACILITY

HARDWARE GROUP NO. 16

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	224XY EPT	628	IVE
2	EA	POWER TRANSFER	EPT10	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	ELEC PANIC HARDWARE	CDSI-RX-LC-35A-EO-299-CON	626	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-35A-NL-OP-388-299-CON 24 VDC	626	VON
2	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	RIM CYLINDER	AS REQUIRED	626	MED
2	EA	90 DEG OFFSET PULL	8190EZHD 10" O	630-316	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	WIRE HARNESS	CON-6W		SCH
2	EA	WIRE HARNESS	CON-XX-P LENGTH AS REQUIRED FOR USE WITH DOOR		SCH
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 BBK 900-2RS KL900 120/240 VAC	LGR	SCE
1	SET	WIRING DIAGRAMS	DOOR ELEVATION AND POINT-TO-POINT CARD READER BY OTHERS SEALS BY DOOR SUPPLIER		SCE

OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. AUTHORIZED ACCESS BY VALID CREDENTIAL, WHICH SHUNTS DOOR POSITION SWITCH AND RETRACTS LATCH BOLT, ALLOWING DOOR TO BE PULLED OPEN. IMMEDIATE EGRESS ALWAYS ALLOWED BY DEPRESSING EXIT DEVICE PUSH RAIL, WHICH SHUNTS DOOR POSITION SWITCH (REX) AND RETRACTS LATCH BOLT, ALLOWING DOOR TO BE PUSHED OPEN.



CITY OF CONCORD FLEET SERVICES FACILITY

HARDWARE GROUP NO. 17

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	652	IVE
1	EA	EU MORTISE LOCK	L9092LEU 03A RX CON 12/24 VDC	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	WIRE HARNESS	CON-XX-P LENGTH AS REQUIRED FOR USE WITH DOOR		SCH
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 BBK KL900 120/240 VAC	LGR	SCE
1	SET	WIRING DIAGRAMS	DOOR ELEVATION AND POINT- TO-POINT CARD READER BY OTHERS		SCE

OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ACCESS BY KEY, OR VALID CREDENTIAL, WHICH SHUNTS DOOR POSITION SWITCH AND MOMENTARILY UNLOCKS OUTSIDE LEVER. INSIDE LEVER ALWAYS FREE FOR EGRESS. OPERATING INSIDE LEVER SHUNTS DOOR POSITION SWITCH FOR REQUEST TO EXIT (REX).

CITY OF CONCORD FLEET SERVICES FACILITY

HARDWARE GROUP NO. 18

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5	630	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	630	IVE
1	EA	EU MORTISE LOCK	L9092LEU 03A RX CON 12/24 VDC	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ	689	LCN
1	EA	RAIN DRIP	141AA 36" (914MM)	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	INTERLOCKING ANGLE	25	628	ZER
1	EA	DOOR BOTTOM	361AA36" (914MM)	AA	ZER
1	EA	THRESHOLD	175A-224-36" (914MM)	A	ZER
1	EA	LOCKING KEY	8361KEY		ZER
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	WIRE HARNESS	CON-XX-P LENGTH AS REQUIRED FOR USE WITH DOOR		SCH
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 BBK KL900 120/240 VAC	LGR	SCE
1	SET	WIRING DIAGRAMS	DOOR ELEVATION AND POINT- TO-POINT CARD READER BY OTHERS		SCE

OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ACCESS BY KEY, OR VALID CREDENTIAL, WHICH SHUNTS DOOR POSITION SWITCH AND MOMENTARILY UNLOCKS OUTSIDE LEVER. INSIDE LEVER ALWAYS FREE FOR EGRESS. OPERATING INSIDE LEVER SHUNTS DOOR POSITION SWITCH FOR REQUEST TO EXIT (REX).

CITY OF CONCORD FLEET SERVICES FACILITY

HARDWARE GROUP NO. 19

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	652	IVE
1	EA	EU MORTISE LOCK	L9092LEU 03A RX CON 12/24 VDC	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	SURFACE CLOSER	4040XP CUSH WMS	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CVX	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	WIRE HARNESS	CON-XX-P LENGTH AS REQUIRED FOR USE WITH DOOR		SCH
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 BBK KL900 120/240 VAC	LGR	SCE
1	SET	WIRING DIAGRAMS	DOOR ELEVATION AND POINT- TO-POINT CARD READER BY OTHERS		SCE

OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. ACCESS BY KEY, OR VALID CREDENTIAL, WHICH SHUNTS DOOR POSITION SWITCH AND MOMENTARILY UNLOCKS OUTSIDE LEVER. INSIDE LEVER ALWAYS FREE FOR EGRESS. OPERATING INSIDE LEVER SHUNTS DOOR POSITION SWITCH FOR REQUEST TO EXIT (REX).

HARDWARE GROUP NO. 20

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	EA	CONT. HINGE	224XY	628	IVE
2	EA	PUSH/PULL BAR	9190HD-10"-NO	630	IVE
2	EA	OH STOP	100S	630	GLY
2	EA	SURFACE CLOSER	4040XP EDA	689	LCN
			SEALS BY DOOR SUPPLIER		

CITY OF CONCORD FLEET SERVICES FACILITY

HARDWARE GROUP NO. 21

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	ELECTRIC HINGE	5BB1HW 4.5 X 4.5 CON TW8	630	IVE
1	EA	EU MORTISE LOCK	L9092LEU 03A RX CON 12/24 VDC	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	LOCK GUARD	LG1	630	IVE
1	EA	SURFACE CLOSER	4040XP SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	WIRE HARNESS	CON-6W		SCH
1	EA	WIRE HARNESS	CON-XX-P LENGTH AS REQUIRED FOR USE WITH DOOR		SCH
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 BBK KL900 120/240 VAC	LGR	SCE
1	SET	WIRING DIAGRAMS	DOOR ELEVATION AND POINT- TO-POINT		SCE
1			CARD READER BY OTHERS		

OPERATIONAL DESCRIPTION: DOOR NORMALLY CLOSED AND LOCKED. AUTHORIZED ACCESS BY KEY OR VALID CREDENTIAL, WHICH SHUNTS DOOR POSITION SWITCH AND MOMENTARILY UNLOCKS OUTSIDE LEVER. IMMEDIATE EGRESS ALWAYS ALLOWED. OPERATING INSIDE LEVER SHUNTS DOOR POSITION SWITCH FOR REQUEST TO EXIT (REX).

CITY OF CONCORD FLEET SERVICES FACILITY

HARDWARE GROUP NO. 22

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
5	EA	HINGE	5BB1 4.5 X 4.5 NRP	652	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	652	IVE
1	EA	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	EU MORTISE LOCK	L9092LEU 03A RX CON 12/24 VDC	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	COORDINATOR	COR X FL	US26D	IVE
2	EA	SURFACE CLOSER	4040XP CUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	MEETING STILE	383AA	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	545A	A	ZER
1	EA	WIRE HARNESS	CON-6W		SCH
2	EA	WIRE HARNESS	CON-XX-P LENGTH AS REQUIRED FOR USE WITH DOOR		SCH
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 BBK KL900 120/240 VAC	LGR	SCE
1	SET	WIRING DIAGRAMS	DOOR ELEVATION AND POINT- TO-POINT		SCE
1			CARD READER BY OTHERS		

OPERATIONAL DESCRIPTION: DOORS NORMALLY CLOSED AND LOCKED. AUTHORIZED ACCESS BY KEY OR VALID CREDENTIAL, WHICH SHUNTS DOOR POSITION SWITCHES AND MOMENTARILY UNLOCKS OUTSIDE LEVER. IMMEDIATE EGRESS ALWAYS ALLOWED. OPERATING INSIDE LEVER SHUNTS DOOR POSITION SWITCHES FOR REQUEST TO EXIT (REX).

CITY OF CONCORD FLEET SERVICES FACILITY

HARDWARE GROUP NO. 23

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
5	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
1	EA	ELECTRIC HINGE	5BB1 4.5 X 4.5 CON TW8	630	IVE
1	EA	CONST LATCHING BOLT	FB51P	630	IVE
1	EA	DUST PROOF STRIKE	DP1	626	IVE
1	EA	EU MORTISE LOCK	L9092LEU 03A RX CON 12/24 VDC	626	SCH
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	COORDINATOR	COR X FL	US26D	IVE
2	EA	SURFACE CLOSER	4040XP CUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	630	IVE
1	EA	GASKETING	488SBK PSA	BK	ZER
1	EA	MEETING STILE	383AA	AA	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	545A	A	ZER
1	EA	WIRE HARNESS	CON-6W		SCH
2	EA	WIRE HARNESS	CON-XX-P LENGTH AS REQUIRED FOR USE WITH DOOR		SCH
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 BBK KL900 120/240 VAC	LGR	SCE
1	SET	WIRING DIAGRAMS	DOOR ELEVATION AND POINT- TO-POINT		SCE
1			CARD READER BY OTHERS		

OPERATIONAL DESCRIPTION: DOORS NORMALLY CLOSED AND LOCKED. AUTHORIZED ACCESS BY KEY OR VALID CREDENTIAL, WHICH SHUNTS DOOR POSITION SWITCHES AND MOMENTARILY UNLOCKS OUTSIDE LEVER. IMMEDIATE EGRESS ALWAYS ALLOWED. OPERATING INSIDE LEVER SHUNTS DOOR POSITION SWITCHES FOR REQUEST TO EXIT (REX).

CITY OF CONCORD FLEET SERVICES FACILITY

HARDWARE GROUP NO. 24

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
8	EA	HINGE	5BB1 4.5 X 4.5 NRP	630	IVE
2	EA	POWER TRANSFER	EPT10 CON	689	VON
1	EA	REMOVABLE MULLION	KR4954 STAB	689	VON
1	EA	ELEC PANIC HARDWARE	LD-RX-LC-98-EO-CON	626	VON
1	EA	ELEC PANIC HARDWARE	RX-LC-QEL-98-NL-CON 24 VDC	626	VON
1	EA	MORTISE CYLINDER	AS REQUIRED	626	MED
1	EA	RIM CYLINDER	AS REQUIRED	626	MED
2	EA	SURFACE CLOSER	4040XP SHCUSH	689	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	RAIN DRIP	142AA	AA	ZER
1	SET	GASKETING	429AA-S	AA	ZER
1	EA	MULLION SEAL	8780NBK PSA	BK	ZER
2	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	655A-223	A	ZER
1	EA	WIRE HARNESS	CON-6W		SCH
2	EA	WIRE HARNESS	CON-XX-P LENGTH AS REQUIRED FOR USE WITH DOOR		SCH
2	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 BBK 900-2RS KL900 120/240 VAC	LGR	SCE
1	SET	WIRING DIAGRAMS	DOOR ELEVATION AND POINT- TO-POINT		SCE
1			CARD READER BY OTHERS		

OPERATIONAL DESCRIPTION: DOORS NORMALLY CLOSED AND LOCKED. AUTHORIZED ACCESS BY KEY OR VALID CREDENTIAL, WHICH SHUNTS DOOR POSITION SWITCHES AND MOMENTARILY RETRACTS EXIT DEVICE LATCHBOLT, ALLOWING DOOR TO BE PULLED OPEN. IMMEDIATE EGRESS ALWAYS ALLOWED. INSIDE PUSH RAILS SHUNT DOOR POSITION SWITCHES FOR REQUEST TO EXIT (REX).

END OF SECTION

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes:
  - 1. Glass products.
  - 2. Glazing sealants and accessories.
- B. Related Requirements:
  - 1. Section 08 88 13 "Fire-Rated Glazing."

**1.2 COORDINATION**

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Materials.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Preconstruction adhesion and compatibility test report.

**1.5 QUALITY ASSURANCE**

- A. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

**1.6 WARRANTY**

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
  - 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating

glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Glass LLC; SNR 43. or a comparable product by one of the following:
1. Cardinal Glass Industries, Inc.
  2. Pilkington North America; NSG Group.
  3. Saint-Gobain Glass Corp.
  4. Vitro Architectural Glass.

### **2.2 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the International Building Code and ASTM E 1300.
1. Design Wind Pressures: As indicated on Drawings.
  2. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
  2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
  3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

### **2.3 GLASS PRODUCTS, GENERAL**

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
1. NGA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
  2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

- C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IgCC.
- D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
- E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

**2.4 GLASS PRODUCTS**

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

**2.5 INSULATING GLASS**

- A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
  - 1. Sealing System: Dual seals.
  - 2. Spacer: Thermally broken aluminum.

**2.6 GLAZING SEALANTS**

- A. General:
  - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  - 3. Sealant shall have a VOC content of 250 g/L or less.
  - 4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range].

**2.7 MISCELLANEOUS GLAZING MATERIALS**

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

**PART 3 - EXECUTION**

**3.1 GLAZING, GENERAL**

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

**3.2 TAPE GLAZING**

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

**3.3 GASKET GLAZING (DRY)**

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

**3.4 CLEANING AND PROTECTION**

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

**3.5 MONOLITHIC TEMPERED GLASS SCHEDULE**

- A. Glass Type G1: Clear fully tempered float glass.
  - 1. Minimum Thickness: 6 mm.

**3.6 INSULATING TEMPERED GLASS SCHEDULE**

- A. Glass Type G2: Basis of design: Guardian Glass SNR 43 Clear / Clear, fully tempered.
  - 1. SHGC: 0.23.
  - 2. Visible Light 43%.
  - 3. Shading Coefficient: 0.26.
  - 4. LSG: 1.88.

**END OF SECTION 08 80 00**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes: **There are or review in this Section.**
  - 1. Decorative Window Film

**1.2 REFERENCES**

- A. ASTM International (ASTM)
  - 1. ASTM E 903 - Standard Methods of Test for Solar Absorbance, Reflectance and Transmittance of Materials Using Integrating Spheres.
  - 2. ASTM E 308 - Standard Recommended Practice for Spectrophotometry and Description of Color in CIE 1931 System.
  - 3. ANSI Z97.1-1984 - Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test
  - 4. 16 CFR 1201 USGS; Category II: Break Strength 100PLI.
- B. ANSI:
  - 1. ANSI Z97.1-1984 - Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- C. Code of Federal Regulations:
  - 1. 16 CFR 1201 USGS; Category II: Break Strength 100PLI.

**1.3 PREINSTALLATION MEETINGS**

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

**1.4 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Manufacturer's Product Data for specified products.
- B. Shop Drawings:
  - 1. Submit shop drawings showing layout, profiles, and product components, including dimensions, anchorage, and accessories.
  - 2. Samples: 4-inch by 4-inch samples of specified color and pattern for verification.
- C. Samples: 4-inch by 4-inch samples of specified color and pattern for verification.
- D. Sample warranties.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Contracts:
  - 1. Maintenance service.
  - 2. Software service agreement.

## SECTION 08 87 00 – ARCHITECTURAL WINDOW FILMS

- B. Warranty Documentation:
  - 1. Manufacturers' special warranties.
  - 2. Installer's special warranties.

### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of maintenance material items.

### 1.7 QUALITY ASSURANCE

- A. Obtain all products in this section from a single Manufacturer with a minimum of 10 years' experience.
- B. Installer: Installation shall be performed by a trained and qualified installer, specialized and experienced in work required for this project. A list of experienced installation integrators is available at 3M.com/AMD or 3M Commercial Solutions Division.

### 1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
- B. Store products protected from weather, temperature, and other harmful conditions as recommended by supplier.
- C. Product must remain in original plastic bag and boxes and have storage conditions as follows:
  - 1. 40 °F – 90 °F.
  - 2. Out of direct sunlight.
  - 3. Clean dry area.
  - 4. Original container.
  - 5. Do not stack boxes over six (6) units high.
  - 6. Handle products in accordance with manufacturer's instructions.

### 1.9 PROJECT CONDITIONS

- A. Apply materials when environmental conditions are within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits. Application temperature range is 60F – 100F.
- B. Environmental Limitations: Do not install 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.

### 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace window films that fail(s) in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Three (3) year(s) from date of Substantial Completion.



**PART 2 - PRODUCTS**

**2.1 MANUFACTURER**

- A. Basis of Design: Subject to the required performances, provide architectural window films as manufactured by 3M Company – Commercial Solutions Division or approved equal by the following:
  - 1. SOLYX Decorative Films.

**2.2 MATERIAL PROPERTIES**

- A. General: Glass finishes field-applied application to glass or plastic material as visual opaque or decorative film:
  - 1. Film: Vinyl.
  - 2. Adhesive: Acrylic, Pressure Sensitive, Permanent.
  - 3. Liner: Silicone-coated Polyester.
  - 4. Thickness (Film and Adhesive without Liner):
    - a. Dusted - 3.2 mils - 7725SE-314 Dusted Crystal White.
  - 5. Fire Performance: Surface burning characteristics when tested in accordance with ASTM E84, Class A

**2.3 OPTICAL PERFORMANCE**

- A. CRYSTAL Dusted Decorative / Privacy Glazing Film:
  - 1. Ultraviolet Transmittance (ASTM E 903): 27 percent.
  - 2. Visible Light Transmittance (ASTM E 903, ASTM E308): 85 percent.
  - 3. Visible Light Reflectance (ASTM E 903): 79 percent.
  - 4. Solar Heat Transmittance: 76 percent.
  - 5. Solar Heat Reflectance: 7 percent.
  - 6. Shading Coefficient at 90 Degrees (Normal Incidence) (ASTM E 903): 0.93.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrate(s) for compliance. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Refer to the applicable 3M Technical Data Sheet to determine compatibility of finish to substrate.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.
- D. Responsibility for state of surfaces prior to installation to be pre-determined by installation specialist.
- E. Scheduling of installation by Owner or its representative implies that substrate and conditions are prepared and ready for product installation per the recommendations of the installation specialist.

## **SECTION 08 87 00 – ARCHITECTURAL WINDOW FILMS**

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- F. Proceeding with installation implies installer’s acceptance of substrate and conditions.

### **3.2 SURFACE PREPARATION**

- A. Comply with all manufacturer’s instructions for surface preparation.
- B. Thoroughly clean substrate of substances that could impair the overlay’s bond, including mold, mildew, oil, grease.
- C. Re-clean surfaces with appropriate surface prep solvent and remove any haze or surface contamination.

### **3.3 APPLICATION**

- A. Application must be performed by qualified installer.
- B. Do not proceed with installation until all finishing work has been completed in and around the work area.
- C. Verify pattern prior to material acquisition.
- D. Comply with manufacturer’s installation instructions applicable to products and applications indicated, except where more stringent requirements apply.
- E. Install substrates with no gaps or overlaps. Form smooth, wrinkle-free, bubble-free surface for finished installation.
- F. Remove air bubbles, wrinkles, blisters and other defects. Use approved procedures to prevent the formation of air bubbles, wrinkles, blisters and other defects.
- G. Refer to the applicable 3M Installation Guide for additional details.

### **3.4 CLEANING AND PROTECTION**

- A. Use cleaning methods recommended by architectural surfacing manufacturer for applicable environment.
- B. Protect completed glass finish during remainder of construction period.
- C. Consult with authorized installation specialist for project specifics.

**END OF SECTION 08 87 00**

# **SECTION 09 21 16 - GYPSUM BOARD SHAFT WALL ASSEMBLIES**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes: Gypsum board horizontal shaft wall assemblies.

### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each component of gypsum board shaft wall assembly.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

### **2.2 GYPSUM BOARD HORIZONTAL SHAFT WALL ASSEMBLIES**

- A. Fire-Resistance Rating: As indicated.
- B. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
  - 1. Depth: As required by UL test.
  - 2. Minimum Base-Metal Thickness: As required by UL test and span.
- C. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
  - 1. Minimum Base-Metal Thickness: Matching steel studs.

### **2.3 PANEL PRODUCTS**

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
- B. Gypsum Shaftliner Board, Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with moisture- and mold-resistant core and surfaces.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Provide products per the UL tested design.
  - 2. Thickness: 1 inch.
  - 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
- C. Gypsum Board: As specified in Section 09 29 00 "Gypsum Board."

## **SECTION 09 21 16 - GYPSUM BOARD SHAFT WALL ASSEMBLIES**

### **2.4 NON-LOAD-BEARING STEEL FRAMING**

- A. Steel Framing Members: Comply with ASTM C 645 requirements for metal.

### **2.5 AUXILIARY MATERIALS**

- A. Trim Accessories: Material and shapes as specified in Section 09 29 00 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
- C. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General: Comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Building Expansion Joints: Frame both sides of expansion joints with furring and other support.
- D. Install supplementary framing around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, handrails, and similar items.
- E. Isolate perimeter of gypsum panels from building structure, while maintaining continuity of fire-rated construction.
- F. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.
- H. Remove and replace panels that are wet, moisture damaged, or mold damaged.

**END OF SECTION 09 21 16**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Non-load-bearing steel framing systems for interior partitions.
  - 2. Suspension systems for interior ceilings and soffits.
  - 3. Grid suspension systems for gypsum board ceilings.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Studs and Runners: Provide documentation that framing members' certification is according to SIFA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."
- B. Shop Drawings:
  - 1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
  - 2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
- C. Delegated Design Submittal: For cold-formed steel framing greater than 20'-0".

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.
- D. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
  - 1. Design Loads: As indicated on Drawings.
  - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:

## **SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING**

- a. Exterior Non-Load-Bearing Framing: Horizontal deflection of:
  - 1) 1/600 of the wall height if supporting masonry veneer.
  - 2) 1/360 of the wall height if supporting plaster or stucco finishes
  - 3) 1/240 of the wall height, unless noted otherwise.
- b. Interior Load-Bearing Wall Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft..
- c. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/240 of the wall height under a horizontal load of 5 lbf/sq. ft..
- a. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
  - a. Upward and downward movement of 1 inch.
5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

### **2.2 FRAMING SYSTEMS (LGMF)**

- A. Substitutions: The following are not permitted nor accepted:
  1. Dimpled steel studs and runners.
  2. Equivalent steel studs and runners.
- B. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- C. Studs and Tracks: ASTM C645. Use conventional steel studs and tracks.
  1. Steel Studs and Runners:
    - a. Minimum Base-Steel Thickness: 0.0329-inch color-coated with white paint on each stud per ASTM C695-09a.
    - b. Depth: As indicated on Drawings.
  2. Steel Studs and Runners for Impact-Resistant Gypsum Board:
    - a. Minimum Base-Steel Thickness: 0.0312-inch color-coated with pink paint on each stud per ASTM C645-09a.
    - b. Depth: As indicated on Drawings.
- D. Slip-Type Head Joints: Where indicated, provide one of the following:
  1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to runners while allowing 1-1/2-inch minimum vertical movement.
  2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
  3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

## SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

1. Minimum Base-Metal Thickness: 0.0329 inch.
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.
1. Depth: 1-1/2 inches Insert depth.
  2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.0179 inch.
  2. Depth: 7/8 inch.
- H. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical.
- I. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
1. Depth: 3/4 inch.
  2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0179 inch.
  3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- J. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

### 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- C. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
- D. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armstrong World Industries, Inc.
    - b. Chicago Metallic Corporation.
    - c. United States Gypsum Company.

### 2.4 IDENTIFICATION

- A. Provide identification on all metal studs as follows:
1. On all studs, provide a legible, permanent, sticker, stamp, stencil, or embossment, spaced a maximum of 4 feet on center and located on the web of the framing member stipulating size and gage of stud.
  2. Use color coding for metal studs as noted above in Section 2.2.C.

## **SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING**

### **2.5 AUXILIARY MATERIALS**

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 PREPARATION**

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
  - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
  - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

#### **3.3 INSTALLATION, GENERAL**

- A. Installation Standard: ASTM C 754.
  - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.



## SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

### 3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two 0.0329 inch studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
  - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Direct Furring:
  - 1. Screw to framing.
  - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Z-Shaped Furring Members:
  - 1. Erect insulation, specified in Section 07 21 00 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 24 inches o.c.
  - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
  - 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
  - 4. Acoustical Studs: Install where indicated.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

**3.5 INSTALLING SUSPENSION SYSTEMS**

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Hangers: 48 inches o.c.
  - 2. Carrying Channels (Main Runners): 48 inches o.c.
  - 3. Furring Channels (Furring Members): 16 inches o.c.
  
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
  
- C. Suspend hangers from building structure as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
  - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 5. Do not attach hangers to steel roof deck.
  - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
  
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
  
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
  
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

**END OF SECTION 09 22 16**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Interior gypsum board.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.
  - 1. Indicate which manufacture and type of gypsum board is to be used on each rated assembly.
- C. Samples for Verification: For the following products:
  - 1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

**1.3 QUALITY ASSURANCE**

- A. Single-Source Responsibility for Panel Products:
  - 1. Obtain each type of gypsum board and other panel products from a single manufacturer.
- B. Single-Source Responsibility for Finishing Materials:
  - 1. Obtain finishing materials from the same manufacturer that supplies gypsum board.

**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 SOURCE LIMITATIONS**

- A. Obtain all gypsum panel and joint finishing material from single source with resources to provide products of consistent quality in appearance and physical properties.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
  - 1. Manufactures specified in UL rated assemblies are the only manufactures permitted for that tested design.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

**2.3 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.

**2.4 INTERIOR GYPSUM BOARD**

- A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. Armstrong Ceiling & Wall Solutions.
    - c. CertainTeed; SAINT-GOBAIN.
    - d. Georgia-Pacific Gypsum LLC.
    - e. Gold Bond Building Products, LLC provided by National Gypsum Company.
    - f. PABCO Gypsum.
    - g. USG Corporation.
    - h. **OR** As required by fire-resistance-rated assembly indicated on Drawings.
  - 2. Thickness: 5/8 inch.
  - 3. Long Edges: Tapered.
- B. Gypsum Ceiling Board: ASTM C1396.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed; SAINT-GOBAIN.
    - c. Georgia-Pacific Gypsum LLC.
    - d. Gold Bond Building Products, LLC provided by National Gypsum Company.
    - e. USG Corporation.
  - 2. Thickness: 1/2 inch.
  - 3. Long Edges: Tapered.

- C. Impact-Resistant Gypsum Board: ASTM C1396 gypsum board, tested in accordance with ASTM C1629.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed; SAINT-GOBAIN.
    - c. Georgia-Pacific Gypsum LLC.
    - d. Gold Bond Building Products, LLC provided by National Gypsum Company.
    - e. USG Corporation.
  - 2. Core: 5/8-inch, Type X.
  - 3. Surface Abrasion: ASTM C1629, meets or exceeds Level 3 requirements.
  - 4. Indentation: ASTM C1629, meets or exceeds Level 3 requirements.
  - 5. Soft-Body Impact: ASTM C1629, meets or exceeds Level 3 requirements.
  - 6. Hard-Body Impact: ASTM C1629, meets or exceeds Level 3 requirements in accordance with test in Annex A1.
  - 7. Long Edges: Tapered.
  - 8. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.
  
- D. Mold-Resistant Gypsum Board: ASTM C1396. With moisture- and mold-resistant core and paper surfaces.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. American Gypsum.
    - b. CertainTeed; SAINT-GOBAIN.
    - c. Georgia-Pacific Gypsum LLC.
    - d. Gold Bond Building Products, LLC provided by National Gypsum Company.
    - e. USG Corporation.
  - 2. Core: 5/8-inch, Type X.
  - 3. Long Edges: Tapered.
  - 4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

**2.5 SPECIALTY GYPSUM BOARD**

- A. Gypsum Board, Type C: ASTM C 1396. Manufactured to have increased fire-resistive capability.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. As required by fire-resistance-rated assembly indicated on Drawings.
  - 2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
  - 3. Long Edges: Tapered.

**2.6 TILE BACKING PANELS**

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C-Cure.
    - b. CertainTeed; SAINT-GOBAIN.
    - c. Custom Building Products.
    - d. FinPan, Inc.
    - e. James Hardie Building Products, Inc.
    - f. PermaBASE Building Products, LLC provided by National Gypsum Company.
    - g. USG Corporation.

2. Thickness: 5/8 inch.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

**2.7 TRIM ACCESSORIES**

- A. Interior Trim: ASTM C 1047.
1. Material: Paper-faced galvanized-steel sheet.
  2. Shapes:
    - a. Cornerbead.
    - b. Bullnose bead.
    - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
    - d. L-Bead: L-shaped; exposed long flange receives joint compound.
    - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.
    - f. Expansion (control) joint.
  3. Interior Reveal Molding:
    - a. Extruded accessories of profiles and dimensions indicated.
    - b. Finish to be corrosion-resistant primer compatible with joint compound and finish materials specified.

**2.8 JOINT TREATMENT MATERIALS**

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
1. Interior Gypsum Board: Paper.
  2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use setting-type, sandable topping compound.
  4. Finish Coat: For third coat, use setting-type, sandable topping compound.
  5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.
- D. Joint Compound for Tile Backing Panels:
1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
  2. Cementitious Backer Units: As recommended by backer unit manufacturer.
  3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

**2.9 AUXILIARY MATERIALS**

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

- C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - 1. See Section 07 92 19 – Acoustical Joint Sealants for this information.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 APPLYING AND FINISHING PANELS, GENERAL**

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.

2. Fit gypsum panels around ducts, pipes, and conduits.
  3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies:
1. Install components according to requirements for design designations from listing organization and publication indicated on Drawings.
  2. See Section 07 92 19 – Acoustical Joint Sealants for this information.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### **3.3 APPLYING INTERIOR GYPSUM BOARD**

- A. Install interior gypsum board in the following locations:
1. Wallboard Type: Vertical surfaces unless otherwise indicated.
  2. Type X: Vertical surfaces unless otherwise indicated.
  3. Ceiling Type: Ceiling surfaces.
  4. Impact-Resistant Type: As indicated on Drawings.
  5. Mold-Resistant Type: As indicated on Drawings.
  6. Type C: As indicated on Drawings or where required for specific fire-resistance-rated assembly indicated.
- B. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
  2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated, allowed 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.
  3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
  4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
  5. Apply 1/2" only where indicated per wall type.
  6. Type C: Where required for specific fire-resistance-rated assembly indicated.
- C. Multilayer Application:
1. On ceilings, apply gypsum board indicated for base layers before applying face layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
  2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer



joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

### **3.4 INSTALLATION OF TILE BACKING PANELS**

- A. Cementitious Backer Units: ANSI A108.11, at showers, tubs, and where indicated on Drawings.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

### **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. Control Joints:
  1. Control joints per ASTM C840, the United States Gypsum Handbook, Centennial Edition, in specific locations approved by Architect for visual effect and as follows:
    - a. Locate at both side jambs of openings to the structure above.
      - 1) Use one system throughout.
    - b. Partitions or furring run exceeding 30 feet.
    - c. Ceiling dimensions exceeds 50 feet in either direction with perimeter relief or 30 feet without relief.
    - d. Extend control joints the full height of the wall or length of soffit/ceiling membrane.
  2. Isolate gypsum construction with control joints:
    - a. Where partitions and ceilings of dissimilar construction meet and remain in the same plane.
    - b. Wings of "L", "U" and "T" shaped ceiling areas are joined.
    - c. Expansion or control joints occur in the base wall construction and/or building structure.
  3. Limitation:
    - a. Where sound and/or fire ratings are prime considerations, an adequate fire or sound seal must be provided behind the control joint.

### **3.6 FINISHING GYPSUM BOARD**

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  - 1. Shall be as per level 1 at Plenum and Concealed Areas.
    - a. Joints:
      - 1) Tape set in joint compound.
    - b. Interior Angles:
      - 1) Tape set in joint compound.
    - c. Surface:
      - 1) Tool marks and ridges are acceptable.
      - 2) Surface free of excess joint compound.
  - 2. Level 4 for flat paint with a pint sheen of <3 @ 60° (MPI Gloss Level 1):
    - a. Joints:
      - 1) Tape embedded in joint compound and wiped with a joint knife, leaving a thin coat of compound over tape, and then covered with two separate coats of joint compound.
    - b. Interior Angles:
      - 1) Tape embedded in joint compound and wiped with a joint knife, leaving a thin coat of compound over tape, and then covered with one separate coat of joint compound.
    - c. Accessories:
      - 1) Shall be covered by one separate coat of joint compound, and another three separate coats of joint compound.
    - d. Fasteners:
      - 1) Shall be covered by one separate coat of joint compound, and another three separate coats of joint compound.
    - e. Surface:
      - 1) Joint compound shall be smooth and free of tool marks and ridges.
- E. The sanding of the gypsum board in all renovations shall be wet sanded, no exceptions.
- F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.
- G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

**3.7 PROTECTION**

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

**3.8 WALL TYPE IDENTIFICATION**

- A. Label all smoke walls and fire rated walls above ceiling.

## SECTION 09 29 00 - GYPSUM BOARD

1. At all areas requiring labels but having no ceiling scheduled, coordinate locations with Owner.
  2. Labels shall be minimum 4" high with black or red lettering and permanently paint stenciled in a manner acceptable to the AHJ at a maximum distance of 8'-0" on center with a minimum of one per wall or barrier.
  3. The hourly rating shall be included on all rated barriers and/or walls.
- B. All identification shall be above ceiling level and in all concealed spaces.
1. Suggested wording:
    - a. For Fire Walls (2 hour to 4 hour rated):
      - 1) "Fire Wall, \_\_\_\_ hour rating. Protect all penetrations."
    - b. For Fire Barriers (1 hour to 4 hour rated):
      - 1) "Fire Barrier, \_\_\_\_ hour rating. Protect all penetrations."
    - c. For Fire Partitions (1 hour rated):
      - 1) "Fire Partition, \_\_\_\_ hour rating. Protect all penetrations."
    - d. For Fire Rated Smoke Barriers (1 hour to 4 hour rated):
      - 1) "Fire Rated Smoke Barrier, \_\_\_\_ hour rating. Protect all penetrations."
    - e. For Walls that Limit the Passage of Smoke (Smoke tight - Unrated):
      - 1) "Passage of Smoke Limited Wall. Protect all penetrations."
    - f. For Shaft Walls (1 hour to 4 hour rated):
      - 1) "Fire Barrier Shaft Wall, \_\_\_\_ hour rating. Protect all penetrations."
    - g. For Fire Rated Wall or Ceiling Access Panels (1 hour to 3 hour rated):
      - 1) "Fire Rated Access Panel, \_\_\_\_ hour rating. Protect all penetrations"

**END OF SECTION 09 29 00**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Ceramic tile.
  - 2. Porcelain tile.
  - 3. Tile backing panels.
  - 4. Crack isolation membrane.

**1.2 ACTION SUBMITTALS**

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

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.

**1.4 MAINTENANCE MATERIAL SUBMITTALS**

- A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 5 percent of amount installed for each type, composition, color, pattern, and size indicated.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
  - 2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.

**1.7 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

**1.8 WARRANTY**

- A. System Warranty: Manufacturer's non-prorated comprehensive warranty that agrees to repair and replace defective installation areas, material, and labor that fail under normal usage within specified warranty period.
  - 1. Warranty Period: Five years from date of Product Purchase.

**PART 2 - PRODUCTS**

**2.1 PRODUCTS, GENERAL**

- A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

**2.2 TILE PRODUCTS**

- A. Tile Type:
  - 1. As indicated on Finish Schedule and Materials Legend.

**2.3 TILE BACKING PANELS**

- A. See Section 09 29 00 – Gypsum Board for Cementitious Backer Units:
  - 1. Thickness: As indicated.

**2.4 CRACK ISOLATION MEMBRANE**

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and fabric reinforcement.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Custom Building Products.
    - b. Laticrete International, Inc.
    - c. MAPEI Corporation.

**2.5 SETTING MATERIALS**

- A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Custom Building Products.
    - b. Laticrete International, Inc.
    - c. MAPEI Corporation.
  - 2. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
  - 3. For wall applications, provide nonsagging mortar.

**2.6 GROUT MATERIALS**

- A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.
- B. Water-Cleanable Epoxy Grout: ANSI A118.3.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Custom Building Products.
    - b. Laticrete International, Inc.
    - c. MAPEI Corporation.

**2.7 MISCELLANEOUS MATERIALS**

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting and adhesive materials for installations indicated.
- B. Metal Flooring Transitions: Profile designed specifically for flooring applications; height to match tile and setting-bed thickness.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Schluter Systems L.P. or comparable product by one of the following:
    - a. Blanke Corporation.
    - b. Custom Building Products.
    - c. Dural USA, Inc.
    - d. Profilitec Corp.
    - e. Progress Profiles America Inc.
  - 2. Description: As indicated on Finish Legend.
  - 3. Material and Finish: Metallic or combination of metal and PVC or neoprene base; polished chrome anodized aluminum exposed-edge material.
    - a. Color: To be selected.
- C. Metal Edge Trim: Profile designed for wall terminations and edge protection.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Schluter Systems L.P. or a comparable product by one of the following:
    - a. Blanke Corporation.
    - b. Custom Building Products.
    - c. Dural USA, Inc.
    - d. Profilitec Corp.
    - e. Progress Profiles America Inc.
  - 2. Description: As indicated on Finish Legend.
  - 3. Terminations: Outside corners matching edge-protection profile.

- 4. Material and Finish: Polished chrome anodized aluminum exposed-edge material.
  - a. Color: See Finish Legend.
- D. Temporary Protective Coating: Formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products and easily removable after grouting is completed without damaging grout or tile.
- E. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- F. Grout Sealer: Grout manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

**3.3 CERAMIC TILE INSTALLATION**

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
  - 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing:
    - a. 95 percent mortar coverage.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.



- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
  - 1. Tile: As indicated.
- F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- G. Metal Edge Strips: Install at locations indicated.

**3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE**

- A. Interior Floor Installations, Concrete Subfloor:
  - 1. Tile Installation F122: Thin-set mortar on waterproof membrane; TCA F122/TCA F125A.
    - a. Thin-Set Mortar: Latex-portland cement mortar.
    - b. Grout: Water-cleanable epoxy grout.
- B. Interior Wall Installations, Metal Studs:
  - 1. Tile Installation W244: Thin-set mortar on cementitious backer units or fiber cement underlayment; TCA W244.
    - a. Bond Coat/Thin-Set Mortar: Latex- portland cement mortar.
    - b. Grout: Water-cleanable epoxy grout.
    - c. Latex Modified Portland cement grout (ANSI A118.7).
  - 2. Water:
    - a. Potable.

**END OF SECTION 09 30 13**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Acoustical panels.
  - 2. Metal suspension system.
  - 3. Metal edge moldings and trim.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data:
  - 1. Acoustical panels.
  - 2. Metal suspension system.
  - 3. Metal edge moldings and trim.
- B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.
- C. Samples for Initial Selection: For components with factory-applied finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
  - 1. Acoustical Panels: Set of 6-inch-square Samples of each type, color, pattern, and texture.
  - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Ceiling suspension-system members.
  - 2. Structural members to which suspension systems will be attached.
  - 3. Method of attaching hangers to building structure.
  - 4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
  - 5. Size and location of initial access modules for acoustical panels.
  - 6. Items penetrating finished ceiling and ceiling-mounted items including the following:
    - a. Lighting fixtures.
    - b. Diffusers.
    - c. Grilles.
    - d. Speakers.
    - e. Sprinklers.
    - f. Access panels.
    - g. Perimeter moldings.

## **SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS**

7. Show operation of hinged and sliding components covered by or adjacent to acoustical panels.
8. Minimum Drawing Scale: 1/8 inch = 1 foot.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each acoustical panel ceiling, for tests performed by a qualified testing agency.

### **1.5 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Acoustical Ceiling Units: Provide 2 full boxes of each style panel.

### **1.6 CLOSEOUT SUBMITTALS**

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

### **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

### **1.8 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

## **PART 2 - PRODUCTS**

### **2.1 SOURCE LIMITATIONS**

- A. Source Limitations for Ceiling System: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

### **2.2 ACOUSTICAL PANELS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Basis of Design and equals listed in Finish Legend.

## SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

- B. Acoustical Panel Standard: Provide manufacturer's standard panels in accordance with ASTM E1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested in accordance with ASTM D3273, ASTM D3274, or ASTM G21 and evaluated in accordance with ASTM D3274 or ASTM G21.

### 2.3 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong Ceiling & Wall Solutions.
  - 2. USG Corporation.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M and designated by type, structural classification, and finish indicated.
- C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch-wide metal caps on flanges.
  - 1. Structural Classification: Heavy-duty system.
  - 2. Face Design: Flat, flush.
  - 3. Cap Material: Cold-rolled steel or aluminum.
  - 4. Cap Finish: Painted white.

### 2.4 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
  - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
  - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.106-inch- diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.
- E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A653/A653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

### 2.5 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Armstrong Ceiling & Wall Solutions.

## **SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS**

2. CertainTeed; SAINT-GOBAIN.
  3. Flannery, Inc.
  4. Fry Reglet Corporation.
  5. Gordon Inc.
  6. Rockfon; ROCKWOOL International.
  7. USG Corporation.
- B. APC Clouds: Provide 6-inch perimeter with all required accessories for a complete installation.
- C. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
1. Edge moldings to fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
  2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

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

#### **3.2 PREPARATION**

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

#### **3.3 INSTALLATION OF ACOUSTICAL PANEL CEILINGS**

- A. Install acoustical panel ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

## SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS

2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  4. 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.
  5. 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.
  6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  7. 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.
  8. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
  2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. Arrange directionally patterned acoustical panels as follows:
    - a. As indicated on reflected ceiling plans.
  2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
  3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
  5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

### 3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

## **SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS**

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### **3.5 CLEANING**

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

**END OF SECTION 09 51 13**

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## **SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Resilient base.
  - 2. Metal accessories.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

#### **1.3 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

#### **1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

#### **1.5 FIELD CONDITIONS**

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

### **PART 2 - PRODUCTS**

- A. MATERIALS
  - 1. Thermoset Rubber Base:

## **SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES**

- a. Products: See Finish Schedule.

### **2.2 INSTALLATION MATERIALS**

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- C. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

### **3.3 RESILIENT BASE INSTALLATION**

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.

## **SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES**

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- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

### **3.4 RESILIENT ACCESSORY INSTALLATION**

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

**END OF SECTION 09 65 13**

**SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Luxury vinyl tile.

**1.2 ACTION SUBMITTALS**

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

**1.3 CLOSEOUT SUBMITTALS**

- A. Maintenance data.
- B. Shop Drawings: For each type of resilient floor tile.
  - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 2. Show details of special patterns.
- C. Samples: Full-size units of each color, texture, and pattern of floor tile required.
- D. Samples for Initial Selection: For each type of floor tile indicated.
- E. Product Schedule: For floor tile. Use same designations indicated on Drawings.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

**1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Floor Tile: Furnish two full boxes of each type, color, and pattern of floor tile installed.

**1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

## **SECTION 09 65 19 - RESILIENT TILE FLOORING**

### **1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

### **1.9 FIELD CONDITIONS**

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

## **PART 2 - PRODUCTS**

### **2.1 LUXURY VINYL TILE.**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. See Finish Legend.

### **2.2 INSTALLATION MATERIALS**

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.

## **SECTION 09 65 19 - RESILIENT TILE FLOORING**

2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
  3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
  4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
    - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

### **3.2 FLOOR TILE INSTALLATION**

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  1. Lay tiles in pattern indicated.
- C. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- D. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- F. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### **3.3 CLEANING AND PROTECTION**

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Cover floor tile until Substantial Completion.

**SECTION 09 65 19 - RESILIENT TILE FLOORING**

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**END OF SECTION 09 65 19**



**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Modular carpet tile.

**1.2 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
    - a. Review delivery, storage, and handling procedures.
    - b. Review ambient conditions and ventilation procedures.
    - c. Review subfloor preparation procedures.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
  - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
  - 2. Carpet tile type, color, and dye lot.
  - 3. Type of subfloor.
  - 4. Type of installation.
  - 5. Pattern of installation.
  - 6. Pattern type, location, and direction.
  - 7. Pile direction.
  - 8. Type, color, and location of insets and borders.
  - 9. Type, color, and location of edge, transition, and other accessory strips.
  - 10. Transition details to other flooring materials.
- C. Samples: For each exposed product and for each color and texture required.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Product test reports.
- C. Sample warranty.

**1.5 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

**1.6 MAINTENANCE MATERIAL SUBMITTALS**

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Carpet Tile: Two full-size boxes of amount installed for each type indicated.

**1.7 QUALITY ASSURANCE**

- A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

**1.8 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with the Carpet and Rug Institute's CRI 104.

**1.9 FIELD CONDITIONS**

- A. Comply with the Carpet and Rug Institute's CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

**1.10 WARRANTY**

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: 10 years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 CARPET TILE**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. See Finish Legend.

**2.2 INSTALLATION ACCESSORIES**

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Concrete Slabs:
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
    - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

**3.2 PREPARATION**

- A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

**3.3 INSTALLATION**

- A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

## **SECTION 09 68 13 - TILE CARPETING**

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- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns indicated on Drawings.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install patterns per Finish Plan.
- I. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

**END OF SECTION 09 68 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Surface preparation and application of paint systems on exterior substrates.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of topcoat product.
- C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. See Finish Legend for additional information.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. PPG Architectural Finishes, Inc.
  - 3. Sherwin-Williams Company (The).

**2.2 PAINT PRODUCTS**

- A. MPI Standards: Provide products complying with MPI standards indicated and listed in its "MPI Approved Products List."
- B. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As selected by Architect from manufacturer's full range.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- B. 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. 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.
  - 2. Uncoated and metallic-coated requiring paint shall be cleaned by removing oil, grease, dirt, dust and foreign matter by solvent cleaning in accordance with SSPC-SP1 prior to apply any finish.
    - a. All primers on hollow metal are shipping primers and they must all be fully prepared and reprimed.
    - b. Do not accept shipping primers as a primer for this project.

**3.3 INSTALLATION**

- A. Apply paints in accordance with manufacturer's written instructions and recommendations in "MPI Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

**3.4 CLEANING AND PROTECTION**

- A. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- B. 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.
- C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

**3.5 EXTERIOR PAINTING SCHEDULE**

- A. Steel and Iron Substrates:
  - 1. Alkyd System:
    - a. Prime Coat: Shop primer specified in Section 055000.

## **SECTION 09 91 14 - EXTERIOR PAINTING**

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- b. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 1), MPI #8.
- B. Galvanized-Metal Substrates:
  - 1. Alkyd System:
    - a. Prime Coat: Primer, galvanized, cementitious, MPI #26.
    - b. Topcoat: Alkyd, exterior, flat (MPI Gloss Level 5), MPI #8.
- C. Pre-Primed Metal Doors
  - 1. Doors should be prepared to SSPC-SP2 specifications. All bare areas and rusty areas should be spot primed prior to applying the topcoat. All slick and glossy areas should be dulled prior to applying any coating.
  - 2. Spot Prime: Use primer suggested from manufacturer.
  - 3. Intermediate Coat: Light industrial coating, exterior, water based, matching topcoat.
  - 4. Topcoat: Light industrial coating, exterior, water based, semi-gloss (Gloss Level 5), MPI #163.

**END OF SECTION 09 91 14**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes surface preparation and the application of paint systems on interior substrates.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of paint system and in each color and gloss of topcoat.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. See Finish Legend for additional information.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. MDC International.
  - 3. PPG Architectural Finishes, Inc.
  - 4. Sherwin-Williams Company (The).

**2.2 PAINT, GENERAL**

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

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

## **SECTION 09 91 23 - INTERIOR PAINTING**

- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Wood: 15 percent.
  - 2. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### **3.2 PREPARATION**

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
  - 2. Uncoated and metallic-coated metals requiring paint shall be cleaned by removing oil, grease, dirt, dust and foreign matter by solvent cleaning in accordance with SSPC-SP1 prior to apply any finish.
    - a. All primers on hollow metal are shipping primers and they must all be fully prepared and reprimed.
    - b. Do not accept shipping primers as a primer for this project.

### **3.3 APPLICATION**

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### **3.4 INTERIOR PAINTING SCHEDULE**

- A. See Finish Legend.

**END OF SECTION 09 91 23**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section includes surface preparation and the application of high-performance coating systems.

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of coating system and each color and gloss of topcoat indicated.
  - 1. Submit Samples on rigid backing, 8 inches square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.
  - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to coating system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  - 1. Maintain containers in clean condition, free of foreign materials and residue.
  - 2. Remove rags and waste from storage areas daily.

**1.5 FIELD CONDITIONS**

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
- C. Do not apply exterior coatings in snow, rain, fog, or mist.

## **SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS**

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company (The) ; High-Performance Coatings or a comparable product by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. PPG Paints; PPG Industries, Inc.
  - 3. Tnemec Company, Inc.
  
- B. Products: Subject to compliance with requirements, provide product listed in the Exterior High-Performance Coating Schedule or Interior High-Performance Coating Schedule for the coating category indicated.

#### **2.2 HIGH-PERFORMANCE COATINGS, GENERAL**

- A. Colors: As indicated in Finish Legend.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Masonry (Clay and CMUs): 12 percent.
  
- C. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
  
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

#### **3.2 PREPARATION**

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and coating systems indicated.
  
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
  
- C. Clean substrates of substances that could impair bond of coatings, 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 coating systems indicated.

## **SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS**

2. All shipping primers are considered to be incompatible primers.
- D. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or alkalinity of mortar joints exceeds that permitted in manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- F. 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.
- G. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied coatings.

### **3.3 APPLICATION**

- A. Apply high-performance coatings according to manufacturer's written instructions and recommendations.
  1. Use applicators and techniques suited for coating and substrate indicated.
  2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
  3. Coat backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.
- D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

### **3.4 FIELD QUALITY CONTROL**

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.
  1. Contractor shall touch up and restore coated surfaces damaged by testing.
  2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

## **SECTION 09 96 00 - HIGH-PERFORMANCE COATINGS**

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### **3.5 CLEANING AND PROTECTION**

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating operation. Correct damage to work of other trades by cleaning, repairing, replacing, and recoating, 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 coated surfaces.

### **3.6 HIGH-PERFORMANCE COATING SCHEDULE**

- A. See Finish Legend.

**END OF SECTION 09 96 00**

## **SECTION 10 14 03 - IDENTIFICATION DEVICES - EXTERIOR**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Furnish labor, materials, tools, equipment, and services required for fabrication and installation of Identification Devices as indicated in the Drawings and described in this Section.
- B. Sign base construction and installation are the responsibility of the signage manufacturer.
- C. The brick base of the monument sign will match the brick used on the main building. Signage manufacturer to coordinate with the general contractor to secure brick stock for construction.
- D. Identification devices indicated in AG-Series Drawings are specified in this Section.
- E. Completely coordinate with work of other trades.

#### **1.2 QUALITY ASSURANCE**

- A. Provide fabrication drawings engineered to support dead, live, lateral (wind or seismic), and snow or ice loads indicated for mechanically mounted or anchored identification devices.
  - 1. Comply with Section 01 71 21, Specialty Engineering Requirements.
  - 2. Include seal and signature of engineer licensed in the state where project is located.
- B. Foundations:
  - 1. Design, engineering, and installation of freestanding footings are the responsibility of the sign manufacturer.
  - 2. Install signage on footings level, plumb, square, and true.
  - 3. Comply with Section 01 71 21, Specialty Engineering Requirements.
  - 4. Include seal and signature of engineer licensed in the state where project is located.
- C. Permits:
  - 1. Secure exterior signage permits based on the local codes and regulations.
  - 2. Notify Architect to resolve design limitations based on code restrictions.

#### **1.3 SUBMITTALS**

- A. Product Data:
  - 1. For each type of material and accessory.
- B. Shop Drawings:
  - 1. Fabrication and installation drawings for identification device types.
    - a. Scaled drawings of major components.
    - b. Demonstrate load capacity of components by labeling or calculations.
    - c. Include dimensioned plans, elevations, and scaled details of identification device wording and lettering layout.
  - 2. Field verify dimensions and locations for identification device types prior to developing shop drawings.
  - 3. Furnish location template drawings for items supported or anchored to permanent building construction.

## **SECTION 10 14 03 - IDENTIFICATION DEVICES - EXTERIOR**

- C. Samples:
  - 1. Scaled print of the sign type.
  - 2. Minimum 6 inches x 6 inches sample of materials for identification device types.
  - 3. Minimum 6 inches x 6 inches sample of colors requiring color matches on samples of actual identification device material.
  
- D. Project Information:
  - 1. Engineering design details and calculations for identification device material components, gauges, footings, anchors with applicable design loads noted, sealed by registered Engineer (licensed to practice Structural Engineering in the state where project is located) for identification devices requiring footings, foundations, and structural support, including identification device types mounted on exterior of building.
    - a. Include plans, and elevations.
    - b. Indicate accessory items and anchorages.
    - c. Design in accordance with Local Building Codes.
  
- E. Contract Closeout Information:
  - 1. Operation and Maintenance Data.
    - a. See Section 01 78 23.
  - 2. Spare parts.
    - a. See Section 01 78 43.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Identification Devices - Exterior:
  - a. Poblocki Sign Company.
  - b. ASI Sign Systems.
  - c. Jones Sign.
  - d. DCL (Design Communication Ltd.)
  - e. L&H Sign Company
  
- B. Other manufacturers desiring approval comply with Section 01 61 00.

#### **2.2 MATERIALS**

- A. Identification Devices:
  - 1. References to Drawings are to sheets labeled AG.
    - a. Information may also be listed on other sheets such as A and E.
  - 2. Following information is shown on Drawings for each sign type:
    - a. Individual component and accent materials.
    - b. Letter style, case, and height.
    - c. Character proportions.
    - d. Letter colors.
    - e. Background color and other graphics.
    - f. Location of sign relative to other building elements.
    - g. Finish level.
  
- B. Identification Device Finish Level:



## SECTION 10 14 03 - IDENTIFICATION DEVICES - EXTERIOR

1. High Finish:
  2. Finish and Contrast:
    - a. Characters and background:
      - 1) Non-glare.
      - 2) 70% contrast between characters with background.
- C. Materials:
1. Inert.
  2. Materials listed establish the minimum acceptable quality, size, and performance. Equivalent or superior materials will be allowed. Acceptance of alternate materials will be determined in the submittal process.
- D. Dissimilar Metals Protection:
1. Prevent galvanic reactions between products used.
- E. Aluminum:
1. Sheet:
    - a. Alloy and temper recommended by aluminum manufacturer for type of use, and finish indicated.
    - b. Provide with minimum strength and durability in accordance with ASTM B209, Table for 5052 for thickness specified.
  2. Extrusions:
    - a. Alloy and temper recommended by aluminum manufacturer for the type of use, and finish indicated.
    - b. Provide with minimum strength and durability in accordance with ASTM B221, Table for 6061 for thickness indicated.
  3. Anodized:
    - a. Mill produced 5005 alloy, anodized quality aluminum.
    - b. Coating: Clear, anodized coating, 0.2 mil thick.
- F. Paints:
1. Apply paint under-coating for identification devices for deterioration of metals prevention.
  2. Evenly spray apply finish in accordance with manufacturer's recommendation.
    - a. Finish to be free of grit, dirt, smears, spots, and orange peel effect.
    - b. Ensure paint compatible with metal used.
  3. Each coat shall have UV Inhibitors
  4. Manufacturer: Matthews Paint Company, Pleasant Prairie, WI.
- G. Fasteners and Anchors:
1. Anchors and inserts:
    - a. Exterior installations, and areas requiring corrosion resistance:
      - 1) Non-ferrous metal, or hot-dipped galvanized anchors and inserts.
    - b. Concrete and masonry work: Toothed steel, or lead expansion bolt devices with inserts for drilled-in-place anchors.
  2. Mechanical fastening: Manufacturer's recommended fasteners based on identification device type and substrate.
  3. Metal letters and numbers:
    - a. Manufacturer's standard fastening method for letter form, type of mounting, and condition of exposure.
    - b. Heavy paper template: Provided by Manufacturer for establishing letter spacing and for locating holes for fasteners.
  4. Installer requirements:
    - a. Based on manufacturer recommendations, installer shall be responsible for fastener compatibility with substrates.

## SECTION 10 14 03 - IDENTIFICATION DEVICES - EXTERIOR

- b. Insure that oxidation does not occur, or that other reactive processes do not occur between related signage materials and fasteners.
- H. Finishes:
  - 1. Metal finishes: Finish in compliance with NAAMM Metal Finishes Manual for finish designations and application recommendations.
  - 2. Paint: Satin finish.
  - 3. Comply with American with Disabilities Act:
    - a. Measure finishes with a Glossimeter to ensure compliance.
- I. Graphics:
  - 1. Image Process:
    - a. Graphic content and style:
      - 1) Provide identification device copy in compliance with requirements indicated for content, finishes, materials, positions, sizes, spacing, styles, and colors of letters, numbers, symbols, and other graphic images.
  - 2. Typography:
    - a. Typography and graphics:
      - 1) Photographically or mechanically reproduced.
    - b. Identification device typeface fonts:
      - 1) Provide as indicated on Drawings.
    - c. Letter forms:
      - 1) Use approved type font masters from original type foundry.
      - 2) Cut letter forms using graphic film cutter plotter equipment.
      - 3) Letter forms edges and corners are to be clean and true.
- J. Artwork:
  - 1. Manufacturer provides typesetting, and mechanical artwork required for identification device types.

### 2.3 FABRICATION

- A. General Requirements:
  - 1. Fabricate and assemble identification devices in shop to the greatest extent possible.
  - 2. Fabricate parts and assemblies ready for installation at the building site.
  - 3. Surface defects considered unacceptable: Oil canning, cupping, and warping.
  - 4. Grind welds smooth.
  - 5. No visible mounting on sign faces.
  - 6. Be responsible for structural stability and mounting for graphics and identification devices.
- B. Identification Device Panels:
  - 1. Comply with requirements indicated for colors, designs, details of construction, finishes, materials, shapes, sizes, and thicknesses.
  - 2. Surfaces: Smooth, even, and level.
  - 3. Identification device panel flatness:
    - a. Fabricate panels to remain flat within 1/32 inches over the concave surface.
    - b. Fabricate panels to remain flat under installed conditions within a tolerance of plus or minus 1/16 inches measured diagonally.
  - 4. Edge Condition: 90 degree square cut, unless otherwise noted.
  - 5. Corner condition: Provide square corners, unless otherwise noted.
  - 6. Panel materials:
    - a. See drawings for types.

## **SECTION 10 14 03 - IDENTIFICATION DEVICES - EXTERIOR**

- C. Metal Letters and Numbers:
  - 1. Comply with requirements indicated for manufacturing process, finish, materials, message content, style, and size.
  - 2. Metal: Aluminum, unless otherwise indicated.
  - 3. Water-jet cut for square and smooth edges.

### **PART 3 - EXECUTION**

#### **3.1 Examination**

- A. Examine conditions under which materials are to be installed.
- B. Installation constitutes acceptance of responsibility for performance.

#### **3.2 INSTALLATION**

- A. General Requirements:
  - 1. Locate identification devices and accessories where shown or scheduled in AG-Series drawings.
  - 2. Use mounting method types indicated and as described, and in accordance with manufacturer's recommendations.
  - 3. Field determine exact locations and dimensions for identification devices prior to fabrication.
  - 4. Immediately notify Owner and Architect if building and site conditions are at variance with drawings.
    - a. Do not proceed until the unsatisfactory conditions have been corrected.
  - 5. Install identification devices in positions shown on drawings.
    - a. Install identification devices at heights indicated, plumb, and in alignment.
    - b. Brace devices securely until permanent anchorage is made.
    - c. Identification device surfaces are to be installed free from distortion or other defects in appearance.
    - d. Perform cutting, drilling, and fitting carefully.
    - e. When required, fit at site before finishing.
- B. Mount identification devices according to methods specified or as indicated on drawings for each type.

#### **3.3 CLEAN-UP**

- A. At completion of the installation, clean identification devices with appropriate cleaning agents prior to final inspection and acceptance. Grease, fingerprints, smudges, adhesive, etc. remaining on identification devices or components will not be acceptable. Protect identification device units from damage until acceptance by Owner.
- B. Remove packing and debris from the project site upon completion and leave the site in a condition which is clean and free of damage and abuse.

**END OF SECTION**

**SECTION 10 14 03 - IDENTIFICATION DEVICES - EXTERIOR**

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## **SECTION 10 14 24 – CODE MANDATED ROOM SIGNAGE FOR CO ONLY**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes code mandated room-identification signs for Certificate of Occupancy Only.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For panel signs.
  - 1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
  - 2. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples: For each exposed product and for each color and texture specified.

#### **1.3 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Deterioration of embedded graphic image.
    - c. Separation or delamination of sheet materials and components.
  - 2. Warranty Period: Five years from date of Final Completion or Beneficial Occupancy.

### **PART 2 - PRODUCTS**

#### **2.1 PERFORMANCE REQUIREMENTS**

- A. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
- B. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities, North Carolina Accessibility requirements, and ICC A117.1 for signs.

#### **2.2 SIGNS**

- A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide Mohawk Sign Systems; or a comparable product from those listed below:

## **SECTION 10 14 24 – CODE MANDATED ROOM SIGNAGE FOR CO ONLY**

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. ACE Sign Systems, Inc.
  - b. Advance Corporation.
  - c. Allen Industries Architectural Signage
  - d. Allen Markings.
  - e. APCO Graphics, Inc.
  - f. ASE, Inc.
  - g. ASI Sign Systems, Inc.
  - h. Best Sign Systems, Inc.
  - i. Bunting Graphics, Inc.
  - j. Clarke Systems.
  - k. Nelson-Harkins Industries.
  - l. Poblocki Sign Company, LLC.
  - m. Seton Identification Products.
  - n. Stamprite Supersine; a division of Stamp Rite Inc.
  - o. Vista System.
  
- C. Panel Sign:
  1. Signs shall be ADA compliant, size 8" x 8" with a 4" accessibility symbol, gender symbol and the verbal description placed directly below followed by Grade 2 braille.
  2. Corners: 1/2" radius
  3. Design: MS-1 (Men), MS-2 (Women), MS-5 (Family), and MS-25 (Staff).
  4. Material: Plastic Laminate or Acrylic.

### **2.3 ACCESSORIES**

- A. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

### **2.4 FABRICATION**

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  
- B. Mounting Methods:
  1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
  
- C. Remove temporary protective coverings and strippable films as signs are installed.

## **SECTION 10 14 24 – CODE MANDATED ROOM SIGNAGE FOR CO ONLY**

### **3.2 SCHEDULE**

- A. Provide the following suggested, but not inclusive list, of Code mandated signage:
1. Men.
  2. Women.
  3. Family.
  4. Staff / Utility / Electrical / Mechanical / Elevator Room / Fire Control Room.
  5. Control.
  6. Office.
  7. Stairs with additional sign for no roof top access.

**END OF SECTION 10 14 24**

**SECTION 10 14 24 – CODE MANDATED ROOM SIGNAGE FOR CO ONLY**

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# **SECTION 10 21 13 - PHENOLIC-CORE TOILET COMPARTMENTS**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachment details.
- C. Samples for each type of toilet compartment material indicated.

### **1.3 INFORMATIONAL SUBMITTALS**

- A. Product certificates.

### **1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE REQUIREMENTS**

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 200 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

### **2.2 PHENOLIC-CORE TOILET COMPARTMENTS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide ASI Global Partitions, ALPACO Classics or comparable product by one of the following:
  - 1. Bobrick Washroom Equipment, Inc.
  - 2. Bradley Corporation.
  - 3. Decolam.
- B. Toilet-Enclosure Style: Overhead braced.

## **SECTION 10 21 13 - PHENOLIC-CORE TOILET COMPARTMENTS**

- C. Urinal-Screen Style: Wall hung.
- D. Door, Panel, Screen, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges and no-sightline system.
  - 1. Provide minimum 3/4-inch-thick doors and pilasters and minimum 1/2-inch-thick panels.
  - 2. Provide with no-sightline system consisting of door and pilaster lapped edges on strike side of door and door and pilaster lapped edges on hinge side of door (unless continuous hinge is used).
- E. Pilaster Shoes: Formed from stainless steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.
- F. Brackets (Fittings):
  - 1. Full-Height (Continuous) Type: Manufacturer's standard design; aluminum.
- G. Phenolic-Panel Finish:
  - 1. Facing Sheet Finish: One color and pattern in each room.
  - 2. Color and Pattern: Asian Night 9550.
  - 3. Edge Color: Manufacturer's standard.

### **2.3 HARDWARE AND ACCESSORIES**

- A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.
  - 1. Material: Chrome-plated zamac.
  - 2. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
- B. Hardware and Accessories: Manufacturer's heavy-duty stainless steel operating hardware and accessories.
  - 1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
- C. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- D. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

### **2.4 FABRICATION**

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

## **SECTION 10 21 13 - PHENOLIC-CORE TOILET COMPARTMENTS**

- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide in-swinging doors for standard toilet compartments and 36-inch-wide out-swinging doors with a minimum 32-inch-wide clear opening for compartments designated as accessible.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
  - 1. Maximum Clearances:
    - a. Pilasters and Panels: 1/2 inch.
    - b. Panels and Walls: 1 inch.
  - 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.
    - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.
  - 3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.
    - a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
    - b. Align brackets at pilasters with brackets at walls.

#### **3.2 ADJUSTING**

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

**END OF SECTION 10 21 13**

**SECTION 10 21 13 - PHENOLIC-CORE TOILET COMPARTMENTS**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Corner guards.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
  - 1. Include plans, elevations, sections, and attachment details.
- C. Samples: For each exposed product and for each color and texture specified, 12 inches long.

**1.3 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**1.4 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

- A. Surface Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

**2.2 CORNER GUARDS**

- A. Surface-Mounted, Metal Corner Guards (CG-1): Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Construction Specialties, Inc.; CO-8 or a comparable product by one of the following:
    - a. Koroseal Interior Products, LLC.

- b. inpro Corporation.
2. Material: Stainless-steel sheet, Type 304.
  - a. Thickness: Minimum 16 gauge.
  - b. Finish: Directional satin, No. 4.
3. Wing Size: Nominal 1-1/2 by 1-1/2 inches.
4. Corner Radius: 1/8 inch.
5. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.

### **2.3 MATERIALS**

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required; thickness as indicated.
- B. Polycarbonate Plastic Sheet: ASTM D6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. of notch when tested according to ASTM D256, Test Method A.
- C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.
- D. Adhesive: As recommended by protection product manufacturer.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.
- C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
  1. Provide anchoring devices and suitable locations to withstand imposed loads.
  2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.

**END OF SECTION 10 26 00**

## **SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Washroom and bathroom accessories.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Samples: Full size, for each exposed product and for each finish specified.

#### **1.3 INFORMATIONAL SUBMITTALS**

- A. Sample warranty.

#### **1.4 WARRANTY**

- A. Manufacturer's Special Warranty for Mirrors: Manufacturer agrees to repair or replace mirrors that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 15 years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.1 WASHROOM ACCESSORIES**

- A. General: All washroom accessories shall be single sourced.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ASI-American Specialties, Inc.
  - 2. Bobrick Washroom Equipment, Inc.
  - 3. Bradley Corporation.
  - 4. Gamco Commercial Restroom Accessories; Bobrick Washroom Equipment, Inc.

#### **2.2 FABRICATION**

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

## **SECTION 10 28 00 - TOILET, BATH, AND LAUNDRY ACCESSORIES**

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### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

#### **3.2 SCHEDULE**

- A. As indicated.

**END OF SECTION 10 28 00**



**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Fire-protection cabinets for portable fire extinguishers.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For fire-protection cabinets.
- C. Samples: For each type of exposed finish required.

**1.3 CLOSEOUT SUBMITTALS**

- A. Maintenance data.

**1.4 COORDINATION**

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

**PART 2 - PRODUCTS**

**2.1 PERFORMANCE REQUIREMENTS**

**2.2 FIRE-PROTECTION CABINET**

- A. Cabinet Type: Suitable for fire extinguisher.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Babcock-Davis.
    - b. J. L. Industries, Inc.; Activar Construction Products Group, Inc.
    - c. Larsen's Manufacturing Company.
    - d. Modern Metal Products.
    - e. Nystrom, Inc.
    - f. Potter Roemer LLC; a Division of Morris Group International.
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Cold-rolled steel sheet.

## SECTION 10 44 13 - FIRE PROTECTION CABINETS

- D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).
  - 1. Rolled-Edge Trim: 2-1/2-inch backbend depth.
- E. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on wall with no trim.
- F. Cabinet Trim Material: Steel sheet.
- G. Door Material: Steel sheet.
- H. Door Style: Vertical duo panel with frame.
- I. Door Glazing: Tempered float glass (clear).
- J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- K. Accessories:
  - 1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
    - a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
      - 1) Location: Applied to cabinet door.
      - 2) Application Process: Pressure-sensitive vinyl letters.
      - 3) Lettering Color: Red.
      - 4) Orientation: Vertical.
- L. Materials:
  - 1. Cold-Rolled Steel: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
    - a. Finish: Baked enamel, TGIC polyester powder coat, HAA polyester powder coat, epoxy powder coat, or polyester/epoxy hybrid powder coat, complying with AAMA 2603.
    - b. Color: As selected by Architect from manufacturer's full range.
  - 2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

### 2.3 FABRICATION

- A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Prepare recesses for recessed and semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.
- B. Install fire-protection cabinets in locations and at mounting heights indicated.
- C. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

## **SECTION 10 44 13 - FIRE PROTECTION CABINETS**

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- D. Identification: Apply vinyl lettering at locations indicated.
- E. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

**END OF SECTION 10 44 13**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Portable fire extinguishers.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 05 50 00 - Metal Fabrications.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Americans with Disabilities Act (ADA):
    - a. 2010 ADA Standards for Accessible Design.
  - 2. National Fire Protection Association (NFPA):
    - a. 10, Standard for Portable Fire Extinguishers.
  - 3. Underwriters Laboratories, Inc. (UL):
    - a. 154, Carbon Dioxide Fire Extinguishers.
    - b. 299, Dry Chemical Fire Extinguishers.
    - c. 711, Rating and Fire Testing of Fire Extinguishers.

**1.3 DEFINITIONS**

- A. Authority Having Jurisdiction (AHJ): Building official, fire chief, fire marshal or other individual having statutory authority.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Ratings and classification of extinguishers.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver and install filled and charged extinguishers just prior to building occupancy.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

## **SECTION 10 44 33 - FIRE PROTECTION SPECIALTIES**

1. Fire extinguishers:
  - a. Amerex Corporation.
  - b. Ansul – Tyco Fire Protection Products.
  - c. Badger Fire Protection.
  - d. United Technologies - Kidde.
  - e. Buckeye Fire Equipment.
2. Fire extinguisher signs:
  - a. Seton.
  - b. Compliance Signs.
  - c. Safety Sign.

### **2.2 MANUFACTURED UNITS**

- A. Fire Extinguisher (FEXT):
  1. Steel bodied, all metal top (head) and valves.
  2. Multi-purpose dry chemical extinguisher with hose and nozzle.
  3. Provide one listed 10 pound. 4A-60BC extinguisher for each fire extinguisher location (FEXT) indicated on Drawings.
  4. Finish: Red with epoxy finish coat.
- B. Wall Brackets:
  1. Bracket type to fit specified extinguisher.
  2. Furnish bracket for each extinguisher not in cabinet.
  3. Bracket to be finished in red or black enamel.
- C. Fire Extinguisher Signage:
  1. Single faced: SETON #21999.
  2. Double faced: SETON #22001.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions and NFPA 10.
  1. Install units with extinguisher top not over 48 inches above floor.
  2. Install wall brackets to concrete or masonry substrate with self-tapping concrete anchors.
    - a. See Specification Section 03 15 19.
- B. Fire extinguisher locations shown on Drawings are approximate locations.
  1. Verify all extinguisher mounting locations with the AHJ.
- C. Provide "FIRE EXTINGUISHER" sign for each extinguisher location.
  1. Provide single or double faced sign to provide optimum visibility for extinguisher location.

**END OF SECTION 10 44 33**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Phenolic lockers.
  - 2. Phenolic locker benches.

**1.2 ACTION SUBMITTALS**

- A. Product Data:
  - 1. For each type of product.
    - a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings:
  - 1. Plans, elevations, sections, and attachment details.
  - 2. Locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  - 3. Locations and sizes of cutouts and holes for items installed in lockers.
  - 4. Locker fillers, trim, base, sloping tops, and accessories.
  - 5. Locker identification system and numbering sequence.
- C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of phenolic locker. Include full range of available options for hardware and accessories involving material, finish, and/or color selection.
- D. Samples for Verification: Actual sample of finished products for each type of phenolic locker, hardware, and accessory.
  - 1. Size: Manufacturers' standard size.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Material Test Reports: For phenolic panel, by a qualified testing agency.
- B. Sample Warranties: For phenolic lockers.

**1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For phenolic lockers including adjusting, repairing, and replacing locker doors and latching mechanisms.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Fabricator of products.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Do not deliver lockers until spaces to receive them are clean, dry, and ready for their installation.

**1.7 FIELD CONDITIONS**

- A. Field Measurements: Verify actual dimensions of construction contiguous with lockers by field measurements, and coordinate before fabrication.

**1.8 COORDINATION**

- A. Coordinate sizes and locations of concealed wood support bases.
  - 1. Requirements are specified in Section 06 10 00 "Rough Carpentry."
- B. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that lockers can be supported and installed as indicated.

**1.9 WARRANTY**

- A. Special Warranty: Manufacturer agrees to repair or replace components of lockers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures.
    - b. Faulty operation of hardware.
    - c. Deterioration of finishes and materials beyond normal use.
  - 2. Warranty Period: Twenty years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 SOURCE LIMITATIONS**

- A. Obtain phenolic lockers, phenolic locker benches, and hardware and accessories from single source from single manufacturer.

**2.2 PERFORMANCE REQUIREMENTS**

- A. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Accessibility Regulations: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 for lockers and locker benches designated as accessible.



**2.3 PHENOLIC LOCKERS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide ASI Storage Solutions; Phenolic Traditional Plus Collection or comparable product by one of the following:
  - 1. Club Resource Group.
  - 2. Hollman, Inc.
  - 3. Ideal Products, Inc.
  - 4. List Industries Inc.
  - 5. Partition Systems International of South Carolina (PSISC); Columbia Systems International of South Carolina LLC.
- B. Construction Style: Manufacturer's standard factory-assembled flush overlay units.
- C. Locker Body: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with beveled and polished edges.
  - 1. Thickness:
    - a. Side Panels: Manufacturer's standard.
    - b. Back Panel: Manufacturer's standard.
    - c. Top Panel: Manufacturer's standard.
    - d. Bottom Panel: Manufacturer's standard.
- D. Doors: Solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with beveled and polished edges.
  - 1. Thickness: 1/2 inch.
- E. End Panels: Match style, material, construction, thickness, and finish of doors.
- F. Fixed Shelves: Match style, material, construction, and finish of locker body.
  - 1. Thickness: 1/2 inch.
- G. Corners and Filler Panels: Match style, material, construction, thickness, and finish of doors.
- H. Continuous Finish Base: Match style, material, construction, thickness, and finish of doors; fabricated in lengths as long as practical to enclose base and base ends of lockers.
- I. Continuously Sloping Tops: Match style, material, construction, thickness, and finish of doors, for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practical, without visible fasteners at splice locations. Provide fasteners, supports, and closures, as follows:
  - 1. Closures: Vertical-end type.
  - 2. Sloping-top corner fillers, mitered.
- J. Phenolic Locker Finish:
  - 1. Black-Core Phenolic:
    - a. Facing Sheet Color: Asian Night 9550.
      - 1) Locker Body: Asian Night 9550.
      - 2) Doors: Asian Night 9550.
    - b. Exposed Edges: Manufacturer's standard black edge.
- K. Locker Base: Provide phenolic pedestals and clip on phenolic panels for front and closed end bases.
- L. Wall Brackets: Provide wall brackets as indicated.

**2.4 HARDWARE**

- A. Locking Device:
  - 1. Padlock Hasp: Surface mounted, steel, through bolted.
    - a. Finish: Manufacturer's standard.
- B. Hinges:
  - 1. Manufacturer's standard.
- C. Handle:
  - 1. Wire Pulls: Back mounted.
    - a. Size: 4 inches long, 5/16 inch in diameter.
    - b. Material and Finish: Manufacturer's standard.
  - 2. Accessible Handle: Metal, fixed, graspable lever handle and rose trim; surface mounted.
    - a. Material and Finish: Manufacturer's standard.
- D. Hooks: Ball-pointed hooks. Attach hooks with at least two fasteners.
  - 1. Hook Configuration:
    - a. Manufacturer's standard.
  - 2. Material and Finish: Manufacturer's standard.
- E. Coat Rods:
  - 1. Size: Manufacturer's standard diameter steel.
  - 2. Configuration:
    - a. Provide coat rod for each compartment of single-tier lockers.
  - 3. Finish: Manufacturer's standard.

**2.5 ACCESSORIES**

- A. Number Identification:
  - 1. Manufacturer's standard.
  - 2. Number Plates: 1-1/2-by-2-1/4-inch-rectangular, etched, embossed, or stamped, aluminum or stainless-steel plates with black numbers and letters at least 3/8 inch high. Identify lockers in sequence indicated during Shop Drawings review.

**2.6 PHENOLIC LOCKER BENCHES**

- A. Bench Top: 3/4-inch-thick, solid phenolic-core material with melamine facing on both sides fused to substrate during manufacture (not separately laminated), and with radiused corners and eased and polished edges.
  - 1. Width: 20 inches.
    - a. Provide 20-inch minimum and 24-inch maximum width where accessible benches are indicated.
  - 2. Height: 18 inches measured from top of bench to floor.
  - 3. Length: As indicated.
  - 4. Finish:
    - a. Black-Core Phenolic:
      - 1) Facing Sheet Color: Match locker facing sheet.
      - 2) Exposed Edges: Manufacturer's standard black edge.
    - b. Through-Color Phenolic:
      - 1) Color: Match locker.

**2.7 MATERIALS**

- A. Anchors: Material, type, size, and finish as required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

**2.8 FABRICATION**

- A. Fabricate each locker with shelves, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.
  - 1. Fabricate lockers to dimensions, profiles, and details indicated.
- B. Fabricate lockers square, rigid, without warp, and with finished faces flat and free of dents, scratches, and chips. Accurately factory machine components for attachments. Make joints tight and true.
- C. Shelving: Provide all shelving 15-inches wide.
- D. Accessible Lockers: Fabricate as follows:
  - 1. Locate bottom shelf no lower than 15 inches above the floor.
  - 2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.
- E. Venting: Fabricate lockers with space between doors and locker assembly of not less than 1/4 inch.
- F. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
  - 1. Use only manufacturer's nuts, bolts, screws, and other devices for assembly.
- G. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install phenolic pedestals and clip on base with phenolic top.

## **SECTION 10 51 29 - PHENOLIC LOCKERS**

- B. Install lockers level, plumb, and true; shim as required, using concealed shims.
  - 1. Connect single rows of lockers together side-to-side at each locker. Connect back-to-back lockers together side-to-side at each locker and back-to-back at each locker. Use manufacturer's standard connecting bolts, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.
  - 2. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c., using manufacturer's standard concealed fasteners for material indicated.
    - a. Anchor single rows of lockers to walls near top and bottom of lockers to base.
- C. Install lockers without distortion so doors fit openings properly and are accurately aligned. Adjust hardware to center doors in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.
- D. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.
- E. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.
- F. Attach sloping-top units to lockers, with end panels covering exposed ends.
- G. Install number identification plates after lockers are in place.
  - 1. Attach number identification plate on each locker door, near top, centered, with at least two screws with finish matching the plate.
- H. Fixed Locker Benches: Provide brackets to each bench as indicated. Securely fasten to undersides of bench tops.

### **3.3 ADJUSTING**

- A. Clean, lubricate, and adjust hardware. Adjust doors to operate easily without binding.

### **3.4 PROTECTION**

- A. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.
- B. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

**END OF SECTION 10 51 23**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

**1.2 WORK INCLUDED**

- A. Equipment items as listed below by Equipment Identifier:
  - 1. 1632 CAROUSEL, STORAGE, TIRE, 44 INCH (117 TIRES) (Ref. Part 2.1)
- B. Installation of equipment with labor, services, and incidentals necessary for complete and operational equipment installation.
- C. Utilities to be roughed in at location recommended by manufacturer.

**1.3 QUALITY ASSURANCE**

- A. Equipment shall be produced by a manufacturer of established reputation with a minimum of five years' experience supplying specified equipment.

**1.4 SUBMITTALS**

- A. Product Data:
  - 1. Submit Product Data in accordance with Division 1 - General Requirements of these specifications.
  - 2. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.
  - 3. Additional costs resulting from substitution of products other than those specified, including drawing changes and construction, shall be at the expense of the contractor.
- B. Operations and Maintenance Manual:
  - 1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
  - 2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
  - 3. Description of system and components.
  - 4. Schematic diagrams of electrical, plumbing, and compressed air system.
  - 5. Manufacturer's printed operating instructions.
  - 6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.

**1.5 PRODUCT SUBSTITUTIONS**

- A. Follow requirements specified in Division 1 - General Requirements.

**SECTION 10 56 00 - STORAGE EQUIPMENT**

- B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.
- C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

**1.6 WARRANTY**

- A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.
- B. Warranty shall include materials and labor necessary to correct defects.
- C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situations resulting from non-performance of a manufacturer’s recommended preventive maintenance schedule.
- D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.
- E. All parts shall be readily available locally in the United States.

**1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver equipment in manufacturer’s containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.
- B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.
- C. Provide equipment and material specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

**PART 2 - PRODUCTS**

**2.1 CAROUSEL, STORAGE, TIRE, 44 INCH  
Equipment Identifier: 1632**

- A. Manufacturer’s Reference:
  - 1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimal acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
VIDIR VERTICAL STORAGE SYSTEMS Model No.: HT54288-0963-12	LEBANON	PA	(717) 270-1000

**SECTION 10 56 00 - STORAGE EQUIPMENT**

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

Manufacturer	City	State	Phone
ALT #1 REMCO STORAGE SOLUTIONS	TROY	MI	(248) 362-0500

B. Capacities/Dimensions:

1. Overall dimension, weight, and capacity:

Overall Dimensions		
Length	Width	Height
178 1/2"	111 1/2"	307"
Weight		Capacity
10968 lb		20000 lb

- Lift drive motor: Dual 2.0 HP motor/gearbox drive system
- Carrier quantity: 9
- Maximum tire size: 44 inch diameter
- Minimum tire quantity: 117 (based upon 11 inch tire)
- Maximum tire carrier capacity: 2,000 pounds each
- Off-balance Load lift capacity: 2,500 pounds
- Lifting speed: 26 feet, 6 inches per minute

C. Features/Performance/Construction:

- The unit shall have a tire restrictor bar to prevent larger tires than recommended to be loaded.
- Provide two tire ends per carrier to secure partial loads.
- Provide wire mesh back and wire mesh front.
- Side panels shall be fully shielded.
- Provide seismic bracing and anchoring to meet any local, state, and national codes and provisions.

D. Controls: single speed forward/reverse, security keypad, and emergency stop.

E. Accessories:

Description	Manufacturer	Model No.	Qty.
TIRE RAMP (ONE EACH PER UNIT)	VIDIR VERTICAL STORAGE SYSTEMS	2-59209	1
SEISMIC BRACING (ONE EACH PER UNIT)	VIDIR VERTICAL STORAGE SYSTEMS	301-1003	1

F. Utility Requirements:

Electrical				
Voltage	Phase	HP	Amperage	Connection Type
460	3	4	15.00	DISCONNECT

G. Finish: Durable enamel in owner's choice of manufacturer's standard colors

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.
- B. Inspect delivered equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.

**3.2 INSTALLATION**

- A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect or designated representative.
- B. Install equipment in accordance with plans, shop drawings, and manufacturer's instructions:
  - 1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.
  - 2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
  - 3. Anchorage: Attach equipment as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.
- C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

**3.3 TESTING**

- A. After final installation is complete and prior to authorizing payment, specified equipment shall be checked with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

**3.4 CLEANUP**

- A. Touch-up damage to painted finishes.
- B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.
- C. Clean area around equipment installation and remove packing and installation debris from job site.
- D. Notify Architect or designated representative when installation and cleanup is 100% complete and ready for final observation (punchlist).



**3.5 TRAINING**

- A. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.
  - 1. 1632 CAROUSEL, STORAGE, TIRE, 44 INCH (117 TIRES); 2 hours (minimum)
- B. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

**END OF SECTION 10 56 00**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

**1.2 WORK INCLUDED**

- A. Equipment items as listed below by Equipment Identifier:
  1. 7015 CABINET, STORAGE, HEATED (DEF) WITH DISPENSER (Ref. Part 2.1)
  2. 7510 PUMP, AIR PISTON, 55 GALLON (CG), WITH HOIST (Ref. Part 2.2)
  3. 7513 PUMP, AIR PISTON, 16 GALLON (CG), PORTABLE (Ref. Part 2.3)
  4. 7520 PUMP, AIR PISTON, 10:1 RATIO (EO1, EO2, EO3, HO) (Ref. Part 2.4)
  5. 7530 PUMP, DIAPHRAGM, NON-MIXING (EC) (Ref. Part 2.5)
  6. 7540 PUMP, DIAPHRAGM, USED FLUID EVACUATION (UO) (Ref. Part 2.6)
  7. 7541 PUMP, DIAPHRAGM, USED FLUID EVACUATION (UC) (Ref. Part 2.7)
  8. 7700 REEL BANK, GENERAL (Ref. Part 2.8)
  9. 7710 REEL BANK (CA 3/8") (Ref. Part 2.9)
  10. 7720 REEL BANK (CA 3/8", CG) (Ref. Part 2.10)
  11. 7750 REEL BANK (CA 3/8", CG, EC, EO1, HO) (Ref. Part 2.11)
  12. 7751 REEL BANK (CA 3/8", EC, EO1, EO2, EO3) (Ref. Part 2.12)
  13. 7958 TANK, DOUBLE WALL, CUBE, 240 GALLON (EC, HO) (Ref. Part 2.13)
  14. 7970 TANK, DOUBLE WALL, CUBE, 500 GALLON (EO2, EO3, UC) (Ref. Part 2.14)
  15. 7974 TANK, DOUBLE WALL, CUBE, 700 GALLON (EO1) (Ref. Part 2.15)
  16. 7975 TANK, DOUBLE WALL, CUBE, 1000 GALLON (UO) (Ref. Part 2.16)
- B. Roughing-in installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

**1.3 QUALITY ASSURANCE**

- A. Manufacturer's Representative:
  1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out, and start up.
  2. Training: Provide a qualified manufacturer's representative to provide training to Owner's maintenance personnel in operation and maintenance of specified equipment.

**1.4 SUBMITTALS**

- A. Product Data:
  1. Submit Product Data in accordance with Division 1 - General Requirements of these specifications.
  2. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.
- B. Operations and Maintenance Manual:

## **SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
  2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
  3. Description of system and components.
  4. Schematic diagrams of electrical, plumbing, and compressed air system.
  5. Manufacturer's printed operating instructions.
  6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information shall indicate that preventive maintenance is not a condition for validation of warranties.
- C. Shop Drawings: Submit Shop Drawings in accordance with of Division 1 - General Requirements of these specifications.

### **1.5 PRODUCT SUBSTITUTIONS**

- A. Follow requirements specified in Division 1 - General Requirements.
- B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, shall be at the expense of the Contractor.
- C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance shall be based on the technical requirements herein as determined by Owner and Architect.

### **1.6 WARRANTY**

- A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.
- B. Warranty shall include materials and labor necessary to correct defects.
- C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situations resulting from non-performance of a manufacturer's recommended preventive maintenance schedule.

### **1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.
- B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.
- C. Provide equipment and material specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

**1.8 LABELING**

- A. Manufacturer shall securely attach in a prominent location, on each major item of equipment, a non-corrosive nameplate showing manufacturer’s name, address, model number, serial number, and pertinent utility or operating data.
- B. All electrical equipment and materials shall be new and shall be listed by Underwriter’s Laboratories, Inc. (UL) in categories for which standards have been set by that agency and labeled as such in the manufacturer’s plant.
- C. Provide air receivers meeting requirements of ASME Code for Unfired Pressure Vessels and carry ASME approval stamp.

**PART 2 - PRODUCTS**

**2.1 CABINET, STORAGE, HEATED (DEF) WITH DISPENSER**  
**Equipment Identifier: 7015**

- A. Manufacturer’s Reference:
  - 1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish minimal acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
SPATCO Model No.: SDT1	CHARLOTTE	NC	(704) 599-7633

- 2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

Manufacturer	City	State	Phone
ALT #1 BLUE1USA	DULUTH	GA	(770) 688-1958
ALT #2 KLEER BLUE	EVANSVILLE	IN	(800) 320-2122

- B. Capacities/Dimensions:
  - 1. Overall dimensions:

Overall Dimensions		
Length	Width	Height
50"	83"	99"
Weight		Capacity
1950 lb		0 lb

- 2. Capacity:
  - a. One 330 gallon tote

- C. Features/Performance/Construction:

**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

1. Housing shall be insulated fiber-reinforced plastic (FRP) panels with R-8.9 insulation rating, weatherproof enclosure. Unit shall be pre-piped and wired.
2. Containment shall be provided to prevent spillage. Capacity of containment shall be greater than 330 gallons.
3. Door(s) shall be single or double and large enough for tote removal and replacement. Doors shall have aluminum handles, hinges and locking latches.
4. Base frame shall be reinforced steel chassis, two way forklift compatible frame. Frame shall be bolt down design for wind and seismic requirements. Unit shall include welded tabs for anchoring standard on four corners.
5. Pump: Pump shall be Mag-drive self-priming type with a flowrate of 6 to 8 GPM. Unit shall come equipped with positive displacement gear flow meter with electronic resettable totalizer, and output pulse for the ability to connect to a fluid management system. The flow meter shall have an accuracy to within at most 0.50% of the actual flow. Pump shall be electrically powered.
6. Filter: Unit shall include an inline filter housing with 1 micron filter. Filter housing shall be mounted to allow easy access to filter.
7. Hoses: Hose shall be at least 15 feet long with a 5 foot suction hose for connecting to the tote. Unit shall include a spring retractable hose reel with stainless steel internals for the dispensing hose. The suction hose shall have an Economic Plastic Valve (EPV) or a Reusable Stainless Valve (RSV) coupler.
8. Nozzle shall be stainless steel automatic non-magnetic type.
9. Unit shall come equipped with a motor starter.
10. Unit shall include a heater with a rating of (1000W).
11. Unit shall be supplied with all necessary safety and instructional signage required by local state and federal code.
12. Tote shall be provided by the owner.
13. Unit shall be UL listed.

D. Controls:

1. Pump shall dispense contents of the tote upon pressing the handle.
2. Heater shall operate on a thermostat to maintain the DEF above its freezing point.
3. Heater and pump shall be powered through the unit's electrical panel. The electrical panel shall have one power input.

E. Utility Requirements:

<b>Electrical</b>				
Voltage	Phase	HP	Amperage	Connection Type
220	1	1.84	40.00	DISCONNECT

F. Finish: Smooth gel coat in manufacturer's standard color

**2.2 PUMP, AIR PISTON, 55 GALLON (CG), WITH HOIST  
Equipment Identifier: 7510**

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standard of quality, performance, features and construction.

**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

Manufacturer	City	State	Phone
GRACO, INCORPORATED Model No.: 226018	MINNEAPOLIS	MN	612-623-6000

2. Alternate manufacturers: *Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS equipment produced by other manufacturers, including the following, may be considered as equal.*

Manufacturer	City	State	Phone
ALT #1 BALCRANK CORPORATION, INC	WEAVERVILLE	NC	828-645-4261
ALT #2 LINCOLN INDUSTRIAL	ST. LOUIS	MO	314-674-4200

**B. Capacities/Dimensions:**

1. Overall dimensions/capacities/weight:

Overall Dimensions		
Length	Width	Height
24"	30"	56"
Weight		Capacity
136 lb		536 lb

2. Products: Chassis grease (CG)
3. Maximum fluid pressure: 4,000 PSI
4. Air motor diameter: 4-1/4 inches
5. Operating range: 40 to 80 PSI
6. Maximum continuous duty flow rate: 3.35 pounds per minute
7. Material outlet: 3/8 inch NPT(F)
8. Material inlet: Slotted

**C. Features/Performance/Construction:**

1. Provide pneumatic operated piston pump, Graco No. 205395 operable with maximum air pressure of 150 PSI.
2. Provide complete assembly with the following standard compressed air line accessories:
  - a. Combination air filter-regulator lubricator, 3/4 inch, Graco No. -217073
  - b. Bleed type air shut-off valve 3/4 inch, Graco No. 110226 to relieve air trapped between air motor and valve.
  - c. Air and product valves
  - d. Provide compressed air runaway valve, Graco No. 224040 before product fluid pump to eliminate unregulated fluid flow in the event of a product pipe break.
3. Air motor shall be a non-corrosive design with no metal-to-metal contact compatible with product being delivered.
4. Provide base, Graco No. 205339; inductor plate, Graco No. 205699; elevator, Graco No. 204385; and carriage support system for chassis grease.
5. Provide complete assembly complete with the following standard fluid line accessories:
  - a. Hose and fitting kit suitable for product, Graco No. 205102
  - b. Fluid drain valve to assist in relieving fluid pressure in the pump, hoses, and dispensing valve
  - c. Pump grounding wires to reduce the risk of static sparking, Graco No. 238909
6. Provide fluid shut-off valve, 1 inch, Parker No. V500HP-16 for isolating oil dispense lines.
7. Provide wishbone support assembly, Graco No. 204461

**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

D. Utility Requirements:

Plumbing		
Domestic Water		
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)

Natural Gas			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum

Compressed Air		
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)
1/2"	19.00	80.00

**2.3 PUMP, AIR PISTON, 16 GALLON (CG), PORTABLE**  
**Equipment Identifier: 7513**

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
GRACO, INCORPORATED Model No.: 226018	MINNEAPOLIS	MN	612-623-6000

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

Manufacturer	City	State	Phone
ALT #1 BALCRANK CORPORATION, INC	WEAVERVILLE	NC	828-645-4261
ALT #2 LINCOLN INDUSTRIAL	ST. LOUIS	MO	314-674-4200

B. Capacities/Dimensions:

1. Overall dimensions, capacities, and weight:

Overall Dimensions		
Length	Width	Height
24"	30"	56"
Weight		Capacity
136 lb		536 lb

2. Fluid Hose
  - a. Length: 6 feet
  - b. Diameter: 1/2 inch

**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

3. Maximum fluid pressure: 900 PSI
4. Air motor diameter: 3 inches
5. Operating range: 40 to 180 PSI
6. Continuous duty flow rate: 3 GPM
7. Air consumption (approximate) at 100 PSI: 10 CFM
8. Air Hose
  - a. Length: 6 feet
  - b. Diameter: 3/8 inch NPT
9. Material outlet: 1/2 inch NPT(F)
10. Material inlet: 1-1/2 inch NPT(F)

**C. Features/Performance/Construction:**

1. Provide pneumatic operated piston pumps operable with maximum air pressure of 180 PSI.
2. Air motor shall be a non-corrosive design with no metal-to-metal contact compatible with product being delivered.
3. Cart shall have a 15 inch diameter recessed arch for a 120 pound drum to securely fit in.
4. Lid shall be equipped with three thumb screws to secure the lid to the drum.
5. Fluid pump shall be attached to the lid.
6. Cart shall be constructed of 16 gauge sheet metal.
7. Four swivel wheels 3 inches in diameter shall be located under each corner of the cart. Wheels shall be made of polyurethane.
8. Two drum brackets shall be provided to hold the drum in place.

**D. Standard Features**

1. Unit shall be equipped with a dispense kit: Graco Part Number 237075 Series B.
  - a. Dispense kit shall include a rubber fluid hose from the pump to the nozzle. Graco Part Number 220591
  - b. Nozzle shall calculate and track the amount of fluid used in quarts or liters. Graco Part Number 255349
  - c. Nozzle shall have a digital screen powered by four AA batteries.
2. Unit shall be equipped with an air regulator kit. Graco Part Number: 224512
  - a. Air regulator kit shall be complete with the following features:
    - 1) 3/8 NPT air regulator: Graco Part Number 110235
    - 2) Air pressure gauge: Graco Part Number 100960
    - 3) Air bleed valve: Graco Part Number 110224
    - 4) Air Safety valve: Graco Part Number 113286
    - 5) 3/8 NPT nipple: Graco Part Number 156849

**E. Utility Requirements:**

<b>PLUMBING</b>		
<b>Domestic Water</b>		
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)

<b>Natural Gas</b>			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum

<b>Compressed Air</b>			
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)	
		Minimum	Maximum
1/2"	19.00	80.00	150.00 psi



**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

**2.4 PUMP, AIR PISTON 10:1 RATIO (EO1, EO2, EO3, HO)**

**Equipment Identifier: 7520**

**A. Manufacturer's Reference:**

1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish minimal acceptable standards of quality, performance, features and construction.

Manufacturer	City	State	Phone
GRACO, INCORPORATED	MINNEAPOLIS	MN	612-623-6000
Model No.: 425 FIRE BALL 205626			

2. Alternate manufacturers: *Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.*

Manufacturer	City	State	Phone
ALT #1 BALCRANK CORPORATION, INC	WEAVERVILLE	NC	828-645-4261
ALT #2 LINCOLN INDUSTRIAL	ST. LOUIS	MO	314-679-4200

**B. Capacities/Dimensions:**

1. Overall dimensions, capacities, and weight:

Overall Dimensions		
Length	Width	Height
8"	6"	25 3/4"
Weight		Capacity
38 lb		0 lb

2. Products: Engine oil (EO1, EO2, EO3), hydraulic oil (HO)
3. Maximum fluid pressure: 1,800 PSI
4. Maximum air inlet pressure: 180 psi
5. Air motor effective diameter: 4-1/4 inches
6. Max continuous pump speed: 4.0 GPM
7. Air consumption at 100 PSI: 45 CFM
8. Air inlet: 1/2-inch NPT (F)
9. Fluid outlet: 3/4-inch NPT(F)
10. Fluid inlet: 1-1/2-inch NPT(F)

**C. Features/Performance/Construction:**

1. Provide pneumatic operated piston pump operable within the pressure range of 40 PSI to 180 PSI.
2. Air motor shall be a non-corrosive design with no metal-to-metal contact compatible with product being delivered.
3. Provide with complete and operable assembly for connection to both compressed air and lube system including the following:
  - a. Lube system components:
    - 1) Provide adapters for mounting on storage tanks, Graco No. 238125.
    - 2) Provide product valves compatible with product being delivered.
    - 3) Provide hose and fitting kit suitable for product being delivered, Graco No. 222068.

**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

- 4) Provide thermal relief valves for the pumping system. Provide connection from pump back to product tank for proper drain back of fluid in piping riser line and pump, Graco No. 240429.
- 5) Provide suction tube properly sized for tank of product being delivered, Graco No. 238596
- 6) Provide lower level cut-off valve, Graco No. 203688.
- 7) Pump grounding wires and clamp to reduce the risk of static sparking, Graco No. 238909.
- b. Compressed air components:
  - 1) Provide combination air filter, air lubricator, regulator and pressure gauge, 3/4-inch NPT, Graco No. 217073
  - 2) Provide hose and fitting kit for air connection to the pump, Graco No. 222068
  - 3) Provide compressed air runaway valve before product fluid pump to eliminate unregulated fluid flow in the event of a product pipe break, Graco No. 224040
  - 4) Provide air valves as required, including bleed-type master air valve, Graco No. 107142.

D. Accessories:

- 1. Provide wall mounting bracket, Graco No. 236778.

E. Utility Requirements:

<b>Plumbing</b>			
<b>Domestic Water</b>			
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)	
<b>Natural Gas</b>			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum

<b>Compressed Air</b>		
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)
1/2"	45.00	80.00

**2.5 PUMP, DIAPHRAGM, MIXING (EC)**

**Equipment Identifier: 7530**

A. Manufacturer's Reference:

- 1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish minimal acceptable standards of quality, performance, features and construction.

Manufacturer	City	State	Phone
GRACO, INC Model No.: 647016	MINNEAPOLIS	MN	(866)361-5929

- a. Reference Service Equipment Layout Drawings Tank with wall mounted diaphragm pump and water tank detail)

**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

2. Alternate manufacturers: *Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.*

Manufacturer	City	State	Phone
ALT #1 BALCRANK	WEAVERVILLE	NC	(828)645-4261
ALT #2 LINCOLN INDUSTRIAL	ST. LOUIS	MO	(314)679-4300

B. Capacities/Dimensions:

1. Overall dimensions, capacities, and weight:

Overall Dimensions		
Length	Width	Height
14 3/4"	10 3/4"	16"
Weight		Capacity
23 lb		0 lb

2. Products: Engine coolant (EC)
3. Pump ratio: 1:1
4. Maximum air pressure: 100 PSI
5. Free flow rate: 50 GPM
6. Air consumption: 64 CFM
7. Fluid outlet: 1 inch NPT(M)
8. Fluid inlet: 1 inch NPT(M)

C. Features/Performance/Construction:

1. Provide pneumatic operated diaphragm pump operable with maximum air pressure of 100 PSI.
2. Materials: Compatible with product being pumped.
3. Pump shall handle engine coolant, windshield washer fluid, water.
4. Pump shall be aluminum/TPE (UL listed)
5. Provide pneumatic pump with complete and operational assembly including the following:
  - a. Compressed air system:
    - 1) Provide a combination filter/regulator (3/4 inch NPT) (Graco No. 106148).
    - 2) Lubricator (3/4 inch NPT).
    - 3) Provide connection from pump back to product tank for proper drain back of fluid in piping riser line and pump.
    - 4) Provide a quick connect air coupler (Graco No. 110119).
    - 5) Provide a quick connect air nipple (Graco No. 110196).
    - 6) Provide (2) bleed type air shut off valve as required (Graco No. 110225).
  - b. Fluid system:
    - 1) Provide compressed air runaway valve before product fluid pump to eliminate unregulated fluid flow in the event of a product pipe leak (Graco No. 247436).
    - 2) Provide pressure relief kit to prevent over pressurization of system due to thermal expansion of fluid (Graco No. 238428).
    - 3) Provide a grounding wire and clamp (Graco No. 222011).
    - 4) Provide (2) suction hose kits compatible with fluid in system (Graco No. 236054).
  - c. Provide a wall bracket for mounting pump on wall above tank (Graco No. 24C637).
  - d. Provide dual inlet manifold for mixing water and fluids together (Graco No. 24D147).
  - e. Provide 30 gallon drum with a float valve.

D. Utility Requirements:

**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

Plumbing			
Domestic Water			
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)	
Natural Gas			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum
Compressed Air			
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)	
		Minimum	Maximum
1/2"	67.00	64.00	100.00 psi

**2.6 PUMP, DIAPHRAGM, USED FLUID EVACUATION (UO)**

**Equipment Identifier: 7540**

**A. Manufacturer's Reference:**

1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standards of quality, performance, features and construction.

Manufacturer	City	State	Phone
GRACO, INCORPORATED Model No.: 647731	MINNEAPOLIS	MN	(800) 533-9655

- a. Reference Equipment Drawings: Service Equipment Layout Plan
2. Alternate manufacturers: *Contingent upon compliance with these specification* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

Manufacturer	City	State	Phone
ALT #1 BALCRANK, CORPORATION	WEAVERVILLE	NC	(828) 645-4261
ALT #1 LINCOLN INDUSTRIAL	WEAVERVILLE	NC	(314) 645-4261

**B. Capacities/Dimensions:**

1. Products: Used oil
2. Pump ratio: 1:1
3. Maximum fluid outlet pressure: 100 PSI
4. Maximum fluid working pressure: 100 PSI
5. Maximum free flow rate: 50 GPM
6. Continuous duty delivery: 15.81 to 23.8 GPM
7. Air inlet: 1/2 inch NPT(F)
8. Fluid outlet: 1 inch NPT(F)
9. Fluid inlet: 1 inch NPT(F)
10. Tank overfill gauge: 2 inch NPT

**C. Features/Performance/Construction:**

## SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT

1. Diaphragm pump shall provide 100 PSI air pressure for pump size and capacity as scheduled.
2. Pump shall be provided in complete assembly, including the following:
  - a. Wall bracket accessory kit, Graco Model No. 24C637; includes lock nut, cylindrical damper, wall mount bracket, and washer.
  - b. Drum style adapter kit, Graco Model No. 240832, includes elbow, nipple, valve, male and female camlock couplers.
  - c. Fluid installation kit, Graco Model No. 240685, includes swivel union, 4 foot coupled fluid hose, short nipple, y-strainer, 10 foot coupled fluid hose, ball valve, and elbow.
  - d. Combination filter regulator and gauge, 3/4 inch NPT, Graco Model No. 133217.
  - e. Reducing pipe adapter, 3/4" NPT M, - 1/2" (F), Graco Model No. 168595
  - f. 4 foot air hose, 1/2" NPT (M) X, NPT (M) Graco Model No. 110046
  - g. Quick-Connect Coupler 1/2" NPT (F), Graco Model No. 110199
  - h. Quick-Connect Nipple, 1/2" NPT (M), Graco Model No. 110196
  - i. Grounding wire and clamp, Graco Model No. 238909
  - j. Air muffler, Graco Model No. 102656
  - k. Provide label "USED OIL" on pump to identify product (minimum 1 inch lettering)
  - l. Bleed-type air valve, Graco Model No. 110226
3. Materials: Compatible with product being delivered.
4. Pump shall handle oil, hydraulic oil, automatic transmission fluid.
5. Pump shall have a monitoring system that shuts off the pump via solenoid valve when the used fluid tank is full.
  - a. Monitoring system shall notify users with a strobe light and an audible alarm system.
    - 1) Manufacturer: BJ Enterprises, (636) 825-7200
    - 2) Monitoring system power supply and solenoid valve: BJE Model No. 007-580, one each
    - 3) Strobe light: BJE Model No. 007-695, one each
  - b. Audible alarm shall draw 10 to 50 milliamps.

D. Accessories:

Description	Manufacturer	Model No.
EXPLOSION PROOF SOLENOID VALVE	ASCO	EF8210G35

E. Utility Requirements:

Electrical				
Voltage	Phase	HP	Amperage	Connection Type
120	1	0	2.00	RECEPTACLE

Plumbing		
Domestic Water		
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)

Natural Gas			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum

Compressed Air		
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)
1/2"	64.00	50.00

## SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT

### 2.7 PUMP, DIAPHRAGM, USED FLUID EVACUATION (UC)

Equipment Identifier: 7541

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standards of quality, performance, features and construction.

Manufacturer	City	State	Phone
GRACO, INCORPORATED Model No.: 647016	MINNEAPOLIS	MN	(800) 533-9655

2. Alternate manufacturers: *Contingent upon compliance with these specification and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.*

Manufacturer	City	State	Phone
ALT #1 BALCRANK, CORPORATION	WEAVERVILLE	NC	(828) 645-4261
ALT #2 LINCOLN INDUSTRIAL	ST. LOUIS	MO	(314) 679-4200

B. Capacities/Dimensions:

1. Products: Used coolant
2. Pump ratio: 1:1
3. Maximum fluid outlet pressure: 100 PSI
4. Maximum fluid working pressure: 100 PSI
5. Maximum free flow rate: 50 GPM
6. Continuous duty delivery: 15.81 to 23.8 GPM
7. Air inlet: 1/2 inch NPT(F)
8. Fluid outlet: 1 inch NPT(F)
9. Fluid inlet: 1 inch NPT(F)
10. Tank overflow gauge: 2 inch NPT

C. Features/Performance/Construction:

1. Diaphragm pump shall be provided with 100 PSI air pressure for pump size and capacity as scheduled.
2. Pump shall be provided in complete assembly, including the following:
  - a. Wall bracket accessory kit, Graco Model No. 24C637; includes lock nut, cylindrical damper, wall mount bracket, and washer.
  - b. Drum style adapter kit, Graco Model No. 240832, includes elbow, nipple, valve, male and female camlock couplers.
  - c. Fluid installation kit, Graco Model No. 240685, includes swivel union, 4 foot coupled fluid hose, short nipple, y-strainer, 10 foot coupled fluid hose, ball valve, and elbow.
  - d. Combination filter regulator and gauge, 3/4-inch NPT, Graco Model No. 246948.
  - e. Reducing pipe adapter, 3/4" NPT M, - 1/2" (F), Graco Model No. 168595
  - f. 4 foot air hose, 1/2" NPT (M) X, NPT (M), Graco Model No. 110046
  - g. Quick-Connect Coupler 1/2" NPT (F), Graco Model No. 110199
  - h. Quick-Connect Nipple, 1/2" NPT (M), Graco Model No. 110196
  - i. Grounding wire and clamp, Graco Model No. 238909.
  - j. Air muffler, Graco Model No. 112182.
  - k. Provide label "USED COOLANT" on pump to identify product (minimum 1 inch lettering)
  - l. Bleed-type air valve, Graco Model No. 110226
3. Materials: Compatible with product being delivered.
4. Pump shall handle coolant.

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5. Pump shall have a monitoring system that shuts off the pump via solenoid valve when the used fluid tank is full.
  - a. Monitoring system shall notify users with a strobe light and an audible alarm system.
    - 1) Manufacturer: BJ Enterprises, (636) 825-7200
    - 2) Monitoring system power supply and solenoid valve: BJE Model No. 007-580, one each
    - 3) Strobe light: BJE Model No. 007-695, one each
  - b. Audible alarm shall draw 10 to 50 milliamps.

D. Utility Requirements:

Electrical				
Voltage	Phase	HP	Amperage	Connection Type
120	1	0	2.00	RECEPTACLE

Plumbing		
Domestic Water		
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)

Natural Gas			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum

Compressed Air		
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)
1/2"	64.00	80.00

**2.8 REEL BANKS, GENERAL**  
**Equipment Identifier: 7700**

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standards of quality, performance, features and construction.

Manufacturer	City	State	Phone
GRACO, INC. Model No.: XD SERIES	MINNEAPOLIS	MN	314-679-4200

2. Alternate manufacturers: *Contingent upon compliance with these specification and documentation requirements set forth in SUBMITTALS equipment produced by other manufacturers, including the following, may be considered as equal.*

Manufacturer	City	State	Phone
ALT #1 LINCOLN INDUSTRIAL CORP	ST LOUIS	MO	314-679-4200
ALT #2 BALCRANK CORP	WEAVERVILLE	NC	828-645-6261

## SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT

- B. General Description: High performance, heavy duty hose reels. Reels are available for the following products:
1. Compressed air (CA): Graco No. HSLD8B
  2. Compressed air (CA-1/2"): Grace No. HSLC8B
  3. Chassis grease (CG): Graco No. HSHC5B
  4. Engine coolant (EC): Graco No. HSLC8B
  5. Engine oil (EO1, EO2, EO3): Graco No. HSMC8B
  6. Hydraulic oil (HO): Graco No. HSMC8B
  7. Windshield washer fluid (WWF): Graco No. HSLC8B
- C. Capacities/Dimensions:
1. Overall reel dimensions, XD20 series (CA, CG, EC, EO1, EO1, EO2, EO3, HO) nominal:
    - a. Length: 20 inches
    - b. Width: 7-1/2 inches
    - c. Height: 25-1/2 inches
  2. Reel fluid inlet:
    - a. CA: 1/2 inch NPSM (M)
    - b. CG: 1/2 inch NPT(M)
    - c. EC, EO1, EO2, EO3, HO: 1/2 inch NPSM(M)
  3. Hose:
    - a. CA:
      - 1) Length: 65 feet
      - 2) Inside diameter: 3/8 inch
      - 3) Working pressure: 300 PSI
    - b. CA-1/2
      - 1) Length: 50 feet
      - 2) Inside diameter: 1/2 inch
      - 3) Working pressure: 300 psi
    - c. CG:
      - 1) Length: 50 feet
      - 2) Inside diameter: 3/8 inch
      - 3) Working pressure: 4,000 PSI
    - d. EO1, EO2, EO3, HO:
      - 1) Length: 50 feet
      - 2) Inside diameter: 1/2 inch
      - 3) Working pressure: 2,000 PSI
    - e. EC:
      - 1) Length: 50 feet
      - 2) Inside diameter: 1/2 inch
      - 3) Working pressure: 300 PSI
- D. Features/Performance/Construction:
1. Reels:
    - a. Construction: Frames, discs, and drum shall be fabricated of heavy gauge steel.
    - b. Double pedestal arm: Reel frame shall have double pedestal arms that are welded and gusseted.
    - c. Hose guide arm: Reel hose guide arm shall be adjustable with nylon rollers on all four sides of roller assembly at hose opening.
    - d. Rewind mechanism: Reel spring shall be enclosed and fastened to reel drum with a reinforcing clip.
    - e. Bearings and ratchet latch: Reel shall have permanently lubricated bearings and extra-large ratchet latch with audible hose position lock.
  2. Ball stop: Adjustment of hose extension length shall be permitted by ball stop:
    - a. 3/8 inch hose, Graco No. 218341, (one per hose reel) (CA, CG)
    - b. 1/2 inch hose, Graco No. 218341, (one per hose reel) (CA, EC, EO1, EO2, EO3, HO)



## SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT

- c. 3/8 inch hose, Graco No. 237873, (one per hose reel) (CG)
  3. Hose covers and tubes: Chassis grease hose shall have Buna-N PVC tube and Buna-N PVC cover. All other commodity hoses shall have Buna N nitrile tube with nitrile PVC cover.
  4. Delivery kits: Each commodity hose shall be fitted with the dispensing control as listed.
    - a. CA: Quick disconnect air coupler with necessary adapter fitting, 3/8 and/or 1/2 inch female. Coordinate coupler style with Owner.
    - b. CG: High pressure control valve with knurled grip body, 1/4 inch, Graco No. 242056 with taper nose coupler and extension; "Z" swivel, Graco No. 202577.
    - c. EC: Electronic in-line style English metered totalizing dispenser (up to 8 GPM) set to dispense in pints to 0.01 increments, with flexible extension, Graco SDM Series, Model No. 25M407.
    - d. EO1, EO2, EO3: Electronic in-line style English metered totalizing dispenser set to dispense (to 8 GPM) in quarts to .01 increments, with rigid extension, Graco SDM Series, Model No. 25M404.
    - e. HO: Electronic in-line style English metered totalizing dispenser set to dispense (up to 8 GPM) in pints to 0.01 increments, with rigid extension, Graco SDM Series, Model No. 25M404.
  5. Inlet hose kit: Each commodity reel shall be fitted with the inlet hose kit as listed.
    - a. CA: 1/2 inch ID by 24 inches, medium pressure hose and fittings, rated for 2,000 PSI, Graco No. 218549, (one each)
    - b. CG: 3/8 inch ID by 24 inches, high pressure hose and fittings, rated for 4,000 PSI, Graco No. 218550, (one each)
    - c. EC, EO1, EO2, EO3, HO: 1/2 inch ID by 24 inches, medium pressure hose and fittings, rated for 2,000 PSI, Graco No. 218549, (one each)
  6. Mounting bracket: Graco No. 204741, one per three reels
  7. Identification labels: Each commodity reel shall have a 3/4 by 4-1/4 inch metal identification label indicating the commodity, attached adjacent to each hose guide arm roller assembly. Label kits including label and mounting hardware as listed for each commodity.
    - a. CA: Graco No. 218675
    - b. CG: Graco No. 218671
    - c. EC: Similar to Graco No. 218677
    - d. EO1, EO2, EO3: Similar to Graco No. 218670
    - e. HO: Graco No. 218674
  8. Mounting channel supply as required for specific reel bank:
    - a. One reel: Graco No. 24A219
    - b. Two reels: Graco No. 24A220
    - c. Three reels: Graco No. 24A221
    - d. Six reels: Graco No. 24A222
- E. Utility Requirements: Contractor shall provide process piping from product pumps to point of connection for each reel specified herein.
- F. Finish: Durable enamel in manufacturer's standard color

### 2.9 REEL BANK (CA 3/8") Equipment Identifier: 7710

- A. Reel bank shall consist of one each (CA 3/8") reel as delineated in part 2.7 REEL BANKS, GENERAL of this specification section.
- B. Reference Equipment Drawings for Details.

**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

**2.10 REEL BANK (CA 3/8", CG)**  
**Equipment Identifier: 7720**

- A. Reel bank shall consist of one each (CA 3/8") reel, and one each (CG) reel as delineated in part 2.7 REEL BANKS, GENERAL of this specification section.
- B. Capacities/Dimensions:
  - 1. Individual Dry Weight Per Reel: 100 lbs.
- C. Reference Equipment Drawings for Details.

**2.11 REEL BANK (CA 3/8", CG, EC, EO1, HO)**  
**Equipment Identifier: 7750**

- A. Reel bank shall consist of one each (CA 3/8") reel, one each (CG) reel, one each (EC) reel, one each (EO1) reel, and one each (HO) reel as delineated in part 2.7 REEL BANKS, GENERAL of this specification section.
- B. Capacities/Dimensions:
  - 1. Individual Dry Weight Per Reel: 100 lbs.
- C. Reference Equipment Drawings for Details.

**2.12 REEL BANK (CA 3/8", EC, EO1, EO2, EO3)**  
**Equipment Identifier: 7751**

- A. Reel bank shall consist of one each (CA 3/8") reel, one each (EC) reel, one each (EO1) reel, one each (EO2) reel, and one each (EO3) reel as delineated in part 2.7 REEL BANKS, GENERAL of this specification section.
- B. Capacities/Dimensions:
  - 1. Individual Dry Weight Per Reel: 100 lbs.
- C. Reference Equipment Drawings for Details.

**2.13 TANK, DOUBLE WALL, CUBE, 240 GALLON (EC, HO)**  
**Equipment Identifier: 7958**

- A. Manufacturer's Reference:
  - 1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimum acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
CONTAINMENT SOLUTIONS	CONROE	TX	877-274-8265
Model No.: LCAA1124008530			

- 2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

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Manufacturer	City	State	Phone
ALT #1 ATLANTIC CONTAINMENT	MCGAHEYSVILLE	VA	800-522-4980
ALT #2 EATON SALES & SERVICE, LLC	DENVER	CO	303-296-4800

B. Capacities/Dimensions:

- Overall dimensions, weight, and capacity:

Overall Dimensions		
Length	Width	Height
50"	40"	49"
Weight		Capacity
850 lb		2850 lb

- Spill box height: 12 inches
- Capacity: 240 gallons

C. Features/Performance/Construction:

- Above ground used oil collection and fluid storage systems shall be constructed in accordance with national, state, and locally recognized *Above Ground Storage Tank* standards, including Uniform Fire Code, Nation Fire Protection Association 30, 30A, and 31, Underwriters Laboratory Standard 142-for single wall tanks.
- The components of the system shall be assembled and tested at the factory and shall be covered under warranty.
- The above ground double wall tank shall be designed, and UL listed as an atmospheric tank with a maximum working pressure of one PSI.
- The primary and secondary storage tanks shall have passed a proof of design hydrostatic pressure test of 25 PSI.
- The above ground double wall tank shall be equipped with nine NPT openings including two for primary and secondary emergency venting as required by UL-142.
- Primary tank enclosure:
  - Primary storage tank shall be rectangular in design and constructed with ASTM A-569 or A-36 carbon steel with continuous welds. Tank shall be equipped with lifting lugs.
  - Primary storage tank shall be constructed, and pressure tested (minimum 3 to 5 PSI) in accordance with UL-142 standards and carry the appropriate marking.
  - Tank enclosure shall be supported by two four-inch high steel support feet channels with internal anchoring holes to maintain ground clearance. (Remove support feet channels prior to installation.)
- Secondary tank enclosure:
  - Secondary storage tank shall be a rectangular design constructed with ASTM A-569 or A-36 carbon steel with continuous welds and listed by Underwriters Laboratories as secondary containment.
  - Secondary enclosure shall provide a minimum of 110 percent secondary containment.
  - Secondary enclosure shall be equipped with a 2 inch monitoring port and a 4 or 6 or 8 inch emergency vent port as required by Underwriters Laboratories.
  - Secondary storage tank shall be constructed, and pressure tested (minimum 3 to 5 PSI) in accordance with UL-142 standards and carry the appropriate marking.
  - Installation of tank shall include seismic bracing and anchoring to meet all local, state, and federal codes and provisions.
- Double float tank gauge that is calibrated by gallons or inches (Scully Golden Gauge or approved equal). Select gauge to match tank depth.

**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

- 9. Spill box: 7 gallon, welded to tank with ½ inch drain (Containment Solutions No. SBB002).
- 10. Venting:
  - a. Primary:
    - 1) Primary working vent: 2 inches NPT(M) (Containment Solutions No. 20000592).  
Vent through roof for used fluids.
    - 2) Primary emergency vent: 4 inches NPT(M) (Containment Solutions No. 20000596)
  - b. Secondary:
    - 1) Secondary emergency vent: 4 inches NPT(M) (Containment Solutions No. 20000596)
- 11. Anchor clips: Anchor tank to floor (Containment Solutions No. ACB005).

D. Utilities:

<b>Electrical</b>				
Voltage	Phase	HP	Amperage	Connection Type
120	1	0	2.00	RECEPTACLE

E. Accessories:

Description	Manufacturer	Model No.	Qty.
TANK MONITORING SYSTEM WITH ALARM (FOR USED FLUID TANKS)	BJ ENTERPRISES	007 575	1

F. Finish: Durable enamel in manufacturer's standard color

**2.14 TANK, DOUBLE WALL, CUBE, 500 GALLON (EO2, EO3, UC)  
Equipment Identifier: 7970**

A. Manufacturer's Reference:

- 1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimum acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
CONTAINMENT SOLUTIONS Model No.: LCAA1500DS001	CONROE	TX	877-274-8265

- 2. Alternate manufacturers: *Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.*

Manufacturer	City	State	Phone
ALT #1 HIGHLAND TANK	STOYSTOWN	PA	814-893-5701
ALT #2 SUPERIOR STORAGE TANKS	LA MIRANDA	CA	800-994-8265

B. Capacities/Dimensions, Weight and Capacity:

- 1. Overall dimensions:

**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

Overall Dimensions		
Length	Width	Height
58"	46"	61"
Weight		Capacity
1315 lb		5600 lb

2. Spill Box Height: 12 inches

C. Features/Performance/Construction:

1. Above ground used oil collection and fluid storage systems shall be constructed in accordance with national, state, and locally recognized *Above Ground Storage Tank* standards, including Uniform Fire Code, Article 79, National Fire Protection Association Sections 30, 30A, and 31, and Underwriters Laboratory Standard 142.
2. The components of the system shall be assembled and tested at the factory and shall be covered under warranty.
3. The above ground double wall tank shall be designed, and UL listed as an atmospheric tank with a maximum working pressure of one (1) PSI.
4. The primary and secondary storage tanks shall have passed a proof of design hydrostatic pressure test of 25 PSI.
5. The above ground double wall tank shall be equipped with nine NPT openings including two for primary and secondary emergency venting as required by UL-142.
6. Primary tank enclosure:
  - a. Primary storage tank shall be rectangular in design and constructed with ASTM A-569 or A-36 carbon steel with continuous welds. Tank shall be equipped with lifting lugs.
  - b. Primary storage tank shall be constructed, and pressure tested (minimum 3 to 5 PSI) in accordance with UL-142 standards and carry the appropriate marking.
  - c. Tank enclosure shall be supported by two 4-inch-high steel support feet channels with internal anchoring holes to maintain ground clearance. Tank shall be equipped with a minimum of two (2) lifting lugs.
7. Secondary tank enclosure:
  - a. Secondary storage tank shall be a rectangular design constructed with ASTM A-569 or A-36 carbon steel with continuous welds and listed by Underwriters Laboratories as secondary containment.
  - b. Secondary enclosure shall provide a minimum of 110 percent secondary containment.
  - c. Secondary enclosure shall be equipped with a 2-inch monitoring port and an emergency vent port as required by Underwriters Laboratories.
  - d. Secondary storage tank shall be constructed, and pressure tested (minimum 3 PSI) in accordance with UL-142 standards and carry the appropriate marking.
8. Installation of tank shall include seismic bracing and anchoring to meet all local, state, and federal codes and provisions.
9. Double float tank gauge calibrated by inches (Scully Golden Gallon Gauge or approved equal). Select gauge to match tank depth.
10. Spill box, 7 gallons, welded to tank with 1/2 inch drain (Containment Solutions No. SBB002).
11. Venting:
  - a. Primary:
    - 1) 2-inch NPT(M) working vent (Containment Solutions No. 20000592). Vent through roof for used fluids.
    - 2) 4-inch NPT(M) tank emergency vent (Containment Solutions No. 20000596).
  - b. Secondary:
    - 1) 2-inch NPT(M) working vent (Containment Solutions No. 20000592).
    - 2) 6-inch NPT(M) containment emergency vent. (Containment Solutions No. 20000598)

**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

12. Anchor Clips: Anchor tank to floor (Containment Solutions No. ACB005).

D. Accessories:

Description	Manufacturer	Model No.	Qty.
TANK MONITORING SYSTEM WITH SOLENOID AND ALARM (FOR USED FLUID TANKS)	BJ ENTERPRISES	007 575	1
ALUMINUM 3-STEP (32w x 10d x 30h) ASSEMBLY	COTTERMAN	D1160021	1

E. Utility Requirements:

Electrical				
Voltage	Phase	HP	Amperage	Connection Type
120	1	0	2.00	RECEPTACLE

F. Finish: Shop primed in manufacturer's standard color.

**2.15 TANK, DOUBLE WALL, CUBE, 700 GALLON (EO1)  
Equipment Identifier: 7974**

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimum acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
CONTAINMENT SOLUTIONS Model No.: LCAA1750D8523	CONROE	TX	(877) 274-8265

2. Alternate manufacturers: *Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.*

Manufacturer	City	State	Phone
ALT #1 HIGHLAND TANK	STOYSTOWN	PA	(814) 893-5701
ALT #2 SUPERIOR STORAGE TANKS	LA MIRANDA	CA	(800) 994-8265

B. Capacities/Dimensions:

1. Overall dimensions, capacities, and weight:

Overall Dimensions		
Length	Width	Height
80"	46"	62 1/2"
Weight		Capacity
1725 lb		7840 lb

2. Spill box height: 12 inches
3. Capacity: 700 gallons

C. Features/Performance/Construction:

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1. Above ground used oil collection and fluid storage systems shall be constructed in accordance with national, state, and locally recognized *Above Ground Storage Tank* standards, including Uniform Fire Code, Nation Fire Protection Association 30, 30A, and 31, The Uniform Fire Code Article 79, Underwriters Laboratory Standard 142.
2. The components of the system shall be assembled and tested at the factory and shall be covered under warranty.
3. The above ground double wall tank shall be designed, and UL listed as an atmospheric tank with a maximum working pressure of one PSI.
4. The primary and secondary storage tanks shall have passed a proof of design hydrostatic pressure test of 25 PSI.
5. The above ground double wall tank shall be equipped with nine NPT openings including two for primary and secondary emergency venting as required by UL-142.
6. Primary tank enclosure:
  - a. Primary storage tank shall be rectangular in design and constructed with ASTM A-569 or A-36 carbon steel with continuous welds.
  - b. Primary storage tank shall be constructed, and pressure tested (minimum 3 PSI) in accordance with UL-142 standards and carry the appropriate marking.
  - c. Tank enclosure shall be supported by two four-inch high steel support feet channels with internal anchoring holes to maintain ground clearance. Tank shall be equipped with a minimum of two (2) lifting lugs.
7. Secondary tank enclosure:
  - a. Secondary storage tank shall be a rectangular design constructed with ASTM A-569 or A-36 carbon steel with continuous welds and listed by Underwriters Laboratories as secondary containment.
  - b. Secondary enclosure shall provide a minimum of 110 percent secondary containment.
  - c. Secondary enclosure shall be equipped with a 2 inch monitoring port and an emergency vent port as required by Underwriters Laboratories.
  - d. Secondary storage tank shall be constructed, and pressure tested (minimum 3 PSI) in accordance with UL-142 standards and carry the appropriate marking.
8. Installation of tank shall include seismic bracing and anchoring to meet all local, state, and federal codes and provisions.
9. Double float tank gauge that is calibrated by gallons or inches (Scully Golden Gallon Gauge or approved equal)
10. Venting:
  - a. Primary:
    - 1) 2 inch NPT(M) working vent, Containment Solutions 20000592
    - 2) 4 inch NPT(M), emergency vent, Containment Solutions 20000596
  - b. Secondary:
    - 1) 2 inch NPT(M) Secondary vent, Containment Solutions 20000592
    - 2) 6 inch NPT(M), Emergency vent, Containment Solutions 20000598
11. Spill box: 7 gallon, welded to tank, with ½ inch drain, Containment Solutions No. SBB002
12. Anchor clips: Anchor tank to floor. Containment Solutions No. ACB005

D. Utility Requirements:

<b>Electrical</b>				
Voltage	Phase	HP	Amperage	Connection Type
120	1	0	2.00	RECEPTACLE

E. Finish: Durable enamel in manufacturer’s standard color.

**SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

**2.16 TANK, DOUBLE WALL, CUBE, 1,000 GALLON (UO)**  
**Equipment Identifier: 7975**

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimum acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
CONTAINMENT SOLUTIONS	CONROE	TX	877-274-8265
Model No.: LCAA101MDDS001			

2. Alternate manufacturers: *Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.*

Manufacturer	City	State	Phone
ALT #1 HIGHLAND TANK	STOYSTOWN	PA	(814) 893-5701

B. Capacities/Dimensions:

1. Overall dimensions, capacities, and weight:

Overall Dimensions		
Length	Width	Height
112"	48"	61"
Weight		Capacity
2400 lb		10800 lb

2. Spill box height: 12 inches
3. Capacity: 1,000 gallons

C. Features/Performance/Construction:

1. Above ground used oil collection and fluid storage systems shall be constructed in accordance with national, state, and locally recognized *Above Ground Storage Tank* standards, including Uniform Fire Code, Nation Fire Protection Association 30, 30A, and 31, The Uniform Fire Code Article 79, Underwriters Laboratory Standard 142.
2. The components of the system shall be assembled and tested at the factory and shall be covered under warranty.
3. The above ground double wall tank shall be designed, and UL listed as an atmospheric tank with a maximum working pressure of one PSI.
4. The primary and secondary storage tanks shall have passed a proof of design hydrostatic pressure test of 25 PSI.
5. The above ground double wall tank shall be equipped with nine NPT openings including two for primary and secondary emergency venting as required by UL-142.
6. Primary tank enclosure:
  - a. Primary storage tank shall be rectangular in design and constructed with ASTM A-569 or A-36 carbon steel with continuous welds.
  - b. Primary storage tank shall be constructed, and pressure tested (minimum 3 PSI) in accordance with UL-142 standards and carry the appropriate marking.
  - c. Tank enclosure shall be supported by two four-inch high steel support feet channels with internal anchoring holes to maintain ground clearance. Tank shall be equipped with a minimum of two (2) lifting lugs.



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- 7. Secondary tank enclosure:
  - a. Secondary storage tank shall be a rectangular design constructed with ASTM A-569 or A-36 carbon steel with continuous welds and listed by Underwriters Laboratories as secondary containment.
  - b. Secondary enclosure shall provide a minimum of 110 percent secondary containment.
  - c. Secondary enclosure shall be equipped with a 2 inch monitoring port and an emergency vent port as required by Underwriters Laboratories.
  - d. Secondary storage tank shall be constructed, and pressure tested (minimum 3 PSI) in accordance with UL-142 standards and carry the appropriate marking.
- 8. Installation of tank shall include seismic bracing and anchoring to meet all local, state, and federal codes and provisions.
- 9. Double float tank gauge that is calibrated by gallons or inches (Scully Golden Gallon Gauge or approved equal)
- 10. Venting:
  - a. Primary:
    - 1) 2 inch NPT(M) Working vent, Containment Solutions 20000592
    - 2) 6 inch NPT(M), Emergency vent, Containment Solutions 20000598
  - b. Secondary:
    - 1) 2 inch NPT(M) Secondary vent, Containment Solutions 20000592
    - 2) 6 inch NPT(M), Emergency vent, Containment Solutions 20000598
- 11. Spill box: 7 gallon, welded to tank, with ½ inch drain, Containment Solutions No. SBB002
- 12. Anchor clips: Anchor tank to floor. Containment Solutions No. ACB005

D. Accessories:

Description	Manufacturer	Model No.	Qty.
TANK MONITORING SYSTEM WITH SOLENOID AND ALARM (FOR USED FLUID TANKS)	BJ ENTERPRISES	007 575	1
ALUMINUM 3-STEP (32W X 10D X 30H) ASSEMBLY	COTTERMAN	D1160021	1

- E. Finish: Durable enamel in manufacturer’s standard color.

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.
- B. Inspect equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.

**3.2 INSTALLATION**

- A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.
- B. Install equipment in accordance with plans, shop drawings, and manufacturer’s instructions:
  - 1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.

## **SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
  3. Anchorage: Attach equipment as detailed or directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.
  4. Air compressor and dryer system:
    - a. Install compressor unit on concrete foundation with sole plates and isolators. Level, grout, and bolt in place.
    - b. Make air cock and drain connection on horizontal casing.
    - c. Install line size ball valve and anti-return valve on compressor discharge.
    - d. Install replaceable cartridge type filter silencer of adequate capacity for each compressor.
    - e. Install condensate filter between compressor and dryer
    - f. Connect condensate drains to nearest floor drain.
    - g. Install valved bypass around air dryer. Factory insulate inlet and outlet connections.
    - h. Install takeoffs to outlets from top of main with shutoff valve after takeoff.
  5. Fluid storage tanks:
    - a. Tank shall be seismically braced and anchored to meet all local, state, and federal codes and provisions.
    - b. Used oil tank shall be vented to the outside of the building.
    - c. Remove support feet channels prior to final installation.
- C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

### **3.3 TESTING**

- A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

### **3.4 CLEANUP**

- A. Touch-up damage to painted finishes.
- B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.
- C. Clean area around equipment installation and remove packing and installation debris from job site.
- D. Notify Architect or designated representative when installation and cleanup is 100% complete and ready for final observation (punchlist).

### **3.5 TRAINING**

- A. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate with Owner, training schedule and list of personnel to be trained.
  1. 7510 PUMP, AIR PISTON, 55 GALLON (CG), WITH HOIST; 1 hours (minimum)
  2. 7520 PUMP, AIR PISTON, 10:1 RATIO (EO1, EO2, EO3, HO); 1 hours (minimum)

## **SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT**

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3. 7530 PUMP, DIAPHRAGM, NON-MIXING (EC); 1 hours (minimum)
4. 7540 PUMP, DIAPHRAGM, USED FLUID EVACUATION (UO); 1 hours (minimum)
5. 7541 PUMP, DIAPHRAGM, USED FLUID EVACUATION (UC); 1 hours (minimum)
6. 7710 REEL BANK (CA 3/8"); 3 hours (minimum)
7. 7720 REEL BANK (CA 3/8", CG); 3 hours (minimum)
8. 7750 REEL BANK (CA 3/8", CG, EO1, EC, HO); 3 hours (minimum)
9. 7751 REEL BANK (CA 3/8", EC, EO1, EO2, EO3); 3 hours (minimum)

- B. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

**END OF SECTION 11 11 00**

# **SECTION 11 11 13 - COMPRESSED AIR VEHICLE SERVICE EQUIPMENT**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

### **1.2 WORK INCLUDED**

- A. Equipment items as listed below by Equipment Identifier:
  1. 8020 COMPRESSOR, AIR, RECIPROCATING, 5 HP, VERTICAL RECEIVER (Ref. Part 2.1)
  2. 8168 COMPRESSOR, AIR, RECIPROCATING, DUPLEX 20 HP (x2), HORIZONTAL (LARGE) RECEIVER (Ref. Part 2.2)
  3. 8504 DRYER, AIR, REFRIGERATED, NON-CYCLING, 25 CFM (Ref. Part 2.3)
  4. 8529 DRYER, AIR, REFRIGERATED, NON-CYCLING, 200 CFM (Ref. Part 2.4)
- B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.
- C. Piping, wiring, and switching between equipment and utilities.

### **1.3 RELATED SECTIONS**

- A. Section 22 05 48 – Vibration and Seismic Controls Plumbing Piping Equipment

### **1.4 REFERENCES**

- A. ASME Code for Unfired Pressure Vessels

### **1.5 DEFINITIONS**

- A. Actual Air: Air delivered at air-compressor outlet. Flow rate is compressed air delivered and measured in acfm.
- B. Standard Air: Free air at 68 deg and 1 atmosphere (before compression or expansion and measured in scfm).

### **1.6 QUALITY ASSURANCE**

- A. Experience: Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.
- B. Manufacturer's Representative:

## **SECTION 11 11 13 - COMPRESSED AIR VEHICLE SERVICE EQUIPMENT**

1. Installation: Provide a qualified manufacturer's representative with a minimum of 5 years experience at site to supervise work related to equipment installation, check out, and start up. Maintenance service technician must be based within 100 miles radius of installation.
2. Training: Provide a qualified manufacturer's representative to provide training to Owner's maintenance personnel in operation and maintenance of specified equipment.

### **1.7 STANDARD AND REGULATORY REQUIREMENTS**

- A. Equipment indicated within this specification section shall comply with all applicable national, state and local codes and regulations, including seismic, fire, and racking codes and regulations. Additional, more specific compliance requirements may be listed under individual equipment headings.

### **1.8 SUBMITTALS**

- A. Product Data:
  1. Submit Product Data in accordance with Division 1 - General Requirements of these specifications.
  2. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page. Include certified data for each unit and accessory system indicating the following:
    - a. Air compressor performance curves at summer design condition
    - b. Intercooler performance at summer design condition
    - c. Air dryer performance at 38 degrees F, dew point at 175 PSIG
  3. Indicate components, assembly, dimensions, weights and loadings, required clearances, location and size of field connections, intake air filter outline, blow-off silencer outline, main motor drive data, aftercoolers, control panel, and electrical pneumatic schematics.
  4. All Product Data submittals shall identify proposed project specific items marked by arrow, circle, underline, reproducible highlight, or other markings clearly discernable by the reviewer, to show which specific items, parts and accessories are being submitted for the project product data review. Non-marked or generic product data submittals with no marks indicating specific items, parts and accessories shall be a cause for rejection.
- B. Shop Drawings:
  1. Submit Shop Drawings in accordance with of Division 1 - General Requirements of these specifications.
  2. Submitted shop drawings shall be project specific and shall include a minimum 1/8 inch to 1 foot scaled (or larger standard architectural imperial scale), dimensioned, graphical representation of the size, orientation, and location for the submitted equipment. The drawings shall further include dimensions from structural elements or architectural grid lines, operational clearances, locations of any utility service connection points, mounting requirements, and structural supports required for the submitted equipment.
  3. Include plans, elevations, sections, and details.
  4. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  5. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
  6. Include diagrams for power, signal, and control wiring.
- C. Operations and Maintenance Manual:

## **SECTION 11 11 13 - COMPRESSED AIR VEHICLE SERVICE EQUIPMENT**

1. Assemble and provide copies of manual 8-1/2 by 11 inch format. Foldout diagrams and illustrations are acceptable. Manual to be reproducible by dry copy method. Provide copies per provisions of Division 1 - General Requirements.
2. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
3. Provide a Complete parts list, operating instructions, and maintenance manual covering equipment at time of installation including, but not limited to:
  - a. Description of system and components.
  - b. Schematic diagrams of electrical, plumbing and compressed air systems.
  - c. Manufacturer's printed operating instructions.
  - d. Printed listing of periodic preventive maintenance items and recommended frequency required to validate warranties. Failure to provide maintenance information shall indicate that preventive maintenance is not a condition for validation of warranties.
  - e. List of original manufacturer's parts, including suppliers' part numbers and cuts, recommended spare parts stockage quantity and local parts and service source.

### **1.9 PRODUCT SUBSTITUTIONS**

- A. Follow requirements specified in Division 1 - General Requirements.
- B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, shall be at the expense of the Contractor.
- C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance shall be based on the technical requirements herein as determined by Owner and Architect.

### **1.10 INFORMATIONAL SUBMITTALS**

- A. Field quality-control reports.

### **1.11 WARRANTY**

- A. Warrant work specified herein for at least one year from substantial completion against defects in materials, functions, and workmanship.
- B. Warranty shall include materials and labor necessary to correct defects.
- C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situations resulting from non-performance of a manufacturer's recommended preventive maintenance schedule.

### **1.12 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.
  1. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.

## **SECTION 11 11 13 - COMPRESSED AIR VEHICLE SERVICE EQUIPMENT**

- B. Provide equipment and material specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

### **1.13 LABELING**

- A. Manufacturer shall securely attach in a prominent location, on each major item of equipment, a non-corrosive nameplate showing manufacturer's name, address, model number, serial number, and pertinent utility or operating data.
- B. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (UL) in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.
- C. Provide air receivers meeting requirements of ASME Code for Unfired Pressure Vessels and carry ASME approval stamp.

### **1.14 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design compressed-air equipment mounting.
- B. GENERAL REQUIREMENTS FOR AIR COMPRESSORS
- C. 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.
- D. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors, dryers, and receivers that deliver air of quality equal to intake air.
- E. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
  - 1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
  - 2. Motor Controllers: Full-voltage, combination-magnetic type with undervoltage release feature and motor-circuit-protector-type disconnecting means and short-circuit protective device.
  - 3. Control Voltage: 120-V ac or less, using integral control power transformer.
  - 4. Motor Overload Protection: Overload relay in each phase.
  - 5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
  - 6. Instrumentation: Include discharge-air and receiver pressure gages, air-filter maintenance indicator, hour meter, air-compressor discharge-air and coolant temperature gages, and control transformer.
- F. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
  - 1. Pressure Rating: At least as high as highest discharge pressure of connected air compressors (200 PSI minimum) and bearing appropriate code symbols.
  - 2. Exterior Finish: Epoxy coating.
  - 3. Accessories: Include safety valve, pressure gauge, automatic drain, and pressure regulator.

**SECTION 11 11 13 - COMPRESSED AIR VEHICLE SERVICE EQUIPMENT**

**PART 2 - PRODUCTS**

**2.1 COMPRESSOR, AIR, RECIPROCATING, 5 HP, VERTICAL RECEIVER**  
**Equipment Identifier: 8020**

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

Manufacturer	City	State	Phone
CHAMPION	QUINCY	IL	(866) 276-3440
Model No.: VR5-8 WITH ACCESSORIES			

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

Manufacturer	City	State	Phone
ALT #1 FS CURTIS	ST. LOUIS	MO	(314)384-1300
ALT #2 QUINCY	BAY MINETTE	AL	(251)937-5900

- B. General Description: Provide compressor unit consisting of air-cooled motor compressors, air receiver, after cooler, pressure reducing station, spring isolators, and operating controls.

C. Capacities/Dimensions:

1. Overall dimensions:

Overall Dimensions		
Length	Width	Height
35"	34 1/2"	76 1/2"
Weight		Capacity
590 lb		0 lb

2. Receiver: 80 gallons
3. Rating: 175 PSIG
4. Speed: 710 RPM
5. Displacement: 21.4 CFM
6. Delivery: 17.3 CFM
7. Bore diameters: 4-5/8 and 2-1/2 inches
8. Stroke: 3 inches
9. Number of cylinders: Two
10. Output valve: 1/2 inch NPT(F)
11. Boltdown dimensions: Three on 26 inch diameter
12. Weight (approximate): 600 pounds

D. Features/Performance/Construction:

1. Compressor construction:
  - a. Construct compressor unit with cast iron housing and head, heat treated forged steel or ductile iron shaft, aluminum alloy connection rods, aluminum pistons with lubricated carbon steel rings, high-strength alloy suction and discharge valves. Statically and dynamically balanced rotating parts.



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- b. Mount motor and compressor on one-piece ribbed cast iron or welded steel base with provision for V-belt adjustment.
- c. Provide vibration isolators under the compressor to stabilize unit.
- 2. Aftercooler:
  - a. Each pump shall be fitted with an air cooled aftercooler suitable for operation under 175 PSIG working pressure.
  - b. Provide a belt guard style aftercooler mounted on the compressor belt guard.
- 3. Air receiver:
  - a. Compressor shall be mounted on a vertical receiver stamped ASME rated for working pressure of 200 PSI. Flange or screw inlet and outlet connections, welded steel construction.
  - b. Fittings to include a pressure relief valve, a pressure gauge, a drain cock, and an automatic pneumatic tank drain.
  - c. Unit shall come equipped with vibration isolation pads.
- 4. Pressure reducing valve:
  - a. Provide pressure reducing stations complete with automatic reducing valve and bypass, and low pressure side relief valve and gauge.
  - b. Valve capacity suitable to reduce receiver pressure from 180 PSIG to 50 PSIG. Pressure reducing valve to be adjustable upward from reduced pressure.
- 5. Pump shall be equipped with a 5 micron intake filter.
- 6. Unit shall be capable of operating from 32 degrees to 104 degrees Fahrenheit.
- 7. Particulate filter; Ingersoll Rand FA401G
- 8. Vibration Isolators
- 9. Automatic, no-loss pneumatic tank drain; Champion No. CC107015

**E. Controls:**

- 1. Pressure switch to cutout at 195 PSIG with minimum differential of 20 PSIG.
- 2. Unit shall include a magnetic starter for thermal overload protection.
- 3. Pump shall come equipped with a low oil level monitor to shut down the unit when the oil falls below an adequate level and to prevent the unit from restarting while at the low oil level condition.
- 4. Unit shall start unloaded each time in order to prolong the life of the pump by utilizing centrifugal unloaders.

**F. Accessories:**

Description	Manufacturer	Model No.	Qty.
CONVERSATION KIT 230 TO 460 VAC	CHAMPION	TEN011727	1
OIL/WATER SEPARATOR	CHAMPION	CHWS-50	1

**G. Utility Requirements:**

<b>Electrical</b>				
Voltage	Phase	HP	Amperage	Connection Type
230	1	5	15.20	PROVIDE DISCONNECT

H. Finish: Durable enamel in manufacturer’s standard color.

**2.2 COMPRESSOR, AIR, RECIPROCATING, DUPLEX 20 HP (X2), HORIZONTAL (LARGE) RECEIVER  
Equipment Identifier: 8168**

A. Manufacturer’s Reference:

**SECTION 11 11 13 - COMPRESSED AIR VEHICLE SERVICE EQUIPMENT**

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

Manufacturer	City	State	Phone
CHAMPION Model No.: HR20D-24	PRINCETON	IL	815-875-3321

2. Alternate manufacturers: *Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.*

Manufacturer	City	State	Phone
ALT #1 INGERSOLL RAND	DAVIDSON	NC	704-896-4000
ALT #2 QUINCY COMPRESSOR	QUINCY	IL	251-937-5900

- B. General Description: Provide duplex compressor unit consisting of air-cooled motor compressors (20 HP), air receiver, after cooler, pressure reducing station, low level monitor, vibration mount pads, and operating controls.

- C. Capacities/Dimensions:

1. Overall dimensions, capacities, and weight:

Overall Dimensions		
Length	Width	Height
7' - 5 1/2"	5' - 6 1/2"	6' - 3 7/8"
Weight		Capacity
2845 lb		0 lb

2. Bore: 6-1/4 and 3-1/4 inches
3. Motor: Two - 20 HP each
4. Receiver: 240 gallons
5. Rating: 175 PSI
6. Pump speed: 655 RPM
7. Displacement: 186 CFM (93 per pump)
8. Delivery: 153.4 CFM (76.7 per pump)
9. Noise level: 82 db (A)
10. Stroke: 4 inches
11. Number of cylinders: Four
12. Discharge connection: 1-1/4 inch NPT(F)

- D. Features/Performance/Construction:

1. Compressor construction:
  - a. Construct compressor unit with cast iron housing and head, heat treated forged steel or ductile iron shaft, aluminum alloy connection rods, aluminum pistons with lubricated carbon steel rings, high-strength alloy suction and discharge valves. Statically and dynamically balance rotating parts.
  - b. Mount motor and compressor on one-piece ribbed cast iron or welded steel base with provision for V-belt adjustment.
2. After cooler:
  - a. Air compressor with air After cooler suitable for operation under 175 PSIG working pressure.
  - b. A belt guard style After cooler mounted on the compressor belt guard.

**SECTION 11 11 13 - COMPRESSED AIR VEHICLE SERVICE EQUIPMENT**

- c. After cooler capacity to cool discharge air to within 20 degrees F of ambient air temperature with compressors operating at specified capacity.
- 3. Air receiver:
  - a. Horizontal receiver stamped ASME rated for working pressure of 200 PSI. Flange or screw inlet and outlet connections, welded steel construction.
  - b. Fittings to include adjustable pressure regulator, safety valve, check valve, isolation valve, pressure gauge, drain cock, and automatic pneumatic tank drain.
- 4. Pressure reducing valve:
  - a. Provide pressure reducing stations complete with automatic reducing valve and bypass, and low pressure side relief valve and gauge.
  - b. Compressor shall be provided with automatic start-stop capacity controls. In addition, provide centrifugal unloading to ensure for an unloaded compressor at start up.
  - c. Valve capacity suitable to compressor reduce pressure from 50 PSI to 180 PSI. Pressure reducing valve to be adjustable upward from reduced pressure.
  - d. Provide valves with bronze or semi-steel bodies with stainless steel springs, stems, and seats.
- 5. Standard features:
  - a. Condensation filter, Champion No. CFF-170A
  - b. Vibration isolators
  - c. Air-cooled after-coolers
  - d. Automatic tank drain
  - e. Low level oil monitor, two each

- E. Controls:
  - 1. Pressure switch to cutout at 175 PSI with maximum differential of 20 PSI.
  - 2. Provide electrical automatic alternation. In the event one compressor fails, the other compressor automatically maintains air pressure.
  - 3. Unit shall be equipped with a three phase magnetic starter.

F. Utility Requirements:

<b>Electrical</b>				
Voltage	Phase	HP	Amperage	Connection Type
480	3	20	27.00	PROVIDE DISCONNECT

<b>Plumbing</b>		
<b>Domestic Water</b>		
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)

<b>Natural Gas</b>			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum

<b>Compressed Air</b>		
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)
1 1/4"	0.00	

- G. Finish: Durable enamel in manufacturer’s standard color.

**SECTION 11 11 13 - COMPRESSED AIR VEHICLE SERVICE EQUIPMENT**

**2.3 DRYER, AIR, REFRIGERATED, NON-CYCLING, 25 CFM**  
**Equipment Identifier: 8504**

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
CHAMPION	PRINCETON	IL	(815) 875-3321
Model No.: CGD25			

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

Manufacturer	City	State	Phone
ALT #1 INGERSOLL RAND	DAVIDSON	NC	(704) 655-4000
ALT #2 QUINCY COMPRESSOR	CHARLOTTE	NC	(217) 222-7700

B. Capacities/Dimensions:

1. Overall dimensions:

Overall Dimensions		
Length	Width	Height
16"	15"	22"
Weight		Capacity
88 lb		0 lb

2. Capacity: 38 degrees F: 25 SCFM
3. Drain connection: 3/4 inch tube
4. Air connection: 3/4 inch NPT(M)
5. Maximum working pressure: 250 PSIG (Level 1 controller standard)
6. Weight: 88 pounds

C. Features/Performance/Construction:

1. Refrigerated air dryer of self-contained mechanical refrigeration type complete with heat exchanger, refrigeration compressor, moisture removal trap, internal wiring and piping, and full refrigerant charge.
2. Provide air inlet and outlet connections and insulate.
3. Heat exchangers to consist of multiple layers of press formed stainless steel. Unit shall contain a moisture separator located at discharge of heat exchanger. Provide heat exchangers with automatic control system to bypass refrigeration system on low or no load condition.
4. Refrigeration unit of hermetically sealed type to operate continuously to maintain specified 38 degree F dew point. House unit in steel cabinet provided with access door and/or panel for maintenance and inspection.
5. Panel mounted gauges: Provide dryer with air inlet temperature gauge, air outlet pressure gauge, and refrigerant head pressure gauge.
6. High temperature alarm with dry contacts.
7. General purpose filter kit (champion no. CFF Grade C) for pre filter application.
8. High efficiency oil removal filter (champion no. CFF Grade E) for post filter application.

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- 9. Provide seismic bracing and anchorage to meet any local, state, and national codes and provisions.

D. Utility Requirements:

<b>Electrical</b>				
Voltage	Phase	HP	Amperage	Connection Type
120	1	0.2	2.20	RECEPTACLE

<b>PLUMBING</b>		
<b>Domestic Water</b>		
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)

<b>Natural Gas</b>			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum

<b>Compressed Air</b>			
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)	
		Minimum	Maximum
3/4"	25.00	100.00	175.00 psi

- E. Finish: Durable enamel in manufacturer’s standard color.

**2.4 DRYER, AIR, REFRIGERATED, NON-CYCLING, 200 CFM  
Equipment Identifier: 8529**

A. Manufacturer’s Reference:

- 1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer’s name and model to establish acceptable standards of quality, performance, features, and construction.

Manufacturer	City	State	Phone
CHAMPION Model No.: XCNC200	PRINCETON	IL	(866) 276-3440

- 2. Alternate manufacturers: *Contingent upon compliance with these specification and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.*

Manufacturer	City	State	Phone
ALT #1 QUINCY COMPRESSORS	QUINCY	IL	(251) 937-5900
ALT #2 INGERSOLL RAND	DAVIDSON	NC	(704) 655-4000

B. Capacities/Dimensions:

- 1. Overall dimensions, capacities, and weight:

**SECTION 11 11 13 - COMPRESSED AIR VEHICLE SERVICE EQUIPMENT**

Overall Dimensions		
Length	Width	Height
30 1/4"	20"	37 1/2"
Weight		Capacity
170 lb		0 lb

2. Capacity: 39 degrees F dewpoint: 200 CFM at 100 PSI and 100 degrees F ambient
3. Drain connection: 1/4 inch NPT(F)
4. Air connection: 1-1/2 inch NPT(M)
5. Maximum working pressure: 203 PSIG with Level 2 I-controller

C. Features/Performance/Construction:

1. Refrigerated air dryer of self-contained mechanical refrigeration type complete with stainless steel brazed plate heat exchangers, refrigeration compressor, moisture removal trap, internal wiring and piping, and full refrigerant charge.
2. Air inlet and outlet connections at same level and factory insulated.
3. Heat exchangers to consist of multiple layers of press formed stainless steel. Unit shall contain a moisture separator located at discharge of heat exchanger.
4. Refrigeration unit of hermetically sealed type to operate continuously to maintain specified 38 degrees F dew point. House unit in and/or steel cabinet with access door and/or panel for maintenance and inspection.
5. Provide dryer with air inlet temperature gauge, air inlet pressure gauge, air outlet pressure gauge, ON/OFF switch, high temperature LED, status indicators, refrigerant head pressure gauge, refrigerant suction gauge, and a timed drain valve.
6. High temperature alarm with dry contacts.
7. Coalescing oil filter: Provide Grade E cold coalescing oil removal filter, oil filter shall extract oils and aerosols from supply air stream down to 0.008 PPM.
8. Provide seismic bracing and anchorage to meet local, state, and national codes and provisions.

D. Controls:

1. I-controller Level 2: Provide controls with on/off switch, power on light and time drain.

E. Utility Requirements:

Electrical				
Voltage	Phase	HP	Amperage	Connection Type
120	1	1.5	10.00	DISCONNECT

Plumbing		
Domestic Water		
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)

Natural Gas			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum

Compressed Air		
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)
1 1/2"	0.00	

## **SECTION 11 11 13 - COMPRESSED AIR VEHICLE SERVICE EQUIPMENT**

- F. Finish: Durable enamel in manufacturer's standard color.

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.
- B. Check equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.

#### **3.2 INSTALLATION**

- A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.
- B. Install equipment in accordance with plans, shop drawings, and manufacturer's instructions:
  - 1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.
  - 2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
  - 3. Anchorage: Attach equipment as detailed or directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces. Install compressed-air equipment to allow maximum headroom unless specific mounting heights are indicated.
  - 4. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
  - 5. Install equipment to allow right of way for piping installed at required slope.
  - 6. Install the following devices on compressed-air equipment:
    - a. Thermometer, Pressure Gauge, and Safety Valve: Install on each compressed-air receiver.
    - b. Pressure Regulators: Install downstream from air compressors, dryers, and filter assemblies.
    - c. Drain Valves: Install on aftercoolers, receivers, and dryers. Discharge condensate over nearest floor drain.
- C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

#### **3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

## **SECTION 11 11 13 - COMPRESSED AIR VEHICLE SERVICE EQUIPMENT**

- C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve(s) if required.
- D. Connect piping to equipment with moving parts, except safety relief valve connections, with flexible connectors of materials suitable for service.
- E. Connect compressed air and fluid tappings with shutoff valve and union or flange at each connection.
- F. Install piping from safety relief valves to nearest floor drain.
- G. Install electrical devices furnished with equipment but not specified to be factory mounted.
- H. Ground equipment according to Division 26.
- I. Install control wiring, in conduit, to field-mounted electrical devices. Connect wiring according to Division 26.

### **3.4 IDENTIFICATION**

- A. Identify compressed-air equipment system components. Comply with requirements for identification specified in Division 22.

### **3.5 CLEANUP**

- A. Touch-up damage to painted finishes.
- B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.
- C. Clean area around equipment installation and remove packing and installation debris from job site.
- D. Notify Architect or designated representative for final acceptance.

### **3.6 STARTUP SERVICE**

- A. Engage a factory-authorized service representative to perform startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Check for lubricating oil in lubricated-type equipment.
  - 3. Check belt drives for proper tension.
  - 4. Verify that air-compressor inlet filters and piping are clear.
  - 5. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
  - 6. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.
  - 7. Drain receiver tank(s).
  - 8. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 9. Test and adjust controls and safeties.
- B. Prepare written report documenting testing procedures and results.



## **SECTION 11 11 13 - COMPRESSED AIR VEHICLE SERVICE EQUIPMENT**

### **3.7 TESTING**

- A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Startup and testing report shall be submitted to the Architect or designated representative.
  - 1. Replace damaged and malfunctioning controls and equipment.
  - 2. Test and adjust controls and safeties.
  - 3. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
    - a. Inspections performed.
    - b. Procedures used.
    - c. Test methods used.
    - d. Results of tests.
- B. Components shall be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

### **3.8 TRAINING**

- A. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.
  - 1. 8020 COMPRESSOR, AIR, RECIPROCATING, 5 HP, VERTICAL RECEIVER; 1 hours (minimum)
  - 2. 8168 COMPRESSOR, AIR, RECIPROCATING, DUPLEX 20 HP (x2), HORIZONTAL (LARGE) RECEIVER; 1 hours (minimum)
  - 3. 8529 DRYER, AIR, REFRIGERATED, NON-CYCLING, 200 CFM; 1 hours (minimum)
- B. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.
- C. Provide a Windows compatible movie file format recording on DVD disk of the training session. The DVD training movie can be of a live session or a produced training video.

**END OF SECTION 11 11 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

**1.2 WORK INCLUDED**

- A. Equipment items as listed below by Equipment Identifier:
  - 1. 2355 CHANGER, HEAVY DUTY, 76 INCH MAX TIRE (Ref. Part 2.1)
- B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.
- C. Piping, wiring, and switching between equipment and utilities.

**1.3 QUALITY ASSURANCE**

- A. Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.
- B. Manufacturer's Representative:
  - 1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out, and start up.
  - 2. Training: Provide technical representative to provide training to Owner's maintenance personnel in operation and maintenance of specified equipment.

**1.4 SUBMITTALS**

- A. Product Data:
  - 1. Submit Product Data in accordance with Division 1 - General Requirements of these specifications.
  - 2. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.
- B. Operations and Maintenance Manual:
  - 1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
  - 2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
  - 3. Description of system and components.
  - 4. Schematic diagrams of electrical, plumbing, and compressed air system.
  - 5. Manufacturer's printed operating instructions.
  - 6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information shall indicate that preventive maintenance is not a condition for validation of warranties.

## **SECTION 11 11 29 - VEHICLE SHOP EQUIPMENT**

- C. Shop Drawings:
  - 1. Submit Shop Drawings in accordance with of Division 1 - General Requirements of these specifications.
  - 2. Submit site specific installation drawings and procedures.

### **1.5 PRODUCT SUBSTITUTIONS**

- A. Follow requirements specified in Division 1 - General Requirements.
- B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, shall be at the expense of the Contractor.
- C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance shall be based on the technical requirements herein as determined by Owner and Architect.

### **1.6 WARRANTY**

- A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.
- B. Warranty shall include materials and labor necessary to correct defects.
- C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.
- D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.
- E. All parts shall be readily available locally in the United States.

### **1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.
- B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.
- C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

### **1.8 LABELING**

- A. Manufacturer shall securely attach in a prominent location, on each major item of equipment, a non-corrosive nameplate showing manufacturer's name, address, model number, serial number, and pertinent utility or operating data.

**SECTION 11 11 29 - VEHICLE SHOP EQUIPMENT**

- B. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (UL) in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

**PART 2 - PRODUCTS**

**2.1 CHANGER, HEAVY DUTY, 76 INCH MAX TIRE  
Equipment Identifier: 2355**

- A. Manufacturer's Reference:
  - 1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
COATS COMPANY Model No.: HIT 5000	LA VERGNE	TN	(800) 688-6359

- 2. Alternate manufacturers: *Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.*

Manufacturer	City	State	Phone
ALT #1 JOHN BEAN COMPANY	CONWAY	AR	(800) 362-4618
ALT #2 HUNTER ENGINEERING COMPANY	BRIDGETON	MO	(314) 731-0000

- B. Capacities/Dimensions:
  - 1. Overall dimensions, capacity, and weight:

Overall Dimensions		
Length	Width	Height
96"	108"	66"
Weight		Capacity
1400 lb		0 lb

- 2. Wheel capacity:
    - a. Rim width: Up to 25 inches
    - b. Rim diameter: 15 to 38 inches, tube or tubeless
  - 3. Maximum tire diameter: 76 inches
  - 4. Rotational torque: 2,900 foot pounds
- C. Features/Performance/Construction:
    - 1. Changer shall have a self-centering hydraulic chuck with adjustable clamping pressure to match rim strength.
    - 2. Changer shall have a roller type spreader.
  - D. Controls shall swing out of the way for safety with a dedicated lever for each powered function.
  - E. Accessories:

**SECTION 11 11 29 - VEHICLE SHOP EQUIPMENT**

Description	Manufacturer	Model No.	Qty.
JAW EXTENSIONS (ONE EACH PER UNIT)	COATS COMPANY	110843	1
OFFSET DISC AND TOOL HOLDER (ONE EACH PER UNIT)	COATS COMPANY	110852	1
PORTABLE RAMP (ONE EACH PER UNIT)	COATS COMPANY	110842	1

F. Utility Requirements:

<b>Electrical</b>				
Voltage	Phase	HP	Amperage	Connection Type
220	1	2	20.00	DISCONNECT

G. Finish: Durable enamel in manufacturer’s standard color.

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.
- B. Inspect delivered equipment for damage from shipping and exposure to weather.
- C. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items.

**3.2 INSTALLATION**

- A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect or designated representative.
- B. Install equipment in accordance with plans, shop drawings, and manufacturer’s instructions:
  - 1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.
  - 2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
  - 3. Anchorage: Attach equipment as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.
- C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

**3.3 TESTING**

- A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

## **SECTION 11 11 29 - VEHICLE SHOP EQUIPMENT**

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### **3.4 CLEANUP**

- A. Touch-up damage to painted finishes.
- B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.
- C. Clean area around equipment installation and remove packing and installation debris from job site.
- D. Notify Architect or designated representative when installation and cleanup is 100% complete and ready for final observation (punchlist).

### **3.5 TRAINING**

- A. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.
  - 1. 2355 CHANGER, HEAVY DUTY, 76 INCH MAX TIRE; 1 hours (minimum)
- B. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

**END OF SECTION 11 11 29**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section. This section covers existing City of Concord -supplied equipment that shall be relocated and installed by the Contractor as specified herein.

**1.2 WORK INCLUDED**

- A. Existing equipment items as listed in the Equipment Schedule Table on Equipment Drawings with an equipment identification number (ID) having 5 digits and noted under "Furnish/Install" column in this table as being "Owner Furnished and Contractor Installed" (OF/CI) shall be relocated and installed by the contractor.
- B. Disconnection, cleaning, removal, transport, and re-installation of existing equipment located at other facilities with labor, services, and incidentals necessary for complete and operational equipment re-installation.

**1.3 QUALITY ASSURANCE AND CONDITION DOCUMENTATION**

- A. Existing Equipment shall be tested and certified as operational and safe by the City of Concord prior to removal by the contractor or his agents.
- B. City of Concord's staff to note all existing defects, and damage to existing equipment to be relocated and provide this document to the Contractor. Defects shall include, but not be limited to, noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.
- C. Contractor to ensure that only qualified, licensed and certified equipment installers are involved in the relocation process. Contractor is responsible for equipment during removal, relocation, installation, testing, and until building is occupied by City of Concord.
- D. Contractor to coordinate directly with the City of Concord or City of Concord's Representative on relocation timeframe and schedule. Relocation will not be scheduled before new facility is considered substantially complete, with exception of equipment specified herein in order to maintain the City of Concord's current operation.

**1.4 SUBMITTALS**

- A. Contractor shall submit a schedule for equipment relocation no less than two months before any relocation is required. City of Concord must approve relocation and installation schedule.
- B. Drawings for existing equipment shall be required where re-installation is provided by the original equipment manufacturer.

**1.5 IMPACT ON ORIGINAL WARRANTY**

- A. The Contractor is responsible for all aspects of relocation including coordination with Original Equipment Manufacturer on the impact of existing equipment still under original warranty.

**1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. A relocation and transport plan listing each item in Part 2.0 requiring re-installation by the contractor must be submitted to the City of Concord's Representative. Plan shall be developed by the Contractor and must convey a complete understanding of required utility disconnection and reconnections and responsibility; crating, transportation, and tie-down methods; and temporary storage methods if required.
- B. Contractor is responsible for constructing or providing any necessary or special crates or packing materials to ensure that equipment is protected during transport or shipment and storage in humid and/or dusty conditions.
- C. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.
- D. Contractor is responsible for providing any required specialized personnel or equipment manufacturer/supplier representatives required for re-installation of existing equipment.

**PART 2 - PRODUCTS**

**2.1 RELOCATION, TRANSPORTATION, AND RE-INSTALLATION**

- A. Each of the Existing Equipment items listed below has been designated as an Owner Furnished/Contractor Installed item. This indicates that the item may require special utility connections, special transportation, or special expertise to successfully re-install the existing equipment.
  - 1. 57071 LIFT, SURFACE MOUNTED, TWIN-POST, CART/TURF
- B. The Relocation Plan shall be developed by the Contractor and must convey an understanding of utility disconnection and reconnection methods and responsibility, transportation and tie down method, and temporary storage methods if any.
- C. Contractor is solely responsible for the security, safety and operation of all Existing Equipment during relocation.
- D. Existing Equipment Schedule: Reference Equipment Layout Drawings for final installation instruction and other directives delineated on the drawing.

**2.2 EXISTING EQUIPMENT SCHEDULE**

- A. Reference Equipment Layout Drawings for final installation instruction and other directives delineated on the drawing.
- B. Relocation shall be completed following an approved schedule submitted by Contractor no less than two months before said relocation. No relocation shall be started before the project is



substantially complete and City of Concord's move-in is imminent, unless approved by City of Concord or City of Concord's Representative.

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Coordinate location of rough-in work and utility stub-outs to assure match with existing equipment to be installed.
- B. Inspect existing equipment transported from other sites for damage from shipping and exposure to weather. Compare delivered equipment with document prepared by the City of Concord noting any pre-existing defects. Contractor and City of Concord's Representative to resolve any differences to this list prior to re-installation and again upon completion of re-installation for each item.

**3.2 INSTALLATION**

- A. Perform work under direct supervision of Construction Superintendent with authority to coordinate re-installation of existing equipment with Architect, and City of Concord's Representative.
- B. Install equipment in accordance with manufacturer's instructions where available:
  - 1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.
  - 2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
  - 3. Anchorage: Attach equipment as required by existing equipment or as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.
- C. Upon completion of work, finish surfaces shall be free of any new (not previously noted) tool marks, scratches, blemishes, and stains.

**3.3 TESTING**

- A. After final connections are made and prior to authorizing payment, re-installed existing equipment shall be tested to ensure re-installation has resulted in a complete and operable equipment item. This test should take place in the presence of the City of Concord's Representative, the Architect or designated representative. Where available, the test should be conducted using acceptance procedures provided by the manufacturer.

**3.4 CLEANUP**

- A. Touch-up damage to painted finishes.
- B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

## **SECTION 11 11 40 - RELOCATION**

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- C. Clean area around equipment installation and remove packing and installation debris from job site.
- D. Notify Architect or City of Concord's Representative for acceptance observation.

**END OF SECTION 11 11 40**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

**1.2 WORK INCLUDED**

- A. Equipment items as listed below by Equipment Identifier:
  - 1. 3454 REEL, VEHICLE EXHAUST, SPRING OPERATED, INDIVIDUAL FAN, FOUR INCH HOSE (Ref. Part 2.1)
  - 2. 3464 REEL, VEHICLE EXHAUST, SPRING OPERATED, INDIVIDUAL FAN, SIX INCH HOSE (Ref. Part 2.2)
- B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.
- C. Piping, ductwork, wiring, and switching between equipment and utilities.

**1.3 QUALITY ASSURANCE**

- A. Experience: Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.
- B. Manufacturer's Representative:
  - 1. Installation: Provide a qualified manufacturer's representative at site to perform work related to equipment installation, check out and start up.
  - 2. Training: Provide technical representative to train Owner's maintenance personnel in operation and maintenance of specified equipment.

**1.4 SUBMITTALS**

- A. Product Data: Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.
- B. Operations and Maintenance Manual:
  - 1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
  - 2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
  - 3. Description of system and components.
  - 4. Schematic diagrams of electrical, plumbing, and compressed air system.
  - 5. Manufacturer's printed operating instructions.
  - 6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information shall indicate that preventive maintenance is not a condition for validation of warranties.

- C. Shop Drawings: Submit Shop Drawings in accordance with Division 1 - General Requirements of these specifications.

**1.5 PRODUCT SUBSTITUTIONS**

- A. Follow requirements specified in Division 1 - General Requirements.
- B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, shall be at the expense of the Contractor.
- C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance shall be based on the technical requirements herein as determined by Owner and Architect.

**1.6 WARRANTY**

- A. Warrant work specified herein for one year from acceptance by Owner against defects in materials, function and workmanship.
- B. Warranty shall include materials and labor necessary to correct defects.
- C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.
- D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.
- E. All parts must be readily available locally in the United States.

**1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and in humid, dusty conditions.
- B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title of this specification.
- C. Provide equipment with materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

**1.8 LABELING**

- A. Manufacturer will securely attach in a prominent location on each major item of equipment a noncorrosive nameplate showing manufacturer's name, address, model number, serial number, and pertinent utility or operating data.
- B. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (U.L.) in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

**PART 2 - PRODUCTS**

**2.1 REEL, VEHICLE EXHAUST, SPRING OPERATED, INDIVIDUAL FAN, FOUR INCH HOSE**  
**Equipment Identifier: 3454**

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimum acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
NEDERMAN	CHARLOTTE	NC	(855) 765-3066
Model No.: 865			

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in Section 01300 SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

Manufacturer	City	State	Phone
ALT #1 PLYMOVEMENT	CRANBURY	NJ	(609) 395-3500
ALT #2 MONOXIVENT	ROCK ISLAND	IL	(309) 794-1000

B. Capacities/Dimensions:

1. Overall dimensions:

Overall Dimensions		
Length	Width	Height
56"	35"	37 1/2"
Weight		Capacity
113 lb		

2. Exhaust hose:
  - a. NFC 1.5: 4 inches, 33 feet, 350 degrees
3. Drum capacity hose length: 39 feet, 6 inches

C. Features/Performance/Construction:

1. Exhaust hose drum:
  - a. The exhaust hose drum, Nederman Model No. 20804365 shall consist of an aluzinc-lined metal cylinder bolted to two metal ends. Inside the drum there shall be a flexible aluminum 6-1/4 inch diameter pipe which links the hose and the swivel.
  - b. The stand shall consist of two aluzinc-lined supports and two aluzinc-plated steel tubes.
  - c. The hose guide shall guide the hose on the first evolution of the drum.
  - d. The connecting tube of aluminum, flexible, 6-1/4 inch diameter, 12 inch length pipe shall be used in a straight position when bends are needed in the duct system.
2. Exhaust fan:
  - a. Each exhaust hose reel shall have an individual exhaust fan which shall be mounted directly to the drum. The exhaust fan shall be Nederman series N16, No. 14511021
  - b. Exhaust fan shall be centrifugal type fan constructed of powder coated steel.
  - c. The exhaust fan shall be mounted to the exhaust reel utilizing a fan mounting bracket, Nederman Model No. 20373556
3. Exhaust hose:

**SECTION 11 24 19 - VACUUM EQUIPMENT**

- a. The hose Nederman series NFC 1.5 No. 87800002 shall be constructed of high temperature fabric with an external steel helix. The steel helix shall have a plastic coating that will prevent it from scratching vehicles.
- b. The exhaust hose shall be resistant to temperatures of up to 300 degrees F continuously.
- c. Hose stop shall be adjustable so that the hose will hang at any required height.

**D. Controls:**

- 1. Exhaust fan shall be controlled by an auto/start stop micro switch Nederman Model No 20373557. When the exhaust hose is pulled down, the exhaust fan will start. When the exhaust hose is returned to the reel, then the exhaust fan will stop.
- 2. Electrical control box with fan controller and 24V transformer to start/stop fan, Nederman Model No. 89115570.

**E. Accessories:**

Description	Manufacturer	Model No.	Qty.
EXTRACTION NOZZLE WITH CLAMP	NEDERMAN	20804161	1
TWIN EXHAUST NOZZLE (FORD F-SERIES)	NEDERMAN	89900491	1

- 1. Nozzle shall be capable of withstanding temperatures of up to 300 degrees F.
- 2. A fully adjustable locking clamp shall be used to secure the nozzle to the vehicle exhaust pipe.
- 3. A steel mesh inlet guard shall be used to prevent passage of debris to hose.

**F. Utility Requirements:**

<b>Electrical</b>				
Voltage	Phase	HP	Amperage	Connection Type
460	3	0.75	1.60	DISCONNECT

<b>Mechanical</b>					
<b>Flue</b>		<b>Exhaust</b>			
Size (IN)	Pressure (PSI)	Width (IN)	Height (IN)	Diameter (IN)	Flow (CFM)
				6"	300

**2.2 REEL, VEHICLE EXHAUST, SPRING OPERATED, INDIVIDUAL FAN, WITH SIX INCH HOSE  
Equipment Identifier: 3464**

**A. Manufacturer's Reference:**

- 1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimum acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
NEDERMAN	CHARLOTTE	NC	(704) 399-7441
Model No.: 865 W/ ACCESSORIES			

- 2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in Section 01300 SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

**SECTION 11 24 19 - VACUUM EQUIPMENT**

Manufacturer	City	State	Phone
ALT #1 PLYMOVEMENT	CRANBURY	NJ	(609) 395-3500
ALT #2 MONOXIVENT	ROCK ISLAND	IL	(309) 794-1000

**B. Overall Capacities/Dimensions/Weights:**

1. Overall reel dimensions:

Overall Dimensions		
Length	Width	Height
60"	35"	33"
Weight		Capacity
150 lb		0 lb

2. Exhaust hose:

- a. NFC 4.2: 6 inches, 24 feet, 800 degrees
  - b. NFC 6.5: 6 inches, 8 feet, 1200 degrees
3. Drum storage capacity hose length: 29 feet, 6 inches

**C. Features/Performance/Construction:**

1. Exhaust hose drum:

- a. The exhaust hose drum, Nederman Model No. 20804865 shall consist of an aluzinc-lined metal cylinder bolted to two metal ends. Inside the drum there is a flexible 6-1/4 inch pipe which links the hose and the swivel.
- b. The stand shall consist of two aluzinc-lined supports and two aluzinc-plated steel tubes.
- c. The hose guide shall guide the hose on the first evolution of the drum.
- d. The connecting tube of aluminum, flexible, 6-1/4 inch diameter, 12 inch length, shall be used in a straight position when bends are needed in the duct system.

2. Exhaust fan:

- a. Each exhaust hose reel shall have an individual exhaust fan which shall be mounted to the ceiling or wall. The exhaust fan shall be Nederman series N24, No. 14511022
- b. Exhaust fan shall be centrifugal type fan constructed of powder coated steel.
- c. The exhaust fan shall be mounted to ductwork utilizing a fan mounting bracket, Nederman Model No. 20373556

3. Exhaust hose

- a. The hose shall be constructed of high temperature fabric with an external steel helix. The steel helix shall have a plastic coating to prevent it from scratching vehicles.
  - 1) First eight feet shall be resistant to temperatures up to 1,200 degrees Fahrenheit. NFC 6.5 Nederman model No. 20824462.
  - 2) Second 24 feet shall be resistant to temperatures of up to 800 degrees F, NFC 4.2 Nederman Model No. 86900692.
- b. The two hose sections shall be connected using Nederman 6 inch hose coupling, No. 20948810

4. Hose stop Nederman Model No 20344476 shall be adjustable so that the hose will hang at any required height.

**D. Controls:**

- 1. Exhaust fan shall be wall mount fan starter with on/off switch. Nederman Model No 20373557 with control box Nederman Model No. 89115570.

**E. Accessories:**

**SECTION 11 24 19 - VACUUM EQUIPMENT**

Description	Manufacturer	Model No.	Qty.
EXTRACTION NOZZLE WITH CLAMP	NEDERMAN	20804761	1
EXTRACTION NOZZLE WITH LIFTING SLEEVE	NEDERMAN	20816661	1
TELESCOPING POLE	NEDERMAN	20374287	1

1. Nozzle shall be capable of withstanding temperatures of 1,200 degrees Fahrenheit (minimum).
2. Nozzle shall be equipped with a hook for telescopic lifting pole and a vise grip. Nozzle shall have a steel mesh inlet to prevent debris from entering the hose.

F. Utility Requirements:

<b>Electrical</b>				
Voltage	Phase	HP	Amperage	Connection Type
460	3	1.5	6.00	DISCONNECT

<b>Mechanical</b>					
<b>Flue</b>		<b>Exhaust</b>			
Size (IN)	Pressure (PSI)	Width (IN)	Height (IN)	Diameter (IN)	Flow (CFM)
		3"	30"	6"	1000

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.
- B. Inspect delivered equipment for damage from shipping and exposure to weather.
- C. Compare delivered equipment with packing lists and specifications to assure receipt of all items.

**3.2 INSTALLATION**

- A. Perform work under direct supervision of Foreman or Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect or designated representative.
- B. Install equipment in accordance with plans, shop drawings and manufacturer's instructions:
  1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level, plumb and at right angles to adjacent work.
  2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
  3. Anchorage: Attach equipment securely to floor, as directed by Architect or designated representative, to prevent damage resulting from inadequate fastening. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.



## **SECTION 11 24 19 - VACUUM EQUIPMENT**

- C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

### **3.3 CLEANING**

- A. Touch-up damage to painted finishes.
- B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.
- C. Clean area around equipment installation and remove packing and installation debris from job site.
- D. Notify Architect or designated representative when installation and cleanup is 100% complete and ready for final observation (punchlist).

### **3.4 TESTING**

- A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

### **3.5 TRAINING**

- A. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.
  - 1. 3454 REEL, VEHICLE EXHAUST, MOTOR OPERATED, INDIVIDUAL FAN, FOUR INCH HOSE; 2 hours (minimum)
  - 2. 3464 REEL, VEHICLE EXHAUST, SPRING OPERATED, INDIVIDUAL FAN, SIX INCH HOSE; 2 hours (minimum)
- B. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

**END OF SECTION 11 24 19**

## **SECTION 11 31 00 - RESIDENTIAL APPLIANCES**

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### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes residential appliances.

#### **1.2 PREINSTALLATION MEETINGS**

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

### **PART 2 - PRODUCTS**

#### **2.1 APPLIANCE SCHEDULE**

- A. Owner Furnished/Contractor Installed (OF/CI).
- B. See selections on drawings.

#### **2.2 GENERAL FINISH REQUIREMENTS**

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install appliances according to manufacturer's written instructions.

**END OF SECTION 11 30 13**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Manually operated, single-roller shades.

**1.2 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Samples: For each exposed product and for each color and texture specified, 10 inches long.
- D. Samples for Initial Selection: For each type and color of shadeband material.
  - 1. Include Samples of accessories involving color selection.
- E. Samples for Verification: For each type of roller shade.
  - 1. Shadeband Material: Not less than 10 inches square. Mark interior face of material if applicable.
  - 2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
  - 3. Installation Accessories: Full-size unit, not less than 10 inches long.
- F. Product Schedule: For roller shades. Use same designations indicated on Drawings.

**1.3 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of shadeband material.

**1.4 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: Fabricator of products.

## **SECTION 12 24 13 - ROLLER WINDOW SHADES**

### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

### **1.7 FIELD CONDITIONS**

- A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

## **PART 2 - PRODUCTS**

### **2.1 SOURCE LIMITATIONS**

- A. Obtain roller shades from single source from single manufacturer.

### **2.2 MANUALLY OPERATED, SINGLE-ROLLER SHADES**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide MechoShade Systems, LLC; Mecho 5 or a comparable product by one of the following:
  - 1. Aperture Contract.
  - 2. Hunter Douglas Architectural.
  - 3. Insolroll Window Shading Systems.
- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
  - 1. Bead Chains: Stainless steel.
    - a. Loop Length: Full length of roller shade.
    - b. Limit Stops: Provide upper and lower ball stops.
    - c. Chain-Retainer Type: Clip, jamb mount.
  - 2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.
    - a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.
- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
  - 1. Roller Drive-End Location: As indicated on Drawings.
  - 2. Direction of Shadeband Roll: Standard roll.
  - 3. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube.

## SECTION 12 24 13 - ROLLER WINDOW SHADES

- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- F. Shadebands:
  - 1. Shadeband Material: Light-filtering fabric.
  - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
    - a. Type: Exposed with endcaps and integral light seal at bottom where it meets the sill.
    - b. Color and Finish: As selected by Architect from manufacturer's full range.
- G. Installation Accessories:
  - 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
    - a. Shape: L-shaped.
    - b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 3 inches.
  - 2. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.
    - a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 3 inches.
  - 3. Endcap Covers: To cover exposed endcaps.
    - a. Closure-Panel Width: 2 inches.
  - 4. Side Channels: With light seals and designed to eliminate light gaps at sides of shades as shades are drawn down. Provide side channels with shadeband guides or other means of aligning shadebands with channels at tops.
  - 5. Bottom (Sill) Channel or Angle: With light seals and designed to eliminate light gaps at bottoms of shades when shades are closed.
  - 6. Installation Accessories Color and Finish: As selected from manufacturer's full range.

### 2.3 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:
  - 1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
  - 2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

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## SECTION 12 24 13 - ROLLER WINDOW SHADES

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
  - 1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.
- B. Roller Shade Locations: As indicated on Drawings.

#### 3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

#### 3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.
- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

**END OF SECTION 12 24 13**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Wall-mounted countertop brackets.

**1.2 REFERENCES:**

- A. American Architectural Manufacturers Association (AAMA):
  - 1. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
- B. ASTM International (ASTM):
  - 1. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

**1.3 ACTION SUBMITTALS**

- A. Product Data: Manufacturer's product data sheets for architectural casework supports.
- B. Installation Drawings: Include installation instructions with fastener locations including recommended fastener sizes and types for support conditions, and requirements for concealed framing, blocking, or backing.
- C. Samples for Selection: In manufacturer's standard sample size, illustrating range of colors and finishes available for Architect's selection.
- D. Samples for Verification: Illustrating selected finish.

**1.4 COORDINATION**

- A. Coordinate required locations for concealed framing, blocking, or backing with Installers. Verify placement prior to concealment.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Basis-of-Design Product: Subject to compliance with requirements of this Section, provide products of Rockford Process Control, Inc. or approved equal.

**2.2 COUNTERTOP SUPPORTS**

- A. Aluminum Countertop Brackets: L-shaped bracket configured for surface-mounting on finished wall, formed from T-shaped 6063-T4 aluminum extrusion, with staggered fastener holes spaced at 1-inch intervals for through-fastening to substrate for all openings over 36" wide.
  - 1. Load Capacity: 450 lb.



## SECTION 12 36 09 – COUNTERTOP SUPPORTS

2. Size:
  - a. 2 by 2 by 1/4-inch extrusion, 12 by 12 inches dimension, supporting up to 18-inch-deep surface.
  - b. 2 by 2 by 1/4-inch extrusion, 18 by 18 inches dimension, supporting up to 25-inch-deep surface.
  - c. 2 by 1/4 inch and 3 by 3/16-inch extruded tee, 18 by 24 inches in dimension, supporting up to 30-inch-deep surface.
3. Finish: Powder coating, Dove Gray.
4. Frame Wall Fasteners: Phillips drive pan head screws, 1/4 by 2 inch.
5. Countertop Fasteners: Type and size recommended by countertop fabricator sized according to thickness of countertop.

### 2.3 MATERIALS

- A. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.
- B. Fasteners: Stainless-steel, of type and size recommended by support manufacturer for application.

### 2.4 FABRICATION

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces. Provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges and outside corners. Remove sharp or rough areas on exposed surfaces.
- C. Form exposed connections with seams welded on both sides.

### 2.5 FINISHES

- A. Aluminum Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify framing and blocking to accept support fasteners are properly located. Proceed with work once conditions meet support manufacturer's written recommendations.

### 3.2 INSTALLATION

- A. Set supports at required height, plumb and level, and securely fastened to wall using manufacturer's recommended fasteners.

## **SECTION 12 36 09 – COUNTERTOP SUPPORTS**

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### **3.3 CLEANING AND PROTECTION**

- A. Repair or replace defective work, including damaged brackets.
- B. Protect installed components.

**END OF SECTION 12 36 09**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Stainless-steel countertops and shelving.

**1.2 COORDINATION**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: For metal fabrications.
  - 1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
  - 2. For countertops, show locations and sizes of cutouts and holes for items installed in metal countertops.
  - 3. For shelving, show concealed mounting brackets.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products only after casework and/or supports on which they will be installed has been completed in installation areas.
- B. Keep finished surfaces of products covered with polyethylene film or other protective covering during handling and installation.

**1.5 FIELD CONDITIONS**

- A. Field Measurements: Where products are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Established Dimensions: Where products are indicated to fit to other construction, establish dimensions for areas where products are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

**PART 2 - PRODUCTS**

**2.1 STAINLESS-STEEL COUNTERTOP AND SHELVING**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Chemtops.
  2. Custom Metal Home.
  3. Stainless Supply.

**2.2 STAINLESS-STEEL FABRICATIONS**

- A. Countertops: Custom fabricate from 16G (.0595-inch-thick), stainless-steel sheet without field-made joints. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Sound deaden the undersurface with heavy-build mastic coating. Provide front and end overhang of 1 inch over the base cabinets.
1. Weld shop-made joints.
  2. See Schedule.
- B. Shelving: Custom fabricate from 16G (.0595-inch-thick), stainless-steel sheet without field-made joints. Provide smooth, clean exposed tops and edges in uniform plane, free of defects.
1. 2" height minimum and 12" depth with return on front and both sides.
  2. Provide integral stiffening brackets as required for smooth, level finish.
  3. Provide concealed, integrated, mounting frame, secured to substrate.
- C. Wall-Mounted Shelves: Fabricate from stainless-steel sheet, not less than 0.050-inch nominal thickness. Weld shop-made joints. Fold front edge down a minimum of 3/4 inch; fold back edge up a minimum of 3 inches. Provide integral stiffening brackets, formed by folding up ends a minimum of 3/4 inch and by welding to upturned edges.

**2.3 MATERIALS**

- A. Stainless-Steel Sheet: ASTM A240/A240M, Type 304.
- B. Sealant for Countertops: Manufacturer's standard sealant that complies with applicable requirements in Section 07 92 00 "Joint Sealants" and the following:
1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, silicone.
  2. Color: As selected by Architect from manufacturer's full range.

**2.4 STAINLESS-STEEL FINISH**

- A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 INSTALLATION**

- A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.
- B. Install metal floating shelf system level, plumb, and true; shim as required. Shelves up to 72-inches in length rated to hold up to 120 lbs.
- C. Field Jointing: Where possible, make field jointing in the same manner as shop jointing; use fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
- D. Secure countertops to cabinets with Z- or L-type fasteners or equivalent; use two or more fasteners at each front, end, and back.
- E. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.
- F. Seal junctures of countertops, splashes, and walls with sealant for countertops.

**3.3 CLEANING AND PROTECTION**

- A. Repair or remove and replace defective work as directed on completion of installation.
- B. Clean finished surfaces. Remove and replace damaged products or touch up and refinish damaged areas to match original factory finish, as approved by Architect.
- C. Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

**3.4 SCHEDULE:**

- A. Custom L-Shape Countertop 304 Stainless Steel, 16G (0.0595"):
  - 1. Finish: #4 Brushed.
  - 2. 1-½" Straight Edge with 1/2" Return on Front and Both Sides.
  - 3. Backer: ¾" Plywood.
- B. Custom Countertop 304 Stainless Steel, 16G (0.0595"):
  - 1. Finish: #4 Brushed.
  - 2. 1-½" Straight Edge with 1/2" Return on Front and Both Sides.
  - 3. Backer: 1-½" Plywood.

## **SECTION 12 36 16 - METAL COUNTERTOPS**

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- C. Custom Island Countertop 304 Stainless Steel, 16G (0.0595"):
  - 1. Finish: #4 Brushed.
  - 2. 1-½" Straight Edge with 1/2" Return on all Sides.
  - 3. Backer: 1½" Plywood.
  
- D. Floating Shelf System 304 Stainless Steel, 16G (0.0595"):
  - 1. Wall-mounted shelves with a concealed internal mounting bracket.
  - 2. Finish: #4 brushed; fully welded and seamless.
  - 3. Provide concealed mounting frame.

**END OF SECTION 12 36 16**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Solid surface material for window sills.

**1.2 ACTION SUBMITTALS**

- A. Shop Drawings: For window sills and accents. Show materials, finishes, and edge.

**PART 2 - PRODUCTS**

**2.1 SOLID SURFACE MATERIALS**

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
- B. Manufacturers:
  - 1. See Finish Legend.

**2.2 FABRICATION**

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
  - 1. Grade: Premium.
- B. Configuration:
  - 1. Front: Straight, eased edge.
- C. Window Sills: 1/2-inch-thick, solid surface material with front edge built up with same material.
- D. Joints: Fabricate window sills without joints.
- E. Color: White.

**2.3 INSTALLATION MATERIALS**

- A. Adhesive: Product recommended by solid surface material manufacturer.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Secure solid surface sill to substrate with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to



## **SECTION 12 36 62 - SOLID SURFACING**

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match sill, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

- B. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

**END OF SECTION 12 36 62**

## **SECTION 12 36 63 - QUARTZ AGGLOMERATE COUNTERTOPS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Quartz agglomerate countertops, backsplashes, and end splashes.

#### **1.2 ACTION SUBMITTALS**

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples: For each type of material exposed to view.

### **PART 2 - PRODUCTS**

#### **2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS**

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.
  - 1. See Finish Legend.
- B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

#### **2.2 COUNTERTOP FABRICATION**

- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI's "Architectural Woodwork Standards."
  - 1. Grade: Premium.
- B. Configuration:
  - 1. See Finish Schedule.
- C. Joints: Fabricate countertops in sections for joining in field, with joints at locations indicated.
- D. Cutouts and Holes:
  - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

#### **2.3 ACCESSORIES**

- A. Countertop supports:
  - 1. 1/2-inch steel, powder coated, manufactured by Centerline Brackets.

## **SECTION 12 36 63 - QUARTZ AGGLOMERATE COUNTERTOPS**

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### **2.4 INSTALLATION MATERIALS**

- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
- B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions.
- B. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
- C. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.
- D. Install aprons to backing and countertops with adhesive.
- E. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
- F. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

**END OF SECTION 12 36 63**

## **SECTION 12 48 13 - ENTRANCE FLOOR MATS AND FRAMES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Resilient entrance mats.
  - 2. Recessed frames.

#### **1.2 COORDINATION**

- A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

#### **1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.
- B. Shop Drawings:
  - 1. Items penetrating floor mats and frames, including door control devices.
  - 2. Divisions between mat sections.
  - 3. Perimeter floor moldings.

#### **1.4 CLOSEOUT SUBMITTALS**

- A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

### **PART 2 - PRODUCTS**

#### **2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL**

- A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

#### **2.2 ENTRANCE FLOOR MATS**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Milliken & Company; OBEX CUTX. or a comparable product by one of the following:
  - 1. Construction Specialties, Inc.
  - 2. Mats Inc.

#### **2.3 FRAMES**

- A. Recessed Frames: Manufacturer's standard extrusion.

## **SECTION 12 48 13 - ENTRANCE FLOOR MATS AND FRAMES**

1. Extruded Aluminum: ASTM B 221, Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
  - a. Color: Mill finish.

### **2.4 CONCRETE FILL AND GROUT MATERIALS**

- A. Provide concrete fill and grout equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

### **2.5 FABRICATION**

- A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.
- B. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.
  1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.
- C. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and floor conditions for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate tops of mat surfaces with bottoms of doors that swing across mats to provide clearance between door and mat.
  1. Install necessary shims, spacers, and anchorages for proper location, and secure attachment of frames.
  2. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

## **SECTION 12 48 13 - ENTRANCE FLOOR MATS AND FRAMES**

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### **3.3 PROTECTION**

- A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

**END OF SECTION 12 48 13**

**SECTION 12 48 13 - ENTRANCE FLOOR MATS AND FRAMES**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

**1.2 WORK INCLUDED**

- A. Equipment items as listed below by Equipment Identifier:
  - 1. 5632 LIFT, AXLE, THREE-POST, TAG AXLE (Ref. Part 2.1)
  - 2. 5655 LIFT, PLATFORM, VERTICAL RISE (Ref. Part 2.2)
  - 3. 5660 LIFT, SURFACE MOUNTED, FOUR POST (Ref. Part 2.3)
  - 4. 5665 LIFT, SURFACE MOUNTED, FOUR POST, ALIGNMENT (Ref. Part 2.4)
  - 5. 5712 LIFT, SURFACE MOUNTED, TWIN-POST, 12,000 POUND (Ref. Part 2.5)
- B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.
- C. Piping, wiring, and switching between equipment and utilities.

**1.3 QUALITY ASSURANCE**

- A. Experience: Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.
- B. Quality standards shall meet or exceed ISO-9001 and be certified by the Automotive Lift Institute (ALI).
- C. Manufacturer's Representative:
  - 1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out, and start up.
  - 2. Training: Provide technical representative to provide training to Owner's maintenance personnel in operation and maintenance of specified equipment.
  - 3. Quality standards shall meet or exceed ISO-9001.

**1.4 SUBMITTALS**

- A. Product Data: Submit Product Data in accordance with Division 1 of these specifications.
- B. Operations and Maintenance Manual:
  - 1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
  - 2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
  - 3. Description of system and components.
  - 4. Schematic diagrams of electrical, plumbing, and compressed air system.
  - 5. Manufacturer's printed operating instructions.



6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.

C. Shop Drawings:

1. Submit Shop Drawings in accordance with Division 1 - General Requirements.
2. Submit site specific installation drawings and procedures.

**1.5 PRODUCT SUBSTITUTIONS**

- A. Follow requirements specified in Division 1 - General Requirements.
- B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, shall be at the expense of the Contractor.
- C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance shall be based on the technical requirements herein as determined by Owner and Architect.

**1.6 WARRANTY**

- A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.
- B. Warranty shall include materials and labor necessary to correct defects.
- C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situations resulting from non-performance of a manufacturer's recommended preventive maintenance schedule.
- D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.
- E. All parts shall be readily available locally in the United States.

**1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.
- B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.

**1.8 LABELING**

- A. Manufacturer shall securely attach in a prominent location, on each major item of equipment, a non-corrosive nameplate showing manufacturer's name, address, model number, serial number, and pertinent utility or operating data.

**SECTION 14 45 00 - VEHICLE LIFTS**

- B. Manufacturer shall securely attach the ALI label of the Automotive Lift Institute.
- C. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (UL) in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

**PART 2 - PRODUCTS**

**2.1 LIFT, AXLE, THREE-POST, TAG AXLE**

**Equipment Identifier: 5632**

A. Manufacturer's Reference:

- 1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
ROTARY Model No.: MOD 35	MADISON	IN	(812) 273-1622

- 2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

Manufacturer	City	State	Phone
ALT #1 STERTIL KONI	STEVENSVILLE	MD	(800) 336-6637

B. General Description

- 1. Lifting units: Lift shall consist of three individual modular lifting assemblies in line with the longitudinal axis of the vehicle, each lifting cylinder so equipped as to engage the axle and suspension, as specified herein. Each modular lifting assembly shall be housed in a totally contained, environmentally safe containment. Movable posts shall be equipped with automatic shutter-plate covers that move with the post so as to keep the trench opening covered at all times. All trench cover plates, including recess covers shall be permanently attached to the floor openings to ensure their proper use. The modular lifting system shall be VEC equalized and controlled. The operation of the lift shall be electrohydraulic.
- 2. Only axle adjusting post-type lifts are acceptable.

C. Capacities/Dimensions:

- 1. Overall dimensions:

Overall Dimensions		
Length	Width	Height
504"	109"	72"
Weight		Capacity
		105000 lb

- 2. Hydraulic lift:
  - a. Lift capacities:
    - 1) Movable post modular: 35,000 pounds
    - 2) Fixed post modular: 35,000 pounds

- 3) Total: 105,000 pounds
  - b. Lift rise:
    - 1) Movable post modular: 73 inches to point of adapter contact.
    - 2) Fixed post modular: 73 inches to point of adapter contact.
  - c. Piston:
    - 1) Two-stage piston with surface not exposed to fluids in the containment.
  - d. Adjustable adapters spread and retract:
    - 1) Movable post modular: 57-3/4 inches (maximum) and 40-1/4 inches (minimum)
    - 2) Fixed post modular: 39-3/4 inches (maximum) and 24-3/4 inches (minimum)
  - e. Wheelbase ranges:
    - 1) Movable Frame: 9 feet, 0 inches (minimum) to 21 feet, 6 inches (maximum)
    - 2) Tandem Frame: 3 feet, 11 inches (minimum) to 7 feet, 0 inches (maximum)
  - f. Length of frame for moveable post modular frames:
    - 1) Movable Frame: 21 feet, 24 feet
    - 2) Tandem Frame: 15 feet
  - 3. Electric-hydraulic power unit: movable post modular:
    - a. Pump: One each, 20 gallons per minute
    - b. Oil capacity: 20 gallons
  - 4. Electric-hydraulic power unit, fixed post modular:
    - a. Pump: One each, 20 gallons per minute
    - b. Oil capacity: 20 gallons
  - 5. Automatic fluid displacement system:
    - a. Fluid displacement: Four gallons per minute at 90 PSI
- D. Features/Performance/Construction:
- 1. Movable post modular:
    - a. The movable post shall be equipped with a carriage assembly with permanent lubricated bearing wheels for smooth and proper movement in the structural channel track. The casing of the movable post shall be coated with a high quality polyurea coating or approved equal coating of 1/4 inch thickness for ultimate durability and maximum protection against deterioration due to electrolysis and/or harsh contaminants.
    - b. Recessed track properly sized for movable post to provide proper engagement for vehicles ranging in wheelbases specified by fleet demand.
    - c. The recess shall allow the superstructure and adapters to be stored completely below grade. When lowered, no part of the saddle or its adapters shall interfere with the drive thru clearance of the bay. It shall not be necessary to remove adapters to achieve full ground clearance and it shall not be required to remove or reposition the adapters in order to close the pit covers. All openings in the floor and gaps between floor and superstructure must be covered when the lift is down.
    - d. Wheelbase adjustment shall be accomplished by a 2 HP, explosion proof electric motor, and chain drive assembly. Adjustment control shall be located on control console.
    - e. Front superstructure shall be of a low-profile design not to exceed 5 inches (including adapters) and shall move forward or backward without interfering with snow removal, tire chains, wheelchair lifts or other "low profile" accessories commonly found on customer's vehicles.
    - f. Lift locks: The lift lock shall be rated at same capacity as the corresponding jacking unit. The lock leg shall be a two-stage telescoping type constructed of rectangular tubing. The lock leg shall be equipped with 18 locking positions on 3-inch increments. The locking latch shall be spring loaded to the lock position and shall be released at the control console. The locking latch shall be gravity activated with a spring-loaded assist. Release mechanism shall be an air cylinder to minimize potential hydraulic leaks. Hydraulically operated or electrically operated safeties are not acceptable. The lift locking leg shall be attached to the saddle to prevent rotation and ensure proper position of locking latches at all times for maximum rigidity.

- g. Electro-hydraulic power unit: The movable post modular unit shall be equipped with a power unit assembly, with an explosion proof motor. (All models bio fluid compatible). The power unit system shall supply ample pressure for operation of lift system. The power unit shall be housed within the modular unit containment.
  - h. Modular containment: The modular containment shall be a steel enclosure 5 feet, 7 inches in depth, appropriately sized in length to accommodate specified wheelbase range. The containment shall be coated internally and externally with "a high quality polyurea coating" of 1/4-inch thickness for ultimate durability and maximum protection against deterioration due to electrolysis and/or harsh contaminates. "A high quality polyurea coating" shall be applied to the inside and the outside of the containment housing to create a 1/2 inch (13 millimeters) thick impermeable shell that is watertight, encapsulated against corrosion and electrolysis. The unit shall be tested against electrolysis by way of a 30,000 volt stray current test. The containment shall be designed to prevent the release of any contaminants into the surrounding soil or infiltration by hydrostatic pressure from surrounding water tables. Parts treated with the "a high quality polyurea coating" shall be warranted against corrosion or electrolysis for a period of 10 years. The containment shall be equipped with a Liquid Detection System that shall relay visual notification to the lift system control upon detection of liquid accumulation in the containment. The containment shall be equipped with a fitting located on a floor cover plate connected to a 1-1/2-inch PVC tube routed to the bottom of the containment, which permits the removal of any liquid accumulation from the surface level.
2. Fixed post modular:
- a. The fixed post shall be of the same design construction, diameter, and rise as the movable post.
  - b. Frame: The frame unit will provide integral wheel chocks at floor level in order to accurately locate vehicle axles over the lifting saddle and adapters. Wheel chocks shall be embedded below grade on both sides of the stationary module. No part of the wheel spotting system shall protrude above the floor surface and the spotting adapters shall be provided on both sides of the module to allow loading by the operator either in forward or reverse gear. The recess shall allow the superstructure and adapters to be stored completely below grade. When lowered, no part of the saddle or its adapters shall interfere with the drive thru clearance of the bay. It shall not be necessary to remove adapters to achieve full ground clearance and it shall not be required to remove or reposition the adapters in order to close the pit covers. The frame assembly shall also provide a recess beneath the floor 48 inches wide for the rear saddle and base adapters when the plunger is in the down position. The recess area shall have cover doors to close over the opening when lift is not in use.
  - c. Lift locks: The lift locks shall be of the same design and construction as the movable post.
  - d. Power unit: The power unit shall be of the same construction and design as the movable post.
  - e. Modular containment: The modular containment shall be a steel enclosure 6 feet in depth, appropriately sized to house fixed post assembly and power unit. The containment shall be coated internally and externally with a high quality polyurea coating of 1/4 inch thickness for ultimate durability and maximum protection against deterioration due to electrolysis and/or harsh contaminates. The containment shall be designed to prevent the release of any contaminants into the surrounding soil.
3. Control: The control system shall be a variable speed computer-controlled equalization system to ensure vehicle stability based upon direct post height measurement and shall be in a wall mounted enclosure with remote control to minimize shop floor footprint and maximize workspace. Complete lift features are operable at the remote control to maximize shop productivity and visibility of the vehicle during operation. The remote control shall include the following features and functions.

**SECTION 14 45 00 - VEHICLE LIFTS**

- a. The remote control shall be equipped with a joystick for infinitely variable speed control of fore and aft movement of the piston and up and down operation of the lift. The joystick shall permit fine adjustment of the lifting carriage or movable piston to permit accurate alignment of axles, unloading of wheels, and reinstallation of drive-train components. The joystick control shall be equipped with protective guard to prevent accidental engagement of the control when not in use.
  - b. The control system shall monitor all lifting assemblies in relation to each other. The equalization shall be accomplished through variable motor speed.
  - c. The remote control shall be equipped with technology allowing system communication through the use of a digital display.
  - d. The remote control shall include a corded reel hanger and a key ring.
  - e. The system shall provide the ability for the following facility required settings:
    - 1) Up to 25 memorized wheel base locations as required by fleet.
    - 2) Up to 25 memorized height requirements as required by facility.
  - f. The control system shall indicate to the operator when the lift is fully lowered to prevent damage to the vehicle, the lift and to eliminate tire damage.
  - g. The control system shall indicate to the operator which lifting pistons are activated, when the moveable piston is moving fore and aft, when the moveable post is in its "home" position and when each piston is fully recessed below grade.
  - h. The control system shall be compliant with the requirements of ANSI, ALI, UL201 and all other applicable NEC requirements.
  - i. Automatic operational positioning shall be accessed from a single button press once a vehicle has been selected.
  - j. Remote control shall be of durable construction but still allow one hand operation in a compact design that provides important information on a digital display.
4. Automatic Wheelbase Positioning: Control system shall allow the operator to program an infinite quantity of wheelbase positions for reduced setup times. The system shall be capable of storing the wheelbase positions by vehicle brand and year or license plate. The movable unit shall travel to the programmed position uninterrupted once selected.
  5. Shutter plate continuous pit cover: The movable post shall be equipped with shutter plate covers that move with the post so as to keep the trench opening covered at all times. Shutterplates shall be zinc electroplate and all pivot points on the shutterplate cover system shall be constructed of zinc electroplate to reduce maintenance.
  6. Fluid Evacuation System: Each modular containment unit will be equipped with an automatic fluid evacuation system.
  7. Provide one School Bus and Heavy Truck adapter kit, Model No. AK-SB-HTA-3PK per lift

E. Accessories:

Description	Manufacturer	Model No.	Qty.
ADAPTER CART	ROTARY	FD2438BK	1

F. Utility Requirements:

Electrical				
Voltage	Phase	HP	Amperage	Connection Type
460	3	10	14.00	DISCONNECT

**SECTION 14 45 00 - VEHICLE LIFTS**

<b>Plumbing</b>			
<b>Domestic Water</b>			
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)	

<b>Natural Gas</b>			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum

<b>Compressed Air</b>			
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)	
		Minimum	Maximum
3/8"	5.00	90.00	120.00 psi

**2.2 LIFT, PLATFORM, VERTICAL RISE**

**Equipment Identifier: 5655**

**A. Manufacturer's Reference:**

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
ROTARY	MADISON	IN	(812) 273-1622
Model No.: V80-32F			

2. Alternate manufacturers: *Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.*

Manufacturer	City	State	Phone
ALT #1 STERTIL KONI	STEVENSVILLE	MD	(410) 643-9001
ALT #2 MOHAWK LIFTS	AMSTERDAM	NY	(518) 842-1431

**B. General Description:**

1. A vertical half-scissors heavy-duty platform lift to elevate large trucks, buses, and other heavy-duty vehicles for the purpose of inspection, maintenance, servicing and cleaning. Lift shall rise in a vertical fashion.

**C. Capacities/Dimensions:**

1. Overall dimensions, weight, and capacity:

<b>Overall Dimensions</b>		
Length	Width	Height
402 1/4"	109"	16 3/4"
<b>Weight</b>		<b>Capacity</b>
0 lb		80000 lb

2. Platform dimensions (two each):
    - a. Length: 32 feet
    - b. Minimum Width: 32 inches
    - c. Maximum Height: 16-1/4 inches
  3. Maximum Control Console Dimensions:
    - a. Length: 27 inches
    - b. Width: 30 inches
    - c. Height: 52 inches
  4. Minimum Lifting Height: 69 inches
  5. Maximum Rise Time: 90 seconds
  6. Platform Spacing: 45 inches maximum.
  7. Lowering speed: 130 seconds maximum.
- D. Features/Performance/Construction:
1. The lift system shall be capable of being flush mounted recessed as indicated on equipment layout drawings.
  2. Lift shall be provided with flush flaps to cover the gap between the lift and the pit. Flaps shall serve as wheel stops when lift is raised.
  3. Complete lift assembly shall consist of an electro-hydraulic lift unit, control console, and specified accessories.
  4. Support leg assembly: All support leg pivot points shall be provided with hardened bushings for extended life and ease of repair.
  5. Platforms:
    - a. Each platform is constructed in a box design. The top box section shall be fabricated of at least 1/4 inch ASTM A572 GR50 steel plate. The sides and bottom sections of the box shall be fabricated of at least 3/8 inch ASTM A572 GR50 steel plates. All plates shall be bent and seam welded into a single platform assembly.
    - b. Each platform shall be finished with an anti-skid coating.
    - c. There shall be no obstructions of connections between the platforms at either floor level or platform level.
    - d. Each platform shall include an automatic wheel stop/chock, fabricated of 5/16 inch ASTM A572 GR50 steel plate. All wheel stops shall be interchangeable and deploy to meet ALI/ALCTV requirements.
  6. Lift system shall incorporate a hydraulic driven cylinder.
  7. The maximum lifting height of the lift system shall be programmable to the height specifications as requested by user.
  8. Entire lift assembly shall consist of an electro-hydraulic unit which drives four cylinders mounted to the half scissors lifting devices using a pull rod.
  9. Drive mechanism:
    - a. The drive system shall be hydraulic and shall permit lifting without any pulsation, jerks, or unsteady lifting. Lifting shall be smooth. The hydraulic power unit shall be an electrically-powered pump, flow control valves, and a fluid reservoir.
    - b. Hydraulic lifting cylinders shall be of a piston type to prevent leakage in the case of piston damage.
    - c. All rotating axles shall be hardened steel for long life and wear.
  10. Safety devices:
    - a. An independent and fail-safe mechanical safety device shall be present on each half scissor. This safety device shall be totally independent from the lifting drive system. A locking catch shall be free to engage all of the teeth of the locking strip attached to the half scissor.
    - b. Each lifting device shall be provided with a position measuring device identified as an inclinometer whose function it is to calculate and synchronize the height of the four lifting devices.
    - c. The lift system shall incorporate a splash proof electrical system (IP 65) so that the lift can be used in a washroom environment without damage to electrical components.

- d. Lift shall be equipped with a tape switch along the outside of both runway platforms. Lift shall automatically stop lowering if any contact is made with the switch.
  - e. Locking mechanism shall be activated in no less than 3 inches (76 millimeters) of lifting height.
11. Lighting system:
- a. Lift shall have a complete lighting system installed on the interior edge to illuminate the work area when the vehicle is raised.
  - b. The LED lighting shall be 120 AC, and rated IP 65
  - c. Individual lamps shall utilize waterproof construction and shall contain ballast and starter assembly integrated within one operating unit.
  - d. Lamps shall be installed in a recessed adjacent to main lifting platform so as to be protected from potential damage caused by falling objects.
  - e. The lighting system must have safety certification from a Third-Party Testing Laboratory such as ETL, UL, CE, or TUV. This certification will be required so as not endanger operator with unsafe working conditions.
  - f. The lighting shall switch on and off at a minimum height when the lift is going up (on) and down (off) and this feature shall be programmable based on operator specifications.
- E. Controls:
- 1. The printed circuit board to provide various safety and operational requirements.
  - 2. The lift system shall have all control voltage rated to a maximum of 24 VDC.
  - 3. Each control box shall have as a minimum:
    - a. System disconnect.
    - b. "Power-on" pilot lamp.
    - c. An "up" button
    - d. A "down" button
    - e. Lock release button
    - f. If needed: Lighting switch.
    - g. Height Limit Switch
  - 4. If needed: The lift shall have a two-speed lowering option.
  - 5. Control panel shall be rated IP 65.
- F. Accessories:
- 1. Repair Bays:
    - a. Air supply set shall be 3/8 inch air line along the vertical rise lift.
    - b. Rolling Bridge Jacks:
      - 1) Bridge jack(s) shall be self-powered and air-hydraulic. Two bridge jacks shall be provided to serve both lifts.
      - 2) Each bridge jack shall be double telescopic piston with a minimum capacity of 36,000 pounds.
      - 3) The bridge jack shall be designed with a flow divider valve to maintain synchronization of pistons in raising and lowering mode; maximum pressure valve shall prevent lifting of loads if loads exceed rated capacity of jack; check valves in each piston shall prevent the accident descent of load.
    - c. Wired remote control:
      - 1) Provide an ergonomic industrial remote control, rated for use in NEC Class 1, Division 2, hazardous locations.
      - 2) Remote control shall be connected to the control console through a multi-conductor cable with military-style DIN connector.
      - 3) Remote control shall allow full function control of the lift, with the following:
        - a) Push/Pull E-Stop Button.
        - b) Push buttons for Lift Raise, Lower and Unlock.
        - c) Selector button for synchronized, front, or rear lifting.
        - d) Push buttons for hydraulic moveable carriage drive.



**SECTION 14 45 00 - VEHICLE LIFTS**

- 4) Remote control shall be equipped with an emergency E-Stop button that de-energizes power to all outputs of the PCB. Re-activation of the control system requires resetting the E-Stop and re-energizing the control system.
- d. Recess cover plates:
  - 1) Lift shall have false floor automatic pit cover plates to follow the lift out of the floor as it rises and retract into the floor as the lift lowers.
  - 2) The cover plates shall have a minimum capacity of 3,00 pounds each.
  - 3) Once the lift platforms are 12 to 24 inches above floor level, the automatic pit covers are at full extension, flush with the floor.
  - 4) Pit covers shall be hot dip galvanized.
  - 5) Provide one per runway platform.

G. Utility Requirements:

Electrical				
Voltage	Phase	HP	Amperage	Connection Type
460	3	20	26.00	DISCONNECT

Plumbing		
Domestic Water		
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)

Natural Gas			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum

Compressed Air		
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)
3/8"	20.00	90.00
3/8"	5.00	90.00

**2.3 LIFT, SURFACE MOUNTED, FOUR POST  
Equipment Identifier: 5660**

A. Manufacturer's Reference:

- 1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
ROTARY Model No.: SM30-S	MADISON	IN	(800) 455-5438

- 2. Alternate manufacturers: *Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.*

**SECTION 14 45 00 - VEHICLE LIFTS**

Manufacturer	City	State	Phone
ALT #1 STERTIL KONI	STEVENSVILLE	MD	(410) 643-9001
ALT #2 MOHAWK LIFTS	AMSTERDAM	NY	(518) 842-1431

**B. Capacities/Dimensions:**

1. Overall dimensions, weight, and capacity:

Overall Dimensions		
Length	Width	Height
309 1/2"	150 1/16"	84 3/4"
Weight		Capacity
3870 lb		18000 lb

2. Runway dimensions:
  - a. Width: 22 inches
  - b. Width between: 46 inches
  - c. Height: 7-1/2 inches
  - d. Lifting height: 68 inches
3. Column dimensions:
  - a. Height: 77-3/4 inches (6 feet, 5-3/4 inches)
  - b. Length between columns: 249 inches
  - c. Width between columns: 121 1/2 inches
4. Speed of rise: 100 seconds
5. Unit weight: 3,870 pounds

**C. Features/Performance/Construction:**

1. The two left columns shall contain two full hydraulic cylinders factory installed. Cylinder shall be a single acting design and contain an automatic air vent located on the upper end of the cylinder. Piston stroke shall be no less than 60 inches. The oil supply ports shall be equipped with an orifice with free-flow reverse to minimize descent rate in the event of hydraulic line breakage.
2. The mechanical lifting system shall be lifted at each end with a single hydraulic power unit in combination with adjustable cables and sheaves for equalization and smooth operation. Overhead cylinder locations and beams are not acceptable. The cables shall be a minimum 5/8 inch diameter galvanized, lubricated wire rope.
3. Runways:
  - a. Shall have front wheel stops included at front of runways.
  - b. The approach ramps shall be permanently anchored to the facility floor. Ramps shall be a minimum of 65-1/4 inches long to provide easy drive on capability and minimum breakover angle.
  - c. Each runway shall have guide tracks of optional rolling jacks as a standard feature.
  - d. Each runway shall be supported by two 8 inch beams.
  - e. The top of the runways shall be diamond type to provide a non-skid surface.
4. Each column assembly shall contain a spring-loaded locking latch mechanism which automatically sets at 4 inch increments after the first 13 inches of travel, continuing through full rise. Locking latch release to be constant pressure air operated push button at power unit. There shall be no less than 10 locking positions per column. A separate slack cable latching mechanism shall be provided.
5. The specified lift shall comply with the requirements of ANSI Standard ALCTV1988, "Safety requirements for the construction, care, and use of automotive lifts," as published by the American National Standards Institute.

**D. Controls:**

**SECTION 14 45 00 - VEHICLE LIFTS**

1. The power units shall be self contained.
2. Power unit is mounted on a 15 by 23 by 45 inches enclosure designed to fit behind the rear column to reduce floor obstructions and provide full view of the lift during operation.
3. Push bottom to raise the lift.
4. Hydraulic Lowering valve shall be designed to restrict descent speed to a maximum of 20 feet per minute.
5. Air latch valve to release locks.
6. Each power unit's fluid system shall have a capacity of 20 quarts and must be filled with a hydraulic fluid that is biodegradable and non-toxic. The fluid shall be viscosity grade 150 32 base and specially formulated to include both anti-wear and anti-rust agents.

E. Accessories:

Description	Manufacturer	Model No.	Qty.
ROLLING JACK (2 EACH PER UNIT)	ROTARY	RJ9100YM	2
LED LIGHT KIT (1 SET PER UNIT)	ROTARY	FA5700	1
REMOVABLE WORK STEP (1 EACH PER UNIT)	ROTARY	FC5663	1
AIRLINE KIT (1 SET PER UNIT)	ROTARY	FC5760-14	1

F. Utility Requirements:

<b>Electrical</b>				
Voltage	Phase	HP	Amperage	Connection Type
460	3	2	8.75	DISCONNECT

<b>PLUMBING</b>		
<b>Domestic Water</b>		
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)

<b>Natural Gas</b>			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum

<b>Compressed Air</b>			
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)	
		Minimum	Maximum
3/8"	4.00	100.00	120.00 psi

**2.4 LIFT, SURFACE MOUNTED, FOUR POST, ALIGNMENT**  
**Equipment Identifier: 5665**

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

**SECTION 14 45 00 - VEHICLE LIFTS**

Manufacturer	City	State	Phone
ROTARY Model No.: ARO22N001	MADISON	IN	(800) 455-5438

2. Alternate manufacturers: Contingent *upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

Manufacturer	City	State	Phone
ALT #1 CHALLENGER LIFTS	LOUISVILLE	KY	(800) 648-5438
ALT #2 BENDPAK	SANTA PAULA	CA	(800) 253-2363

B. Capacities/Dimensions:

1. Overall dimensions, capacities, and weight:

Overall Dimensions		
Length	Width	Height
308 3/4"	153 3/4"	107 1/2"
Weight		Capacity
8438 lb		22000 lb

2. Runway dimensions:
- Width: 29 inches
  - Width between: 40 inches
  - Length: 261 inches
  - Height: 8-5/16 inches
  - Lifting height: 74-5/16 inches maximum
3. Column dimensions:
- Height: 107-3/8 inches
  - Length between columns: 243-3/4 inches
  - Width between columns: 119-3/4 inches
4. Wheel base: 230 inches maximum
5. Lifting capacity: 22,000 pounds
6. Speed of rise: 92 seconds

C. Features/Performance/Construction:

- The two left columns shall contain two full hydraulic cylinders factory installed. Cylinder shall be a single acting design and contain an automatic air vent located on the upper end of the cylinder. Piston stroke shall be no less than 60 inches. The oil supply ports shall be equipped with an orifice with free-flow reverse to minimize descent rate in the event of hydraulic line breakage.
- The mechanical lifting system shall be lifted at each end with a single hydraulic power unit in combination with adjustable cables and sheaves for equalization and smooth operation. Overhead cylinder locations and beams are not acceptable. The cables shall be a minimum 5/8 inch diameter galvanized, lubricated wire rope.
- Platform:
  - Shall have front wheel stops included at front of runways.
  - The approach ramps shall be permanently anchored to the facility floor. Ramps shall be a minimum of 40-1/8 inches long to provide easy drive on capability and minimum breakover angle.
  - Each runway shall have guide tracks for rolling.
  - Two rolling jacks shall be provided with the following lifting capacities:
    - Front: 9,000 pounds

**SECTION 14 45 00 - VEHICLE LIFTS**

- 2) Rear: 15,000 pounds
- e. The top of the runways shall be diamond type to provide a non-skid surface.
- f. Two rotating radius gauges shall be provided for use when aligning vehicles. Top of gauges shall be flush with top of runways for an accurate measurement.
- g. Platform shall be equipped with internal airline connections to be used by the rolling jacks and hand operated pneumatic tools.
- 4. Each column assembly shall contain a spring loaded locking latch mechanism which automatically sets at 1-3/4 inch increments after the first 16-3/4 inches of travel, continuing through full rise. Locking latch release to be constant pressure air operated push button at power unit. There shall be no less than 13 locking positions per column. A separate slack cable latching mechanism shall be provided.
- 5. The specified lift shall comply with the requirements of ANSI Standard ALCTV1988, "Safety requirements for the construction, care, and use of automotive lifts," as published by the American National Standards Institute.

D. Controls:

- 1. The power units shall be self-contained.
- 2. Power unit is mounted on a 15 by 23 by 45 inches enclosure designed to fit behind the rear column to reduce floor obstructions and provide full view of the lift during operation.
- 3. Push bottom to raise the lift.
- 4. Hydraulic Lowering valve shall be designed to restrict descent speed to a maximum of 20 feet per minute.
- 5. Air latch valve to release locks.
- 6. Each power unit's fluid system shall have a capacity of 20 quarts and must be filled with a hydraulic fluid that is biodegradable and non-toxic. The fluid shall be viscosity grade 150 32 base and specially formulated to include both anti-wear and anti-rust agents.

E. Utility Requirements:

<b>Electrical</b>				
Voltage	Phase	HP	Amperage	Connection Type
208	1	4	14.00	DISCONNECT

<b>Plumbing</b>		
<b>Domestic Water</b>		
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)

<b>Natural Gas</b>			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum

<b>Compressed Air</b>			
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)	
		Minimum	Maximum
3/8"	20.00	90.00	120.00 psi

**2.5 LIFT, SURFACE MOUNTED, TWIN-POST, 12,000 POUND**  
**Equipment Identifier: 5712**

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

Manufacturer	City	State	Phone
ROTARY	MADISON	IN	(800) 445-5438
Model No.: SPO12-TA			

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers *may* be considered as equal.

Manufacturer	City	State	Phone
ALT #1 BENDPAK	SANTA PAULO	CA	(805) 933-9970
ALT #2 MOHAWK	AMSTERDAM	NY	(518) 842-1431

B. Capacities/Dimensions:

1. Overall dimensions, weight, and capacity:

Overall Dimensions		
Length	Width	Height
137 5/8"	118 1/8"	164"
Weight		Capacity
2000 lb		12000 lb

2. Lift rise: 72-3/4 inches, minimum
3. Distance between columns: 114-7/8 inches
4. Drive-through clearance: 102-3/8 inches
5. Floor to overhead switch bar: 159-1/8 inches
6. Floor to overhead bar:
  - a. Standard model: 165 inches
7. Arm reach (two-stage arms with flip-up adapter):
  - a. Front: 27-1/2 inches minimum, 59 inches maximum
  - b. Rear: 27-1/2 inches minimum, 59 inches maximum
8. Minimum adapter height: 4-3/4 inches (floor to top of adapter)
9. Lifting speed: 60 seconds

C. Features/Performance/Construction:

1. Columns shall be manufactured of one-piece formed steel. Carriage bearing surfaces shall be placed to the back of the column.
2. Each column assembly shall incorporate an external locking latch mechanism which automatically engages at 4-1/4 inch increments after the first 18-1/2 inches of travel, continuing through full rise. Dual locking latch system release shall be constant pressure air operated switch. Locking latches shall be spring actuated and shall automatically reset when the latch handle is released. There shall be no less than 13 locking positions per column assembly.
3. Each hydraulic cylinder shall be designed with a restrictor orifice to regulate the lowering speed so that it shall not exceed 20 feet per minute at rated capacity. Cylinder shall be installed so that all lifting force is applied directly to column base and is not attached to the

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carriage. Cylinder replacement shall be achieved without disassembly of columns, column extensions, or overhead assembly.

4. Arm/adaptor assembly shall consist of four telescoping swing arm assemblies. Each arm assembly shall have an adapter base which is laterally adjustable and shall be equipped with a screw type adjustable height vehicle contact adapter, 4 inch and 8 inch adapter extensions shall be provided for additional adapter height. The vehicle contact adapter shall be capable of accommodating optional adapters for special lifting applications. Each arm assembly shall be equipped with an arm restraint feature, capable of withstanding 150 pounds of horizontal force, which shall engage when the carriage has been raised 1 inch and shall automatically release when the carriage is fully lowered.
5. Floor-mounted, three-position wheel spotting dishes shall be provided.
6. Power unit shall be self-contained. Fluid system shall have a 13 quart capacity. Standard power unit shall be suitable for indoor or outdoor use.
7. Lift shall be equipped with a mechanical equalization system consisting of adjustable cables and sheaves with self lubricating bearings.
8. Lift shall be equipped with an overhead limit switch composed of a padded overhead trip bar which actuates a limit switch wired to interrupt the power to the power unit in the event that a vehicle contacts the trip bar.
9. Lift shall be anchored to foundation. Foundation requirements and mounting methods shall be verified with manufacturer's shop drawings.
10. A rubber guard shall be included on the columns in order to protect the vehicle doors.
11. A light kit shall be included with the unit to illuminate the underside of the vehicle.

D. Controls: Single point manual controls push button "UP" and lowering lever for descent mounted on lift column.

E. Accessories:

Description	Manufacturer	Model No.	Qty.
AIR/ELECTRIC UTILITY BOX (ONE EACH PER UNIT)	ROTARY	FA5911BK	1

F. Utility Requirements:

<b>Electrical</b>				
Voltage	Phase	HP	Amperage	Connection Type
120	1	0	15.00	J-BOX
460	3	2	8.60	DISCONNECT

<b>PLUMBING</b>		
<b>Domestic Water</b>		
Connection (IN)	Flow Rate(CFM)	Capacity (PSI)

<b>Natural Gas</b>			
Connection (IN)	Capacity (BTU/Hr)	Pressure (PSI)	
		Minimum	Maximum

<b>Compressed Air</b>			
Connection (IN)	Flow Rate (CFM)	Pressure (PSI)	
		Minimum	Maximum
1/4"	5.00	80.00	120.00 psi

- G. Finish: Durable enamel in manufacturer's standard color.

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.
- B. Inspect delivered equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.
- C. Report in writing to the Architect, any damaged, missing or incomplete scheduled equipment and improper rough-in or utility stub-outs.

**3.2 INSTALLATION**

- A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect or designated representative.
- B. Install equipment in accordance with plans, shop drawings, and manufacturer's instructions:
  - 1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.
  - 2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
  - 3. Anchorage: Attach equipment as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.
  - 4. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

**3.3 TESTING**

- A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.
- B. Each lift shall be tested with the vehicle types operated by the Owner.

**3.4 CLEANUP**

- A. Touch-up damage to painted finishes.
- B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.
- C. Clean area around equipment installation and remove packing and installation debris from job site.



- D. Notify Architect or designated representative when installation and cleanup is 100% complete and ready for final observation (punchlist).

**3.5 TRAINING**

- A. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.
  - 1. 5632 LIFT, AXLE, THREE-POST, TAG AXLE; 8 hours (minimum)
  - 2. 5655 LIFT, PLATFORM, VERTICAL RISE; 8 hours (minimum)
  - 3. 5660 LIFT, SURFACE MOUNTED, FOUR POST; 2 hours (minimum)
  - 4. 5665 LIFT, SURFACE MOUNTED, FOUR POST, ALIGNMENT; 2 hours (minimum)
  - 5. 5712 LIFT, SURFACE MOUNTED, TWIN-POST, 12,000 POUND; 2 hours (minimum)
- B. Demonstrate each lift operation utilizing each of the vehicle types operated by Owner.
- C. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

**END OF SECTION 14 45 00**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Sprinkler systems, wet-pipe.
  - 2. Fire protection piping.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME).
    - a. B31.1, Power Piping.
  - 2. FM Global (FM).
  - 3. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 4. National Fire Protection Association (NFPA):
    - a. 13, Standard for the Installation of Sprinkler Systems.
    - b. 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
    - c. 70, National Electrical Code (NEC).
  - 5. Underwriters Laboratories, Inc. (UL):
    - a. 508, Standard for Industrial Control Equipment.
- B. Qualifications:
  - 1. Use subcontractors with prior, demonstrable experience with fire protection systems.
  - 2. Fire protection system to be designed by a Professional Engineer, registered in the State of North Carolina.
    - a. Drawings to include certification, signature and registration number of the Professional Engineer.
  - 3. Installers: Use workmen skilled in this trade.
- C. Design, furnish and install complete fire protection systems as indicated and as required by local authorities.
  - 1. Where there is conflict between local authority requirements or other standards agency requirements and these Drawings and Specifications, requirements of standards agencies of local authorities shall govern.
  - 2. Design and install entire system in accordance with indicated codes, standards and regulations.

**1.3 SYSTEM DESCRIPTION**

- A. Design Requirements:
  - 1. Design fire sprinkler systems.
  - 2. Design fire sprinkler and suppression systems.
    - a. Obtain water supply fire flow test prior to designing systems.
    - b. Compare flow test results to those listed below and use lowest pressure of the two (2) to design systems.
      - 1) Test conducted by Concord Fire Department on 03/29/23 09:20
      - 2) Static Pressure (psi): 118

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- 3) Residual Pressure (psi): 96
  - 4) Pitot Pressure (psi): 60
  - 5) Combine Hydrant Outlet Flow (gpm): 3,884
  - 6) Outlet Flow Adjusted for 20 psi Residual Pressure: 8,702 gpm
  - c. Design systems using adjusted water supply curve:
    - 1) Adjust the flow test water supply curve to correspond with the low hydraulic grade line as provided by the water supplier.
  - d. Designs shall include a minimum safety allowance of 70 kPa 10 psiG below the adjusted water supply curve.
  - e. For systems with fire pumps, demonstrate (through calculations) that adjusted water supply is capable of providing a minimum of 140 kPa 20 psiG at the suction side of the fire pump while the pump is operating at 150% of its rated capacity.
- B. Completely coordinate work of this Specification Section with all other work in order to provide a complete and workable system acceptable to fire authorities and in accordance with the Contract Documents.

### 1.4 SUBMITTALS

- A. Shop Drawings:
1. Submit complete layout drawings of sprinkler systems, alarm and signal devices.
  2. Submit wiring diagrams of control, alarm and signal devices.
  3. Indicate hazard classification of all sprinkled spaces on Shop Drawings.
  4. Submit complete hydraulic and/or pipe schedule (as applicable), sizing and design calculations for all portions of the sprinkler system.
  5. Submit catalog data and specifications for all manufactured components supplied as part of the fire protection system.
  6. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations per Section 01 61 03.
- B. Certifications:
1. Certification that all plans and calculations, including sprinkler flow calculations have been approved by all agencies with jurisdiction.
  2. Certification that all required post installation tests and inspections have been completed and approved by all agencies with jurisdiction.
- C. Contract Closeout Information:
1. Operation and Maintenance Data:
    - a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- D. Recommended Spare Parts:
1. Spare parts inventory with individual cost.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Fire department valves:

## SECTION 21 05 00 - FIRE PROTECTION SYSTEMS

- a. Elkhart.
  - b. Potter-Roemer.
  - c. Croker-Standard.
  2. Fire department (Siamese) connections:
    - a. Elkhart.
    - b. Potter-Roemer.
    - c. Croker-Standard.
  3. Alarm and signal devices:
    - a. Potter Signal
    - b. System Sensor
  4. Sprinkler heads:
    - a. Globe.
    - b. Reliable.
    - c. Tyco Fire.
    - d. Viking.
    - e. Victaulic.
  5. Pipe hangers:
    - a. Anvil International.
    - b. Caddy.
    - c. Erico.
    - d. PDH Manufacturing.
    - e. Tolco.
- B. Use only new, unused material, designed and guaranteed to perform service required and approved by NFPA.
- C. Pipe and Fittings:
1. Meet or exceed applicable NFPA standards.
  2. Working pressure: Not less than 175 psi.
  3. The following are not permitted:
    - a. Lightwall and Schedule 5 pipe.
    - b. Plain end, pressure fit type fittings.
    - c. Hole cut mechanical tee fittings.
  4. Fittings: galvanized where galvanized piping is used.
  5. Corrosion Resistance Ratio (CRR) of all pipe used: equal to or greater than one.
- D. Above ground pipe normally containing water:
1. Examples: Wet-pipe systems.
  2. Sprinkler piping 4 inches and greater:
    - a. Black steel, Schedule-10:
      - 1) Welded joints.
      - 2) Mechanical coupling joints:
        - a) Rolled groove type (cut grooving not allowed).
        - b) Mechanical locking (push-on) type.
  3. Sprinkler piping less than 4 inches:
    - a. Black steel, Schedule-40:
      - 1) Threaded joints.
      - 2) Welded joints.
      - 3) Mechanical joints:

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- a) Cut or rolled groove type.
- b) Mechanical locking (push-on) type.

### E. Fittings:

1. Threaded:
  - a. Black cast iron, Class 150.
  - b. Black malleable iron.
  - c. Galvanized malleable iron.
2. Flanged:
  - a. Black cast iron, short body, Class 125.
  - b. Galvanized malleable iron.
  - c. Gaskets: Full face of 1/8 inches minimum red sheet rubber.
  - d. Flange Bolts: ANSI-B18.2.
    - 1) Hexagon head machine bolts with heavy semi-finished hexagon head nuts, zinc-nickel plated.
3. Welded:
  - a. Black steel, standard weights.

### F. Pipe Supports:

1. All-purpose type, UL listed and FM approved.
2. Supports, hanger rods, inserts, and clamps acceptable to NFPA.

## 2.2 MANUFACTURED UNITS

### A. Pipe Hangers:

1. All purpose type, UL listed and FM approved.
2. Space in accord with requirements of NFPA.
3. Hangers, hanger rods, inserts and clamps constructed as approved by NFPA.

### B. Valves and Hose Connections:

1. General:
  - a. UL and FM approved.
  - b. Minimum: 175 psi class.
  - c. Outlet/inlet threads to fit local fire department standards.
2. Fire department valves (FDV): 2-1/2 inches fire department valve with 300 pound cast brass body, cap and chain; rough brass finish.
3. Automatic ball drip valve:
  - a. Straight or angle cast brass ball drip, 1/2 inches.
  - b. Mount on siamese side of check valves and fire pump test header OS&Y valve.
  - c. Potter-Roemer 148 or 181.
4. Alarm check valve:
  - a. 175 pound UL listed, FM approved iron body, cast bronze clapper, neoprene O-ring seal, tapped bosses for and with water pressure gages, alarm test valve, main drain valve, alarm retarding chamber.
  - b. Include angle valves, globe valves, alarm line strainer, orifice restriction, pipe nipples and fittings.

### C. Sprinkler Heads:

1. General:

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- a. Provide heads of type required for service indicated.
  - b. Standard 165 degrees F rating except when application requires higher rating.
  - c. In no case use heads rated less than 50 degrees F higher than anticipated ambient temperature.
  - d. All sprinklers UL listed.
  - e. Head application:
    - 1) Rooms without ceilings: Type 1.
    - 2) Finished rooms: Type 2 except as indicated.
    - 3) Sprinkler head Type 1:
      - a) Upright or pendent design as required.
      - b) Standard bronze finish.
    - 4) Sprinkler head Type 2:
      - a) Pendent design.
      - b) Satin chrome finish with escutcheon plate.
- D. Alarm and Signal Devices:
- 1. Water-flow detector:
    - a. Vane type flow switch with retard mechanism or manual adjustment to prevent false alarm for wet pipe sprinkler systems.
    - b. 175 psi rated.
    - c. 115 VAC/30 VDC rated for pilot duty only.
    - d. Suitable for working pressure of 150 psi with sensitivity adjusting screw.
    - e. Provide with contacts for remote signal wiring.
  - 2. Water motor alarm:
    - a. 175 pound UL listed, FM approved iron body mechanical alarm device with 8 inches diameter gong, 5 inches water motor.
    - b. Drive shaft length compatible with wall thickness encountered.
    - c. Red hood finish with nameplate.
    - d. For use with alarm valve systems.
  - 3. Valve tamper switch:
    - a. 115 VAC/30 VDC.
    - b. Switches for butterfly valves to be UL approved.
  - 4. Pressure gages:
    - a. 3-1/2 inches dial, phosphor bronze tube, brass socket, 300 psi range.
- E. Fire Department Siamese Connections - Outside type:
- 1. Size: 4 x 2-1/2 x 2-1/2 inches unless otherwise indicated.
  - 2. Finish: Rough brass.
  - 3. Lettering: Auto Sprinkler (SPKR) Fire Department Conn..
  - 4. Exposed wall connections: Double-clapper, 90 degrees, 2-way body, escutcheon plate with lettering, caps and chain.
  - 5. Separate wall plate designating special service:
    - a. Finish same as siamese, anchored to wall.
    - b. Provide where indicated.

### 2.3 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Sprinkler Systems:
- 1. Provide sprinkler system types as designated on the Drawings.
  - 2. Design shall be hydraulically designed sprinkler system if applicable and in accordance with applicable NFPA Codes and Standards.
  - 3. Wet pipe systems:
    - a. Office Areas:

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- 1) Coverage: Minimum discharge density of 0.1 gpm/SQFT over the hydraulically most remote 1500 square feet, while allowing 250 gpm for hose streams.
  - 2) Sprinkler heads: 165 degrees F rated.
  - 3) Sprinkler head spacing: 225 square feet maximum per head.
  - b. Garage Maintenance Bays:
    - 1) Coverage: Minimum discharge density of 0.12 gpm/SQFT over the hydraulically most remote 1500 square feet, while allowing 250 gpm for hose streams.
    - 2) Sprinkler heads: 165 degrees F rated.
    - 3) Sprinkler head spacing: 130 square feet maximum per head.
  - c. Tire Storage (10 ft in height):
    - 1) Coverage: Minimum discharge density of 0.3 gpm/SQFT over the hydraulically most remote 2500 square feet, while allowing 250 gpm for hose streams.
    - 2) Sprinkler heads: 165 degrees F rated.
    - 3) Sprinkler head spacing: 100 square feet maximum per head.
  - d. Lube Room:
    - 1) Lube Room will be designed for sprinkler protection of palletized storage of Class II and Class III Liquids in listed and labeled rigid nonmetallic intermediate bulk containers with max capacity of 793 gallons, storing 1 container high in a space with a maximum ceiling height of 30 ft. Sprinklers will be designed with a K-factor of greater than 11.2 for standard release heads at a density 0.45 gpm/ft<sup>2</sup> over and application area of 3,000 ft<sup>2</sup> (NFPA 30, Table 16.5.2.9).
  - e. Small Parts Storage/Palletized Storage:
    - 1) Classified as Class IV commodity stored below 10 ft. Ordinary hazard group 2: 0.2 gpm/ft<sup>2</sup> over 1,500 ft<sup>2</sup> (NFPA 13, Table 13.2.1).
- B. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes. See Section 01 61 03 for information on how to determine the available fault current, such that, the SCCR rating meets or exceeds the available fault current.

### 2.4 MAINTENANCE MATERIALS

- A. Sprinkler System:
1. Provide spare sprinkler heads in types and quantities required by NFPA 13.
    - a. Include sprinkler wrench and cabinet.
  2. Furnish one (1) emergency rubber ball shutoff on long handle to be used for temporary closing of sprinkler head after fire has been extinguished.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Cooperate with other trades to insure adequate space for equipment and piping placement.
- B. Review plans, Specifications and Shop Drawings of other trades to coordinate work.
- C. Do not begin installation until all Agency approvals are submitted to Engineer.

**3.2 INSTALLATION**

A. General:

1. Install in strict accord with approved Shop Drawings.
2. Install all piping, valves, and connections from mains to building fire protection systems.

B. Piping, Valves and Accessories:

1. Install sprinkler piping within first 6 inches of space under floor construction.
  - a. Where conditions of construction require piping installation at a lower elevation, route piping to avoid interference with work of other trades.
  - b. Offset, crossover and otherwise route piping to install system in available space.
    - 1) All offsets not shown.
  - c. Pitch all branch lines, cross mains, feed mains and risers to drainage points.
  - d. Provide angle drain valves at all low points.
    - 1) Plugs permitted at offsets when approved by local authority.
2. Provide OS&Y valve and flow switch within sprinkler system at each of following locations:
  - a. Each zone takeoff within sprinkler piping system.
  - b. Base of all sprinkler risers.
3. Install monitor switch on each OS&Y or butterfly valve within fire protection piping system, including valve assembly at fire pump or sprinkler control, base of standpipe and sprinkler zone, and/or isolation valves and post indicator valve.
4. Provide auto ball drip valves at outside fire department connections between hose connection and check and/or shutoff valve.
5. Flush outside fire water mains prior to connecting to inside system.
6. Provide wall flange at each FDV and within FHC boxes when risers are concealed.
7. Install pressure gages at top of each sprinkler risers and elsewhere as required by local authority.

C. Sprinkler:

1. Install in accord with approved Shop Drawings.
  - a. Modifications made to system design or arrangement after approval of drawings by local authority may only be made after receiving written approval of authority and Engineer.
  - b. Such modifications do not include minor relocations in piping or head placement.
  - c. Make all revisions in accord with NFPA 13.
2. Install approved dirt legs and drain valves at low points of all piping to permit complete drainage of system without disconnection of any piping.
  - a. Drain valves at base of risers to have 1-1/2 inches hose adapters matching threads of hose systems in the building.
3. Extend 2 inches main drain(s) and 1 inch inspector's test connections on ends of sprinkler branches to nearest floor drain or janitor's sink.
4. Provide chrome plated escutcheon plates at pipe penetrations of ceilings, floors and walls in finished areas.
5. Do not install sprinkler heads through or with escutcheon plate covering suspended ceiling grids.

D. Electrical Wiring:

1. Work under this section shall include:
  - a. Wet pipe system alarm and supervisory wiring.



## **SECTION 21 05 00 - FIRE PROTECTION SYSTEMS**

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### **3.3 INSTALLATION OF HANGERS AND SUPPORTS**

- A. Support pipe by means of simple rod hangers from above or structural cross members from below.
- B. All hanger details, sketches, takeoffs, etc., shall be the responsibility of the Contractor.
  - 1. Hangers shall be selected by hanger manufacturer and shall meet the requirement of ASME B31.1, Paragraph 121 "Design of Pipe Supporting Elements."
- C. Hanger assemblies shall include hanger, washers, nuts, bolts, turnbuckles, rods, beam clamps, and all other items necessary to make a complete assembly.
- D. Support and Hanger Spacing in accordance with NFPA 13.

### **3.4 FIELD QUALITY CONTROL**

- A. Test complete alarm system including control and signal circuits wired by Electrical Contractor.
  - 1. Complete testing prior to acceptance by Owner.
- B. Provide services of factory trained engineer to supervise installation of sprinkler systems, conduct final field pump acceptance tests, and instruct Owner's personnel.
- C. Give advance notice and arrange for field tests and inspections by local authority, including paying for inspection fees and securing permits for same.
- D. Each hydraulically calculated system should be identified by a permanent placard attached to the base of the riser indicating the design characteristics of the system.
  - 1. Information on the placard should include the design density and area and the flow and pressure required at the base of the riser.

**END OF SECTION 21 05 00**

# **SECTION 22 05 03 - PIPE AND PIPE FITTINGS - PLUMBING SYSTEMS**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Plumbing Piping.
  - 2. Water Hammer Arrestors.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 22 05 29 – Hanger and Support for Plumbing Piping and Equipment
  - 2. Section 22 05 23 - General Duty Valves for Plumbing Applications.
  - 3. Section 23 42 00 - Pipe, Duct and Equipment Insulation.

### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. B1.2, Gages and Gaging for Unified Screw Threads.
    - b. B31.9, Building Services Piping.
    - c. B40.100, Pressure Gauges and Gauge Attachments.
  - 2. ASTM International (ASTM):
    - a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    - b. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
    - c. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
    - d. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
    - e. B32, Standard Specification for Solder Metal.
    - f. B88, Standard Specification for Seamless Copper Water Tube.
    - g. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
    - h. D1785, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
    - i. D2241, Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
    - j. D2466, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
    - k. D2467, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
    - l. D2855, Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
  - 3. American National Standards Institute (ANSI/ASTM):
    - a. B16.3, Malleable Iron Threaded Fittings.
    - b. B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
    - c. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
    - d. B16.23, Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
    - e. B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
  - 4. American Water Works Association (AWWA):
    - a. B300-10, Standard for Hypochlorites.
    - b. C110, Standard for Ductile-Iron and Gray-Iron Fittings.

## **SECTION 22 05 03 - PIPE AND PIPE FITTINGS - PLUMBING SYSTEMS**

- c. C150, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
  - d. C151, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
  - e. C203, Coal-Tar Protective Linings for Steel.
  - f. C206, Field Welding of Steel Water Pipe.
  - g. C207, Steel Pipe Flanges for Waterworks Service.
  - h. C606, Grooved and Shouldered Joints.
  - i. C651, Disinfecting Water Mains.
  - j. M11, Steel Pipe- A Guide for Design and Installation.
  - 5. American Welding Society (AWS):
    - a. A5.8M/A5.8, Specification for Filler Metals for Brazing and Braze Welding.
  - 6. Chlorine Institute, Inc. (CI):
    - a. Pamphlet 6, Piping Systems for Dry Chlorine.
  - 7. Cast Iron Soil Pipe Institute (CISPI):
    - a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- B. Qualifications:
- 1. Use only certified welders meeting procedures and performance outlined in ASME Section IX, AWWA C200 Section 3.3.3 and other codes and requirements per local building and utility requirements.

### **1.3 SUBMITTALS**

- A. Shop Drawings:
- 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
    - c. Separate schedule sheet for each piping system scheduled in this Specification Section showing compliance of all system components.
      - 1) Attach technical product data on gaskets, pipe, fittings, and other components.
    - d. Water hammer arrestors.
  - 2. Welders' certificates.
- B. Contract Closeout Information:
- 1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
- 1. Qualifications of lab performing disinfection analysis on water systems.
  - 2. Test reports:
    - a. Copies of pressure test results on all piping systems.
    - b. Reports defining results of dielectric testing and corrective action taken.
    - c. Disinfection test report.
    - d. Notification of time and date of piping pressure tests.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- 1. Water Hammer Arresters:

## SECTION 22 05 03 - PIPE AND PIPE FITTINGS - PLUMBING SYSTEMS

- a. Base:
  - 1) Wade Division/Tyler Pipe
- b. Optional:
  - 1) Jay R. Smith Manufacturing Co.
  - 2) Josam Company
  - 3) Zurn Industries, Inc

### MATERIALS

- B. Piping Systems:
  - 1. Piping systems are scheduled by service in PART 3 of this specification.
- C. Pipe and Tube:
  - 1. Copper:
    - a. Type K or L tube per ASTM B88.
    - b. Utilize only annealed (soft) type tubing where flared joints are used and drawn temper (hard) type tubing where soldered or brazed joints are used.
    - c. Fittings, per System Type:
      - 1) Cast copper or bronze (pressure): Per ASTM B16.18.
      - 2) Wrought copper or bronze (pressure, solder): ASTM B16.22.
      - 3) Cast copper or bronze (DWV): Per ASTM B16.23.
      - 4) Wrought copper or bronze (pressure, flared): Per ASTM B16.26.
    - d. Joints:
      - 1) Flared.
      - 2) Soldered or Brazed:
        - a) Above ground below 180 degrees F: ASTM B32 solder with a tin/antimony ratio of 95/5 and non-corrosive flux.
        - b) Above ground 180 degrees F and above: use brazing alloy with melting temperature above 1000 degrees F and suitable flux.
        - c) Buried: Silver solder per AWS A5.8M/A5.8.
        - d) Provide unions and valves and equipment.
    - e. Unions: Class 150, bronze.
  - 2. Cast Iron Soil Pipe
    - a. Service weight, ASTM A74.
    - b. Fittings, per System Type:
      - 1) Hubless per CISPI 310.
      - 2) Hub and spigot per ASTM A74.
    - c. Joints, per System Type:
      - 1) Neoprene gaskets and stainless steel clamp and shield assemblies per CISPI 310.
      - 2) Rubber gasket joint devices per ASTM C564.
      - 3) Lead and oakum per ASTM C564.
    - d. Coatings:
      - 1) Bituminous.
  - 3. Plastic:
    - a. PVC:
      - 1) Per ASTM D2729 for DWV.
      - 2) Fittings, per System Type:
        - a) PVC per ASTM D2466 or ASTM D2467.
        - b) PVC DWV fittings per D2729.
      - 3) Joints:
        - a) Solvent weld per ASTM D2855.
        - b) Hub and spigot with solvent weld per ASTM D2855.

## **SECTION 22 05 03 - PIPE AND PIPE FITTINGS - PLUMBING SYSTEMS**

### **2.2 MANUFACTURED UNITS**

- A. Unions:
  - 1. Copper pipe:
    - a. Copper ground joint unions for pipe sizes 2 inches and smaller.
    - b. Brass flanged unions for pipe sizes larger than 2 inches.

### **2.3 ACCESSORIES**

- A. Heating Water Application:
  - 1. For steel heating lines, provide braided, flanged stainless steel connectors for connection to equipment.
  - 2. Provide pump connectors with stainless steel construction, rubber filled bellows and flanged end connections.
- B. Bellows-type Expansion Fitting:
  - 1. Single sphere style stainless steel construction.
  - 2. Pressure rating: 200 psiG.
  - 3. Temperature Rating: 400 degrees F.
  - 4. Maximum Compression: 3 inches.
  - 5. Maximum Extension: 1/4 inches.
  - 6. Joint: As specified for individual piping system.

### **2.4 WATER HAMMER ARRESTERS**

- A. Engineered, and certified in accordance with Plumbing and Drainage Institute (PDI) Standard WH-201.
- B. Type and construction:
  - 1. Bellows type and constructed entirely of stainless steel.
  - 2. Piston type is not acceptable.
- C. Water hammer arrestors shall be bellows type and constructed entirely of stainless steel.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Ream pipe and tube ends.
- B. Remove burrs.
- C. Remove scale and dirt on inside and outside before assembly.
- D. Prepare piping connections to equipment with flanges and unions.
- E. Deep open ends of pipe free from scale and dirt.
- F. Protect open ends with temporary plugs or caps.

## **SECTION 22 05 03 - PIPE AND PIPE FITTINGS - PLUMBING SYSTEMS**

### **3.2 EXTERIOR BURIED PIPING INSTALLATION**

- A. Unless otherwise shown on the Drawings, provide a minimum of 4 feet and maximum of 8 feet earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing.
- B. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals specified in Specification Section 01 73 20 and as shown on Drawings.
- C. When entering or leaving structures with buried mechanical joint piping, install joint within 2 feet of point where pipe enters or leaves structure.
  - 1. Install second joint not more than 6 feet or less than 4 feet from first joint.
- D. Laying Pipe in Trench:
  - 1. Excavate and backfill trench in accordance with Specification Section 31 23 33.
  - 2. Clean each pipe length thoroughly and inspect for compliance to specifications.
  - 3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
  - 4. Install gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
  - 5. Except for first two joints, before making final connections of joints, install two full sections of pipe with earth tamped alongside of pipe or final with bedding material placed.
  - 6. Lay pipe in only suitable weather with good trench conditions.
    - a. Never lay pipe in water except where approved by Engineer.
  - 7. Seal open end of line with watertight plug if pipe laying stopped.
  - 8. Remove water in trench before removal of plug.
- E. Lining Up Push-On Joint Piping:
  - 1. Lay piping on route lines shown on Drawings.
  - 2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.
  - 3. Observe maximum deflection values stated in manufacturer's written literature.
  - 4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.
  - 5. Install shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.
- F. Anchorage and Blocking:
  - 1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends.
  - 2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall.
    - a. Concrete blocks shall not cover pipe joints.
  - 3. Provide bearing area of concrete in accordance with drawing detail.
- G. Install underground hazard warning tape per Specification Section 22 05 53.
- H. Install insulating components where dissimilar metals are joined together.

### **3.3 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION**

- A. Install piping in vertical and horizontal alignment as shown on Drawings.
- B. Alignment of piping smaller than 4 inches may not be shown; however, install according to Drawing intent and with clearance and allowance for:

## **SECTION 22 05 03 - PIPE AND PIPE FITTINGS - PLUMBING SYSTEMS**

1. Expansion and contraction.
  2. Operation and access to equipment, doors, windows, hoists, moving equipment.
  3. Headroom and walking space for working areas and aisles.
  4. System drainage and air removal.
- C. Enter and exit through structure walls, floor and ceilings using penetrations and seals specified in Specification Section 01 73 20 and as shown on the Drawings.
- D. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.
- E. Pipe Support:
1. Use methods of piping support as shown on Drawings and as required in Specification Section 22 05 29.
  2. Where pipes run parallel and at same elevation or grade, they may be grouped and supported from common trapeze-type hanger, provided hanger rods are increased in size as specified for total supported weight.
    - a. The pipe in the group requiring the least maximum distance between supports shall set the distance between trapeze hangers.
  3. Size pipe supports with consideration to specific gravity of liquid being piped.
- F. Locate and size sleeves and castings required for piping system.
1. Arrange for chases, recesses, inserts or anchors at proper elevation and location.
- G. Use reducing fittings throughout piping systems.
1. Bushings will not be allowed unless specifically approved.
- H. Equipment Drainage:
1. Provide drip pans and piping at equipment where condensation may occur.
  2. Avoid piping over electrical components such as motor control centers, panelboards, etc.
    - a. If piping must be so routed, utilize 16 GA, 316 stainless steel drip pan under piping and over full length of electrical equipment.
    - b. Hard pipe drainage to nearest floor drain.
- I. Miscellaneous Piping:
1. If system is not otherwise specified, provide stainless steel tubing.
  2. Size to handle application with 3/4 inches being minimum size provided.
- J. Unions:
1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.
  2. Mechanical type couplings may serve as unions.
  3. Additional flange unions are not required at flanged connections.
- K. Install expansion devices as necessary to allow expansion/contraction movement.
- L. Provide full face gaskets on all systems.
- M. Anchorage and Blocking:
1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.
- N. Equipment Pipe Connections:

## **SECTION 22 05 03 - PIPE AND PIPE FITTINGS - PLUMBING SYSTEMS**

1. Make piping connections to plumbing and HVAC equipment, including but not limited to installation of fittings, strainers, pressure reducing valves, flow control valves and relief valves provided with or as integral part of equipment.
  2. Furnish and install sinks, fittings, strainers, pressure reducing valves, flow control valves, pressure relief valves, and shock absorbers which are not specified to be provided with or as integral part of equipment.
  3. For each water supply piping connection to equipment, furnish and install union and gate or angle valve.
    - a. Provide wheel handle stop valve at each laboratory sink water supply.
    - b. Minimum size: 1/2 inches.
  4. Furnish and install "P" trap for each waste piping connection to equipment if waste is connected directly to building sewer system.
    - a. Size trap as required by IPC.
  5. Stub piping for equipment, sinks, lavatories, supply and drain fittings, key stops, "P" traps, miscellaneous traps and miscellaneous brass through wall or floor and cap and protect until such time when later installation is performed.
- O. Provide insulating components where dissimilar metals are joined together.

### **3.4 CONNECTIONS WITH EXISTING PIPING**

- A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.
- B. Perform connections with existing piping at time and under conditions which will least interfere with service to customers affected by such operation.
- C. Undertake connections in fashion which will disturb system as little as possible.
- D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.
- E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.
- F. Where connection involves potable water systems, provide disinfection methods as prescribed in this Specification Section.
- G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

### **3.5 ACCESS PROVISIONS**

- A. Comply with the access doors or panels requirements as specified in section 08 31 00 - Access Doors.
- B. Provide access doors or panels in walls, floors, and ceilings to permit access to valves, piping and piping appurtenances requiring service.
- C. Size of access panels to allow inspection and removal of items served, minimum 10 x 14 inches size.



## **SECTION 22 05 03 - PIPE AND PIPE FITTINGS - PLUMBING SYSTEMS**

- D. Provide with key locks, keyed alike, in public use areas.
- E. Furnish panels with prime coat of paint.
- F. Style and type as required for material in which door installed.

### **3.6 INSTALLATION – PIPE SYSTEM SPECIFIC**

#### **A. Potable Water Piping Installation:**

1. Install drain tees with capped nipples of IPS brass 3 inches long at low points.
  - a. If low point occurs in concealed piping, provide approved flush access panel.
  - b. These drains are not shown on Drawings.
2. Slope water lines down to drain points not less than 1 inch in 60 feet.
3. Install all threaded piping with clean-cut tapered threads and with ends thoroughly reamed after cutting to remove burrs.
  - a. Pipe joint cement permitted only on external threads.
4. For screwed nipples for connections to flush valves, lavatory supplies, and other equipment with threaded connections use iron, copper, or brass pipe.
5. Install ball, butterfly and plug valves where indicated or required to adequately service all parts of system and equipment.
  - a. Install valves on each branch serving restroom.
  - b. Install valves on inlet and outlet connections of heat exchangers and on other equipment connected to water lines.
6. Install unions between valves and connections to each piece of equipment, and install sufficient number of unions throughout piping system to facilitate installation and servicing.
  - a. On copper pipe lines, install wrought, solder-joint, copper to copper unions for lines 2 IN and smaller and, for lines 2-1/2 inches and over install brass flange unions.
7. Construct and equip plumbing fixtures and equipment with anti-siphon devices as to entirely eliminate any danger of siphoning waste material into potable water supply system.
8. Where exposed pipes 6 inches in size and smaller pass through floors, finished walls, or finished ceilings, fit with nickel or chrome-plated plates large enough to completely close hole around pipes.
  - a. Secure plates to pipe by set screw in approved manner.
9. Size supply branches to individual fixtures as scheduled or indicated on Drawings.
10. Install piping so as to be free to expand with proper loops, anchors and joints without injury to system or structure.
11. Provide branches to wall hydrants or hose bibbs in exterior locations with interior shutoff and drain valves.
12. Provide approved type vacuum breaker and backflow preventer installations indicated or as required by Code.
13. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings.

#### **B. Soil and Waste Piping Installation:**

1. Install horizontal soil or waste lines less than 4 inches diameter with a slope of not less than 1/4 IN/FT or 2% toward the point of disposal.
2. Install 4 inches and larger piping at 1/8 inches/FT.
3. Install as close to construction as possible to maintain maximum head room.
4. Make changes of direction with 1/8 bends and junctions with wye fittings.
5. Use short wye fittings in vertical pipe only.
6. Install handhole test tee at base of each stack.
7. Install cleanouts at dead ends, at changes of direction and at 50 feet intervals on horizontal runs.

## **SECTION 22 05 03 - PIPE AND PIPE FITTINGS - PLUMBING SYSTEMS**

- a. Where cleanouts occur in concealed spaces, provide with extensions to floors above or to walls as required.
  8. Install piping true to grade and alignment.
    - a. Begin at the system low point.
  9. Locate vertical extensions of underground piping below partition walls for concealment in wall.
    - a. In locations where hubs are wider than partition, set hubs 1 inch below final floor.
  10. Install concealed, in finished structures such as administration and office facilities and at locations shown on Drawings.
  11. For hub and spigot joints, install hub facing flow.
- C. Vent Piping Installation:
1. Run vent stack parallel to each soil or waste stack to receive branch vents from fixtures.
  2. Originate each vent stack from soil or waste pipe at its base.
  3. Where possible, combine soil, waste or vent stacks before passing through roof so as to minimize roof openings.
  4. Offset pipes running close to exterior walls away from such walls before passing through roof to permit proper flashing.
  5. Provide pipes passing through roofs with cast iron increaser's minimum of 12 inches below roof one size larger than pipe but in no case less than 4 inches.
  6. Terminate each vent with approved frost proof jacket.
  7. Carry vent stacks 4 inches and larger full size through roof.
    - a. Extend vent stacks at least 12 inches above roofing.
  8. Pipe vents from pressure regulating devices in compliance with local codes.
  9. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings.

### **3.7 WATER HAMMER ARRESTORS**

- A. Provide water hammer arrestors on hot and cold water lines in accordance with PDI Standard WH-201 sizing and placement data; the Contractor shall be responsible for sizing of water hammer arrestors in accordance with this standard.

### **3.8 JOINING**

- A. Install products in accordance with manufacturer's instructions.
- B. Joining Method - Welded Joints:
1. Perform welding in accordance with AWWA C206 and this Section.
  2. For flange attachment perform in accordance with AWWA C207.
  3. Have each welding operator affix an assigned symbol to all his welds.
    - a. Mark each longitudinal joint at the extent of each operator's welding.
    - b. Mark each circumferential joint, nozzle, or other weld into places 180 degrees apart.
  4. Welding for all process piping shall conform to ASME B31.3.
    - a. Welding of utility piping 125 psi and less shall be welded per ASME B31.9.
    - b. Utility piping above 125 psi shall conform to ASME B31.1.
  5. Provide caps, tees, elbows, reducers, etc., manufactured for welded applications.
  6. Weldolets may be used for 5 inches and larger pipe provided all slag is removed from inside the pipe.
  7. Weld-in nozzles may be used for branch connections to mains and where approved by Engineer.
  8. Use all long radius welding elbows for expansion loops and bends.

## **SECTION 22 05 03 - PIPE AND PIPE FITTINGS - PLUMBING SYSTEMS**

9. Use long radius reducing welding elbows 90 degrees bends and size changes are required.
- C. Joining Method - Threaded and Coupled (T/C):
1. Provide T/C end conditions that meet ASME B1.2 requirements.
  2. Furnish pipe with factory-made T/C ends.
  3. Field cut additional threads full and clean with sharp dies.
  4. Leave not more than three pipe threads exposed at each branch connection.
  5. Ream ends of pipe after threading and before assembly to remove burrs.
  6. Use Teflon thread tape on male thread in mating joints.

### **3.9 FIELD QUALITY CONTROL**

- A. Pipe Testing - General:
1. Test piping systems as follows:
    - a. Test exposed, non-insulated piping systems upon completion of system.
    - b. Test exposed, insulated piping systems upon completion of system but prior to application of insulation.
    - c. Test concealed interior piping systems prior to concealment and, if system is insulated, prior to application of insulation.
    - d. Test buried piping (insulated and non-insulated) prior to backfilling and, if insulated, prior to application of insulation.
  2. Isolate equipment which may be damaged by the specified pressure test conditions.
  3. Perform pressure test using calibrated pressure gages and calibrated volumetric measuring equipment to determine leakage rates.
    - a. Select each gage so that the specified test pressure falls within the upper half of the gage's range.
    - b. Notify the Engineer 24 hours prior to each test.
  4. Completely assemble and test new piping systems prior to connection to existing pipe systems.
  5. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.
  6. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.
- B. Pressure Testing:
1. Testing medium:
    - a. Water systems: Water.
    - b. Waste and drain systems: Water.
  2. Testing pressure:
    - a. See below for gravity systems.
    - b. For pumped systems, test at no less than 125% of pump head plus the system fill pressure.
    - c. For pressurized systems, test at 150 psiG.
  3. Allowable leakage rates:
    - a. All pressure piping systems and all buried, insulated piping systems which are hydrostatically pressure tested shall have zero leakage at the specified test pressure throughout the duration of the test.
  4. Hydrostatic pressure testing methodology:
    - a. General:
      - 1) All joints, including welds, are to be left exposed for examination during the test.
      - 2) Provide additional temporary supports for piping systems designed for vapor or gas to support the weight of the test water.
      - 3) Provide temporary restraints for expansion joints for additional pressure load under test.

## **SECTION 22 05 03 - PIPE AND PIPE FITTINGS - PLUMBING SYSTEMS**

- 4) Isolate equipment in piping system with rated pressure lower than pipe test pressure.
- 5) Do not paint or insulate exposed piping until successful performance of pressure test.
- b. Soil, waste, drain and vent systems:
  - 1) Test at completion of installation of each stack or section of piping by filling system with water and checking joints and fittings for leaks.
  - 2) Eliminate leaks before proceeding with work or concealing piping.
  - 3) Minimum test heights shall be 10 feet above highest stack inlet.
- C. Dielectric Testing Methods and Criteria:
  1. Provide electrical check between metallic non-ferrous pipe or appurtenances and ferrous elements of construction to assure discontinuity has been maintained.
  2. Wherever electrical contact is demonstrated by such test, locate the point or points of continuity and correct the condition.

### **3.10 CLEANING, DISINFECTION AND PURGING**

- A. Cleaning:
  1. Clean interior of piping systems thoroughly before installing.
  2. Maintain pipe in clean condition during installation.
  3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
  4. Immediately prior to pressure testing, clean and remove grease, metal cuttings, dirt, or other foreign materials which may have entered the system.
  5. At completion of work and prior to Final Acceptance, thoroughly clean work installed under these Specifications.
    - a. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge which may have accumulated by operation of system, from testing, or from other causes.
    - b. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to Owner.
  6. Clean chlorine piping in accordance with CI Pamphlet 6.
- B. Disinfection of Potable Water Systems:
  1. After favorable performance of pressure test and prior to Final Acceptance, thoroughly flush entire potable water piping system including supply, source and any appurtenant devices and perform disinfection as prescribed.
  2. Perform work, including preventative measures during construction, in full compliance with AWWA C651.
  3. Perform disinfection using sodium hypochlorite complying with AWWA B300-10.
  4. Flush each segment of system to provide flushing velocity of not less than 2.5 feet per second.
  5. Drain flushing water to sanitary sewer.
    - a. Do not drain flushing water to receiving stream.
  6. Use continuous feed method of application.
    - a. Tag system during disinfection procedure to prevent use.
  7. After required contact period, flush system to remove traces of heavily chlorinated water.
  8. After final flushing and before placing water in service, obtain an independent laboratory approved by the Owner to collect samples and test for bacteriological quality.
    - a. Repeat entire disinfection procedures until satisfactory results are obtained.
  9. Secure and deliver to Owner, satisfactory bacteriological reports on samples taken from system.

## **SECTION 22 05 03 - PIPE AND PIPE FITTINGS - PLUMBING SYSTEMS**

- a. Ensure sampling and testing procedures are in full compliance to AWWA C651, local water purveyor and applicable requirements of State of \_\_North Carolina\_\_.

### **3.11 SCHEDULES**

- A. System 1 - Potable Water:
  1. Piping symbol and service:
    - a. CW – Potable Water Cold.
    - b. HW – Potable Water Hot.
    - c. An “R” designation after piping symbol denotes Recirculation.
  2. Above ground, less than 3 inches diameter:
    - a. Pipe: Type L Copper.
    - b. Fittings: Wrought Copper or bronze.
    - c. Joints: Brazed or Soldered.
  3. Above ground, 3 inches diameter and larger:
    - a. Pipe: Ductile Iron, Class 150.
    - b. Fittings: Ductile or Gray Iron.
    - c. Joints: Flanged or grooved mechanical couplings.
  4. Buried, less than 3 inches diameter:
    - a. Pipe: Type K Copper.
    - b. Fittings: Cast or Wrought Copper.
    - c. Joints: Flared.
  5. Buried, 3 inches diameter and larger:
    - a. Pipe: Ductile Iron, Class 150.
    - b. Fittings: Ductile or Gray Iron.
    - c. Joints: Push-on mechanical stuffing box type at fittings and valves.
- B. System 2 - Non Potable Water:
  1. Piping symbol and service:
    - a. NPW – Nonpotable Water.
  2. Above Ground:
    - a. Pipe: Schedule 40 Galvanized Steel.
    - b. Fittings: Malleable Iron or Forged Steel.
      - 1) Galvanized.
    - c. Joints: Threaded.
- C. System 3 - Waste and Vent:
  1. Piping symbol and service:
    - a. SAN – Sanitary Sewer.
    - b. V – Vent.
    - c. SD/OD – Storm Drainage.
    - d. OW - Oil Water Waste
  2. Above ground, less than 2 inches diameter:
    - a. Pipe: Schedule 40 Galvanized Steel.
    - b. Fittings: Cast Iron DWV.
    - c. Joints: Threaded.
  3. Above ground, 2 inches diameter and larger:
    - a. Pipe: Cast Iron Drainage Pipe.
    - b. Fittings: Cast Iron DWV.
    - c. Joints: No hub.
  4. Buried (Sanitary/Storm):
    - a. Pipe: Cast Iron Drainage Pipe.
    - b. Fittings: Cast Iron DWV.
    - c. Joints: Hub and Spigot.

## **SECTION 22 05 03 - PIPE AND PIPE FITTINGS - PLUMBING SYSTEMS**

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5. Buried (Oil Water Waste)
  - a. Pipe: DWV grade PVC.
  - b. Fittings: DWV PVC.
  - c. Joints: Solvent Weld.
  
- D. System 4 - Condensate and Equipment Drains:
  1. Piping symbol and service:
    - a. CD – Condensate Drain.
    - b. ED – Equipment Drain.
  2. Above Ground (gravity drainage):
    - a. Pipe: DWV grade PVC.
    - b. Fittings: DWV PVC.
    - c. Joints: Solvent Weld.
  3. Above ground (pumped):
    - a. Pipe: Schedule 40 PVC or CPVC (for systems above 100 degrees F).
    - b. Fittings: Schedule 40 PVC or CPVC to match pipe.
    - c. Joints: Solvent weld.
  
- E. System 5 - Oil-Water Drains:
  1. Buried:
    - a. Pipe: DWV grade PVC.
    - b. Fittings: DWV PVC.
    - c. Joints: Solvent Weld.

**END OF SECTION 22 05 03**

# **SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Ball valves.
  - 2. Butterfly valves.
  - 3. Check valves.
  - 4. Calibrated balance valves.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 09 96 00 - High Performance Industrial Coatings.
  - 2. Section 22 05 03 - Pipe and Pipe Fittings - Plumbing Systems.

### **1.2 QUALITY ASSURANCE**

- A. Reference Standards:
  - 1. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
    - a. SP 67, Butterfly Valves.
    - b. SP 71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
    - c. SP 110, Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
  
- B. For drinking water service, provide valves complying with NSF 61.

### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product Data: Submit manufacturers catalog information with valve data and ratings for each service.
  - 2. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
  
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Apollo Valves by Conbraco Industries, Inc.
  - 2. Crane ChemPharma Energy.
  - 3. DeZURICK/APCO/Hilton.

## **SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING**

4. Milwaukee Valve Company.
5. NIBCO, Inc.
6. Stockham by Crane ChemPharma Energy.
7. Bell & Gossett.
8. Cla-Val.
9. Watts Regulator
10. Fisher

### **2.2 GATE VALVES**

- A. 2 inches and Smaller: MSS SP 80, Class 150, bronze body, bronze trim, threaded bonnet, non-rising stem, inside screw, solid wedge disc, alloy seat rings, solder or threaded ends.
- B. 2-1/2 inches and Larger: MSS SP 70, Class 125, cast iron body, bronze trim, bolted bonnet, non-rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged ends. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.

### **2.3 BALL VALVES**

- A. 2 inches and Smaller: MSS SP 110, 400 psiWOG, two-piece bronze body, chrome plated brass ball, full port, teflon seats, blow-out proof stem, solder or threaded ends with union, lever handle.

### **2.4 BUTTERFLY VALVES**

- A. 2-1/2 inches and Larger: MSS SP 67, Class 150.
  1. Body: Cast or ductile iron, lug ends, stainless steel stem, extended neck.
  2. Disc: Nickel-plated ductile iron, Aluminum bronze, Elastomer coated ductile iron, Chrome plated ductile iron, or stainless steel.
  3. Seat: Resilient replaceable EPDM.
  4. Handle and Operator: 10 position lever handle.

### **2.5 CHECK VALVES**

- A. Horizontal Swing Check Valves:
  1. 2 inches and Smaller: MSS SP 80, Class 150, bronze body and cap, bronze seat, Teflon disc, solder or threaded ends.
  2. 2-1/2 inches and Larger: MSS SP 71, Class 125, cast iron body, bolted cap, bronze or cast-iron disc, renewable disc seal and seat, flanged ends.

### **2.6 CALIBRATED BALANCING VALVE:**

- A. Type: Ball type calibrated balance valve.
- B. NSF-61 Annex G compliant.
- C. Connections:
  1. NPT up to 3 IN DIA.



## **SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING**

- D. Construction:
  - 1. Body: Lead-free brass.
  - 2. Ball: 304 stainless steel.
  - 3. Seat rings: Glass and carbon filled TFE.
  - 4. Stem "O" ring: EPDM.
- E. Readout valve: Brass fitted with integral EPT insert and check valve.
- F. Calibrated nameplate.
- G. Maximum Working pressure: 400 psig.

### **2.7 PRESSURE REDUCING VALVES:**

- A. Use pilot operated or direct acting PRV based on pipe size indicated on plans.
  - 1. 3 inches and larger: pilot operated.
- B. Pilot operated PRV:
  - 1. Hydraulically operated, pilot-controlled diaphragm type valve.
    - a. Pilot control: Direct acting, adjustable, spring loaded, normally open.
  - 2. Main valve shall comply with NSF/ANSI Standard 61 and certified lead free to NSF/ANSI 372 as a safe drinking water system component.
  - 3. Pattern: Globe or angle.
  - 4. Pilot System:
    - a. Pilot control: Stainless-steel.
    - b. Trim: Stainless-steel type 303
    - c. Rubber: Buna-N synthetic rubber.
  - 5. Single removable seat and resilient disc.
  - 6. Fixed orifice in control system.
  - 7. Pressure rating: 150 class B16.42.
  - 8. Temperature rating: 180 deg F.
  - 9. Valve body: Ductile Iron ASTM A536.
  - 10. Provide thermal relief if PRV is installed on cold-water side of water heater.
  - 11. Adjustment Range:
    - a. Non-potable Water: 30 to 300 psi.
  - 12. Pipe size indicated on plans: 3 inches.
    - a. Min PRV flow rate: 15 gpm.
    - b. Normal maximum flow rate: 150 gpm.
    - c. Maximum intermittent flow rate: 260 gpm.
  - 13. Pipe size indicated on plans: 4 inches.
    - a. Min PRV flow rate: GPM.
    - b. Normal maximum flow rate: 310 gpm.
    - c. Maximum intermittent flow rate: 475 gpm.
  - 14. Pipe size indicated on plans: 6 inches.
    - a. Min PRV flow rate: 50 gpm.
    - b. Normal maximum flow rate: 720 gpm.
    - c. Maximum intermittent flow rate: 1000 gpm.
  - 15. Options:
    - a. Pressure gauges.
    - b. Y strainer.
    - c. Isolation valves.
    - d. Body Coating: Fusion Bond Epoxy Coated, NSF/ANSI 61.
    - e. LFS trim: Precise and smooth flow for velocities lower than 1 fps.

## **SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING**

16. Type:
  - a. Cla-Val model 90-01.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install valves with stems upright or horizontal, not inverted.
- B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
- C. Install 3/4 inches ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.
- D. Install valves with clearance for installation of insulation and allowing access.
- E. Provide access where valves and fittings are not accessible.
- F. Refer to Section 22 05 29 for pipe hangers.
- G. Refer to Section 23 42 00 for insulation requirements for valves.
- H. Refer to Section 22 05 03 for piping materials applying to various system types.

#### **3.2 VALVE APPLICATIONS**

- A. Install ball or gate valves for drain service at locations indicated on Drawings in accordance with this Section.
- B. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.
- C. Install gate valves for throttling, bypass, or manual flow control services.
- D. Install ball valves in domestic water systems for shut-off service.

**END OF SECTION 22 05 23**

# **SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Pipe hangers and supports.
  - 2. Hanger rods.
  - 3. Inserts.
  - 4. Flashing.
  - 5. Sleeves.
  - 6. Formed steel channel.
  
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 03 00 05 - Concrete.
  - 2. Section 22 05 03 - Pipe and Pipe Fittings - Plumbing Systems.

### **1.2 QUALITY ASSURANCE**

- A. Reference Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. B31.9, Building Services Piping.
  - 2. ASTM International (ASTM):
    - a. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
    - b. E119, Standard Test Methods for Fire Tests of Building Construction and Materials.
    - c. E814, Standard Test Method for Fire Tests of Through Penetration Fire Stops.
    - d. F708, Standard Practice for Design and Installation of Rigid Pipe Hangers.
    - e. E1966, Standard Test Method for Fire-Resistive Joint Systems.
  - 3. American Welding Society (AWS):
    - a. D1.1, Structural Welding Code - Steel.
  - 4. FM Global (FM):
    - a. Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
  - 5. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
    - a. SP 58, Pipe Hangers and Supports - Materials, Design and Manufacturer.
    - b. SP 69, Pipe Hangers and Supports - Selection and Application.
    - c. SP 89, Pipe Hangers and Supports - Fabrication and Installation Practices.
  - 6. Underwriters Laboratories Inc. (UL):
    - a. 263, Fire Tests of Building Construction and Materials.
    - b. 723, Tests for Surface Burning Characteristics of Building Materials.
    - c. 1479, Fire Tests of Through-Penetration Firestops.
    - d. 2079, Tests for Fire Resistance of Building Joint Systems.
    - e. Fire Resistance Directory.
  - 7. Intertek Testing Services (Warnock Hersey Listed):
    - a. WH - Certification Listings.
  
- B. Perform Work in accordance with applicable authority and AWS D1.1 for welding hanger and support attachments to building structure.

## **SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

### **1.3 SUBMITTALS**

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
- C. Product Data:
  - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
  - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Manufacturer's Installation Instructions:
  - 1. Hangers and Supports: Submit special procedures and assembly of components.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

### **1.4 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

### **1.6 ENVIRONMENTAL REQUIREMENTS**

- A. 01 61 00 - Common Products Requirements.

### **1.7 FIELD MEASUREMENTS**

- A. Verify field measurements prior to fabrication.

### **1.8 WARRANTY**

- A. Furnish five year manufacturer warranty for pipe hangers and supports.

## **PART 2 - PRODUCTS**

### **2.1 PIPE HANGERS AND SUPPORTS**

- A. Manufacturers:

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1. Anvil International.
  2. CADDY by nVent.
  3. Carpenter & Paterson, Inc.
  4. B-Line by Eaton.
  5. Empire Industries, Inc.
  6. ERICO by nVent.
  7. Globe Pipe Hanger Products, Inc.
  8. Haydon Corporation.
  9. Hilti, Inc.
  10. NIBCO, Inc.
  11. PHD Manufacturing, Inc.
  12. TOLCO by Eaton.
- B. Plumbing Piping - DWV:
1. Conform to MSS SP58.
  2. Hangers for Pipe Sizes 1/2 to 1-1/2 inches: Malleable iron or Carbon steel, adjustable swivel, split ring.
  3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
  4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
  6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
  7. Vertical Support: Steel riser clamp.
  8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
- C. Plumbing Piping - Water:
1. Conform to MSS SP58.
  2. Hangers for Pipe Sizes 1/2 to 1-1/2 inches: Malleable iron or Carbon steel, adjustable swivel, split ring.
  3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
  4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
  5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
  6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
  7. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
  8. Vertical Support: Steel riser clamp.
  9. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  10. Floor Support for Hot Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
  11. Copper Pipe Support: Copper-plated, Carbon-steel ring.

### **2.2 ACCESSORIES**

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.
1. Electro-galvanized or zinc-nickel plated after threads are cut.

### **2.3 INSERTS**

- A. Manufacturers:

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1. Hilti, Inc.
2. Simpson Strong-Tie Company, Inc.
3. TOLCO by Eaton.
4. Cooper B-Line.
5. Grinnell.

B. Inserts: Malleable iron case of [galvanized] steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

### **2.4 FLASHING**

- A. Metal Flashing: 26 gage thick galvanized steel.
- B. Metal Counterflashing: 22 gage thick galvanized steel.
- C. Lead Flashing:
  1. Waterproofing: 5 pound/SQFT sheet lead.
  2. Soundproofing: 1 pound/SQFT sheet lead.
- D. Flexible Flashing: 47 MIL thick sheet butyl; compatible with roofing.
- E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

### **2.5 SLEEVES**

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sealant: Acrylic.

### **2.6 MECHANICAL SLEEVE SEALS**

- A. Manufacturers:
  1. Flexicraft Industries.
  2. GPT Industries.
  3. Proco Products, Inc.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

### **2.7 FORMED STEEL CHANNEL**

- A. Manufacturers:
  1. Unistrut by Atkore International, Inc.
  2. B-Line by Eaton.

## **SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

3. ERICO by Pentair.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

### **2.8 FIRESTOPPING**

A. Firestopping Materials: Comply with requirements of Section 07 84 13 and 07 84 43.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

A. Verify openings are ready to receive sleeves.

### **3.2 PREPARATION**

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.

B. Remove incompatible materials affecting bond.

C. Obtain permission from Engineer before using powder-actuated anchors.

D. Obtain permission from Engineer before drilling or cutting structural members.

### **3.3 INSTALLATION - INSERTS**

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

### **3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS**

A. Install in accordance with MSS SP 58.

B. Support horizontal piping as scheduled.

C. Install hangers with minimum 1/2 inches space between finished covering and adjacent work.

## **SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inches minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide copper plated hangers and supports for copper piping.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation.

### **3.5 INSTALLATION - FLASHING**

- A. Provide flexible flashing and metal counterflashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 3 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and seal, metal counter-flash, and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inches sheet size. Fasten flashing to drain clamp device.
- D. Seal floor, mop sink drains watertight to adjacent materials.
- E. Adjust storm collars tight to pipe with bolts; seal around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

### **3.6 INSTALLATION - SLEEVES**

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inches above finished floor level. Seal sleeves.



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- E. Where piping penetrates floor, ceiling, or wall, close off space between pipe and adjacent work with firestopping insulation and sealant. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- F. Install stainless steel escutcheons at finished surfaces.

**3.7 SCHEDULES**

<b><u>PIPE HANGER SPACING</u></b>		
<b>PIPE MATERIAL</b>	<b>MAXIMUM HANGER SPACING (FT)</b>	<b>HANGER ROD DIAMETER (IN)</b>
Cast Iron (All Sizes)	5	5/8
Cast Iron (All Sizes) with 10 feet length of pipe	10	5/8
Copper Tube, 1-1/4 inches and smaller	6	1/2
Copper Tube, 1-1/2 inches and larger	10	1/2
PVC (All Sizes)	4	3/8

**END OF SECTION 22 05 29**

# **SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Nameplates.
  - 2. Tags.
  - 3. Stencils.
  - 4. Pipe markers.
  - 5. Ceiling tacks.
  - 6. Labels.
  - 7. Lockout devices.
  
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 09 96 00 - High Performance Industrial Coatings.

### **1.2 QUALITY ASSURANCE**

- A. Reference Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. A13.1, Scheme for the Identification of Piping Systems.
  
- B. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
  
- C. Maintain one copy of each document on site.

### **1.3 SUBMITTALS**

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
  
- B. Product Data: Submit manufacturers catalog literature for each product required.
  
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
  
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
  
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
  
- F. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
  - 2. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

# **SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Nameplates, Tags and Stencils:
    - a. Brady Corporation.
    - b. Panduit.
    - c. Seton by Brady Corporation.
    - d. National Band & Tag Company.
    - e. Carlton Industries, LP.

### **2.2 NAMEPLATES**

- A. Laminated two-layer phenolic or DR (high impact) acrylic with engraved black letters on light contrasting background color.
  - 1. Thickness: Minimum 1/16 inches.
  - 2. Color: Manufacturer standard or as specified.
- B. Alternate: Laminated three-layer plastic with engraved black letters on light contrasting background color.
  - 1. Thickness: Minimum 60 mils.
  - 2. Color: Manufacturer standard or as specified.

### **2.3 SELF ADHESIVE PIPE AND EQUIPMENT MARKERS**

- A. Color and Lettering: Conform to ASME A13.1.
- B. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
  - 1. Thickness: Minimum 5 mils.
  - 2. Letter Height:
    - a. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inches high letters.
    - b. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1 inch high letters.
    - c. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
    - d. Equipment: 1-3/4 inches high letters.
  - 3. Indoor/outdoor grade.
  - 4. Weather and UV resistant inks.
  - 5. Permanent adhesive.

### **2.4 UNDERGROUND WARNING TAPE**

- A. Description: Polyethylene tape with metallic core for detection and location of piping with metal detector resistant to acids, alkalis and other soil components.
  - 1. Size: 0.004 inches thick; 6 inches wide.
  - 2. Color: As Specified.
  - 3. Service Marking: Printed text as selected by Architect/Engineer in contrasting color and repeated at maximum 40 inches intervals.

# **SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 96 00 for stencil painting.

### **3.2 INSTALLATION**

- A. Install identifying devices after completion of coverings and painting.
- B. All identification devices to be printed by mechanical process. Hand printing is not acceptable.
- C. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
- D. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.
- E. Tag single items of equipment enclosed in a housing or compartment on outside of housing.
  - 1. Tag multiple items mounted inside a housing or compartment individually inside the housing.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify piping, concealed or exposed, with pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

### **3.3 SCHEDULES**

- A. Above Grade Piping:
  - 1. Install labels on all piping in accordance with Article 3.2.
    - a. Stencils or self-adhesive labels.
  - 2. Color Coding: Per ASME A13.1.
    - a. Black lettering on yellow background:
      - 1) Hazardous, flammable or high temperature fluids:
        - a) Domestic Hot Water.
        - b) Domestic Hot Water Return..
    - b. White lettering on green background:
      - 1) Low temperature water:
        - a) Domestic Cold Water.
        - b) Tepid Water.
        - c) Nonpotable Water.
- B. Below Grade Piping
  - 1. Use underground warning tape in accordance with Article 3.2.
    - a. Lettering: Minimum: 1-1/4 inches.
    - b. Wording:
      - 1) First line "CAUTION CAUTION CAUTION"

## **SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

- 2) Second line: "BURIED (Pipe Descriptor) LINE BELOW"
- c. Pipe Descriptors and color coding:
  - 1) Sewer or Waste: Black Lettering on Green Background.
  - 2) Water (potable): Black lettering on blue background.
  - 3) Water (nonpotable): Black lettering on Green background.
- C. Valves:
  - 1. Install on all automatic valves used in temperature controls:
    - a. Label per Control Drawings.
  - 2. Install on manual valves as indicated on Drawings:
    - a. Number and schedule all valves utilized on project. Coordinate numbering system with Tag Chart.
  - 3. Utilize nonmetallic or metal tags.
    - a. Use stainless steel metal tags only for corrosive areas.
- D. Equipment:
  - 1. Provide nameplate or stencil as warranted per Article 3.2.
  - 2. Label with equipment tag as shown on the Drawings.
    - a. Black lettering on white background.
  - 3. Provide OSHA warning sign for equipment that starts automatically.
  - 4. Label all equipment control panels located remote from unit.
  - 5. Label all thermostats with self-adhesive markers with tag of equipment served.

**END OF SECTION 22 05 53**

## **SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS**

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### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Contract Drawings and provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.
- B. Section 019113 – Commissioning General Requirements
- C. Section 230800 – Commissioning of Mechanical Systems
- D. Section 250800 – Commissioning of Integrated Automation Systems
- E. Section 260800 – Commissioning of Electrical Systems
- F. Commissioning Plan

#### **1.2 DESCRIPTION OF WORK**

- A. An independent third-party Commissioning Agent has been retained to lead the project participants through the commissioning process. The section below is provided for informational purposes and to inform the contractor of the extent of the commissioning process and the involvement required. The Commissioning Agent is RMF Engineering, Inc.
- B. The purpose of this section is to specify commissioning responsibilities directly related to the Division 22 contractors and vendors. All contractors responsible for Division 22 installation or other activities shall have commissioning responsibilities described herein.
- C. The majority of the Commissioning Requirements apply to all trades and therefore are defined within Section 019113 – Commissioning General Requirements. Specific requirements herein apply generally to the Plumbing Contractors alone.
- D. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Plumbing Systems, which are a part of this project.
- E. Commissioning shall be a team effort to ensure that all equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for verification of proper loading and unloading, fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, quality control, equipment start-up, third party testing, final verification and performance testing, training, turn-over and possible deferred or seasonal testing including a final warranty verification.

## **SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS**

- F. The Commissioning Team is defined in Specification 019113 Section 1.3 – Definitions. The plumbing trades represented on the Commissioning Team shall include but not be limited to; pipe and fitting, controls, test and balance, plumbing, vendors, manufactures, and water treatment. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.
- G. Plumbing Contractor(s) are responsible for plumbing system installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 1 and Division 22 specification sections. Plumbing Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 019113.
- H. Sections 019113 - Commissioning General Requirements and 220800 – Commissioning of Plumbing Systems DO NOT relieve the Plumbing Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 220800 – Commissioning of Plumbing Systems shall not relieve any other discipline or trade contractor from any obligations set forth within other divisions of the specifications.

### **1.3 DEFINITIONS**

- A. Plumbing Contractor(s): The term Plumbing Contractor(s) utilized herein refers to any and all subcontracting companies or venders who are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning and are defined within Division 22 of the specifications. Subcontracting parties outside of the scope of the Systems to be Included in Commissioning or outside of the scope of Division 22 are not included.
- B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies who are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 22 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.
- C. Third Party Testing Agencies: The term Third Party Testing Agency utilized herein refers to any and all subcontracting companies who are responsible for performing testing or other quality control activities which do not necessarily involve installation activities, such as a company performing disinfection activities or a company performing water quality tests for potable water.
- D. See specification 019113 – General Commissioning Requirements for additional definitions utilized herein.

## **SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS**

### **1.4 ROLES AND RESPONSIBILITIES**

- A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company, vender or manufacturer whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are further defined within Division 22 of the specifications and project drawings.
- B. Every Plumbing Contractor, Subcontractor, Vendor, etc. is responsible for providing a minimum of one team member to participate in the Commissioning Process for the duration of the project. This team member shall be labeled as that companies Commissioning Representative. Each Contractor is responsible for ensuring re the subcontractors under their contract have included the same representation.
- C. All Division 22 Contractors are responsible for the requirements defined in section 019113 section 1.4-D – Subcontractors.
- D. Plumbing Contractor(s)
  - 1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
  - 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
  - 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
  - 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
  - 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.
- E. Equipment Manufacturer(s)
  - 1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
  - 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
  - 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
  - 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
  - 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.
- F. Third Party Testing Agencies
  - 1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
  - 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
  - 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
  - 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution



## **SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS**

5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.

### **1.5 SYSTEMS INCLUDED IN COMMISSIONING**

- A. See specification 019113 section 1.5 – Systems Included in Commissioning for the full list of Division 22 Plumbing Systems included within the Commissioning Scope.

### **1.6 COORDINATION**

- A. Overall Coordination of Commissioning Tasks is the responsibility of the Construction Manager/General Contractor. The Commissioning Agent does not have any direct control over contractors or the construction schedule and therefore, cannot dictate task schedule. However, the Commissioning Agent typically has the most Commissioning Experience and will assist with coordination of Commissioning Tasks by providing input and feedback to the Commissioning Team.
- B. The Owner, System Design Professionals, Commissioning Agent, Contractors, Sub-Contractors, Vendors and 3rd Part Test Agencies are all required to assist with Coordination. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.
- C. Various tasks included as part of the commissioning process must be coordinated by the Cx Team. These tasks require advance notification by the subcontractors to the Owner, Designers and Commissioning Agent for planning and participation. Tasks required to be coordinated with the Commissioning Team include but are not limited to:
  1. Submittal Reviews
  2. Quality Control Plans and Tests
  3. Equipment and Systems Start-Up
  4. Third Party Testing
  5. Pre-Verification Testing
  6. Functional Performance Testing
  7. Close-Out Inspections
  8. Close-Out Document Review (O&M's, As-Builts, Warranties)

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Work products to be provided by the Plumbing Contractors are defined within Specification 019113 – General Commissioning Requirements part 2. Work products specific to the Plumbing Contractors, Manufacturers and Third Party Test Agencies Include:
  1. 2.1 - Project Schedule
  2. 2.2 - Schedule of Values
  3. 2.3 - Submittals
  4. 2.4 - Quality Control Plan
  5. 2.5 - Quality Control Reports
  6. 2.6 - Systems and Equipment Start-Up Plan
  7. 2.8 - Start-Up Reports
  8. 2.9 - Preventative Maintenance Plan
  9. 2.10 - Pre-Verification Tests

## **SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS**

10. 2.11 - Functional Performance Tests
  11. 2.12 - Test and Proprietary Equipment
- B. Work products under the Construction Manager/General Contractor purview are to be coordinated with the Plumbing Contractors, Manufacturers and Third-Party Test Agencies to ensure products are up to date and accurate.
- C. Work products under the Contractors purview outside of Division 22 are to be coordinated with the Plumbing Contractors, Manufacturers and Third-Party Test Agencies to ensure related tasks and activities to not impede Division 22 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 22 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Execution of Commissioning Activities to be performed by the Plumbing Contractors are defined within Specification 019113 – General Commissioning Requirements part 3. Execution Activities specific to the Plumbing Contractors, Manufacturers and Third-Party Test Agencies Include:
1. 3.1 – Commissioning Plan and Kick-Off Meeting
  2. 3.2 – Construction Observations
  3. 3.3 – Systems and Equipment Start-Up
  4. 3.4 – Temporary Utilization
  5. 3.5 – Quality Control and Start-Up Reporting
  6. 3.6 – Pre-Verification Tests
    - a. Plumbing PVT's are primarily the responsibility of the Plumbing Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to participate in portions of the Plumbing PVT's. For these activities, the Plumbing Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
    - b. Plumbing Contractors are responsible for portions of PVT's which are primarily the responsibility of other Contractors such as Fire Protection or Mechanical. For these items, the Plumbing Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
  7. 3.7 – Functional Performance Tests
    - a. Plumbing FPT's are primarily the responsibility of the Plumbing Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to participate in portions of the Plumbing FPT's. For these activities, the Plumbing Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.
    - b. Plumbing Contractors are responsible for portions of FPT's which are primarily the responsibility of other Contractors such as Fire Protection or Mechanical. For these items, the Plumbing Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.
  8. 3.8 – TAB Verification
    - a. Test, Adjustment and Balance is generally considered a Mechanical Trade and performed under Division 23. However, all fluid flowing equipment such as pumps must be properly tested for operational characteristics typically performed by a TAB contractor. Additionally, Balancing Valves or Circuit Setters which set flow rates throughout the Plumbing Systems must also be adjusted and balanced by a TAB contractor. The Plumbing Contractor may coordinate with the Mechanical

## **SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS**

Contractor to include these services within the same TAB Contractor scope or may utilize an independent company. Ultimately, the Plumbing Contractor will be required to demonstrate operational and flow characteristics to the Commissioning Team as part of Quality Control and Functional Testing.

9. 3.9 – Integrated Systems Test
10. 3.10 – Operations and Maintenance Manuals
11. 3.11 – Exclusions
12. 3.16 – Prerequisites to Substantial Completion

- B. Execution of Commissioning Activities under the Construction Manager/General Contractor purview are to be coordinated with the Plumbing Contractors, Manufacturers and Third Party Test Agencies to ensure activities are executed without any impedance or interference by Division 22 or any other contractors.
- C. Execution of Commissioning Activities under the Contractors purview outside of Division 22 are to be coordinated with the Plumbing Contractors, Manufacturers and Third Party Test Agencies to ensure related tasks and activities to not impede Division 22 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 22 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

### **3.2 SCHEDULE**

- A. The Plumbing Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.
- B. Work is to be scheduled and completed such that all Commissioning Activities including Pre-Verification Tests and Functional Performance Tests can be executed with sufficient time for issue resolution prior to Beneficial Occupancy. It is the Contractors responsibility to determine the amount of time needed to test, troubleshoot and retest the Plumbing Systems such that all deficiencies are resolved prior to Final Acceptance.

### **3.3 PARTICIPATION IN ACCEPTANCE PROCEDURES**

- A. The Plumbing Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 22. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Plumbing Contractor(s). Plumbing Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained, at no cost to the Owner.

## **SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS**

- C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Plumbing Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

### **3.4 DEFICIENCIES AND FAILURES**

- A. Deficiencies are installations which do not comply with either the Construction Documents or the Manufacturer's Installation Requirements. Where the Construction Documents and the Manufacturer's Installation Requirements are in direct conflict, the Design Professional shall make the final decision regarding which requirement to follow. Deficiencies can be documented upon discovery if the installation appears to be progressed past the point of temporary work. If installation progress is such that the installation may not be complete and the deficiency may resolve itself as the installation progresses, the deficiency should be documented as a observations and not a true deficiency.
- B. Deficiencies found during an inspection for wall or ceiling closure or upon a final inspection or otherwise noted to be complete by the Contractors shall be required to have the associated progress or closure delayed until such time as the deficiency can be corrected and reinspected. All deficiencies must be reinspected unless otherwise proven beyond a doubt that the deficiency was resolved. Time and expenses related to additional site visits, re-inspections or extended inspection time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- C. Test failures are those that occur during Quality Control Testing or Functional Performance Testing which require any level of rework. This may include the addition of sealant to reduce leakage or a slight setting adjustment such that a sequence of operations will work. These deficiencies should have been previously discovered and addressed by the Contractors and should not be found during observation or witnessing by the Commissioning Agent.
- D. While minor issues can occur despite previous testing and some minor adjustments may be required during the final test, these should be minimized through the pre-test requirements of the Pre-Verification Tests. Therefore, an increase of more than five percent (5%) of the time associated with witnessing a Quality Control Test or Functional Performance Test shall be grounds for a test failure and/or termination of the test. This is referred to as the Percent Failure Time. Whether the test is terminated and fully repeated at a later date/time or the test is extended until deficiencies are resolved, time and expenses related to this additional time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- E. A test failure of a reading may vary depending upon the criticality of the reading. For example, general hot water temperature leaving a mixing valve may be allowed to be within 10% of the expected value without being considered a failure. However, hot water temperatures serving an eye wash station have a zero tolerance for being outside of the code required range. Values such as gauge and sensor readings must be calibrated to within their specified tolerances.
- F. For general purposes or unless otherwise specified, a total number of test failures that comprise 10% of the total test readings shall be considered a fully failed test. 9% or fewer reading failures can be individually logged as deficiencies and the associated test can be documented as completed with issues. This does not supersede any Quality Control Test requirements set forth within other specification sections.

## **SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS**

- G. There may be cases during testing where the final pass/fail decision cannot be made on the spot and values must be calculated, reviewed and assessed to determine if they are acceptable. In these cases, the testing will capture all of the needed values which will then be provided to the entire Commissioning Team. The Design Professional and the Commissioning Agent will perform the necessary calculation and analysis. Ultimately, the Design Professional will determine if the contract requirements have been met or if there is any deficiency. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner.

### **3.5 DEFICIENCY RESOLUTION**

- A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. All members shall have input and the opportunity to discuss, debate, and work out problems. Final direction for issue resolution is to come from the responsible Design Professional. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner. The Commissioning Agent does NOT have final authority over the acceptance of systems or equipment.
- B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

### **3.6 ADDITIONAL COMMISSIONING**

- A. The Plumbing Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a functional test. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.
- B. The Commissioning Agent will continue to serve the construction project if the schedule is extended, will repeat site visits and inspections if such activities prove deficiencies and attend additional testing to re-witness previously failed tests. For these services, the Commissioning Agent will invoice the Owner for additional time required for commissioning activities including additional meetings, additional site visits, or additional witnessing of retests due to failed FPT's. It is the Construction Manager/General Contractor and Sub-Contractor's responsibility to maintain scheduled, verify completion prior inviting the Commissioning Agent to inspect work, and properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness testing.

### **3.7 SEASONAL COMMISSIONING**

- A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load or shoulder season conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons. Depending upon project schedule, some seasonal testing may be captured during the project acceptance phase, prior to Final Acceptance. Any seasonal testing left incomplete must be accommodated by the Contractors, coordinated with the Commissioning Team and will be witnessed by the Commissioning Agent.

## **SECTION 22 08 00 – COMMISSIONING OF PLUMBING SYSTEMS**

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- B. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

**END OF SECTION 220800**

# SECTION 22 20 00 - PLUMBING FIXTURES AND EQUIPMENT

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Plumbing fixtures, trim, and equipment.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 01 61 03 - Equipment - Basic Requirements.
  - 2. Section 22 05 23 - Pipe and Pipe Fittings - Plumbing Systems.

### 1.2 QUALITY ASSURANCE

- A. Referenced Standards:
  - 1. Americans with Disabilities Act (ADA):
    - a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
  - 2. American National Standards Institute (ANSI):
    - a. Z358.1, Emergency Eyewash and Shower Equipment.
  - 3. American Society of Heating, Refrigerating and Air Conditioning Engineers/Illuminating Engineering Society of North America (ASHRAE/IESNA):
    - a. 90.1 IP, Energy Standard for Buildings Except Low-Rise Residential Buildings.
  - 4. American Society of Mechanical Engineers (ASME):
    - a. A112.19.3, Stainless Steel Plumbing Fixtures (Designed for Residential Use).
  - 5. American Society of Sanitation Engineers (ASSE):
    - a. 1011, Performance Requirements for Hose Connection Vacuum Breaker.
  - 6. Canadian Standards Association (CSA).
  - 7. NSF International (NSF).
  - 8. NFPA 30: Flammable and Combustible Liquids Code, Latest Edition.
  - 9. The American Petroleum Institute Publication 421.
  - 10. Underwriters Laboratories, Inc. (UL).
  - 11. Building Code:
    - a. International Code Council (ICC).

### 1.3 SUBMITTALS

- A. Shop Drawings:
  - 1. See Specification Section 01 61 03 and Specification Section 40 05 00.
  - 2. Color selection charts for Owner color selection.
  - 3. Fabrication and/or layout drawings:
    - a. Layout plan(s) showing dimensions, elevations, etc.
    - b. Details showing connections, installation, rough-in locations, etc.
  - 4. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Chemical-resistance data.
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:

## **SECTION 22 20 00 - PLUMBING FIXTURES AND EQUIPMENT**

- a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Plumbing fixtures (vitreous china):
    - a. American Standard.
    - b. Crane.
    - c. Kohler.
    - d. Eljer.
  2. Stainless steel sinks:
    - a. Just Manufacturing.
    - b. Elkay.
  3. Premolded mop sinks:
    - a. Powers - Fiat.
    - b. Standard - Elsmar Granite Co.
    - c. Williams.
    - d. Florestone.
  4. Service sink:
    - a. American Standard.
    - b. Kohler.
    - c. Eljer.
    - d. Elkay.
  5. Premolded shower:
    - a. Powers - Fiat.
    - b. Standard - Elsmar Granite Co.
    - c. Williams.
    - d. Florestone.
  6. Water closet seats:
    - a. Church.
    - b. Beneke.
  7. Lavatory fittings:
    - a. American Standard.
    - b. Chicago Faucets.
    - c. Kohler.
    - d. Sloan.
  8. Service sink fittings:
    - a. American Standard.
    - b. Chicago Faucets.
    - c. Kohler.
  9. Mop sink fittings:
    - a. American Standard.
    - b. Chicago Faucets.
    - c. Kohler.
  10. Sink fittings:
    - a. American Standard.
    - b. Kohler.
    - c. Just.
  11. Shower fittings:



## **SECTION 22 20 00 - PLUMBING FIXTURES AND EQUIPMENT**

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- a. Symmons.
- b. Leonard.
- 12. Flush valves:
  - a. Sloan.
  - b. Zurn.
  - c. Delany.
- 13. Emergency shower and eyewash:
  - a. Speakman.
  - b. Haws.
  - c. Guardian Equipment.
- 14. Electric water coolers:
  - a. Halsey-Taylor.
  - b. Elkay.
  - c. Haws.
  - d. Oasis.
  - e. Sunroc.
- 15. Drains, roof drains, carriers, and shock absorbers:
  - a. Wade.
  - b. Josam.
  - c. Zurn.
  - d. Smith.
- 16. Trap primer:
  - a. Precision Plumbing Products.
- 17. Hose bibs:
  - a. Nibco.
  - b. Woodford.
- 18. Domestic water heater:
  - a. A. O. Smith.
  - b. Ruud.
  - c. Rheem.
  - d. State.
- 19. Reduced pressure backflow preventer:
  - a. Watts.
  - b. Febco.
  - c. Clayton.
- 20. Hydrants:
  - a. Wade.
  - b. Josam.
  - c. Smith.
  - d.
- 21. Hot water circulating pump:
  - a. Bell and Gossett.
  - b. Taco.
- 22. Prefabricated trench drain system:
  - a. Zurn
  - b. ACO Drain, Inc.
  - c. Poly Drain, Inc.
  - d. Duratrench.
- 23. Oil Water Separator:
  - a. Highland Tank and Manufacturing Company, Inc.
  - b. Xerxes Corporation
  - c. Containment Solutions
  - d. Approved Equal

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### 2.2 MANUFACTURED UNITS

#### A. Plumbing Fixtures (Vitreous China):

1. Water closet (WC):
  - a. White.
  - b. 1.28 GAL per flush.
  - c. Siphon jet.
  - d. Elongated bowl.
  - e. 1-1/2 inches top spud or close coupled tank.
  - f. Bolt caps.
  - g. Type:
    - 1) WC-1 (floor mounted) American Standard "Madera" 3451.001.
    - 2) WC-2 (handicapped floor mounted) American Standard "Madera" 3043.001.
2. Urinal (U):
  - a. White.
  - b. Top spud.
  - c. 0.125 GAL per flush.
  - d. Type:
    - 1) U-1 (wall hung) American Standard "Washbrook" 6590.001.
    - 2) U-2 (handicapped wall hung) American Standard "Washbrook" 6590.001.
3. Lavatory (L):
  - a. White.
  - b. Front overflow.
  - c. Type:
    - 1) L-1 (wall hung 20 x 18 inches) American Standard "Lucerne" 0356.015.
    - 2) L-2 (wall hung 60" wide stainless steel trough basin) Neo-Metro SS WEDGE Stainless Steel Trough WSW260-F60.
    - 3) L-3 (wall hung 90" wide stainless steel trough basin) Neo-Metro SS WEDGE Stainless Steel Trough WSW390-F60.
    - 4) L-4 (under-counter mount) Kohler Verticyl K-2882-0.

#### B. Sinks (S):

1. Stainless steel sink:
  - a. Type 304, 18-8 stainless steel.
  - b. Self-rimming, drop-in mount.
  - c. Fully coated underside.
  - d. Drain punch centered in each bowl.
  - e. Basket strainer and tailpiece.
  - f. 3-faucet holes on 4 inches centers.
  - g. ASME A112.19.3.
  - h. Type:
    - 1) S-1: Elkay Lustertone Classic Stainless Steel 27" x 22" x 10" Single Bowl Dual Mount Sink.
2. Mop sink (MS):
  - a. Precast terrazzo (marble chips cast in Portland cement, ground and polished with all air voids grouted).
  - b. One-piece.
  - c. Drop front.
  - d. 2 inches wide shoulder.
  - e. Stainless steel threshold.
  - f. Integral drain body, removable strainer and 3 inches drain pipe.
  - g. Type:
    - 1) MS-1 (corner) 24 x 24 x 12 inches.

#### C. Service Sink (SS):

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1. Stainless steel 27" x 27-1/2" x 14"
  2. Floor mounted.
  3. Rim guard.
  4. Cast iron P-trap, acid-resisting enamel inside.
  5. Chrome strainer.
  6. Type:
    - a. SS-1 (with holes for faucet) Elkay 2281242.
- D. Showers (SH):
1. SH-1 shower:
    - a. Precast shower floor:
      - 1) One-piece molded stone with slip-resistant surface.
      - 2) Shoulder not less than 3-1/16 inches high.
      - 3) Tiling flange not less than 1-1/2 inches above shoulder.
      - 4) Threshold not less than 5 inches high.
      - 5) Factory installed drain stainless steel with removable stainless steel strainer plate.
      - 6) Provide drain with lead calk joint for 2 inches drain pipe.
      - 7) Basin of dimensions and shape as shown on Drawings.
      - 8) Color as selected by Owner.
- E. Toilet Seat:
1. Molded plastic.
  2. Open front.
  3. No cover.
  4. Stainless steel hinge with check.
  5. For elongated bowl.
- F. Electronic Hand Washing Faucet Type (L-1,2,3,4):
1. Battery Operated Type.
  2. ADA compliant.
  3. Sensor range adjustment screw.
  4. LED indicator lights.
  5. Filtered solenoid valve with serviceable "Y" strainer filter.
  6. Bak-chek tee.
  7. Trim plate (4 inches center) with anti-rotation pin.
  8. Provide four "C" sized batteries for initial use and one replacement set per faucet.
  9. Vandal resistant spray head.
  10. Type: Sloan Optima Model ETF-80.
- G. Service Sink Fittings:
1. Type:
    - a. Sink with holes (hot and cold service) Kohler Triton Bowe – K-838T60-4A.
- H. Break Sink Fittings:
1. Type:
    - a. Deck mounted pull down single handle kitchen faucet with stainless steel finish: Kohler Crue K-22972-VS
- I. Mop Sink Fittings:
1. Type:
    - a. Mounted on wall with pipe chase behind American Standard 8344.112.
- J. Sink Fittings:
1. Lever handle.

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2. Renewable washer.
3. Renewable seats.
4. Aerator.
5. Stopper and 1-1/2 inches tail piece.
6. Coupling nuts.
7. Chrome plated.

### K. Shower Fittings:

1. Moen Commercial 8342 Shower System:
  - a. ASME A112.18.1/CSA B125.1.
  - b. Chrome plated metal construction.
  - c. 3 function transfer valve.
  - d. Shower arm, shower head, hand held shower, and metal hose.
  - e. Vandal resistant.
  - f. Integral volume control and stops.
  - g. ADA compliant level handles.
  - h. 2.5 gpm flow restrictor.

### L. Manual Flush Valve:

1. Rubber diaphragm type with filtered bypass.
2. Non-hold-open handle.
3. Screw driver Bak-Chek angle stop.
4. Adjustable tailpiece.
5. Vacuum breaker flush connection and spud coupling.
6. Wall and spud flanges.
7. Spud size as required.
8. Gallon per flush as required per fixture.
9. Type:
  - a. Water Closet: Sloan, Royal model 111.
  - b. Urinal: Sloan, Royal model 186.

### M. Emergency Fixtures:

1. Emergency shower and eye/face wash (ESEW):
  - a. ANSI Z358.1.
  - b. Flow switch:
    - 1) Rating: 125/250 V, 5 A.
    - 2) Single pole, double throw.
    - 3) UL listed.
  - c. Deluge shower head:
    - 1) Stay-open ball valve.
    - 2) Pull-chain.
  - d. Eye/face wash:
    - 1) Aerated eye/face wash with stainless steel bowl.
    - 2) Stay-open full port ball valve.
    - 3) Push handle control for eye/face wash.
    - 4) Supply line strainer for eye/face wash.
  - e. Type:
    - 1) ESEW-1 (free standing, cast flange base and pull-chain for shower): Guardian G1994.

### N. Electric Water Cooler (EWC):

1. Wall-hung steel construction.
2. Stainless steel.
3. ADA & ICC A117.1 compliant.
4. UL Listed.

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5. Stainless steel fountain top.
  6. Hermetically sealed, air-cooled condensing unit.
  7. Filtered.
  8. 1/2 inches supply shut off valve.
  9. 1-1/2 inches waste pipe.
  10. Bubbler to be shielded for protection with an anti-squirt, anti-sweat and abrasion resistant design.
  11. Capacity rating is minimum GPH cooled to 50 degrees F with 80 degrees F inlet water temperature and room temperature at 90 degrees F.
  12. Type:
    - a. EWC-1 (minimum capacity rating 8.0 gph) Elkay EZSTL8WSLK (two-station water coolers with bottle filler) compressor motor, 115 V, 1 PH, 325 watts, 3.7 FLA.
    - b. EWC-2 (barrier-free capacity rating 6.7 gph) Elkay LZS8WSSP (wall mounted water cooler with bottle filler) compressor motor, 115V, 1 PH, 600 watts, 8.0 FLA.
- O. Carriers:
1. Urinals: Wade W-400 series.
  2. Lavatories: Wade W-520 series.
  3. Drinking fountains (electric water coolers): Wade W-400 series.
  4. Service sinks: Wade W-630.
- P. Drains, Roof Drains and Downspout Nozzle:
1. Floor drain/Floor Sink (FD/FS):
    - a. Bottom outlet.
    - b. Clamping seepage flange.
    - c. Seepage openings.
    - d. Size as shown on Drawings.
    - e. Type: Cast iron body.
      - 1) FD-1 (unfinished area) sediment bucket, bucket shall support grate: Wade W-1200-TD.
      - 2) FD-2 (finished area) adjustable satin nickel bronze strainer: Wade W-1100.
      - 3) FS-1 (unfinished area) cast iron, enamel coated interior, dome bottom strainer: Watts FS-740.
  2. Roof drain (RD):
    - a. Bottom outlet cast iron drain with flashing clamp, removable cast iron mushroom-type dome and cast iron deck clamp.
    - b. Provide cast iron extension flange (-DF) where insulation thickness exceeds 2 inches.
    - c. Type:
      - 1) RD-1: Wade W-3000.
      - 2) ORD-1: Wade W-3000-D, 2 inches dam.
  3. Downspout nozzle:
    - a. Cast bronze downspout.
    - b. Wade W-3940.
  4. Gutter Downspout to PVC Adapter:
    - a. Aquabarrel
    - b. Egutter
    - c. Rectangular to Circular PVC Adapter.
- Q. Traps:
1. Floor and equipment drains:
    - a. Same material and coating as the piping system.
    - b. 3 inches minimum seal.
  2. Fixture drains:
    - a. 2 inches minimum seal.
    - b. Cast brass.

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- c. Chrome plated.
- d. Size as required.
- e. PVC.
- f. Size as required.
3. Ventilation housing drains: Extra-deep seal sufficient to maintain seal against static pressure maintained in fan housing.

### R. Trap Primer:

1. Body:
  - a. All brass construction.
  - b. 1/2 inches male NPT inlet.
  - c. 1/2 inches female NPT outlet.
  - d. Stainless steel debris screen.
  - e. Isolation Valve.
  - f. Electrical:
    - 1) Power: 120 volts, single phase.
    - 2) 2 2-amp circuit breaker.
    - 3) Test button.
    - 4) Timer.
    - 5) UL Listed solenoid valve.
  - g. Brass piston.
  - h. Trap primer distribution:
    - 1) Up to 6 traps.
    - 2) 2 inches copper body.
    - 3) Brass outlet.

### S. Cleanouts (CO/FCO/GCO):

1. Cleanouts for cast iron pipe:
  - a. Tapped extra heavy cast iron ferrule.
  - b. Calked into cast iron fittings.
  - c. Extra heavy brass neoprene seal screw plug with solid hexagonal nut.
2. Cleanouts for steel pipe: Extra heavy brass screw plug in drainage fittings.
3. Cleanouts for polypropylene:
  - a. Tapped polypropylene ferrule.
  - b. Polypropylene screw plug with solid hexagonal nut.
4. Access housing with adjustable anchor flange and secured scoriated cast: Wade W-3800-MF.
5. Cleanouts turning out through walls and up through floor shall be made by long sweep ells or "y" and 1/8 bends with plugs and face or deck plates to conform to architectural finish in room.
  - a. Where definite finish is not indicated, wall plates shall be chrome-plated cast-brass and floor plates polished brass.
6. Code:
  - a. Provide cleanouts of same size as pipe up to 4 inches and not less than 4 inches for larger pipes.
  - b. Close access openings for concealed cleanouts with flush floor or flush wall cover plates or flush ceiling access panels.
  - c. Provide wall plates with chrome plated cast-brass round cleanout cover with flanged ring.
  - d. Provide screws which match cover plate material.
7. Cleanouts installed in floor with a resilient tile finish: Wade W-6000-TS.
8. Cleanouts installed in floor with ceramic tile, concrete, or Terrazzo finish: Wade W-6000-U.
9. Cleanouts installed in finished rooms flush with wall: Wade W-8480-S stainless steel.
10. Cleanouts installed in completely accessible pipe chases or where piping is exposed do not require special covers.

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- T. Hose Bibb (HB-1):
  - 1. 3/4 inches boiler drain with attached vacuum breaker-backflow preventer.
  - 2. Vacuum breaker: Non-removable, manual draining, meeting the requirements of the ASSE 1011.
  
- U. Hydrants (WH):
  - 1. Wall hydrant:
    - a. Non-freeze.
    - b. Integral vacuum breaker.
    - c. Nylon seat.
    - d. 3/4 inches hose connection.
    - e. 3/4 inches inlet connection.
    - f. Length as recommended by manufacturer for wall thickness.
    - g. Type:
      - 1) WH-1 (exposed) Wade 8600.
      - 2) WH-2 (wall box) Wade 8600.
  
- V. Domestic Water Heater (EWH-1):
  - 1. Electric tank type:
    - a. Size and capacity as scheduled.
    - b. UL listed.
    - c. Internal surfaces:
      - 1) Glass-lined with alkaline borosilicate composition fused-to-steel.
      - 2) Provide magnesium rods rigidly supported for cathodic protection.
    - d. Low watt density heating elements with zinc-plated copper sheath.
      - 1) Provide thermostat with each element, high temperature cutoff and temperature and pressure relief valve.
    - e. Insulate tank with vermin-proof glass fiber insulation or equal.
    - f. Heavy gage steel jacket with baked enamel finish.
    - g. Warranty against corrosion for three year period.
    - h. Provide water heaters meeting ASHRAE/IESNA 90.1 IP SI for energy efficiencies.
  
- W. Reduced Pressure Backflow Preventer:
  - 1. Backflow preventers consist of two check valves, test cocks and relief valve, all assembled as an integral unit.
  - 2. Reduced pressure backflow preventers Watts 909.
  - 3. Backflow preventer to have threaded ends in sizes through 2 inches, flanged 2-1/2 inches and larger.
  - 4. Pressure loss through backflow preventer not exceeding 14 psi at design flow.
  - 5. Provide air gap and pipe discharge to within 6 inches of finished floor.
  
- X. Hose Valve:
  - 1. Cast brass.
  - 2. Minimum pressure rating 150 psi.
  - 3. Angle configuration.
  - 4. Hose outlet connection 1-1/2 inches or 2-1/2 inches as shown on Drawings or scheduled.
  - 5. Pin lug protective hose thread cap with chain.
  
- Y. Water Meter:
  - 1. As indicated of a type approved by Water Department.
    - a. Coordinate meters furnished by Water Department as to type and size.
    - b. Obtain and pay necessary permits and approvals required to complete installation of water service.
    - c. Provide valve on each side of meter and 3/4 inches drain valve spilling over floor drain.

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2. Install full sized bypass line around meter with a sealed valve approved by Water Department.
  - a. Meters 2 inches and less: Threaded fittings.
  - b. Meters 2-1/2 inches and larger: Flanged connections.
  
- Z. Domestic Hot Water Circulating Pump:
  1. Pump casing and impeller: Bronze, designed for domestic water circulating.
  2. Provide pump as scheduled on Drawings.
  
- AA. Prefabricated Trench Drain System:
  1. Grating: ExtraHeavy-duty cast iron rated for 89,000 pound flat tire wheel loads.
  2. Grating frames: Galvanized steel.
  3. Drain Body: High density polyethylene structural composite drain channel.
  4. Zurn: Z886 and P6-DGE grates.
  
- BB. Tepid Water Delivery System:
  1. Mixing Valve:
    - a. Designed for emergency safety drench systems.
    - b. Tepid water delivery: 85 degrees F, 23 gpm flow for 15 minute duration.
    - c. Safety features:
      - 1) Low hot water pressure override.
      - 2) Low cold water pressure valve closure.
      - 3) Outlet temperature safety override.
  2. System Requirements:
    - a. Meets requirements of ANSI Z.358.1 standard.
  
- CC. Oil Water Separator:
  1. Below Ground Separator:
    - a. Designed for gravity separation of settleable solids, semisolids, and free oils from wastewater associated with light vehicle maintenance and washing operations.
      - 1) Separator shall be cylindrical, horizontal, atmospheric-type steel vessel intended for the separation and storage of flammable and combustible liquids.
    - b. Separator shall be standard pre-packaged, pre-engineered, ready to install unit.
    - c. Separator shall consist of inlet and outlet connections, integral sand interceptor compartment, non-clogging flow distributor and energy dissipater device, stationary under flow baffle, presettling chamber for solids, sludge baffle, oil coalescing chamber with removable parallel flat/corrugated plate coalesce and/or removable plates, and sectionalized removable polypropylene impingement coalescers to optimize separation of free oil from water, effluent downcomer positioned to prevent discharge of free oil that has been separated from the water, access ways for coalescers and each chamber, fittings for vent, oil pump-out, sampling, gauging, leak detection, and lifting lugs.
      - 1) A 6-inch flanged influent connection with an internal influent nozzle at the inlet end of the separator. Nozzle discharge point will be located at the furthest diagonal point from the effluent discharge opening.
      - 2) A 6-inch flanged effluent connection.
      - 3) Fittings for vent, interface/level sensor, leak detection, waste oil pump-out, sampling, and gauge.
      - 4) An integral sand interceptor compartment containing one (1) 24-inch diameter manhole, UL approved, complete with extension, cover, gasket, and bolts. A heavy-duty bulkhead shall retain sand, grit, settleable solids or semisolids and prevent them from entering the separation chamber. Bulkhead shall have 6-inch transfer pipe.
      - 5) Grade Level Manways for vehicle traffic loading (H2O)
      - 6) A sediment chamber to disperse flow and collect oily solids and sediments.



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- 7) A sludge baffle to retain settleable solids and sediment and prevent them from entering the separation chamber.
- 8) Two (2) 24-inch diameter manholes, UL approved, complete with extensions (length based on burial depth), covers, gaskets, and bolts. One manway shall be placed between the inlet and the parallel-flat/corrugated plate coalescer to facilitate access into sediment chamber for solids removal. One manway shall be placed between the parallel flat/corrugated plate coalescer and outlet to facilitate access into the oil water separation chamber for oil removal.
- 9) Polyester or steel hold-down straps (10'-6" maximum diameter for polyester straps)
- d. Separator to be furnished with a Corella® inclined parallel flat/corrugated plate coalescer to simultaneously separate free oil droplets and settleable or suspended solids particles from water without clogging of the coalescer.
- e. Separator shall be installed underground with top access at or above grade level.
- f. Separator shall be furnished with oil level alarm and leak detection systems.
  - 1) Separator shall have the following oil storage capacities:
    - a) High oil level (warning), equal to about 20% of the static vessel volume,
    - b) High-high oil (alarm), equal to about 43% of the static vessel volume,
    - c) Emergency oil spill capacity equal to about 80% of the static vessel volume.
- g. Separator capacities, dimensions, construction, and thickness shall be in strict accordance with Underwriters Laboratories, Subject UL-58 Standard for Safety, Steel Underground Tanks for Flammable and Combustible Liquids, Double-wall construction with 360-degree Steel Secondary Containment. Separator shall comply with National Fire Protection Association NFPA 30 Flammable and Combustible Liquids Code. The inner steel tank shall be completely contained within the outer steel tank, enclosing 100% of the tank volume. The tank must have a double steel shell without a defined space between the layers (UL Type I Double-wall).

### 2.3 FABRICATION

- A. Trench Sections:
  1. Pre-cast fiberglass modular channel sections.
  2. Nominal Dimensions: 8 inches interior width, 1.0% slope built into the bottom, 6 feet length.
  3. Vertical side walls and a radiused bottom.
  4. 2 inches bolted lap joint.
  5. End caps: Same material as channel, design that allows the caps to interlock with channel sections and either close off the end of the channel or provide for drain pipe connection.
  6. Bottom outlet:
    - a. Where shown on Drawings.
    - b. Same material as channel.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Cross Connection: Do not install any plumbing components that will provide a cross connection between potable and non-potable or drainage systems.
- B. Fixtures:
  1. Install fixtures at locations indicated on Drawings and in compliance with local Codes.
  2. Connect plumbing supply, drain and vent line sizes as shown on Drawings.
  3. Set proper grounds to form secure base for each fixture and rigid setting.

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4. Install fixtures except water closets with water supply above rim and with Code approved backflow preventers.
  5. Seal fixture joints abutting walls and floors with silicone sealant.
  6. Connect exposed traps and supply pipes for fixtures and equipment to rough piping systems at wall, unless otherwise specified.
  7. Install emergency fixtures in accordance with ANSI Z358.1.
- C. Drains:
1. Install drains at locations indicated on Drawings and in compliance with local Codes.
  2. In quarry tile floors:
    - a. 24 x 24 inches 6 pound lead sheet clamped to drain.
    - b. Set 1-1/2 inches above structural slab for mortar set and 1/2 inches for thin set.
  3. In uncovered concrete slabs:
    - a. Install at the low points of surface areas to be drained or as indicated.
    - b. Set tops of drains flush with the finished floor.
    - c. Install drain flashing collar or a flange so that no leakage occurs between the drain and the adjoining surfaces.
    - d. Maintain the integrity of waterproof membranes, where penetrated.
  4. Trench drains:
    - a. Install in accordance with manufacturer's instructions and approved Shop Drawings.
    - b. Install trench sections with the top edges level and straight at elevations indicated.
      - 1) Support channel sections in place while concrete is placed under and around sections as indicated.
- D. Wall Hydrants:
1. Install 24 inches above exterior grade.
  2. Support units from the structure and mount flush with structure face.
  3. Prior to final setting, fill the back of the face with a non-hardening silicone caulk and press firmly in place to stop infiltration and water leakage.
  4. Install isolation valves in line to each wall hydrant.
- E. Hose Bibbs:
1. Install 36 inches above finished floor.
  2. In exterior locations, provide interior isolation valve.
- F. Shock Absorbers:
1. Install on hot and cold water lines adjacent to each battery of fixtures or other equipment where indicated on Drawings.
  2. Size as recommended by manufacturer for length of pipe served.
  3. Locations having two fixtures or less, install capped air chamber 12 inches long on hot and cold water runouts to each fixture, same size as runout.
  4. Runouts to hose bibbs and wall hydrants do not require air chambers.
  5. Install units vertically on top of pipe or as detailed on the Drawings.
- G. Cleanouts:
1. Install cleanouts:
    - a. Above floor in each vertical riser that connects to horizontal branch below floor.
    - b. At test tee to receive proper test plugs in each vertical riser at least every other floor.
    - c. As required by local Code.
- H. Wall Plates and Escutcheons: Install as specified in Specification Section 40 05 00 or this Specification Section.
- I. Water Heater:

## **SECTION 22 20 00 - PLUMBING FIXTURES AND EQUIPMENT**

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1. Install all water heaters in accordance with details, manufacturer's recommendations, and applicable Codes.
2. For units located on concrete pads, plumb level and orient to allow access to the controls, elements and other items requiring service.
3. Connect hot and cold water piping to the unit with line-size, isolation valves and dielectric unions.
4. Connect recirculating hot water to cold inlet piping with unions and valves at check valves as detailed.
5. Start up the unit and adjust all controls for proper temperature control and maximum efficiency.

J. Reduce Pressure Backflow Preventer: Install on water lines as required by Code.

### **3.2 FIELD QUALITY CONTROL**

A. Test piping and fixtures for leaks per Specification Section 40 05 00.

**END OF SECTION 22 20 00**

# **SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC AND PLUMBING EQUIPMENT**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Equipment furnished for plumbing and HVAC systems.
  - 2. Single phase motors for plumbing and HVAC equipment.
  - 3. Three-phase motors for plumbing and HVAC equipment.
  - 4. Motors shipped loose for installation in plumbing and HVAC equipment.
  
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 07 92 00 - Joint Sealants.
  - 2. Section 09 96 00 - High Performance Industrial Coatings.
  - 3. Section 10 14 00 - Identification Devices.

### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Bearing Manufacturers Association (ABMA).
  - 2. International Electrotechnical Commission (IEC).
  - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
  - 4. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. ICS 6, Enclosures for Industrial Control and System.
    - c. MG 1, Motors and Generators.
  - 5. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC):
  - 6. Occupational Safety and Health Administration (OSHA):
    - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
  - 7. Underwriters Laboratories, Inc. (UL):
    - a. 508A, Standard for Industrial Control Panels.
    - b. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.

### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Equipment technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Data sheets that include manufacturer's name and complete product model number.
      - 1) Clearly identify all optional accessories that are included.
    - c. Equipment identification utilizing numbering system and name utilized in Drawings.
    - d. Equipment installation details:
      - 1) Location of anchorage.
      - 2) Type, size, and materials of construction of anchorage.
      - 3) Anchorage setting templates.
      - 4) Manufacturer's installation instructions.
    - e. Equipment physical characteristics:

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- 1) Dimensions (both horizontal and vertical).
  - 2) Materials of construction and construction details.
  - 3) Shipping and operating weight.
  - 4) Duct and piping connection sizes, type and location.
  - f. Equipment lining and coatings:
    - 1) Equipment factory primer and paint data.
  - g. Operating characteristics:
    - 1) Utility requirements, natural gas, electric and other.
    - 2) Performance curves.
    - 3) Equipment capacity and efficiency.
  - h. Electric motors:
    - 1) Nameplate data.
    - 2) Performance data.
  - i. Control panels:
    - 1) Panel layout and construction.
    - 2) Control ladder diagrams.
    - 3) Nameplate schedule.
    - 4) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
- B. Contract Closeout Information:
1. Operation and Maintenance Data:
    - a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, refer to individual equipment Specification Sections for acceptable manufacturers.
- B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Motors:
    - a. ABB Baldor-Reliance.
    - b. General Electric.
    - c. Hyundai Heavy Industries.
    - d. Marathon Electric.
    - e. Siemens.
    - f. TECO-Westinghouse.
    - g. Toshiba U.S.
    - h. U.S. Motors, Nidec Motor Corporation.
    - i. WEG.

**2.2 MANUFACTURED UNITS**

- A. Equipment: Refer to individual equipment Specification Sections for product requirements.
- B. Electric Motors:
  1. Design for frequent starting duty equivalent to duty service required by driven equipment.

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2. Design for full voltage starting.
  3. Design bearing life based upon actual operating load conditions imposed by driven equipment.
  4. Size for altitude of Project.
  5. Furnish with stainless steel nameplates which include all data required by NFPA 70 (NEC), Article 430.
  6. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment specified by model number in which a redesign of the complete unit would be required in order to provide a motor with features specified.
  7. AC electric motors less than 1/3 hp:
    - a. Single phase, 60 Hz, designed for the supply voltage shown on the Drawings.
    - b. Permanently lubricated sealed bearings conforming to ABMA standards.
    - c. Built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element with stainless steel enclosure.
  8. AC electric motors 1/3 to 1 hp:
    - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    - b. Permanently lubricated sealed bearings conforming to ABMA standards.
      - 1) For single phase motors, provide built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element.
  9. AC electric motors 1-1/2 to 10 hp:
    - a. 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    - b. Permanently lubricated sealed bearings conforming to ABMA standards.
    - c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
  10. AC electric motors greater than 10 hp:
    - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
    - b. Oil or grease lubricated antifriction bearings conforming to ABMA standards.
      - 1) Design bearing life for 90% survival rating at 50,000 hours of operation for motors up to and including 100 hp.
      - 2) For motors greater than 100 hp, design bearing life for 90% survival rating at 100,000 HRS of operation.
    - c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
  11. Severe duty motor to have the following minimum features:
    - a. All cast iron construction.
    - b. Gasketed conduit box.
    - c. Epoxy finish for corrosion protection.
    - d. Hydroscopic varnish on windings for corrosion protection.
    - e. Drain plug and breather.
- C. NEMA Design Squirrel Cage Induction Motors:
1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific duty imposed by the driven equipment.
  2. Motors to meet NEMA MG 1 (NEMA Premium) local jurisdiction efficiencies.
  3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard for the assigned NEMA code letter.
  4. For use on variable frequency type adjustable speed drives, provide:
    - a. Induction motors that are in compliance with NEMA MG 1, Part 31.
    - b. Nameplate identification meeting NEMA MG 1, Part 31 requirements.
    - c. Insulated drive end bearing on all motors.
    - d. Shaft grounding ring on all motors:
      - 1) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
      - 2) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.

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5. Design motor insulation in accordance with NEMA standards for Class F insulation with Class B temperature rise above a 40 degrees C ambient.
6. Design motors for continuous duty.
7. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15% greater than the maximum HP requirements of the driven equipment over its entire operating range.
  - a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate HP is at least equal to the maximum HP requirements of the driven equipment over its entire operating range.
8. Motor enclosure and winding insulation application:
  - a. The following shall apply unless modified by specific Specification Sections:

<b>MOTOR LOCATION</b>	<b>MOTOR ENCLOSURE / WINDING INSULATION</b>
Unclassified Indoor Areas	[DPFG (for horizontal motors)], [WP-I (for vertical motors)] [Standard Insulation], [TEFC, Standard Insulation]
Wet indoor Areas	[TEFC, Standard Insulation] [TEFC, Encapsulated Windings] [WP-II (for vertical motors)]
Wet outdoor Areas	[TEFC, Extra Dip and Bake for Moisture] [TEFC Encapsulated Windings] [WP-II (for vertical motors)]
Corrosive Areas	TEFC, Severe/ Chemical Duty
Class I, Division 1 Areas	Explosion Proof, Approved for Class I Division 1 Locations
Class II, Division 1 Areas	Explosion Proof, Approved for Class II Division 1 Locations
Class I or Class II, Division 2 Areas	Explosion Proof, Approved for Division 1 Locations or TEFC with maximum external frame temperature compatible with the gas or dust in the area, [Extra Dip and Bake for moisture] [Encapsulated Windings]

**NOTE: Provide TENV motors in the smaller horsepower ratings where TEFC is not available.**

9. Provide oversize conduit box complete with clamp type grounding terminals inside the conduit box.
- D. Submersible Motors: Refer to individual narrow-scope Specification Sections for submersible motor requirements.
- E. V-Belt Drive:
1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
  2. Provide V-belt drives with a service factor of at least 1.6 at maximum speed.
  3. Provide static proof belts.

**2.3 ACCESSORIES**

- A. Guards:
1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
  2. Interior applications:
    - a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
    - b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 inches spacing.
    - c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
  3. Exterior applications:
    - a. Construct from 16 GA stainless steel or aluminum.

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- b. Construct to preclude entrance of rain, snow, or moisture.
  - c. Roll to conform to shaft or coupling surface.
  - d. Connect to equipment frame with stainless steel bolts and wing nuts.
- B. Data Plate:
- 1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
  - 2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.
- C. Lifting Eye Bolts or Lugs:
- 1. Provide on all equipment 50 pounds or greater.
  - 2. Provide on other equipment or products as specified in the narrow-scope Specification Sections.
- D. Platforms and Ladders:
- 1. Design and fabricate in accordance with OSHA Standards.
  - 2. Fabricate components from aluminum.
  - 3. Provide platform surface: Non-skid [grating] [checkered plate], unless specified in narrow-scope Specification Sections.

### **2.4 FABRICATION**

- A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop practices.
- B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.
- C. Furnish like parts of duplicate units to be interchangeable.
- D. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.
- E. Furnish equipment which requires periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts.
- 1. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.
- F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option.
- 1. Provide drain connection for 3/4 inches PVC tubing.
- G. Machine the mounting feet of rotating equipment.
- H. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid back to back placement of surfaces that cannot be properly prepared and painted.
- 1. When such back to back fabrication cannot be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment.
  - 2. Where continuous welds are not practical, after painting seal the back to back surfaces from the environment in accordance with Section 07 92 00.
- I. Critical Speed:



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1. All rotating parts accurately machined and in as near perfect rotational balance as practicable.
  2. Excessive vibration is sufficient cause for equipment rejection.
  3. Ratio of all rotative speeds to critical speed of a unit or components: Greater than 1.2.
- J. Control Panels Engineered and Provided with the Equipment by the Manufacturer:
1. Manufacturer's standard design for components and control logic unless specific requirements are specified in the specific equipment Specification Section.
  2. NEMA or IEC rated components are acceptable, whichever is used in the manufacturer's standard engineered design, unless specific requirements are required in the specific equipment Specification Section.
  3. Affix entire assembly with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to delivery.
    - a. Control panels without an affixed UL 508A or UL 698A label shall be rejected.
  4. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
    - a. Determine the SCCR rating by one of the following methods:
      - 1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
      - 2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
      - 3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
    - b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
    - c. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

### **2.5 SHOP OR FACTORY PAINT FINISHES**

- A. Electrical Equipment:
1. Provide factory-applied paint coating system(s) for all electrical equipment components except those specified in Section 09 96 00 to receive field painting.
    - a. Field painted equipment: See Section 09 96 00 for factory applied primer/field paint compatibility requirements.
- B. Field paint other equipment in accordance with Section 09 96 00.
1. See Section 09 96 00 for factory applied primer/field paint compatibility requirements.

### **2.6 SOURCE QUALITY CONTROL**

- A. The Owner reserves the right to select and have tested any motor included within the project.
1. If motor passes testing requirements, the Owner shall be responsible for any shipping and testing costs incurred.
  2. Costs shall be determined by current freight rates and manufacturer's published rates at the time of the test.
  3. If motor fails test, Supplier shall be responsible for all costs incurred.
  4. If two successive motors fail the test, the Owner has the right to reject any or all motors from that manufacturer.
  5. The Owner also reserves the right to witness any routine or complete tests at the Buyer's expense.
  6. Notify the Buyer a minimum of 14 days in advance of the testing.

# **SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC AND PLUMBING EQUIPMENT**

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.
- B. Utilize templates for anchorage placement for slab-mounted equipment.
- C. For equipment having drainage requirements such as condensate, provide 3/4 inches PVC or clear plastic tubing from equipment base to nearest floor or equipment drain.
  - 1. Route clear of major traffic areas and as approved by Engineer.
- D. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows easy access of fittings from closest operating floor level.
- E. Equipment Base:
  - 1. Construct level in both directions.
  - 2. Take particular care at anchor bolt locations so these areas are flat and level.
- F. Machine Base:
  - 1. Mount machine base of rotating equipment on equipment base.
    - a. Level in both directions, using a machinist level, according to machined surfaces on base.
  - 2. Level machine base on equipment base and align couplings between driver and driven unit using steel blocks and shims.
    - a. Size blocks and shims to provide solid support at each mounting bolt location.
      - 1) Provide area size of blocks and shims approximately 1-1/2 times area support surface at each mounting bolt point.
    - b. Provide blocks and shims at each mounting bolt.
      - 1) Furnish blocks and shims that are square shape with "U" cut out to allow blocks and shims to be centered on mounting bolts.
    - c. After all leveling and alignment has been completed and before grouting, tighten mounting bolts to proper torque value.
- G. Couplings:
  - 1. Align in the annular and parallel positions.
    - a. For equipment rotating at 1200 rpm or less, align both annular and parallel within 0.001 IN tolerance for couplings 4 inches size and smaller.
      - 1) Couplings larger than 4 inches size: Increase tolerance 0.0005 inches per inches of coupling diameter, i.e., allow 6 inches coupling 0.002 inches tolerance, and allow a 10 inches coupling 0.004 inches tolerance.
    - b. For equipment rotating at speeds greater than 1200 rpm allow both annular and parallel positions within a tolerance rate of 0.00025 inches per inch coupling diameter.
  - 2. If equipment is delivered as a mounted unit from factory, verify factory alignment on site after installation and realigned if necessary.
  - 3. Check surfaces for runout before attempting to trim or align units.
- H. Grouting:
  - 1. After machine base has been shimmed, leveled onto equipment base, couplings aligned and mounting bolts tightened to correct torque value, place a dam or formwork around base to contain grouting between equipment base and equipment support pad.
    - a. Extend dam or formwork to cover leveling shims and blocks.
    - b. Do not use nuts below the machine base to level the unit.

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2. Saturate top of roughened concrete subbase with water before grouting.
  - a. Add grout until entire space under machine base is filled to the top of the base underside.
  - b. Puddle grout by working a stiff wire through the grout and vent holes to work grout in place and release any entrained air in the grout or base cavity.
3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed grout surface to fine, smooth surface.
  - a. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout.
  - b. When the grout has fully hardened (after a minimum of seven (7) days) tighten all anchor bolts to engage equipment base to grout, shims, and equipment support pad.
  - c. Recheck driver-driven unit for proper alignment.

**3.2 INSTALLATION CHECKS**

- A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation.
  1. In each case, representative(s) shall be present during placement and start-up of equipment and as often as necessary to resolve any operational issues which may arise.
- B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:
  1. Has been properly installed and lubricated.
  2. Is in accurate alignment.
  3. Is free from any undue stress imposed by connecting piping or anchor bolts.
  4. Has been operated under full load conditions and that it operated satisfactorily.
    - a. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.
- C. No separate payment shall be made for installation checks.
  1. All or any time expended during installation check does not qualify as Operation and Maintenance training or instruction time when specified.

**3.3 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS**

- A. Identify equipment and install hazard warning signs in accordance with Section 10 14 00.

**3.4 FIELD HIGH PERFORMANCE INDUSTRIAL COATINGS**

- A. For required field High Performance Industrial Coatings, comply with Section 09 96 00.

**3.5 WIRING CONNECTIONS AND TERMINATION**

- A. Clean wires before installing lugs and connectors.
- B. Coat connection with oxidation eliminating compound for aluminum wire.
- C. Terminate motor circuit conductors with copper lugs bolted to motor leads.
- D. Tape stripped ends of conductors and associated connectors with electrical tape.

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1. Wrapping thickness shall be 150% of the conductor insulation thickness.
- E. Connections to carry full ampacity of conductors without temperature rise.
- F. Terminate spare conductors with electrical tape.

**END OF SECTION 23 05 13**

# **SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
1. Vibration isolators.

### **1.2 QUALITY ASSURANCE**

- A. Reference Standards:
1. American National Standards Institute (ANSI):
    - a. S1.4, Specification for Sound Level Meters.
    - b. S12.60, Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools.
  2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
    - a. Handbook - HVAC Applications.
  3. ASTM International (ASTM):
    - a. E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
    - b. E477, Standard Test Method for Laboratory Measurements of Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
    - c. E596, Standard Test Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures.
  4. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
    - a. HVAC Duct Construction Standards - Metal and Flexible.

### **1.3 SUBMITTALS**

- A. Section 01 33 00 - Submittal: Requirements for submittals.
- B. Product Data:
1. Submit schedule of vibration isolator type with location and load on each.
  2. Submit manufacturer catalog information indicating materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.
- C. Contract Closeout Information:
1. Operation and Maintenance Data:
    - a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

### **1.4 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

# **SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT**

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
- C. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## **PART 2 - PRODUCTS**

### **2.1 PERFORMANCE AND DESIGN CRITERIA**

- A. Provide vibration isolation devices on motor-driven equipment over 0.5 hp, plus connected piping and ductwork.

### **2.2 VIBRATION ISOLATORS**

- A. Manufacturers:
  - 1. Ace Mountings Co., Inc.
  - 2. California Dynamics Corporation.
  - 3. Isolation Technology, Inc.
  - 4. Kinetics Noise Control, Inc.
  - 5. Mason Industries, Inc.
  - 6. Vibration Eliminator Co., Inc.
  - 7. Vibration Isolation.
  - 8. The VMC Group.
- B. Open Spring Isolators:
  - 1. Spring Isolators:
    - a. Exterior and Humid Areas: Furnish hot-dip galvanized housings and neoprene-coated springs.
    - b. Code: Color-code springs based on load carrying capacity.
  - 2. Springs:
    - a. Minimum Horizontal Stiffness: 75% of vertical stiffness.
    - b. Working Deflection: Between 30 and 60% of maximum deflection.
  - 3. Spring Mounts: Furnish leveling devices, minimum 0.25 inches thick neoprene sound pads, and zinc chromate-plated hardware.
  - 4. Sound Pads:
    - a. Size: Based on minimum deflection of 0.05 inches.
    - b. As specified for neoprene pad isolators.
- C. Restrained Spring Isolators:
  - 1. Spring Isolators:
    - a. Exterior and Humid Areas: Furnish hot-dip galvanized housings and neoprene-coated springs.
    - b. Code: Color-code springs based on load carrying capacity.
  - 2. Springs:

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- a. Minimum Horizontal Stiffness: 75% of vertical stiffness.
    - b. Working Deflection: Between 30 and 60% of maximum deflection.
  3. Spring Mounts: Furnish leveling devices, minimum 0.25 inches thick neoprene sound pads, and zinc chromate-plated hardware.
  4. Sound Pads:
    - a. Size: Based on minimum deflection of 0.05 inches.
  5. As specified for neoprene pad isolators.
  6. Restraints: Furnish mounting frame and limit stops.
- D. Closed Spring Isolators:
  1. Spring Isolators:
    - a. Exterior and Humid Areas: Furnish hot-dip galvanized housings and neoprene-coated springs.
    - b. Code: Color-code springs based on load carrying capacity.
  2. Type: Closed spring mount with top and bottom housing separated by neoprene rubber stabilizers.
  3. Springs:
    - a. Minimum Horizontal Stiffness: 75% of vertical stiffness.
    - b. Working Deflection: Between 30 and 60% of maximum deflection.
  4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators and neoprene side stabilizers with minimum clearance of 0.25 inches.
- E. Restrained Closed Spring Isolators:
  1. Spring Isolators:
    - a. Exterior and Humid Areas: Furnish hot-dip galvanized housings and neoprene-coated springs.
    - b. Code: Color-code springs based on load carrying capacity.
  2. Type: Closed spring mount with top and bottom housing separated by neoprene rubber stabilizers.
  3. Springs:
    - a. Minimum Horizontal Stiffness: 75% of vertical stiffness.
    - b. Working Deflection: Between 30 and 60% of maximum deflection.
  4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators and neoprene side stabilizers with minimum clearance of 0.25 inches and limit stops.
- F. Spring Hangers:
  1. Spring Isolators:
    - a. Exterior and Humid Areas: Furnish hot-dip galvanized housings and neoprene-coated springs.
    - b. Code: Color-code springs based on load carrying capacity.
  2. Springs:
    - a. Minimum Horizontal Stiffness: 75% of vertical stiffness.
    - b. Working Deflection: Between 30 and 60% of maximum deflection.
  3. Housings: Incorporate rubber hanger with threaded insert.
  4. Misalignment: Capable of 20-degree hanger rod misalignment.
- G. Neoprene Pad Isolators:
  1. Rubber or neoprene-waffle pads.
    - a. Hardness: 30 durometer.
    - b. Minimum Thickness: 1/2 inches.
    - c. Maximum Loading: 40 psi.
    - d. Rib Height: Not greater than 0.7 times width.
  2. Configuration: 1/2 inches-thick waffle pads bonded to each side of 1/4 inches-thick steel plate.

## **SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT**

- H. Rubber Mount or Hanger:
  - 1. Material: Molded rubber.
  - 2. Deflection: 0.5 inches.
  - 3. Insert: Threaded.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that equipment, ductwork, and piping are installed before starting Work of this Section.

#### **3.2 INSTALLATION**

- A. Install isolation for motor-driven equipment.
- B. Make equipment level.
- C. Install spring hangers without binding.
- D. Isolators:
  - 1. Closed Spring Isolators: Adjust such that side stabilizers are clear under normal operating conditions.
  - 2. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height; when full load is applied, adjust isolators to load to allow shim removal.
- E. Provide vibration isolation as required by manufacturer and as indicated on drawings.

**END OF SECTION 23 05 48**



# **SECTION 23 05 53 - IDENTIFICATION FOR HVAC, DUCTWORK, PIPING AND HVAC EQUIPMENT**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Nameplates.
  - 2. Pipe markers.
  - 3. Labels.

### **1.2 QUALITY ASSURANCE**

- A. Reference Standards:
  - 1. American Society of Mechanical Engineers (ASME):
    - a. A13.1, Scheme for the Identification of Piping Systems.
- B. Maintain one copy of each document on site.

### **1.3 SUBMITTALS**

- A. Product Data: Submit manufacturers catalog literature for each product required.
- B. Shop Drawings: Submit Identification Register including list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- D. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Nameplates:
    - a. Brady Corporation.
    - b. Panduit.
    - c. Seton by Brady Corporation.
    - d. National Band and Tag Company.
    - e. Carlton Industries, LP.

## **SECTION 23 05 53 - IDENTIFICATION FOR HVAC, DUCTWORK, PIPING AND HVAC EQUIPMENT**

### **2.2 NAMEPLATES**

- A. Laminated two-layer phenolic or DR (high impact) acrylic with engraved black letters on light contrasting background color.
  - 1. Thickness: Minimum 1/16 inches.
  - 2. Color: Manufacturer standard or as specified.
  
- B. Alternate: Laminated three-layer plastic with engraved black letters on light contrasting background color.
  - 1. Thickness: Minimum 60 mils.
  - 2. Color: Manufacturer standard or as specified.

### **2.3 SELF ADHESIVE PIPE AND DUCT MARKERS**

- A. Color and Lettering: Conform to ASME A13.1.
  
- B. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
  - 1. Thickness: Minimum 5 mils.
  - 2. Letter Height:
    - a. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inches high letters.
    - b. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1 inch high letters.
    - c. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
    - d. Ductwork and Equipment: 1-3/4 inches high letters.
  - 3. Indoor/outdoor grade.
  - 4. Weather and UV resistant inks.
  - 5. Permanent adhesive.

### **2.4 CEILING GRID LABELS**

- A. Clear adhesive label.
  
- B. Color Code as Follows:
  - 1. HVAC equipment: Black.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### **3.2 INSTALLATION**

- A. Install identifying devices after completion of coverings and painting.
  
- B. All identification devices to be printed by mechanical process. Hand printing is not acceptable.
  
- C. Install nameplates with adhesive where equipment has sufficient surface area and texture.
  - 1. Attach tabs with plastic strap where screws should not or cannot penetrate substrate.

## **SECTION 23 05 53 - IDENTIFICATION FOR HVAC, DUCTWORK, PIPING AND HVAC EQUIPMENT**

- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer.
- E. Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with nameplates. Identify in-line pumps and other small devices with tags.
- F. Identify control panels and major control components outside panels with plastic nameplates.
- G. Identify piping, concealed or exposed, with pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.
- H. Identify ductwork with labels. Identify service and direction. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction and change of direction and not to exceed 20 feet spacing on straight runs.
- I. Identify equipment located above ceilings (VAV boxes) with ceiling grid label adhered to ceiling grid frame.

### **3.3 SCHEDULES**

- A. Ductwork:
  - 1. Install labels on all duct in accordance with Article 3.2.
    - a. Stencils or self-adhesive labels.
  - 2. Color Coding:
    - a. Black lettering on yellow background:
      - 1) Supply Air, Outside Air or Makeup Air.
    - b. White lettering on green background:
      - 1) Return Air, Exhaust Air and Relief Air.
- B. Equipment:
  - 1. Provide nameplate or stencil as warranted per Article 3.2.
  - 2. Label with equipment tag as shown on the Drawings.
    - a. Black lettering on white background.
  - 3. Provide OSHA warning sign for equipment that starts automatically.
  - 4. Label all equipment control panels located remote from unit.
  - 5. Label all thermostats with self-adhesive markers with tag of equipment served.

**END OF SECTION 23 05 53**

# **SECTION 23 05 93 - HVAC SYSTEMS - BALANCING AND TESTING**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Adjusting, balancing, and testing of all heating, ventilating and air conditioning (HVAC) systems, including the following systems:
    - a. Air distribution and exhaust systems.
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 23 09 00 - Instrumentation and Control for HVAC Systems.
  - 2. Section 23 31 00 - HVAC - Ductwork.
  - 3. Section 23 80 00 - HVAC - Equipment.

### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Associated Air Balance Council (AABC):
    - a. National Standards for Total System Balance.
  - 2. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
    - a. HVAC Applications Handbook, Chapter entitled "Laboratories".
    - b. HVAC Systems and Equipment Handbook, Chapter entitled "Testing, Adjusting, and Balancing".
  - 3. National Environmental Balancing Bureau (NEBB):
    - a. Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
- B. Qualifications:
  - 1. Work of this Section to be accomplished by an independent testing and balancing firm certified by one (1) of the following:
    - a. Associated Air Balance Council (AABC).
    - b. National Environmental Balancing Bureau (NEBB).
    - c. Other certification entity approved by Engineer.
  - 2. The independent firm shall not be the same firm as the firm installing the HVAC equipment, nor under contract to the firm installing the equipment.

### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Certifications:
    - a. Letter stating the name and qualifications of the firm proposed.
    - b. Evidence that relevant subcontractors have been notified of the requirement to coordinate balance and test elements in the work with the testing and balancing firm.
  - 2. Report forms:
    - a. Procedures and forms to be used in calibrating of test instruments, balancing systems, and recording and reporting test data.
- B. Informational Submittals:
  - 1. Completed test reports and data forms upon completion of installation, balance and testing of HVAC systems for near-peak summer and near-peak winter conditions.

## **SECTION 23 05 93 - HVAC SYSTEMS - BALANCING AND TESTING**

- a. Insert recorded information on report forms required by specifications and approved for use on project.
- b. Additional written verification and other related information clearly identifying project, date and specifics of verification.
- c. Utilize report forms similar to those shown in Section V of AABC Standard.
- d. Provide forms typed and signed by the testing and balancing firm.

### **PART 2 - PRODUCTS - (NOT USED)**

### **PART 3 - EXECUTION**

#### **3.1 PREPARATION**

- A. Secure approved Shop Drawings of all HVAC equipment.
- B. Procedures and Forms:
  1. Submit procedures and forms to be used in calibration of test instruments, balancing systems, and recording and reporting test data.
  2. Obtain approval before beginning balancing and testing.
- C. Do not begin balancing and testing until HVAC systems are complete and in full working order.
  1. Place HVAC systems into full operation and continue their operation during each working day of balancing and testing.
- D. Provide qualified heating and ventilating Engineer(s) to supervise and perform balancing and testing.
- E. Review design Drawings, specifications, approved Shop Drawings and other related items to become thoroughly acquainted with the design of HVAC systems.
- F. Check all installed systems against Contract Drawings, Specifications and Shop Drawings to see that system is installed as required.
  1. Report deficiencies to the Engineer.
  2. Report deficiencies to Contractor for remedial action including providing corrective measures required in the function of any part of system to complete balancing.
- G. Make necessary adjustments as required to balance the systems.

#### **3.2 FIELD QUALITY CONTROL**

- A. Balance and Test Air Systems:
  1. Seasonal Testing:
    - a. Perform TAB procedures during near-peak summer and perform additional TAB during near-peak winter conditions.
  2. Adjust equipment RPM to design requirements.
  3. Report motor full load amperes.
  4. Obtain design CFM at fans.
    - a. Make pitot tube traverse of main supply and exhaust ducts.
      - 1) Fans providing minimum code required exhaust air or minimum code required outside ventilation air shall be within -0/+10 PCT of design airflows.

## **SECTION 23 05 93 - HVAC SYSTEMS - BALANCING AND TESTING**

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- 2) Fans providing supply air shall be within -5 PCT/+5 PCT
5. Test and record system static pressures, suction, and discharge.
6. Obtain design CFM for recirculated air.
7. Obtain design CFM outside air.
8. Test and record entering air temperatures, (DB, heating and cooling).
9. Test and record leaving air temperatures, (DB, heating and cooling).
10. Test and record leaving air temperatures, (WB, cooling).
11. Adjust dampers in supply, exhaust and return air ducts to design CFM.
12. Test diffusers, grilles, and registers as follows:
  - a. Adjust to comply with design requirements within 10%.
  - b. Identify location and area of each.
  - c. Adjust face velocity to establish required CFM.
    - 1) Retest after initial adjustments.
  - d. Adjust to minimize drafts and to ensure uniform air distribution in all areas.
13. Identify and list size, type and manufacturer of diffusers, grilles, registers, and HVAC equipment.
  - a. Use manufacturer's ratings on equipment to make required calculations.
14. Adjust and assure that the operation of automatically operated dampers are as specified.
  - a. Check and calibrate controls.
15. Prepare and submit reports.

**END OF SECTION 23 05 93**

## **SECTION 23 08 00 – COMMISSIONING OF MECHANICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Contract Drawings and provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.
- B. Section 019113 – Commissioning General Requirements
- C. Section 220800 – Commissioning of Plumbing Systems
- D. Section 230800 – Commissioning of Mechanical Systems
- E. Section 230901 – Commissioning of Integrated Automation Systems
- F. Section 260800 – Commissioning of Electrical Systems
- G. Commissioning Plan

#### **1.2 DESCRIPTION OF WORK**

- A. An independent third-party Commissioning Agent has been retained to lead the project participants through the commissioning process. The section below is provided for informational purposes and to inform the contractor of the extent of the commissioning process and the involvement required. The Commissioning Agent is RMF Engineering, Inc.
- B. The purpose of this section is to specify commissioning responsibilities directly related to the Division 23 contractors and vendors. All contractors responsible for Division 23 installation or other activities shall have commissioning responsibilities described herein.
- C. The majority of the Commissioning Requirements apply to all trades and therefore are defined within Section 019113 – Commissioning General Requirements. Specific requirements herein apply generally to the Mechanical Contractors alone.
- D. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Mechanical Systems, which are a part of this project.
- E. Commissioning shall be a team effort to ensure that all equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for verification of proper loading and unloading, fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, quality control, equipment start-up, third party testing, final verification and performance testing, training, turn-over and possible deferred or seasonal testing including a final warranty verification.

## **SECTION 23 08 00 – COMMISSIONING OF MECHANICAL SYSTEMS**

- F. The Commissioning Team is defined in Specification 019113 Section 1.3 – Definitions. The mechanical trades represented on the Commissioning Team shall include but not be limited to; sheet metal, pipe and fitting, controls, test and balance, mechanical, vendors, manufacturers and chemical treatment. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.
- G. Mechanical Contractor(s) are responsible for mechanical system installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 1 and Division 23 specification sections. Mechanical Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 019113.
- H. Sections 019113 - Commissioning General Requirements and 230800 – Commissioning of Mechanical Systems DO NOT relieve the Mechanical Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 230800 – Commissioning of Mechanical Systems shall not relieve any other discipline or trade contractor from any obligations set forth within other divisions of the specifications.

### **1.3 DEFINITIONS**

- A. Mechanical Contractor(s): The term Mechanical Contractor(s) utilized herein refers to any and all subcontracting companies or vendors who are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning and are defined within Division 23 of the specifications. Subcontracting parties outside of the scope of the Systems to be Included in Commissioning or outside of the scope of Division 23 are not included.
- B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies who are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 23 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.
- C. Third Party Testing Agencies: The term Third Party Testing Agency utilized herein refers to any and all subcontracting companies who are responsible for performing testing or other quality control activities which do not necessarily involve installation activities, such as a company performing test, adjustment and balance or a company performing cleaning, flushing and water treatment tests for hydronic systems.
- D. See specification 019113 – General Commissioning Requirements for additional definitions utilized herein.



## **SECTION 23 08 00 – COMMISSIONING OF MECHANICAL SYSTEMS**

### **1.4 ROLES AND RESPONSIBILITIES**

- A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company, vendor or manufacturer whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are further defined within Division 23 of the specifications and project drawings.
- B. Every Mechanical Contractor, Subcontractor, Vendor, etc. is responsible for providing a minimum of one team member to participate in the Commissioning Process for the duration of the project. This team member shall be labeled as that company's Commissioning Representative. Each Contractor is responsible for ensuring re the subcontractors under their contract have included the same representation.
- C. All Division 23 Contractors are responsible for the requirements defined in section 019113 section 1.4-D – Subcontractors.
- D. Mechanical Contractor(s)
  - 1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
  - 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
  - 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
  - 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
  - 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.
- E. Controls Contractor(s)
  - 1. Controls Contractors may be a subcontractor to the Mechanical Contractor but their responsibilities are defined in specification 230901 – Commissioning of Integrated Automation Systems. Controls Contractors installing controls under Division 23 shall follow the requirements set forth in specification 230901 – Commissioning of Integrated Automation System but will apply the same requirements to the Division 23 installations for which they are responsible.
- F. Test, Adjustment and Balance Contractor(s)
  - 1. The Test, Adjustment and Balance (TAB) Contractor is a Third-Party Test Agency and therefore their roles and responsibilities are defined in section H below.
  - 2. The TAB Contractor contributes a very large part to the Commissioning Process:
    - a. TAB is required to provide early submittals, installation inspections, etc.
    - b. TAB has several various report types which are all included within Quality Control requirements.
    - c. TAB Verification is accomplished by TAB performing a large portion of the Pre-Verification Tests and repeating these measurements as Functional Performance Tests witnessed by the Commissioning Agent. In the case of TAB Verification, the TAB contractor must account for performing TAB once for their Final TAB Report and a spot-check of readings to be performed during Functional Performance Testing. See 019113 section 3.10-H for details regarding redundant equipment spot-checks.
- G. Equipment Manufacturer(s)

## **SECTION 23 08 00 – COMMISSIONING OF MECHANICAL SYSTEMS**

1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.

### **H. Third Party Testing Agencies**

1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.

### **1.5 SYSTEMS INCLUDED IN COMMISSIONING**

- A. See specification 019113 section 1.5 – Systems Included in Commissioning for the full list of Division 23 Mechanical Systems included within the Commissioning Scope.

### **1.6 COORDINATION**

- A. Overall Coordination of Commissioning Tasks is the responsibility of the Construction Manager/General Contractor. The Commissioning Agent does not have any direct control over contractors or the construction schedule and therefore, cannot dictate task schedule. However, the Commissioning Agent typically has the most Commissioning Experience and will assist with coordination of Commissioning Tasks by providing input and feedback to the Commissioning Team.
- B. The Owner, System Design Professionals, Commissioning Agent, Contractors, Sub-Contractors, Vendors and 3rd Part Test Agencies are all required to assist with Coordination. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.
- C. Various tasks included as part of the commissioning process must be coordinated by the Cx Team. These tasks require advance notification by the subcontractors to the Owner, Designers and Commissioning Agent for planning and participation. Tasks required to be coordinated with the Commissioning Team include but are not limited to:
  1. Submittal Reviews
  2. Quality Control Plans and Tests
  3. Equipment and Systems Start-Up
  4. Third Party Testing
  5. Pre-Verification Testing

## **SECTION 23 08 00 – COMMISSIONING OF MECHANICAL SYSTEMS**

6. Functional Performance Testing
7. Close-Out Inspections
8. Close-Out Document Review (O&M's, As-Builts, Warranties)

### **PART 2 - PRODUCTS**

#### **2.1 GENERAL**

- A. Work products to be provided by the Mechanical Contractors are defined within Specification 019113 – General Commissioning Requirements part 2. Work products specific to the Mechanical Contractors, Manufacturers and Third-Party Test Agencies Include:
  1. 2.1 - Project Schedule
  2. 2.2 - Schedule of Values
  3. 2.3 - Submittals
  4. 2.4 - Quality Control Plan
  5. 2.5 - Quality Control Reports
  6. 2.6 - Systems and Equipment Start-Up Plan
  7. 2.8 - Start-Up Reports
  8. 2.9 - Preventative Maintenance Plan
  9. 2.10 - Pre-Verification Tests
  10. 2.11 - Functional Performance Tests
  11. 2.12 - Test and Proprietary Equipment
- B. Work products under the Construction Manager/General Contractor purview are to be coordinated with the Mechanical Contractors, Manufacturers and Third-Party Test Agencies to ensure products are up to date and accurate.
- C. Work products under the Contractors purview outside of Division 23 are to be coordinated with the Mechanical Contractors, Manufacturers and Third-Party Test Agencies to ensure related tasks and activities to not impede Division 23 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 23 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Execution of Commissioning Activities to be performed by the Mechanical Contractors are defined within Specification 019113 – General Commissioning Requirements part 3. Execution Activities specific to the Mechanical Contractors, Manufacturers and Third-Party Test Agencies Include:
  1. 3.1 – Commissioning Plan and Kick-Off Meeting
  2. 3.2 – Construction Observations
  3. 3.3 – Systems and Equipment Start-Up
  4. 3.4 – Temporary Utilization
  5. 3.5 – Quality Control and Start-Up Reporting
  6. 3.6 – Pre-Verification Tests
    - a. Mechanical PVT's are primarily the responsibility of the Mechanical Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to participate in portions of the Mechanical PVT's. For these activities, the

## **SECTION 23 08 00 – COMMISSIONING OF MECHANICAL SYSTEMS**

- Mechanical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
- b. Mechanical Contractors are responsible for portions of PVT's which are primarily the responsibility of other Contractors such as Plumbing or Controls. For these items, the Mechanical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
7. 3.7 – Functional Performance Tests
    - a. Mechanical FPT's are primarily the responsibility of the Mechanical Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to participate in portions of the Mechanical FPT's. For these activities, the Mechanical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.
    - b. Mechanical Contractors are responsible for portions of FPT's which are primarily the responsibility of other Contractors such as Plumbing or Controls. For these items, the Mechanical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.
  8. 3.8 – TAB Verification
    - a. Test, Adjustment and Balance is generally considered a Mechanical Trade and performed under Division 23.
  9. 3.9 – Integrated Systems Test
  10. 3.10 – Operations and Maintenance Manuals
  11. 3.11 – Exclusions
  12. 3.12 – Prerequisites to Substantial Completion
- B. Execution of Commissioning Activities under the Construction Manager/General Contractor purview are to be coordinated with the Mechanical Contractors, Manufacturers and Third-Party Test Agencies to ensure activities are executed without any impedance or interference by Division 23 or any other contractors.
- C. Execution of Commissioning Activities under the Contractors purview outside of Division 23 are to be coordinated with the Mechanical Contractors, Manufacturers and Third-Party Test Agencies to ensure related tasks and activities to not impede Division 23 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 23 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

### **3.2 SCHEDULE**

- A. The Mechanical Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.
- B. Work is to be scheduled and completed such that all Commissioning Activities including Pre-Verification Tests and Functional Performance Tests can be executed with sufficient time for issue resolution prior to Beneficial Occupancy. It is the Contractors responsibility to determine the amount of time needed to test, troubleshoot and retest the Mechanical Systems such that all deficiencies are resolved prior to Final Acceptance.

## **SECTION 23 08 00 – COMMISSIONING OF MECHANICAL SYSTEMS**

### **3.3 PARTICIPATION IN ACCEPTANCE PROCEDURES**

- A. The Mechanical Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 23. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Mechanical Contractor(s). Mechanical Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained, at no cost to the Owner.
- C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Mechanical Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

### **3.4 DEFICIENCIES AND FAILURES**

- A. Deficiencies are installations which do not comply with either the Construction Documents or the Manufacturer's Installation Requirements. Where the Construction Documents and the Manufacturer's Installation Requirements are in direct conflict, the Design Professional shall make the final decision regarding which requirement to follow. Deficiencies can be documented upon discovery if the installation appears to be progressed past the point of temporary work. If installation progress is such that the installation may not be complete and the deficiency may resolve itself as the installation progresses, the deficiency should be documented as a observations and not a true deficiency.
- B. Deficiencies found during an inspection for wall or ceiling closure or upon a final inspection or otherwise noted to be complete by the Contractors shall be required to have the associated progress or closure delayed until such time as the deficiency can be corrected and reinspected. All deficiencies must be reinspected unless otherwise proven beyond a doubt that the deficiency was resolved. Time and expenses related to additional site visits, re-inspections or extended inspection time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- C. Test failures are those that occur during Quality Control Testing or Functional Performance Testing which require any level of rework. This may include the addition of sealant to reduce leakage or a slight setting adjustment such that a sequence of operations will work. These deficiencies should have been previously discovered and addressed by the Contractors and should not be found during observation or witnessing by the Commissioning Agent.

## **SECTION 23 08 00 – COMMISSIONING OF MECHANICAL SYSTEMS**

- D. While minor issues can occur despite previous testing and some minor adjustments may be required during the final test, these should be minimized through the pre-test requirements of the Pre-Verification Tests. Therefore, an increase of more than five percent (5%) of the time associated with witnessing a Quality Control Test or Functional Performance Test shall be grounds for a test failure and/or termination of the test. Whether the test is terminated and fully repeated at a later date/time or the test is extended until deficiencies are resolved, time and expenses related to this additional time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- E. A test failure of a reading may vary depending upon the criticality of the reading. For example, space temperature within an open office space may be allowed to be within 10% of the expected value without being considered a failure. However, space temperature within a BSL laboratory has a much smaller tolerance due to the criticality of the space. Values such as gauge and sensor readings must be calibrated to within their specified tolerances.
- F. For general purposes or unless otherwise specified, a total number of test failures that comprise 10% of the total test readings shall be considered a fully failed test. 9% or fewer reading failures can be individually logged as deficiencies and the associated test can be documented as completed with issues. This does not supersede any Quality Control Test requirements set forth within other specification sections.
- G. There may be cases during testing where the final pass/fail decision cannot be made on the spot and values must be calculated, reviewed and assessed to determine if they are acceptable. In these cases, the testing will capture all of the needed values which will then be provided to the entire Commissioning Team. The Design Professional and the Commissioning Agent will perform the necessary calculation and analysis. Ultimately, the Design Professional will determine if the contract requirements have been met or if there is any deficiency. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner.

### **3.5 DEFICIENCY RESOLUTION**

- A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. All members shall have input and the opportunity to discuss, debate, and work out problems. Final direction for issue resolution is to come from the responsible Design Professional. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner. The Commissioning Agent does NOT have final authority over the acceptance of systems or equipment.
- B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

### **3.6 ADDITIONAL COMMISSIONING**

- A. The Mechanical Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a functional test. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.

## **SECTION 23 08 00 – COMMISSIONING OF MECHANICAL SYSTEMS**

- B. The Commissioning Agent will continue to serve the construction project if the schedule is extended, will repeat site visits and inspections if such activities prove deficiencies and attend additional testing to re-witness previously failed tests. For these services, the Commissioning Agent will invoice the Owner for additional time required for commissioning activities including additional meetings, additional site visits, or additional witnessing of retests due to failed FPT's. It is the Construction Manager/General Contractor and Sub-Contractor's responsibility to maintain scheduled, verify completion prior inviting the Commissioning Agent to inspect work, and properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness testing.

### **3.7 SEASONAL COMMISSIONING**

- A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load or shoulder season conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons. Depending upon project schedule, some seasonal testing may be captured during the project acceptance phase, prior to Final Acceptance. Any seasonal testing left incomplete must be accommodated by the Contractors, coordinated with the Commissioning Team and will be witnessed by the Commissioning Agent.
- B. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

**END OF SECTION 23 08 00**

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# **SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC SYSTEMS**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Instrumentation and control for HVAC systems.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 23 05 13 - Common Motor Requirements for HVAC and Plumbing Equipment.
  - 2. Section 23 31 00 - HVAC - Ductwork.
  - 3. Section 23 80 00 - HVAC - Equipment.
  - 4. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
  - 5. Section 26 05 33 - Raceways and Boxes.

### **1.2 QUALITY ASSURANCE**

- A. See Specification Section 01 61 03.
- B. Referenced Standards:
  - 1. The International Society of Automation (ISA):
    - a. S5.1, Instrumentation Symbols and Identification.
  - 2. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 3. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 4. Underwriters Laboratories, Inc. (UL).
- C. Miscellaneous:
  - 1. Controls to be in compliance with Specification Section 26 05 00 for NEMA and NFPA 70 enclosure class requirements unless noted or specified otherwise.
  - 2. Unless specifically noted otherwise, components of systems shall be industrial duty suitable for moist, corrosive environments.

### **1.3 SYSTEM DESCRIPTION**

- A. Work shall be provided as an integrated operating system.
- B. Provide a complete system of automatic temperature control, thermostats, relays, valves, damper operators and other associated controls and appurtenances required to maintain minimum conditions described in detail herein and on Drawings, together with thermometers, gages, and other accessory equipment.
  - 1. Assemble control system with complete system of wiring to fulfill requirements of the Contract Documents.
- C. Install system using competent mechanics under direct supervision of control manufacturer.
- D. Controls, as set out in "Sequence of Operation" on drawings, are designed to illustrate operating functions only.

## **SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC SYSTEMS**

1. These minimum specified items, and any additional controls, not indicated but required to meet performance as outlined in the Contract Documents, shall be furnished and installed at no additional cost to Owner to make a complete system.

E. Sequence of Operation – General:

1. Sequence of operation indicated on drawings illustrates basic operating functions only.
2. Review Drawings and submit complete installation data, including minor details, to provide proper operation in his proposal.
3. Where an item differs from specifications, control manufacturer shall submit manufacturer's recommendations subject to Engineer's approval.

### **1.4 SUBMITTALS**

A. Shop Drawings:

1. Wiring diagrams showing point to point termination with auxiliary interlocks for each item in each control loop.

B. Quality Control Submittals:

1. Secure from equipment manufacturers, detailed and complete control and power wiring diagrams, word descriptions of controls provided as part of the HVAC equipment or equipment interfaced or interlocked thereto, and submit with equipment manufacturer's submittals.
  - a. Provide the above information to control manufacturer.

C. Contract Closeout Information:

1. Operation and Maintenance Data:
  - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Manufacturer's catalog numbers hereinafter are for reference to type, style, dimension, related items and to establish a standard of quality.
    - a. Reference to a manufacturer's number hereinafter does not imply full compliance to these Specifications.
  2. Instrumentation and control systems:
    - a. Reliable Controls.
    - b. Honeywell.
    - c. Johnson Control Co.
    - d. Distech.

### **2.2 EQUIPMENT**

A. Dampers:

1. Refer to Specification Section 23 31 00.

## **SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC SYSTEMS**

- B. Damper Operators:
1. Provide operators of proper size and number to secure true throttling or two-position action as required.
  2. Furnish damper operators for installation inside ductwork and attached to frame of damper, or installed outside ductwork and connected to extended shaft as required.
  3. Provide operators for outside air, spring-loaded with sufficient power to assure tight closing of dampers on fan shutdown or in the fail safe position indicated by "Sequence of Controls."
  4. Electric operators:
    - a. Provide damper operators with integral spring return motor springs to make controls fail safe in position specified under "Sequence of Controls."
    - b. Provide fully modulating operators from proportional electric controllers.
    - c. Provide end switches or proportioning controllers permitting simultaneous operation or interlocking with other equipment.
    - d. Provide separate electrical circuits for damper operators with no more than four operators on a circuit.
  5. Coordinate with dampers provided:
    - a. Provide damper operators that are rated for the required torque.
    - b. If single damper operator cannot meet torque requirement, provide sectional dampers to match operator torque.
  6. Ensure coordination to provide for the installation of tight closing dampers low leakage type (6 cfm per square foot at 4 inches WC pressure across damper) with compatible dampers, damper operators and related controls.
- C. Electric Control Instruments:
1. Thermostat
    - a. Low-voltage space thermostat
      - 1) 24 V
      - 2) Exposed temperature set point.
      - 3) Exposed temperature indication.
      - 4) Deg F indication.
    - b. Carbon Dioxide (CO<sub>2</sub>) Sensors:
      - 1) Carbon dioxide (CO<sub>2</sub>) sensors shall measure CO<sub>2</sub> concentrations between 0 to 2000 parts per million (ppm) using non-dispersive infrared (NDIR) technology.
      - 2) Accuracy: ±50 PPM and a maximum response time of 1 minute.
      - 3) The sensor shall be rated for operation at ambient air temperatures within the range of 32 to 122 DEGF and relative humidity within the range of 0 to 95 PCT (non-condensing).
      - 4) The sensor shall have a maximum drift of 2 PCT.
      - 5) Wall mount style.
  2. Provide transformers for supplying current to control equipment operating at less than 120 V and where required by manufacturer's automatic control system design capable of supplying 125% of energy requirements of equipment connected for not less than 1 hour.
    - a. Enclose transformers in UL listed cabinets with conduit connections.
    - b. Provide fused disconnect switches on both primary and secondary sides.
  3. Provide low limit electric thermostats of two-position type with 20 feet bulb and manual reset.
    - a. Shall be capable of opening thermostat circuit if any 1 foot section of bulb is subjected to a temperature below thermostat setting.
    - b. Each thermostat shall have two circuits, one to shut down fan, another for alarm.
    - c. Install all freeze-stats to override starter circuits regardless of position.
    - d. For corrosive environments provide thermostats with stainless steel sensing elements.
      - 1) Ensure element is installed to sense coldest point should stratification occur.
  4. Provide each thermostat with an accurate red-reading thermometer sensing temperature outside of enclosure.

## **SECTION 23 09 00 - INSTRUMENTATION AND CONTROL FOR HVAC SYSTEMS**

5. Label thermostat with identification tag of HVAC equipment controlled using phenolic nameplate in accordance with Specification Section 10 14 00.
- D. Local Temperature Control Panel:
  1. Panel shall be floor or wall-mounted and be sized to accommodate electrical switches, protective devices (except electrical switches and devices furnished as an integral part of air handling unit).
  2. Mount indicating controllers or receiver-controllers, relay, switching relays, ammeters and other accessory items on local sub-panels set in vicinity of equipment to be served.
    - a. Where two similar items of equipment are installed adjacent to each other a single panel may be used to contain all instruments.
  3. Fully compensated capillaries connected to instruments shall be of sufficient length to allow them to be run between equipment and placed in such a position so that they will not obstruct service of equipment or become damaged.
  4. Miniature milliamp meters for electronic temperature transmission may be used.
  5. Manufacture panels in one of the following manners:
    - a. NEMA electrical panel boxes.
  6. Mount all relays, etc., on rear inside of enclosure.
    - a. Tag each instrument corresponding to symbols used on control diagrams.
  7. Temperatures, pressures, equipment operation, and related items shall be continuously indicated on panels.
  8. Points to be monitored are scheduled on drawings.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Comply with requirements of Specification Section 26 05 19 and Specification Section 26 05 33.
- C. Identification: See Specification Section 10 14 00.
- D. Connect control devices to perform functions indicated and perform in required sequence.
- E. Use remote element temperature transmitters for points of temperature transmitters for points of temperature measurement occurring in air ducts.
- F. In general, locate thermostats for room control immediately inside door, above light switch, unless shown otherwise.
  1. Where light switch is in an entryway to room, locate thermostat on wall within room so it is capable of sensing true space conditions.
  2. Prior to installation, coordinate thermostat location with Engineer.
- G. Mount local control panels adjacent to equipment served.
- H. Locate panels so visual observation and adjustment can be accomplished from floor level.

**END OF SECTION 23 09 00**

# **SECTION 23 09 01 – COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS**

## **PART 1 - GENERAL**

### **1.1 RELATED DOCUMENTS**

- A. Contract Drawings and provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.
- B. Section 019113 – Commissioning General Requirements
- C. Section 230800 – Commissioning of Mechanical Systems
- D. Section 260800 – Commissioning of Electrical Systems
- E. Commissioning Plan

### **1.2 DESCRIPTION OF WORK**

- A. An independent third-party Commissioning Agent has been retained to lead the project participants through the commissioning process. The section below is provided for informational purposes and to inform the contractor of the extent of the commissioning process and the involvement required. The Commissioning Agent is RMF Engineering, Inc.
- B. The purpose of this section is to specify commissioning responsibilities directly related to the Division 23 contractors and vendors. All contractors responsible for Division 23 installation or other activities shall have commissioning responsibilities described herein. Additionally, Controls Contractors responsible for controls installations under Divisions 22, 23, and 26 shall also be responsible for the Controls Commissioning Requirements herein.
- C. The majority of the Commissioning Requirements apply to all trades and therefore are defined within Section 019113 – Commissioning General Requirements. Specific requirements herein apply generally to the Controls Contractors alone.
- D. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Controls Systems, which are a part of this project.
- E. Commissioning shall be a team effort to ensure that all equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for verification of proper loading and unloading, fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, quality control, equipment start-up, third party testing, final verification and performance testing, training, turn-over and possible deferred or seasonal testing including a final warranty verification.

## **SECTION 23 09 01 – COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS**

- F. The Commissioning Team is defined in Specification 019113 Section 1.3 – Definitions. The controls trades represented on the Commissioning Team shall include but not be limited to; controls raceways, plumbing controls, HVAC controls, electrical controls, fuel system controls, lighting controls, controls integration, etc. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.
- G. Controls Contractor(s) are responsible for controls system installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 1 and Division 23 specification sections. Controls Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 019113.
- H. Sections 019113 - Commissioning General Requirements and 230901 – Commissioning of Controls Systems DO NOT relieve the Controls Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 230901 – Commissioning of Controls Systems shall not relieve any other discipline or trade contractor from any obligations set forth within other divisions of the specifications.

### **1.3 DEFINITIONS**

- A. Controls Contractor(s): The term Controls Contractor(s) utilized herein refers to any and all subcontracting companies or vendors who are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning.
- B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies who are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 23 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.
- C. Third Party Testing Agencies: The term Third Party Testing Agency utilized herein refers to any and all subcontracting companies who are responsible for performing testing or other quality control activities which do not necessarily involve installation activities, such as a company performing systems integration verification.
- D. See specification 019113 – General Commissioning Requirements for additional definitions utilized herein.

### **1.4 ROLES AND RESPONSIBILITIES**

- A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company, vendor or manufacturer whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning and project drawings.

## **SECTION 23 09 01 – COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS**

- B. Every Controls Contractor, Subcontractor, Vendor, etc. is responsible for providing a minimum of one team member to participate in the Commissioning Process for the duration of the project. This team member shall be labeled as that company's Commissioning Representative. Each Contractor is responsible for ensuring re the subcontractors under their contract have included the same representation.
- C. All Division 23 Contractors are responsible for the requirements defined in section 019113 section 1.4-D – Subcontractors.
- D. Controls Contractor(s)
  - 1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
  - 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
  - 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
  - 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
  - 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.
- E. Equipment Manufacturer(s)
  - 1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
  - 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
  - 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
  - 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
  - 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.
- F. Third Party Testing Agencies
  - 1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
  - 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
  - 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
  - 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
  - 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.

### **1.5 SYSTEMS INCLUDED IN COMMISSIONING**

- A. See specification 019113 section 1.5 – Systems Included in Commissioning for the full list of Systems included within the Commissioning Scope.

## **SECTION 23 09 01 – COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS**

### **1.6 COORDINATION**

- A. Overall Coordination of Commissioning Tasks is the responsibility of the Construction Manager/General Contractor. The Commissioning Agent does not have any direct control over contractors or the construction schedule and therefore, cannot dictate task schedule. However, the Commissioning Agent typically has the most Commissioning Experience and will assist with coordination of Commissioning Tasks by providing input and feedback to the Commissioning Team.
- B. The Owner, System Design Professionals, Commissioning Agent, Contractors, Sub-Contractors, Vendors and 3rd Part Test Agencies are all required to assist with Coordination. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.
- C. Various tasks included as part of the commissioning process must be coordinated by the Cx Team. These tasks require advance notification by the subcontractors to the Owner, Designers and Commissioning Agent for planning and participation. Tasks required to be coordinated with the Commissioning Team include but are not limited to:
  - 1. Submittal Reviews
  - 2. Quality Control Plans and Tests
  - 3. Electrical Energization
  - 4. Equipment and Systems Start-Up
  - 5. Third Party Testing
  - 6. Pre-Verification Testing
  - 7. Functional Performance Testing
  - 8. Close-Out Inspections
  - 9. Close-Out Document Review (O&M's, As-Builts, Warranties)

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Work products to be provided by the Controls Contractors are defined within Specification 019113 – General Commissioning Requirements part 2. Work products specific to the Controls Contractors, Manufacturers and Third Party Test Agencies Include:
  - 1. 2.1 - Project Schedule
  - 2. 2.2 - Schedule of Values
  - 3. 2.3 - Submittals
  - 4. 2.4 - Quality Control Plan
  - 5. 2.5 - Quality Control Reports
  - 6. 2.6 - Systems and Equipment Start-Up Plan
  - 7. 2.8 - Start-Up Reports
  - 8. 2.9 - Preventative Maintenance Plan
  - 9. 2.10 - Pre-Verification Tests
  - 10. 2.11 - Functional Performance Tests
  - 11. 2.12 - Test and Proprietary Equipment
- B. Work products under the Construction Manger/General Contractor purview are to be coordinated with the Controls Contractors, Manufacturers and Third Party Test Agencies to ensure products are up to date and accurate.



## **SECTION 23 09 01 – COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS**

- C. Work products under the Contractors purview outside of Division 25 are to be coordinated with the Controls Contractors, Manufacturers and Third Party Test Agencies to ensure related tasks and activities to not impede Division 25 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 25 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Execution of Commissioning Activities to be performed by the Controls Contractors are defined within Specification 019113 – General Commissioning Requirements part 3. Execution Activities specific to the Controls Contractors, Manufacturers and Third Party Test Agencies Include:
  - 1. 3.1 – Commissioning Plan and Kick-Off Meeting
  - 2. 3.2 – Construction Observations
  - 3. 3.3 – Systems and Equipment Start-Up
  - 4. 3.4 – Temporary Utilization
  - 5. 3.2 – Quality Control and Start-Up Reporting
  - 6. 3.6 – Pre-Verification Tests
    - a. Controls PVT's are primarily the responsibility of the Controls Contractors. Other Contractors such as Electrical or Mechanical or Manufacturers may be required to participate in portions of the Controls PVT's. For these activities, the Controls Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
    - b. Controls Contractors are responsible for portions of PVT's which are primarily the responsibility of other Contractors such as Electrical or Mechanical. For these items, the Controls Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
  - 7. 3.7 – Functional Performance Tests
    - a. Controls FPT's are primarily the responsibility of the Controls Contractors. Other Contractors such as Electrical or Mechanical or Manufacturers may be required to participate in portions of the Controls FPT's. For these activities, the Controls Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.
    - b. Controls Contractors are responsible for portions of FPT's which are primarily the responsibility of other Contractors such as Electrical or Mechanical. For these items, the Controls Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.
  - 8. 3.8 – TAB Verification
    - a. Test, Adjustment and Balance (TAB) is generally considered a Mechanical Trade and performed under Division 23. Controls Contractors are required to work with the TAB Contractor to manipulate systems and adjust set-points to accommodate TAB readings, measurements and adjustments.
  - 9. 3.9 – Integrated Systems Test
  - 10. 3.10 – Operations and Maintenance Manuals
  - 11. 3.11 – Exclusions
  - 12. 3.12 – Prerequisites to Substantial Completion
- B. Execution of Commissioning Activities under the Construction Manager/General Contractor purview are to be coordinated with the Controls Contractors, Manufacturers and Third-Party Test Agencies to ensure activities are executed without any impedance or interference by Division 23 or any other contractors.

## **SECTION 23 09 01 – COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS**

- C. Execution of Commissioning Activities under the Contractors purview outside of Division 23 are to be coordinated with the Controls Contractors, Manufacturers and Third-Party Test Agencies to ensure related tasks and activities to not impede Division 23 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 23 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

### **3.2 SCHEDULE**

- A. The Controls Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.
- B. Work is to be scheduled and completed such that all Commissioning Activities including Pre-Verification Tests and Functional Performance Tests can be executed with sufficient time for issue resolution prior to Beneficial Occupancy. It is the Contractors responsibility to determine the amount of time needed to test, troubleshoot and retest the Controls Systems such that all deficiencies are resolved prior to Final Acceptance.

### **3.3 PARTICIPATION IN ACCEPTANCE PROCEDURES**

- A. The Controls Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 23. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Controls Contractor(s). Controls Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained, at no cost to the Owner.
- C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Controls Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

## **SECTION 23 09 01 – COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS**

### **3.4 DEFICIENCIES AND FAILURES**

- A. Deficiencies are installations which do not comply with either the Construction Documents or the Manufacturer's Installation Requirements. Where the Construction Documents and the Manufacturer's Installation Requirements are in direct conflict, the Design Professional shall make the final decision regarding which requirement to follow. Deficiencies can be documented upon discovery if the installation appears to be progressed past the point of temporary work. If installation progress is such that the installation may not be complete and the deficiency may resolve itself as the installation progresses, the deficiency should be documented as a observations and not a true deficiency.
- B. Deficiencies found during an inspection for wall or ceiling closure or upon a final inspection or otherwise noted to be complete by the Contractors shall be required to have the associated progress or closure delayed until such time as the deficiency can be corrected and reinspected. All deficiencies must be reinspected unless otherwise proven beyond a doubt that the deficiency was resolved. Time and expenses related to additional site visits, re-inspections or extended inspection time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- C. Test failures are those that occur during Quality Control Testing or Functional Performance Testing which require any level of rework. This may include the addition of sealant to reduce leakage or a slight setting adjustment such that a sequence of operations will work. These deficiencies should have been previously discovered and addressed by the Contractors and should not be found during observation or witnessing by the Commissioning Agent.
- D. While minor issues can occur despite previous testing and some minor adjustments may be required during the final test, these should be minimized through the pre-test requirements of the Pre-Verification Tests. Therefore, an increase of more than five percent (5%) of the time associated with witnessing a Quality Control Test or Functional Performance Test shall be grounds for a test failure and/or termination of the test. Whether the test is terminated and fully repeated at a later date/time or the test is extended until deficiencies are resolved, time and expenses related to this additional time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- E. A test failure of a reading may vary depending upon the criticality of the reading. For example, space temperature within an open office space may be allowed to be within 10% of the expected value without being considered a failure. However, space temperature within a BSL laboratory has a much smaller tolerance due to the criticality of the space. Values such as gauge and sensor readings must be calibrated to within their specified tolerances.
- F. For general purposes or unless otherwise specified, a total number of test failures that comprise 10% of the total test readings shall be considered a fully failed test. 9% or fewer reading failures can be individually logged as deficiencies and the associated test can be documented as completed with issues. This does not supersede any Quality Control Test requirements set forth within other specification sections.
- G. There may be cases during testing where the final pass/fail decision cannot be made on the spot and values must be calculated, reviewed and assessed to determine if they are acceptable. In these cases, the testing will capture all of the needed values which will then be provided to the entire Commissioning Team. The Design Professional and the Commissioning Agent will perform the necessary calculation and analysis. Ultimately, the Design Professional will determine if the contract requirements have been met or if there is any deficiency. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner.

## **SECTION 23 09 01 – COMMISSIONING OF INTEGRATED AUTOMATION SYSTEMS**

### **3.5 DEFICIENCY RESOLUTION**

- A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. All members shall have input and the opportunity to discuss, debate, and work out problems. Final direction for issue resolution is to come from the responsible Design Professional. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner. The Commissioning Agent does NOT have final authority over the acceptance of systems or equipment.
- B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

### **3.6 ADDITIONAL COMMISSIONING**

- A. The Controls Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a functional test. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.
- B. The Commissioning Agent will continue to serve the construction project if the schedule is extended, will repeat site visits and inspections if such activities prove deficiencies and attend additional testing to re-witness previously failed tests. For these services, the Commissioning Agent will invoice the Owner for additional time required for commissioning activities including additional meetings, additional site visits, or additional witnessing of retests due to failed FPT's. It is the Construction Manager/General Contractor and Sub-Contractor's responsibility to maintain scheduled, verify completion prior inviting the Commissioning Agent to inspect work, and properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness testing.

### **3.7 SEASONAL COMMISSIONING**

- A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load or shoulder season conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons. Depending upon project schedule, some seasonal testing may be captured during the project acceptance phase, prior to Final Acceptance. Any seasonal testing left incomplete must be accommodated by the Contractors, coordinated with the Commissioning Team and will be witnessed by the Commissioning Agent.
- B. Heating equipment shall be tested during winter design extremes. Cooling equipment shall be tested during summer design extremes with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

**END OF SECTION 250800**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. HVAC ductwork and accessories.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 01 61 03 - Equipment - Basic Requirements.
  - 2. Section 23 05 13 - Common Motor Requirements for HVAC and Plumbing Equipment.
  - 3. Section 23 09 00 - Instrumentation and Control for HVAC Systems.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
    - a. 52, Method of Testing Air Conditioning Devices Used in General Ventilation for Removing Particulate Matter.
  - 2. National Fire Protection Association (NFPA).
  - 3. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
    - a. Ducted Electric Heat Guide for Air Handling Systems.
    - b. HVAC Duct Construction Standards - Metal and Flexible.
  
- B. Qualifications:
  - 1. Fabricator: Firms regularly engaged in the manufacture of the specific product, of type, size required, whose products have been in use in similar service for not less than three years.
  - 2. Installers: Firm with at least five years installation experience on products similar to that required for this Project.

**1.3 DEFINITIONS**

- A. Installer or Applicator:
  - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
  - 2. Installer and applicator are synonymous.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 61 03.
  - 2. Efficiency ratings per ASHRAE 52 for factory built and assembled filter units.
  - 3. Scaled ductwork drawings (1/4 inches equals 1 foot) showing duct and accessory layout and support.
  
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

- C. Miscellaneous Submittal:
  - 1. Documentation of qualifications for fabricators and installers.
  
- D. Refer to Section 01 81 33 – Cyber Security Requirements for required cyber security related submittals.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Transverse joints (factory fabricated aluminum):
    - a. Ductmate Industries, Inc.
  - 2. Flexible ducts:
    - a. Thermaflex.
    - b. Condu-flex.
    - c. Glass-flex.
  - 3. Turning vanes:
    - a. Ductmate Industries, Inc.
    - b. Duro Dyne.
    - c. SEMCO Incorporated.
    - d. Ward Industries, Inc.
  - 4. Flexible duct connections:
    - a. Vent Fabrics.
    - b. Duro Dyne.
  - 5. Access doors in ductwork:
    - a. Vent Fabrics.
    - b. American Warming.
  - 6. Backdraft dampers:
    - a. Air Balance.
    - b. Ruskin.
    - c. American Warming.
  - 7. Ceiling diffusers:
    - a. Hart Cooley.
    - b. Price.
    - c. Carnes.
    - d. Titus.
  - 8. Grilles and registers:
    - a. Hart Cooley.
    - b. Price.
    - c. Carnes.
    - d. Titus.
  - 9. Manual (volume) dampers:
    - a. Air Balance.
    - b. Ruskin.
    - c. American Warming.
  - 10. Variable Volume Air Terminal Units:
    - a. Price.
    - b. Carrier.
    - c. Titus.
    - d. Krueger.
  - 11. Duct sealers:

- a. Durkee-Atwood.
  - b. Unitec McGill.
  - c. Benjamin Foster.
  - d. Design Polymerics.
12. Louvers:
- a. Greenheck.
  - b. Ruskin.
  - c. Air Balance.
  - d. American Warming.

## **2.2 COMPONENTS**

- A. Duct and Fittings (Metallic):
- 1. Materials:
    - a. G90 galvanized steel:
      - 1) Comply with ASTM A653 and ASTM A90.
  - 2. Fabrication (galvanized steel):
    - a. Minimum Sheet Metal Thickness:
      - 1) Per SMACNA for 4 inches WC pressure class.
        - a) Heavier gage sheet material may be used with associated reinforcement as an alternate to minimum thickness specified.
        - b) Lighter gage sheet material with associated reinforcement shall not be used as an alternate to minimum thickness specified.
    - b. Longitudinal Seams:
      - 1) Pittsburgh lock seam.
      - 2) Continuously Welded.
    - c. Transverse Seams:
      - 1) SMACNA T-22 or T-24 companion flange.
      - 2) Factory fabricated flanged duct connection system:
        - a) Ductmate 25/35.
        - b) Angles and Cleates: Galvanized.
        - c) Snap cleats: Galvanized.
        - d) Gaskets: Close cell neoprene.
        - e) Bolts and screws: Stainless.
    - d. Sealing:
      - 1) Per SMACNA for Seal Class A.
    - e. Finish:
      - 1) Exposed Ductwork: Flat white paint.
- B. Supports and Hangers:
- 1. Materials (for galvanized duct):
    - a. Support angles: Galvanized or stainless steel, minimum 1-1/2 by 1-1/2 by 1/4 angle.
    - b. Hanger rods: Galvanized or Stainless steel.
    - c. Anchors: Stainless steel wedge type.
  - 2. Fabrication: Trapeze type units.
  - 3. Strap hangers are not allowed.
  - 4. Finish:
    - a. Exposed ductwork hangers: Flat white paint.
- C. Turning Vanes:
- 1. Materials: Same as duct.
  - 2. Fabrication:
    - a. Fabricate double vane units.

## SECTION 23 31 00 - HVAC - DUCTWORK

- b. Pressure drop through elbows: Maximum 20% of velocity pressure.
- D. Flexible Connections:
  - 1. Materials: Hypalon, double coated closely woven glass fabric.
  - 2. Fabrication: Withstand 4.5 inches water column, positive and negative pressure.
- E. Access Doors:
  - 1. Materials:
    - a. Inner panel, out panel and frame: Same as duct.
    - b. Gaskets: Closed cell neoprene.
    - c. Insulation: 1 pound density fiberglass.
    - d. Hinges: Stainless steel.
    - e. Latches:
      - 1) Aluminum-zinc alloy.
      - 2) Outside lever handle.
      - 3) Adjustable spacer.
      - 4) Beveled inside flange.
      - 5) Studs:
        - a) Minimum 3/8 inches diameter stud for doors up to 24 inches wide x 48 inches high.
        - b) Minimum 1/2 inches diameter stud for doors larger than 24 x 48 inches.
  - 2. Fabrication:
    - a. Provide four-side continuous gaskets.
    - b. Utilize continuous piano hinges.
    - c. Latches required:
      - 1) 12 inches in any direction: One.
      - 2) Up to 18 x 18 inches: Two.
      - 3) Up to 24 x 48 inches: Two with inside handles.
      - 4) Up to 24 x 72 inches: Three with inside handles.
      - 5) Minimum door size: 12 x 12 inches.
- F. Flexible Duct:
  - 1. Material: Continuous steel supporting spiral covered with 100% continuous filament fiberglass with nonporous fiberglass/vinyl liner and reinforced Mylar/neoprene outer cover.
  - 2. UL listed, Class 1 with flame spread of 25 or less and smoke development rating not to exceed 50.
- G. Drain Pan:
  - 1. Materials: Aluminum.
  - 2. Fabrication: 0.080 inches.
- H. Backdraft Dampers:
  - 1. Material:
    - a. G90 galvanized steel.
    - b. Blade edge seals: Extruded vinyl.
  - 2. Fabrication:
    - a. Frame thickness: 16 gage minimum.
    - b. Blade thickness: 18 gage minimum.
    - c. Linkage: 1/2 inches tie bars.
    - d. Bearings: Synthetic.
- I. Diffusers:
  - 1. Materials:
    - a. Body: Extruded aluminum.
    - b. Ceiling diffuser gaskets: Sponge rubber.



2. Fabrication:
  - a. Type: Square or rectangular with removable core.
  - b. Key operated opposed blade damper mounted in neck except where indicated on Drawings to be omitted.
    - 1) Dampers to be housed in round to square adapters.
  - c. Linear supply diffusers:
    - 1) Internal pattern control vanes which also function as volume control dampers, adjustable through slots.
    - 2) Mounting: Hanger inside ductwork.
    - 3) Length: As indicated on Drawings.
    - 4) Number of slots, size, location, and throw: See Drawings.
  - d. Finish:
    - 1) Interior of perforated supply and return diffusers: White unless noted otherwise.
    - 2) Exterior of perforated supply and return diffusers: White unless noted otherwise.
- J. Linear Slot Diffusers:
  1. Materials:
    - a. See Diffuser, Register, and Grille schedule for quantity of slots and length of diffuser.
    - b. The supply diffusers shall have aerodynamically curved "ice-tong" shaped pattern controllers for 180 degree air pattern control and airflow dampering, if required.
    - c. The return units shall match the supply units in appearance.
    - d. The diffuser border shall be extruded aluminum construction with extruded aluminum spacers and mitered end flanges, open ends, flush end caps, or flange end caps.
    - e. Continuous length units shall be provided with factory assembled corner modules to suit drawings and site conditions. Splice plates and alignment plates shall be provided to align continuous slot assemblies. The maximum section length shall be 72 inches.
    - f. The linear slot diffusers shall be compatible for surface mounting with the following border style:
      - 1) Suspended ceiling, ¾ inch frame.
  2. Paint Specification:
    - a. Finish:
      - 1) The diffuser face shall have a custom baked enamel finish in a color to match a customer supplied sample: White unless noted otherwise.
- K. Air Grille and Register Assembly:
  1. Materials:
    - a. Assembly: Extruded aluminum.
    - b. Gaskets: Sponge rubber.
  2. Fabrication:
    - a. Supply registers: Two sets individually adjustable louvers.
    - b. Exhaust and return registers: 45 degrees deflection front blades.
    - c. Dampers: Key-operated opposed blade.
    - d. Screws, duct collars, and transitions as required.
    - e. Finish:
      - 1) Manufacturer's standard factory applied finish.
      - 2) Color: White.
- L. Manually (Volume) Operated Dampers and Motorized Dampers:
  1. Material:
    - a. Body: 6063 T5 aluminum.
    - b. Seal blade edge: Extruded vinyl.
  2. Fabrication:
    - a. Frame thickness: 0.125 inches minimum.
    - b. Provide flanged connections.
    - c. Blades:

- 1) Two-position damper: Parallel blade.
  - 2) Mixing and volume damper: Opposed blade.
  - 3) Airfoil shape.
  - 4) Maximum 6 inches width.
  - d. Linkage: Concealed in frame.
  - e. Axles: 1/2 inches plated steel hex.
  - f. Bearings: Molded synthetic.
  - g. Seals:
    - 1) Jamb: Flexible compression type.
  - h. Control shaft: Removable, 1/2 inches diameter.
  - i. Air leakage (4 feet SQ damper) at 4 inches WG pressure: 99 cfm maximum.
  - j. Motors for motor operated damper: See Specification Section 23 09 00.
  - k. Provide outboard support for operator linkage where damper motor is to be installed outside of duct.
  - l. Provide stainless steel locking quadrants for manual (volume) dampers.
  - m. Provide fold out operator mounting bracket where damper motor is to be installed on face of damper or inside duct.
  - n. Finish: 215 R1 anodized.
- M. VAV Air Terminal Units:
- 1. Certifications:
    - a. AHRI Standard 880.
  - 2. Materials:
    - a. Casing:
      - 1) Galvanized steel:
        - a) Minimum 22-gauge.
    - b. Damper:
      - 1) Shaft: Steel.
      - 2) Blade: Steel:
        - a) Minimum 20-gauge.
      - 3) Bearings: Derlin.
        - a) Self-lubricating.
    - c. Coil: See Section 23 80 00.
    - d. Insulation:
      - 1) Fiber free elastomeric:
        - a) 1/2 inches minimum thickness.
        - b) Resistant to fungus and bacteria.
  - 3. Fabrication:
    - a. Casing:
      - 1) Constructed to limit air leakage to no more than 7 cfm at 0.5 inches W.C. pressure drop.
      - 2) All exposed insulation edges sealed.
      - 3) Slip and drive construction for attachment to ductwork.
    - b. Damper:
      - 1) Synthetic seal to limit close-off leakage.
      - 2) Seal marked to indicate damper position.
        - a) Non removable.
      - 3) Mechanical stop.
    - c. Electric Heating Coil: See Section 23 80 00.
  - 4. Capacity and size as indicated on the Drawings.
  - 5. Controls:
    - a. Actuators and controls to be provided per Section 23 09 00 by Temperature Controls Contractor.

N. Duct sealer:

1. NFPA rating of "Non-Combustible".
2. Flame spread rating: 25 or lower, in dry condition.
3. Smoke developed rating: 50 or lower, in dry condition.
4. Resistant to water and water vapors.
5. Comply with UL 181.
6. Pressure rupture rating: 16 inches WG, minimum.

**O. Louvers:**

1. 5 inches deep.
2. Vertical drainable with blades at 37-1/2 degrees.
3. Continuous blade appearance.
4. ASTM B221 extruded aluminum, alloy 6063T5, minimum 0.081 inches thick.
5. Minimum free area: As scheduled.
6. Maximum pressure drop: As scheduled.
7. AMCA certified.
8. Greenheck "EVH-501".
9. Bird screen:
  - a. 1/2 inches SQ mesh.
  - b. 16 GA aluminum.
  - c. Install in standard, folded frame.
10. Anchors, fasteners, reinforcing: Aluminum or stainless steel.
11. Finish:
  - a. Meet requirements of AAMA 2605.
    - 1) PVDF coating with minimum 70% resin content.
    - 2) Color selected by architect from manufacturer standard colors.
12. Size: Refer to Mechanical Drawings for louver size, and refer to Architectural Drawings for louver elevations.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. See Specification Section 01 61 03.
- B. Metal Ductwork:
1. Install with longitudinal seams sealed for zero leakage.
    - a. For welded seams, submit sample for approval by Engineer.
  2. Install gaskets at each transverse joint and fasten sections together with bolts.
    - a. Tighten for zero leakage.
  3. Install supports and hangers with anchors in accordance with SMACNA HVAC Duct Construction Standards.
  4. Install turning vanes in square elbows:
    - a. Unsupported vane length not to exceed 48 inches.
    - b. Position vanes at proper angle to meet specified pressure drop.
  5. Install flexible connections at fans:
    - a. Locate as close as possible to fan.
    - b. Allow 1 inch of slack to prevent vibration transmission.
    - c. Install thrust restraints across connectors.
  6. Install access doors where indicated on Drawings and at smoke and fire damper in accordance with NFPA requirements.
  7. Volume extractors:
    - a. Install at supply registers, grilles, diffusers and supply branch connections from ducts.

- b. Provide branch duct extensions into main duct above and below extractor when branch duct is narrower than main duct.
  - 8. All insulation shall be external. internal duct liner or internal insulation shall not be utilized.
- C. Flexible Ductwork:
  - 1. Install in concealed areas between: low velocity duct work and diffusers, return air grilles or exhaust outlets and ducts.
  - 2. Use low loss fittings for connection to duct.
  - 3. Connect to metal duct collars by means of non-combustible synthetic rubber sealing compound and stainless steel drawband.
  - 4. Install with maximum length of 3 feet and no change in direction.
- D. Dampers:
  - 1. Install where indicated on Drawings of sizes shown.
  - 2. Install fire and smoke dampers in ductwork passing through 1 hour or higher fire-rated construction.
    - a. Install in wall and floor openings utilizing steel sleeves, angles and other materials following practices required to provide installation in accordance with local building codes.
- E. Diffusers:
  - 1. Install where shown on Drawings of size and capacities scheduled on Drawings.
  - 2. Install painted lay-in type in lay-in ceilings.
  - 3. Install prime painted diffusers in areas where duct work is concealed.
  - 4. Install anodized diffusers in exposed duct work.
- F. Air Grille and Register Assemblies:
  - 1. Install where shown on Drawings of size and capacities scheduled on Drawings.
  - 2. Install prime painted grilles and registers in areas where duct work is concealed.
    - a. Field paint to match adjacent surface finish.
- G. Louvers:
  - 1. Install in accordance with manufacturer's instructions.
    - a. Provide anchoring and bracing accessories as required.
    - b. Seal around perimeter on exterior and interior.
      - 1) See Specification Section 07 92 00.
    - c. Provide aluminum flashing at sill to match louver.
      - 1) See Specification Section 07 62 00.
- H. Roof-mounted Intake Hoods: Install where shown on Drawings.

**3.2 CLOSEOUT ACTIVITIES**

- A. Refer to Section 01 81 33 – Cyber-Security Requirements for cyber security related closeout requirements.

**END OF SECTION 23 31 00**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Heating, ventilating, and cooling equipment.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 01 61 03 - Equipment - Basic Requirements.
  - 2. Section 23 05 93 - HVAC Systems - Balancing and Testing.
  - 3. Section 23 09 00 - Instrumentation and Control for HVAC Systems.
  - 4. Section 23 31 00 - HVAC - Ductwork.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Air Movement and Control Association (AMCA).
    - a. AMCA Publication 203 "Field Performance Measurement of Fan Systems".
    - b. ANSI/AMCA 210 "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating".
  - 2. Air Conditioning and Refrigeration Institute (ARI).
  - 3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
    - a. HVAC Applications Handbook, Chapter entitled "Sound and Vibration Control."
    - b. 20, Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.
    - c. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
  - 4. Canadian Standards Association (CSA).
  - 5. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 6. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 7. National Roofing Contractors Association (NRCA).
  - 8. Underwriters Laboratories, Inc. (UL):
    - a. 507, Standard for Electric Fans.
  
- B. Miscellaneous:
  - 1. Gage thickness specified herein shall be manufacturer's standard gage for steel and Brown and Sharpe gage for non-ferrous metals.
  - 2. Corrosion protection of equipment to be as specified herein.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Wiring diagrams.
    - d. Control diagrams.

- e. Manufacturer's catalog cuts and technical data.
- f. Fan curves.
- g. Sound data.
- h. Vibration isolation.
- i. Performance data on all equipment.
- 2. Certifications:
  - a. Fan systems have been tested in accordance with AMCA Standard 210 or 260, and are licensed to bear the AMCA Certified Ratings Seal.
- B. Factory Performance test for any fan having a flow rate greater than 1,000 cfm and/or a total static pressure rating equal to or greater than 1.5 inches WC.
  - 1. Pursuant to AMCA Publication 203 or 210 with no plus tolerances on Power and no minus tolerances on flow or pressure.
- C. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Vibration isolation assemblies:
    - a. Mason.
    - b. Vibration Mounting and Controls Co.
    - c. Vibro-Acoustics.
  - 2. Roof-mounted centrifugal exhaust fans:
    - a. Loren Cook.
    - b. Greenheck.
    - c. PennBarry Ventilator Co., Inc.
  - 3. High Volume, Low Speed Fans:
    - a. Big Ass Fans.
    - b. MacroAir.
    - c. Airmax.

### **2.2 GENERAL**

- A. All Manufactured Units:
  - 1. Comply with Specification Section 23 05 13.
  - 2. Factory wired and assembled.
  - 3. Use fasteners made of same material as unit.
  - 4. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
    - a. Type: As per Table 47, Chapter 48, ASHRAE HVAC Applications Handbook.

### **2.3 MANUFACTURED UNITS**

- A. Roof-Mounted Centrifugal Exhaust Fans:

1. AMCA certified.
  2. Non-overloading horsepower capability.
  3. Materials:
    - a. Top cap: Spun aluminum.
    - b. Wheel and inlet shroud: Aluminum.
    - c. Baffle: Aluminum.
    - d. Base: One-piece aluminum.
    - e. Drive assembly supports: Steel.
    - f. Drive shaft: Solid stainless steel.
    - g. Minimum 10 GA motor mounting plate.
  4. Backward inclined blades.
  5. Tapered inlet shroud.
  6. Statically and dynamically balanced wheel.
  7. Bearings:
    - a. Cast iron pillow blocks.
    - b. Concentric bearing locking collar for drive shafts 1 inch and larger.
      - 1) SKF "ConCentra."
      - 2) Dodge "D Lock."
    - c. Regreaseable.
    - d. 200,000 hour average life.
    - e. 5-to-1 load capability to actual load ratio.
  8. Weathertight compartment for motor and drives.
    - a. Separated from airstream.
  9. Motor:
    - a. See Specification Section 23 05 13.
    - b. Belt Drive Units:
      - 1) Driver and driven sheaves:
        - a) Keyed hub type.
        - b) Drive sheaves: Fixed pitch diameter.
      - c) Driver:
        - (1) Shipped with variable pitch diameter sheave.
        - (2) Fixed pitch diameter size based on approved test and balance reports.
      - d) V-belt drives sized for 150% motor horsepower.
    - 2) Automatic drive belt tensioner.
    - c. Vibration isolated drive assembly.
  10. Accessories:
    - a. Prefabricated insulated aluminum roof curb.
    - b. Backdraft damper: See Specification Section 23 31 00.
    - c. Bird screen.
    - d. Extended grease lines and fittings.
  11. Size and capacity as scheduled on Drawings.
- B. High Volume, Low Speed Fan:**
1. UL listed.
  2. AMCA certified.
  3. Materials:
  4. VFD:
    - a. Capable of integration with building automation systems.
    - b. Digital wall controller.
    - c. Operating temperature of up to 131°F ambient conditions.
    - d. IP66-rated aluminum enclosure for protection in harsh environments.
  5. Blades:
    - a. Straight with contoured shape.
    - b. Rolled edges.
    - c. Weight balanced.

6. Mounting Post:
  - a. A36 steel
  - b. No critical welds
  - c. Powder coated for corrosion resistance.
7. Safety cables:
  - a. Safety cables that provide additional means for securing the fan assembly to the building structure.
8. Digital Variable Speed Wall Controller:
  - a. Fan shall be equipped with a digital variable speed wall controller. Controller shall be wall-mounted with a touch interface.
  - b. Controller shall provide fan start/stop, speed, and direction control functions.
9. Motor:
  - a. See Specification Section 23 05 13.
  - b. Permanent magnet brushless motor rated for continuous operation at maximum speed with the capability of modulating the fan speed from 0-100% without the use of a gearbox or other mechanical means of control.
  - c. Totally enclosed in IP66-rated enclosure.
10. Guy Wires:
  - a. Provide guy wires to limit potential for lateral movement.
11. Accessories:
  - a. LED light kit.
  - b. Down-rod.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with Specification Section 23 05 13.
- B. Install fixed pitched drive sheave after sheave has been sized based on accepted test and balance report.
- C. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated and fan has been test run under observation.
- D. HVLS fans shall have a typical bar joist or existing I-beam structure from which to mount the fan.
- E. Mounting structure shall be able to support the weight and operational torque of the HVLS fan.
- F. HVLS fans location shall be free from obstacles such as lights, cables, or other building components. Consult manufacturer's installation instructions.

### **3.2 FIELD QUALITY CONTROL**

- A. Comply with Specification Section 23 05 93.

### **3.3 ADJUSTING**

- A. Install new filters on units which have been running prior to acceptance of Project.



**END OF SECTION 23 34 00**

# SECTION 23 42 00 - PIPE, DUCT AND EQUIPMENT INSULATION

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section Includes:
  - 1. Insulation:
    - a. Piping insulation.
    - b. Duct insulation.
    - c. Equipment insulation.
  - 2. Adhesives, mastics, sealants, and finishes.
  - 3. Grease and air ventilation duct wrap fire protection systems.

### 1.2 QUALITY ASSURANCE

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of Guarded-Hot-Plate Apparatus.
    - b. C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
    - c. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
    - d. C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
    - e. C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
    - f. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
    - g. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
    - h. E96, Standard Test Methods for Water Vapor Transmission of Materials.
    - i. F25, Standard Test Method for Sizing and Counting Airborne Particulate Contamination in Cleanrooms and Other Dust-Controlled Areas.
    - j. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
    - k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
    - l. E119 Standard Method of Fire Tests of Building Construction, 2 Hour Wall Panel Test, 2 Hour External Total Engulfment Test, hose stream evaluation.
    - m. E136, Combustion Characteristics of Building Materials in a Vertical Tube Furnace.
    - n. E162, Surface Flammability of Materials.
    - o. E814, Through-Penetration, 2-Hour Firestop Test.
    - p. E2336: Standard Test Methods Fire Resistive Grease Duct Enclosure Systems.
  - 2. ISO 6944-1985, Method of Determining Fire Resistance of Ventilation Ducts.
  - 3. National Fire Protection Association (NFPA):
    - a. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
  - 4. Underwriters Laboratories, Inc. (UL):
    - a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.
  - 5. National Commercial and Industrial Insulation Standards (2013 seventh edition).
    - a. Published by Midwest Insulation Contractors Association (MICA).
    - b. Endorsed by National Insulation Association (NIA).
    - c. MICA plate numbers listed in this specification reference this document.

## **SECTION 23 42 00 - PIPE, DUCT AND EQUIPMENT INSULATION**

### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Submit complete specification of insulation materials, adhesives, cement, together with manufacturer's recommended methods of application and coverage for coatings and adhesives.
  - 2. Submit itemized schedule by building of proposed insulation systems showing density, thermal conductivity, thickness, adhesive, jackets and vapor barriers.
  - 3. Certifications: Products will meet the requirements of the Contract Documents.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Elastomeric insulation:
    - a. Rubatex.
    - b. Armstrong.
  - 2. Fiberglass insulation:
    - a. CertainTeed Corporation.
    - b. Johns Manville.
    - c. Owens Corning.
    - d. Knauf.
  - 3. PVC jacket:
    - a. Ceel-Co.
    - b. PIC Plastics.
  - 4. Equipment insulation:
    - a. CertainTeed Corporation.
    - b. Johns Manville.
    - c. Owens Corning.
  - 5. Ductwork insulation:
    - a. CertainTeed.
    - b. Johns Manville.
    - c. Owens Corning.
  - 6. High density perlite:
    - a. Johns Manville.
    - b. Industrial Insulation Group (LIC).
  - 7. High density calcium silicate:
    - a. Industrial Insulation Group (LIC).
  - 8. Adhesives, mastics, sealants, and finishes:
    - a. Foster Products.
    - b. Childers.
    - c. Dow Corning.
    - d. Johns Manville.
    - e. Knauf.

## **SECTION 23 42 00 - PIPE, DUCT AND EQUIPMENT INSULATION**

### **2.2 PIPING INSULATION - ELASTOMERIC**

- A. General:
  - 1. Insulation fire and smoke hazard ratings for composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation), as tested by procedure ASTM E84, NFPA 255 and UL 723, not exceeding:
    - a. Flame spread: 25.
    - b. Smoke developed: 50.
  - 2. Accessories (adhesives, mastics, cements, and tapes: Same component ratings as listed above.
  - 3. Indicate on product labels or their shipping cartons: Flame and smoke ratings do not exceed above requirements.
  - 4. Permanent treatment of jackets or facings to impart flame and smoke safety is required.
    - a. Water-soluble treatments are prohibited.
  - 5. Insulated shields at pipe support points.
- B. Pipe, Fitting, and Valve Insulation:
  - 1. Flexible elastomeric closed cell pipe insulation.
    - a. Average thermal conductivity not to exceed 0.27 (BTU-IN)/(HR-FT<sup>2</sup>-DEGF) at mean temperature of 75 degrees F, temperature range -40 to 220 degrees F; permeability not to exceed 0.20 by ASTM E96; water absorption 3% by ASTM D1056 and ozone resistance.
  - 2. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

### **2.3 PIPING INSULATION - FIBERGLASS**

- A. Pipe and Fitting Insulation:
  - 1. Preformed fiberglass pipe insulation:
    - a. Density: 4 pounds/CUFT.
    - b. Temperature rated: 650 degrees F.
    - c. Average thermal conductivity not to exceed 0.23 (BTU-IN)/(HR-FT<sup>2</sup>-DEGF) at mean temperature of 75 degrees F.
    - d. Fire hazard rating:
      - 1) UL 723, ASTM E84, NFPA 255.
      - 2) Flame spread not exceeding 25 and smoke developed not exceeding 50.
  - 2. Moisture adsorption:
    - a. ASTM C553.
    - b. Not greater than 5% moisture by volume when exposed to moisture laden air at 120 degrees F and 96% RH.
  - 3. Fungi and bacteria resistance:
    - a. ASTM C665.
    - b. Does not breed or promote growth.
    - c. Flame attenuated glass fibers bonded with thermosetting resin.
  - 4. Piping jackets (general applications):
    - a. Aluminum: 16 mil embossed aluminum.
    - b. PVC: Preformed 0.028 inches thick PVC jackets fabricated from Johns Manville, or approved equal, PVC sheeting V-66 with proven resistance to ultraviolet degradation when temperatures do not exceed the limits of PVC.
    - c. Piping jacket not required on concealed piping.
  - 5. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

## **SECTION 23 42 00 - PIPE, DUCT AND EQUIPMENT INSULATION**

### **2.4 PIPE INSULATION INSERTS AT HANGERS**

- A. High Density Perlite:
  - 1. Pre-formed.
  - 2. Fire hazard rating:
    - a. UL 723, ASTM E84, NFPA 255.
    - b. Flame spread: Zero.
    - c. Smoke developed: Zero.
  - 3. Average density: 13 pounds/CUFT.
  - 4. Compressive strength: 80 psi to produce 5% compression.
  - 5. Maximum surface temperature: 1,200 degrees F.
  
- B. High Density Calcium Silicate:
  - 1. Pre-formed.
  - 2. Fire hazard rating:
    - a. UL 723, ASTM E84, NFPA 255.
    - b. Flame spread: Zero.
    - c. Smoke developed: Zero.
  - 3. Average density: 14 pounds/CUFT.
  - 4. Compressive strength: 100 psi to produce 5% compression.
  - 5. Maximum surface temperature: 1,200 degrees F.

### **2.5 DUCTWORK INSULATION: FIBERGLASS**

- A. Flexible Insulation:
  - 1. Material: Commercial-grade fiberglass thermal insulation, formaldehyde free.
  - 2. Scheduled thickness and installed R-value. Installed R-value when compressed to a maximum of 25% following recommended duct wrap stretch outs.
  - 3. Factory-applied foil scrim vapor barrier facing.
  - 4. Average thermal conductivity not to exceed 0.27 (BTU-IN)/(HR-FT<sup>2</sup>-DEGF) at a mean temperature of 75 degrees F (installed).
  - 5. Fungi and bacteria resistance:
    - a. ASTM C1338.
    - b. Does not breed or promote growth.
  - 6. Fire hazard classification:
    - a. UL 723, ASTM E84, NFPA 255.
    - b. Flame spread not exceeding 25 and smoke developed not exceeding 50.
  - 7. Basis of design: Johns Manville Microlite fiberglass duct wrap insulation.
  
- B. Semi-Rigid Insulation for Indoor Installation:
  - 1. Scheduled thickness and R-value.
  - 2. Factory applied vapor barrier facing-white or paintable scrim foil.
  - 3. Average thermal conductivity not to exceed 0.23 (BTU-IN)/(HR-FT<sup>2</sup>-DEGF) at a mean temperature of 75 degrees F.
  - 4. Fungi and bacteria resistance:
    - a. ASTM C1338.
    - b. Does not breed or promote growth.
  - 5. Moisture adsorption:
    - a. ASTM C553.
    - b. Not greater than 0.5% moisture by volume when exposed to moisture laden air at 120 degrees F and 96% RH.
  
- C. Semi-Rigid Insulation for Outdoor Installation:

## **SECTION 23 42 00 - PIPE, DUCT AND EQUIPMENT INSULATION**

1. Scheduled thickness and R-value.
  2. Factory-applied foil scrim vapor barrier facing.
  3. Average thermal conductivity not to exceed 0.23 (Btu-IN)/(HR-FT<sup>2</sup>-DegF) at mean temperature of 75 degrees F.
  4. Minimum density: 3 pounds/CUFT.
  5. Fungi and bacteria resistance:
    - a. ASTM C1338.
    - b. Does not breed or promote growth.
  6. Basis of Design: Johns Manville #815 SPIN-GLASS fiberglass duct insulation.
- D. Grease Duct and Ventilation Duct Wrap Fire Protection Systems:
1. High temperature flexible fireproof wrap.
  2. Fire rating: 1 HR.
  3. Minimum thickness: 1-1/2 inches.
  4. Density: 6 pcf.
  5. Flame spread not exceeding 25 and smoke developed not exceeding 50.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. General:
1. Piping below ground covered with earth will not be insulated except as specified in Specification Section 40 05 25.
  2. Consider ductwork, piping and equipment as exposed, except as otherwise indicated.
  3. Consider ductwork, piping and equipment in walls, partitions, floors, pipe chases, pipe shafts and duct shafts as concealed.
    - a. Consider ductwork, piping and equipment above ceilings as concealed.
  4. Provide release for insulation application after installation and testing is complete.
    - a. Apply insulation on clean, dry surfaces after inspection.
  5. Provide insulation continuous through wall, roof and ceiling openings, pipe hangers, supports and sleeves.
  6. Provide insulation with vapor barrier for piping, ductwork and equipment where surfaces may be cooler than surrounding air temperatures.
    - a. Provide vapor barrier (0.17 perm-IN; ASTM C553) continuous and unbroken.
    - b. Hangers, supports, anchors, and related items that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.
  7. Apply specified adhesives, mastics and coatings at the manufacturer's recommended coverage per unit volume.
- C. Piping Insulation - Elastomeric:
1. Do not insulate until satisfactory completion of required pressure testing.
  2. Apply insulation to clean, dry surfaces.
  3. Slip insulation on pipe prior to connection.
    - a. Whenever the slip-on technique is not possible provide insulation neatly slit and snapped over the pipe.
  4. Fabricate and install fitting cover insulation according to manufacturer's recommendations.
  5. Seal joints, slits, miter-cuts and other exposed edges of insulation with adhesive, recommended by the insulation manufacturer, to ensure complete vapor barrier.

## **SECTION 23 42 00 - PIPE, DUCT AND EQUIPMENT INSULATION**

- D. Piping Insulation - Fiberglass:
  - 1. Apply over clean dry pipe.
    - a. Butt all joints together firmly.
  - 2. Seal joints, slits, miter-cuts and other exposed edges of insulation as recommended by the insulation manufacturer.
  - 3. Insulate fittings, valves, and flanges with insulation thickness equal to adjacent pipe.
  - 4. PVC pipe jacket:
    - a. Apply jacketing with a minimum of 1 inch overlap.
      - 1) Weld longitudinal and circumferential seams with adhesives as recommended by manufacturer.
    - b. Provide slip-joints every 30 feet and between fittings if distance exceeds 8 feet.
      - 1) Construct slip-joints by overlapping jacket sections 6 to 10 inches.
    - c. Provide pre-molded PVC covers of same material and manufacturer as jacket for fittings, valves, flanges, and related items in insulated piping systems.
  - 5. Aluminum pipe jacket:
    - a. Field-applied aluminum jacket with vapor-sealed longitudinal and butt joints.
    - b. Provide smooth and straight joint with a minimum 2 inches overlap.
    - c. Secure joints with corrosion-resistant screws spaced 0.25 to 0.50 inches back from edge.
    - d. Center spacing of screws 5 inches maximum or as required to provide smooth tight-fitted joints.
    - e. Place joints on least exposed side of piping to obtain neat appearance.
- E. Equipment: Install per manufacturer's instructions.
- F. Ductwork Insulation - Fiberglass:
  - 1. All insulation shall be external. internal duct liner or internal insulation shall not be utilized.
  - 2. Flexible insulation:
    - a. Butt edges tightly.
      - 1) Secure insulation with Benjamin Foster 85-20 adhesive applied in 6 inches strips on 12 IN centers and/or pins, applied on not more than 18 inches centers so that the insulation conforms to the duct surfaces uniformly and firmly.
    - b. Seal joints with facing overlap or 4 inches wide strips of like facing material adhered and stapled in place.
    - c. Properly seal any penetration in vapor barrier facing with Benjamin Foster 85-20.
    - d. Cut insulation slightly longer than the perimeter of the duct to ensure full thickness at corners.
  - 3. Semi-rigid insulation
    - a. Impaling over pins.
      - 1) Apply insulation with edges tightly butted.
      - 2) Apply insulation with mechanically welded fasteners to the duct and secured with speed clips.
      - 3) Clip pins off close to clip.
      - 4) Space pins as required to hold insulation firmly against duct surface but not less than one pin per 1.5 square feet.
      - 5) Seal joints and speed clips with 3 inches wide strip of facing adhered with Benjamin Foster 85-20 adhesive.
    - b. If the welded pin method is impossible, secure insulation to the duct with Benjamin Foster 85-20 adhesive.
      - 1) Cover the entire surface of duct with adhesive.
      - 2) Use corner metal angle to protect edge of insulation.
      - 3) Protect edge of insulation.
      - 4) Seal joints as above.
    - c. For outdoor application finish with Benjamin Foster #4610 weatherproof mastic with white glass fabric membrane.

## SECTION 23 42 00 - PIPE, DUCT AND EQUIPMENT INSULATION

### 3.2 REPAIR

- A. Whenever any factory applied insulation or job-applied insulation is removed or damaged, replace with the same quality of material and workmanship.

### 3.3 SCHEDULES

- A. Refrigeration Lines (35-60 degrees F):
1. Elastomeric.
  2. 1/2 inches thickness for lines 1 inch and smaller.
- B. Pipe, Fittings and Valves:
1. Fiberglass.

<u>APPLICATION</u>	<u>PIPE SIZE</u>	<u>THICKNESS</u>	<u>JACKET</u>
Roof Drainage	2-1/2 to 6 inches	1/2 inches	PVC
Hot Water (domestic)	1-1/2 inches and less	1 inch	PVC
	Over 1-1/2 inches	1-1/2 inches	PVC
Cold Water (domestic)	All sizes	1 inch	PVC
Refrigeration Lines (35 - 60 degrees F)	All	1 inch	PVC

- C. Ductwork:
1. Fiberglass.

<u>DUCT SERVICE</u>	<u>INSULATION AND THICKNESS</u>	<u>MINIMUM R-VALUE (HR-FT<sup>2</sup>-DEGF)/BTU</u>
Outside air and supply air downstream of heat recovery units, outside building	2-1/2 inches semi-rigid for outdoor installation	12.0
Supply and return air ducts inside building	2 inches flexible with vapor barrier	6.0
Supply and return air ducts outside building and where exposed to atmospheric air	2-1/2 inches semi-rigid for outdoor installation	12.0
Return air duct in non-conditioned areas including shafts	2-1/2 inches flexible with vapor barrier	12.0
Exhaust air ducts upstream of heat recovery units, inside building	1-1/2 inches semi-rigid	6.0
Exhaust air ducts upstream of heat recovery units, outside building	2-1/2 inches semi-rigid for outdoor installation	12.0
All other ductwork	Uninsulated	N/A



**SECTION 23 42 00 - PIPE, DUCT AND EQUIPMENT INSULATION**

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**END OF SECTION 23 42 00**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Refrigeration piping system.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
    - a. 15, Safety Code for Mechanical Refrigeration.
  - 2. ASTM International (ASTM):
    - a. B280, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
  - 3. Federal Specification (FS):
    - a. WW-T-799, Tube, Copper, Seamless, Water (For Use With Solder-Flared or Compression-Type Fittings).

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
  - 2. Test reports:
    - a. A dated declaration of the test of the refrigerant piping for each system shall be provided.
      - 1) The dated declaration shall include the information outlined in Article 12.3 of ASHRAE 15.
    - b. Test reports of the refrigerant piping leak tests for all refrigerant piping systems installed.
    - c. The test reports shall contain the following information:
      - 1) System refrigerant and high and low side pressure used.
      - 2) Listing of the necessary repairs made before the refrigerant piping system passed the leak test.
      - 3) Identification of specific system by referencing specific equipment identification numbers.
      - 4) Leak testing media used.
      - 5) Suction and discharge refrigerant gas pressures and temperatures taken after the refrigerant system has been charged.
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Refer to Section 01 81 33 – Cyber Security Requirements for required cyber security related submittals.

**1.4 WARRANTY**

- A. The completed refrigerant piping system shall be guaranteed to be sufficiently free from leaks so that the loss of refrigerant for 18 months from the date of final payment shall not exceed 5 percent.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Refrigerant piping specialties:
    - a. Sporlan.
  - 2. Expansion valves:
    - a. Sporlan.
    - b. Alcoa.
  - 3. Silver solder - "Easy-Flow 45 inches":
    - a. Harman.
  - 4. Moisture indicator - "SEE-ALL":
    - a. Sporlan.

**2.2 REFRIGERANT PIPING AND FITTINGS**

- A. Refrigerant Piping:
  - 1. Copper tubing conforming to ASTM B280 and/or FS WW-T-799, dehydrated for refrigerant use, with high-temperature soldered joints and wrought copper (400 psiG) fittings.
    - a. For underground use: Type K.
    - b. For aboveground use: Type L.
- B. Piping Joints:
  - 1. Joints between copper tubing and fittings to be high temperature soldered (melting point not less than 1000 degrees F, but less than that of the metal being joined) with phos-copper alloys.
  - 2. Joints between copper and brass, steel, etc., shall be silver soldered only.
    - a. Silver solder to be Handy Harmon "Easy-Flow 45."
- C. Precharged Line Sets: Size per manufacturer's recommendations.
- D. Field Assembled Units:
  - 1. Size refrigeration lines according to manufacturer's published tables using pressure or temperature drops as follows:
    - a. Suction lines: 2 degrees F.
    - b. Liquid lines: 1 degree F or 2 psi.
    - c. Hot gas lines: 1 degree F or 3.6 psi.
    - d. Size discharge and hot gas risers for positive oil return to compressors.
- E. Hangers: As specified in Specification Section 40 05 07.

**2.3 REFRIGERANT PIPING SPECIALTIES**

- A. Refrigerant Dryer:
  - 1. Sporlan material "CATCH-ALL" filter-drier with aluminum molded core:
  - 2. In each liquid line.
  - 3. A three-valve bypass around filter-drier.
  - 4. Install so core can be removed without cutting or breaking any refrigerant line.
  
- B. Moisture Indicator:
  - 1. Show presence of moisture in system by change of color.
  - 2. Install full size in the main liquid line adjacent to the filter-drier.
  - 3. Use Sporlan "SEE-ALL."
  
- C. Strainers:
  - 1. Design to permit removing screen without removing strainer from piping system.
  - 2. Screens not larger than 80 mesh.
  - 3. Strainers on liquid line serving each thermostatic expansion valve and in suction line serving each refrigerant compressor not equipped with integral strainer.
  
- D. Oil Traps: Provide in lines as indicated.

**2.4 VALVES**

- A. All Valves:
  - 1. All bronze.
  - 2. 2 inches and less: Solder ends.
  - 3. 3 inches and over: Four bolt union ends.
  
- B. Shut-Off Valves:
  - 1. Packed type with gas-tight cap seal and hard metal seats and shoulders which permit packing stuffing boxes wide open under pressure; or sealed diaphragm type.
  - 2. Wheel, globe, angle or "T" handle.
  
- C. Check Valves:
  - 1. In liquid lines 5/8 inches and less: Lift check type.
  - 2. In lines 3/4 to 2 inches: Swing check type.
  - 3. In lines 3 inches and over: Wafer type swing check with bronze disc.
  
- D. Expansion Valves:
  - 1. Sized by manufacturer for refrigerant used.
  - 2. Provide one in each circuit with liquid distributor connection immediately after.
  
- E. Vent and Test Valves: Angle cap type with seal and outlet caps.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Precharged Line Sets: Install per manufacturer's recommendations.
  
- B. Field Assembled Lines:

## **SECTION 23 74 36 - REFRIGERANT PIPING SYSTEM**

1. Refrigerant piping:
  - a. In accordance with Specification Section 40 05 00.
  - b. Purge refrigerant piping of all air while connections of refrigerant piping are being made.
    - 1) Shut-off valves.
    - 2) Connect tank of dry nitrogen to line on back side of valve.
    - 3) Introduce dry nitrogen into line as refrigerant piping joints are successively made up from valve to each condenser.
2. Testing:
  - a. Refrigerant piping systems: Follow general testing guidelines of ASHRAE 15, except as modified herein.
  - b. Pressurize the high and low pressure sides of the piping system after completion of the refrigerant piping.
    - 1) Pressurize at the test pressures specified in ASHRAE 15 for the refrigerant type to be used in the system.
  - c. Repair any leaks and repeat tests until no further leaks are found and the system passes a static leak test at test pressure for a duration of 24 hours.
3. Cleaning:
  - a. Disconnect suction and discharge lines from compressor for clean up after complete system is tested.
  - b. Valve or blank off system into three separate systems for purpose of cleanup.
    - 1) Suction side including cooling coils.
    - 2) Discharge side including air cooled condenser.
    - 3) Hot gas reheat side including heating DX coils.
  - c. Thoroughly clean each system using pumped refrigerant until system is proven clean to satisfaction of refrigeration compressor serviceman.
  - d. Notify Engineer for a visual inspection of both cleaning process and completely cleaned system.
4. Evacuation and Drying:
  - a. After tests and cleaning have been completed and system proved tight, charge each circuit with dry clean refrigerant to gas pressure as recommended by the equipment manufacturer.
  - b. Evacuate to 100 micron Hg and hold for 72 hours.
    - 1) Use laboratory type vacuum pump capable of holding absolute pressure of 50 micron Hg.
    - 2) Check the vacuum with a suitable mercury column gage.
  - c. Admit another drying charge of refrigerant and allow 4 to 6 hours to absorb moisture and install dryer cores.
  - d. Use second evacuation to remove all refrigerant and moisture.
  - e. After second evacuation, charge system with refrigerant.
  - f. Charge the system with refrigerant as required after final evacuation.

### **3.2 CLOSEOUT ACTIVITIES**

- A. Refer to Section 01 81 33 – Cyber-Security Requirements for cyber security related closeout requirements.

**END OF SECTION 23 74 36**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Heating, ventilating, and cooling equipment.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 01 61 03 - Equipment - Basic Requirements.
  - 2. Section 23 05 93 - HVAC Systems - Balancing and Testing.
  - 3. Section 23 09 00 - Instrumentation and Control for HVAC Systems.
  - 4. Section 23 31 00 - HVAC - Ductwork.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Air Movement and Control Association (AMCA).
  - 2. Air Conditioning and Refrigeration Institute (ARI).
  - 3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
    - a. HVAC Applications Handbook, Chapter entitled "Sound and Vibration Control."
    - b. 20, Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.
    - c. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
  - 4. Canadian Standards Association (CSA).
  - 5. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 6. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 7. National Roofing Contractors Association (NRCA).
  - 8. Underwriters Laboratories, Inc. (UL):
    - a. 507, Standard for Electric Fans.
- B. Miscellaneous:
  - 1. Gage thickness specified herein shall be manufacturer's standard gage for steel and Brown and Sharpe gage for non-ferrous metals.
  - 2. Corrosion protection of equipment to be as specified herein.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Fabrication and/or layout drawings.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Wiring diagrams.
    - d. Control diagrams.
    - e. Manufacturer's catalog cuts and technical data.
    - f. Corrosion-protection information.

- g. Fan curves.
  - h. Sound data.
  - i. Vibration isolation.
  - j. Control description.
  - k. Performance data on all equipment.
3. Certifications:
- a. Provide certification of thickness of corrosion-protection coating.
- B. Contract Closeout Information:
- 1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Refer to Section 01 81 33 – Cyber Security Requirements for required cyber security related submittals.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 1. Vibration isolation assemblies:
    - a. Mason.
    - b. Vibration Mounting and Controls Co.
    - c. Vibro-Acoustics.
  - 2. Cooling and Heating coils - direct expansion:
    - a. Carrier.
    - b. AAON.
    - c. TRANE.
  - 3. Heating coil - electric:
    - a. Carrier.
    - b. TRANE.
    - c. AAON.
  - 4. Fan coils:
    - a. Carrier.
    - b. TRANE.
    - c. AAON.
  - 5. Make-up air units, electric:
    - a. Hastings.
    - b. TRANE.
    - c. AAON.
    - d. Carrier.
  - 6. Air-cooled Heat Pump units - split system:
    - a. Bosch.
    - b. Carrier.
    - c. AAON.
    - d. TRANE.
  - 7. Packaged roof-top AC units:
    - a. TRANE.
    - b. AAON.
    - c. Carrier.

**2.2 GENERAL**

- A. All Manufactured Units:
  - 1. Comply with Specification Section 01 61 03.
  - 2. Factory wired and assembled.
  - 3. Use fasteners made of same material as unit.
  - 4. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
    - a. Type: As per Table 47, Chapter 48, ASHRAE HVAC Applications Handbook.

**2.3 MANUFACTURED UNITS**

- A. Equipment Coils:
  - 1. Cooling and Heating coils - direct expansion:
    - a. ARI certified.
    - b. Material:
      - 1) Aluminum.
      - 2) Copper with aluminum fins for use in administration units only.
    - c. Fin spacing: Minimum 80 fins per foot.
    - d. Minimum standard operating limit: 250 psi.
    - e. Size and capacity as scheduled.
  - 2. Heating coil - electric:
    - a. ARI certified.
    - b. 80% nickel, 20% chromium elements.
    - c. Maximum heating density: 35 watts/SQIN.
    - d. Built-in thermal protection.
    - e. Airflow switch.
    - f. Built-in circuit fusing.
    - g. Control voltage transformer.
    - h. Terminal block.
    - i. Magnetic contactor.
    - j. Fused disconnect switch.
    - k. Step controller as required by instrumentation.
    - l. Single point electrical connection.
    - m. Size and capacity as scheduled on Drawings.
- B. Fan Coils:
  - 1. ARI certified.
  - 2. Coils: See paragraph(s) in Article 2.3, Equipment Coils.
  - 3. Blower:
    - a. Fan wheels: Centrifugal forward-curved, double width.
    - b. Fan housing: Galvanized steel.
    - c. Statically and dynamically balanced.
    - d. Motor:
      - 1) See Specification Section 01 61 03.
      - 2) Integral overload protection.
  - 4. Cabinet:
    - a. Material: Galvanized steel, 18 GA minimum.
    - b. Exposed units equipped with hinged access panel, intake and discharge grilles.
    - c. Concealed units equipped with return plenum, filter section and discharge duct collar.
  - 5. Drain pans:
    - a. Material: Galvanized steel.
    - b. Equip with drain connection.
    - c. Insulated.
  - 6. Filters: See Specification Section 23 31 00.



7. Size and capacity as scheduled on Drawings.
- C. Make-Up Air Units, Electric:
1. ARI certified.
  2. Sectionalized construction.
  3. Materials:
    - a. Cabinet: Galvanized steel.
    - b. Scroll housing: Galvanized steel.
  4. Blower section:
    - a. Blower wheels:
      - 1) Statically and dynamically balanced.
      - 2) Backward inclined.
      - 3) Mounted on solid turned ground steel shaft.
    - b. Bearings:
      - 1) Self-aligning grease lubricated ball type.
      - 2) Extended lubrication lines with external grease fittings.
      - 3) Average life rating: 200,000 hours.
    - c. Blower scrolls, bearings and adjustable base to be mounted on reinforced angle iron frame.
    - d. Internal spring isolation.
    - e. Driver and driven sheaves:
      - 1) Keyed hub type.
      - 2) Drive sheaves: Fixed pitch diameter.
      - 3) Driver: Variable pitch diameter sheave.
      - 4) V-belt drives sized for 150% motor horsepower.
    - f. Motors: See Specification Section 01 61 03.
    - g. Insulated cabinet.
  5. Heating(cooling) section:
    - a. Coils: See paragraph(s) in Article 2.3, Equipment Coils.
    - b. Insulated cabinet.
  6. Drain pan: Double pan construction, insulated.
  7. Accessories:
    - a. Factory-built heavy-duty filter section with access doors.
    - b. Filters: See Specification Section 23 31 00.
    - c. Combination Angular filter and mixing box with parallel acting blade dampers.
    - d. Face and bypass damper section with opposed blade dampers.
    - e. Inlet hood with birdscreen.
    - f. Prefabricated insulated roof curb.
  8. Motor starter.
  9. Size and capacity as scheduled on Drawings.
- D. Air-Cooled Heat Pump Units - Split System:
1. ARI rated.
  2. UL listed.
  3. Materials:
    - a. Casing: Galvanized steel.
    - b. Mounting/lifting rails: Steel.
    - c. Outdoor coil: Seamless aluminum tubing and aluminum fins.
    - d. Fan blades: Aluminum.
  4. Weatherproof casing:
    - a. Hail screen for condenser coil.
    - b. Access panels.
  5. Compressor:
    - a. Hermetically sealed.
    - b. Internal pressure protector.

- c. Crankcase heater.
  - d. Internal spring mounts.
  - e. Centrifugal oil pump.
  - f. Built-in overload protection.
  - 6. Condenser fans and motors:
    - a. Vertical discharge.
    - b. Direct drive.
    - c. Statically and dynamically balanced.
    - d. Motor:
      - 1) See Specification Section 01 61 03.
      - 2) Permanently lubricated bearings.
      - 3) Built-in current and thermal overload protection.
  - 7. Built-in refrigerant filter dryer.
  - 8. Built-in liquid line and gas line service valves with gage ports.
  - 9. Outdoor coil:
    - a. Fins mechanically bonded to tubing.
    - b. Lab tested to 2000 psi.
  - 10. 24 V factory-wired controls to include fusing and control power transformer.
  - 11. Size and capacity as scheduled on Drawings.
- E. Packaged Roof-Top AC Units:
- 1. UL listed.
  - 2. Designed for outdoor application.
  - 3. Unit construction:
    - a. Fabricate unit with 14 GA channel posts and panels secured with mechanical fasteners.
      - 1) Seal all panels, access doors, and ship sections with permanently applied bulb-type gasket.
      - 2) Loose shipped gasketing is not allowed.
    - b. Construct panels and access doors as a 2 inches nominal thick; thermal broke double wall assembly, injected with foam insulation for an R-value of not less than R-13.
      - 1) Construct the outer panel and inner liner of G90 galvanized steel.
    - c. Panel deflection:
      - 1) Do not exceed L/240 ratio at 125% of design static pressure, maximum positive or negative 8 inches of static pressure.
      - 2) Measure deflection at the midpoint of the panel height.
    - d. Casing leakage rate: Do not exceed 0.5 cfm per square foot of cabinet area at 6 inches of negative static pressure or 5 inches of positive static pressure.
    - e. Module to module assembly:
      - 1) Provide an overlapping, full perimeter, insulated, internal splice joint sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.
    - f. Entire unit:
      - 1) Provide with a 4 inches full perimeter base rail for structural rigidity and condensate trapping.
      - 2) Overhang the roof curb for positive water runoff and seat on the roof curb gasket to provide positive weather tight seal.
      - 3) Provide lifting lugs on unit base and with fork lift slots in unit base.
    - g. Access doors:
      - 1) Flush mounted to cabinetry, with minimum of two, 6 inches long stainless steel piano-type hinges, latch and full size (4.5 inches minimum) handle assembly (provide inspection window for fan section).
      - 2) Swing door outward for unit sections under negative pressure (inward for unit sections under positive pressure).

## SECTION 23 80 00 - HVAC - EQUIPMENT

- 3) Provide a secondary latch to relieve pressure and prevent injury upon access doors limited from swinging inward (such as side access filter sections) on positive pressure sections, shall have.
- h. Construct drain pans from stainless steel with cross break and double sloping pitch to drain connection.
  - 1) Provide drain pans under cooling coil section.
  - 2) Drain connection centerline: A minimum of 3 IN above the base rail to aid in proper condensate trapping.
  - 3) Drain connections that protrude from the base rail are not acceptable.
  - 4) There must be a full 2 inches thickness of insulation under drain pan.
4. Refrigerant condensing section:
  - a. Compressors:
    - 1) Inverter scroll type, with five year non-prorated warranty.
    - 2) Suction and discharge service valves.
    - 3) Crankcase heater.
    - 4) Thermal overload protection.
  - b. Refrigeration circuit:
    - 1) Sight glass.
    - 2) Filter dryer.
    - 3) Manual shut-off valve.
    - 4) High pressure relief valve.
    - 5) Refrigerant bypass valve between suction and discharge lines for low head pressure starting.
  - c. Compressor isolators.
  - d. Condenser coils:
    - 1) Nominal 3/8 inches OD seamless copper mechanically bonded to corrugated aluminum fins.
    - 2) Factory leak tested at 315 psiG under water.
  - e. Condenser fans:
    - 1) Direct drive: See Specification Section 01 61 03.
    - 2) Propeller-type.
  - f. Condenser fan motors:
    - 1) Heavy duty, inherently protected, non-reversing.
    - 2) Permanently lubricated bearings.
    - 3) Integral rain shield.
5. Cooling coil section:
  - a. Evaporator coils: See paragraph(s) in Article 2.3, Equipment Coils.
  - b. Evaporator coil circuiting:
    - 1) Adjustable thermal expansion valve per circuit with external equalizer.
    - 2) Combination row/split face circuiting.
  - c. Drain pan:
    - 1) Mastic-coated:
    - 2) Threaded drain connections.
6. Heating section:
  - a. Natural gas heater section:
    - 1) Heat exchanger:
      - a) Stainless steel combustion chamber.
      - b) Stainless steel header.
    - 2) Secondary heat exchanger: Stainless steel tubing.
    - 3) Condensate drain.
    - 4) Burner:
      - a) UL listed.
      - b) Forced draft type.
      - c) Flame supervision.
      - d) Internal prepurge timing.

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- e) Combustion air proving switch.
- f) Complete gas train including: Gas valve, main pressure regulator, main shut-off valve, pilot gas valve, pilot pressure regulator, pilot cock, and electronic flame supervision.
- b. Hot water heat:
  - 1) Coil: See paragraph(s) in the EQUIPMENT COILS Article.
  - 2) Factory-installed control package to include: Three-way modulating control valve, piping, and spring return valve operator.
- c. Steam heat:
  - 1) Coil: See paragraph(s) in the EQUIPMENT COILS Article.
  - 2) Factory-installed control package to include:
    - a) Two-way modulating control valve, steam traps.
    - b) Float and thermostatic, thermodynamic.
- d. Electric heat:
  - 1) Coil: See paragraph(s) in the EQUIPMENT COILS Article.
  - 2) Automatic reset high limit control.
- 7. Supply fan section:
  - a. Supply fans:
    - 1) Double-width, double-inlet centrifugal type.
    - 2) Forward curved.
    - 3) Solid steel shafts.
    - 4) 200,000 hour relubricative ball-bearings.
  - b. Fan motors:
    - 1) See Specification Section 01 61 03.
    - 2) Relubricative ball-bearings.
    - 3) Adjustable base.
  - c. Driver and driven sheaves:
    - 1) Keyed hub type.
    - 2) Drive sheaves: Fixed pitch diameter.
    - 3) Driver:
      - a) Shipped with variable pitch diameter sheave.
      - b) Fixed pitch diameter size based on approved test and balance reports.
    - 4) V-belt drives sized for 150% motor horsepower.
  - d. Isolated fan assembly.
- 8. Filter section:
  - a. Filters: See Specification Section 23 31 00.
  - b. Access doors for filter removal.
- 9. Return air section:
  - a. Return fans:
    - 1) Double-width, double-inlet, centrifugal type.
    - 2) Forward curve.
    - 3) Solid steel shaft.
    - 4) 200,000 hour relubricative ball-bearings.
  - b. Fan motors:
    - 1) See Specification Section 01 61 03.
    - 2) Relubricative ball-bearings.
    - 3) Adjustable base.
  - c. Driver and driven sheaves:
    - 1) Keyed hub type.
    - 2) Drive sheaves: Fixed pitch diameter.
    - 3) Driver:
      - a) Shipped with variable pitch diameter sheave.
      - b) Fixed pitch diameter size based on approved test and balance reports.
    - 4) V-belt drives sized for 150% motor horsepower.
  - d. Isolated fan assembly.

- e. Designed to form a plenum.
- 10. Outdoor air section:
  - a. Designed to form a plenum.
  - b. 0 to 100% outside air with economizer control.
  - c. Horizontal louvers with rain lip and birdscreen.
  - d. Floor sloped for water drainage.
  - e. Dampers:
    - 1) Sized to handle 100% supply air volume.
    - 2) Arranged vertically to encourage mixing of return and outside airstreams.
    - 3) Airfoil type.
    - 4) Fully gasketed and side sealed.
  - f. Adjustable potentiometer.
  - g. Adjustable enthalpy control outside of airstream.
  - h. Modulating spring return type damper motor.
- 11. Electrical:
  - a. Factory wired in accordance with NFPA 70 requirements.
  - b. 115 V control circuit transformer.
  - c. 115 V receptacle.
  - d. Return air firestat.
  - e. Supply air firestat.
  - f. System service switch.
  - g. Control circuit fuse.
  - h. Individually fused supply and return fan motors, compressor and condenser fan motor branch circuits.
  - i. Weatherproof control panel with dead-front cover over main power controls.
  - j. Disconnect switch.
- 12. Remote monitoring panel to include:
  - a. "Heat-Auto-Cool" switch.
  - b. "On-Off" fan switch.
  - c. Minimum outside air damper potentiometer.
  - d. Supply fan operation signal lights.
  - e. Mechanical cooling malfunction indicating light.
  - f. Clogged filters indicating light.
- 13. Roof curb:
  - a. Prefabricated.
  - b. Perimeter type with rail support for condensing unit section.
  - c. Wood nailer strip.
  - d. Gasket for installation between curb and unit.
  - e. Nominal 16 inches high.
  - f. Approved by NRCA.
- 14. Size and capacity as scheduled on Drawings.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with Specification Section 01 61 03.
- B. Install fixed pitched drive sheave after sheave has been sized based on accepted test and balance report.

**3.2 FIELD QUALITY CONTROL**

- A. Comply with Specification Section 23 05 93.

**3.3 ADJUSTING**

- A. Install new filters on units which have been running prior to acceptance of Project.

**3.4 CLOSEOUT ACTIVITIES**

- A. Refer to Section 01 81 33 – Cyber-Security Requirements for cyber security related closeout requirements.

**END OF SECTION 23 80 00**

# **SECTION 26 05 00 - ELECTRICAL - BASIC REQUIREMENTS**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Basic requirements for electrical systems.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 15 19 - Anchorage to Concrete.
  - 2. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
  - 3. Section 26 05 33 - Raceways and Boxes.

### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Aluminum Association (AA):
    - a. ADM, Aluminum Design Manual.
  - 2. American National Standards Institute (ANSI).
  - 3. ASTM International (ASTM):
    - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. C2, National Electrical Safety Code (NESC).
  - 5. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 6. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 7. Underwriters Laboratories, Inc. (UL).
- B. Products to be listed by a Nationally Recognized Testing Laboratory (NRTL) in accordance with applicable product standards.
  - 1. Applicable product standards including, but not limited to, ANSI, FM, IEEE, NEMA and UL.
  - 2. NRTL includes, but is not limited to, CSA Group Testing and Certification (CS), FM Approvals LLC (FM), Intertek Testing Services NA, Inc. (ETL), and Underwriters Laboratories, Inc. (UL).

### **1.3 DEFINITIONS**

- A. For the purposes of providing materials and installing electrical work the following definitions shall be used.
  - 1. Outdoor area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
  - 2. Architecturally finished interior area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.
  - 3. Non-architecturally finished interior area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.

## **SECTION 26 05 00 - ELECTRICAL - BASIC REQUIREMENTS**

4. Highly corrosive and corrosive area: Areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.
  5. Hazardous areas: Class I, II or III areas as defined in NFPA 70.
  6. Shop fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.
- B. Coordinate installation of the service transformer and metering with the serving utility.
1. The serving utility for this Project is Electric Systems, City of Concord.
    - a. Contact: Fred Porter, 704-920-5303.
  2. Provide the transformer pad, secondary conduit and wire, space in the secondary connection cabinet for mounting of metering CT's, a 1 inch conduit from the CT compartment to the meter socket, and a telephone conduit to the vicinity of the transformer.
    - a. Size and construct transformer pad in conformance with the utilities requirements.
  3. The utility will furnish the transformer, primary service conduit and wire, metering CT's to be mounted in the secondary connection, meter and meter socket, and make all connections at the transformer, CT's, and meter socket.
    - a. Coordinate the switchboard supplier and the utility for the CT compartment.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
1. General requirements:
    - a. Provide manufacturer's technical information on products to be used, including product descriptive bulletin.
    - b. Include data sheets that include manufacturer's name and product model number.
      - 1) Clearly identify all optional accessories.
    - c. Acknowledgement that products are NRTL listed or are constructed utilizing NRTL recognized components.
    - d. Manufacturer's delivery, storage, handling and installation instructions.
    - e. Product installation details.
    - f. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
    - g. See individual specification sections for any additional requirements.
  2. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
  3. Fabrication and/or layout drawings:
    - a. Concrete and reinforcing steel, per Division 03 requirements.
- B. Operation and Maintenance Manuals:
1. See Specification Section 01 78 23 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content process of Operation and Maintenance Manuals.
- C. When a Specification Section includes products specified in another Specification Section, all Specification Sections shall be submitted simultaneously.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect nameplates on electrical equipment to prevent defacing.



## **SECTION 26 05 00 - ELECTRICAL - BASIC REQUIREMENTS**

### **1.6 AREA DESIGNATIONS**

- A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.
  - 1. Outdoor areas:
    - a. Wet.
    - b. Also, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.
  - 2. Indoor areas:
    - a. Dry.
    - b. Also, wet, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, refer to specific Electrical Specification Sections and specific material paragraphs below for acceptable manufacturers.
- B. Provide all components of a similar type by one (1) manufacturer.

#### **2.2 MATERIALS**

- A. Electrical Equipment Support Pedestals and/or Racks:
  - 1. Manufacturers:
    - a. Modular strut:
      - 1) Unistrut Building Systems.
      - 2) B-Line by Eaton.
      - 3) Globe Strut.
      - 4) Superstrut by Thomas & Betts.
  - 2. Material requirements:
    - a. Modular strut:
      - 1) Galvanized steel: ASTM A123/123M or ASTM A153/A153M.
      - 2) Stainless steel: AISI Type 316.
      - 3) PVC coated galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 mil PVC coating.
      - 4) Aluminum: AA Type 6063-T6.
    - b. Structural members (e.g., I beams, L and C channels):
      - 1) Galvanized steel: ASTM A36/A36M steel with galvanizing per ASTM A123/A123M.
      - 2) Aluminum: AA Type 6061-T6 or 6063-T6.
    - c. Mounting plates:
      - 1) Galvanized steel: ASTM A36/A36M steel with galvanizing per ASTM A123/A123M.
      - 2) Aluminum: AA Type 6063-T6.
    - d. Mounting hardware:
      - 1) Galvanized steel.
      - 2) Stainless steel.
    - e. Anchorage per Specification Section 03 15 19.
    - f. Concrete and reinforcing steel: See Division 03 specifications.
- B. Equipment pads (interior and exterior):

## **SECTION 26 05 00 - ELECTRICAL - BASIC REQUIREMENTS**

1. Concrete and reinforcing steel: See Division 03 specifications.
- C. Field touch-up of galvanized surfaces.
  1. Zinc-rich primer.
    - a. One coat, 3.0 mils, ZRC by ZRC Products.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install and wire all equipment, including prepurchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specification Sections and ensure that equipment is ready and safe for energization.
- B. Install equipment in accordance with the requirements of:
  1. NFPA 70.
  2. IEEE C2.
  3. The manufacturer's instructions.
- C. In general, conduit routing is not shown on the Drawings.
  1. The Contractor is responsible for routing all conduits including those shown on one-line and control block diagrams and home runs shown on floor plans.
  2. Conduit routings and stub-up locations that are shown are approximate; exact routing to be as required for equipment furnished and field conditions.
- D. When complete branch circuiting is not shown on the Drawings:
  1. A homerun indicating panelboard name and circuit number will be shown and the circuit number will be shown adjacent to the additional devices (e.g., light fixture and receptacles) on the same circuit.
  2. The Contractor is to furnish and install all conduit and conductors required for proper operation of the circuit.
  3. The indicated home run conduit and conductor size shall be used for the entire branch circuit.
  4. See Specification Section 26 05 19 for combining multiple branch circuits in a common conduit.
- E. Do not use equipment that exceed dimensions or reduce clearances indicated on the Drawings or as required by the NFPA 70.
- F. Install equipment plumb, square and true with construction features and securely fastened.
- G. Install electrical equipment, including pull and junction boxes, minimum of 6 inches from process, gas, air and water piping and equipment.
- H. Install equipment so it is readily accessible for operation and maintenance, is not blocked or concealed and does not interfere with normal operation and maintenance requirements of other equipment.
- I. Device Mounting Schedule:
  1. Unless indicated otherwise on the Drawings, mounting heights are as indicated below:
    - a. Light switch (to center): 46 inches.
    - b. Receptacle in architecturally finished areas (to center): 18 inches.

## **SECTION 26 05 00 - ELECTRICAL - BASIC REQUIREMENTS**

- c. Receptacle on exterior wall of building (to center): 18 inches.
  - d. Receptacle in non-architecturally finished areas (to center): 46 inches.
  - e. Telephone outlet in architecturally finished areas (to center): 18 inches.
  - f. Telephone outlet for wall-mounted phone (to center): 46 inches.
  - g. Safety switch (to center of operating handle): 54 inches.
  - h. Separately mounted motor starter (to center of operating handle): 54 inches.
  - i. Pushbutton or selector switch control station (to center): 46 inches.
  - j. Panelboard (to top): 72 inches.
- J. Avoid interference of electrical equipment operation and maintenance with structural members, building features and equipment of other trades.
- 1. When it is necessary to adjust the intended location of electrical equipment, unless specifically dimensioned or detailed, the Contractor may make adjustments of up to 6 inches in equipment location with the Engineer's approval.
- K. Provide electrical equipment support system per the following area designations:
- 1. Dry areas:
    - a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
    - b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation before rust appears.
  - 2. Wet areas:
    - a. Galvanized system consisting of galvanized steel channels and fittings, nuts and hardware.
    - b. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation before rust appears.
  - 3. Corrosive areas:
    - a. Aluminum system consisting of aluminum channels and fittings with stainless steel nuts and hardware.
  - 4. Highly corrosive areas:
    - a. PVC coated steel system consisting of PVC coated steel channels and fittings with stainless steel nuts and hardware.
- L. Provide all necessary anchoring devices and supports rated for the equipment load based on dimensions and weights verified from approved submittals, or as recommended by the manufacturer.
- 1. See Specification Section 03 15 19.
  - 2. Do not cut, or weld to, building structural members.
  - 3. Do not mount safety switches or other equipment to equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.
- M. Provide non-metallic corrosion resistant spacers to maintain 1/4 inches separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas.
- N. Do not place equipment fabricated from aluminum in direct contact with earth or concrete.
- O. Screen or seal all openings into equipment mounted outdoors to prevent the entrance of rodents and insects.
- P. Do not use materials that may cause the walls or roof of a building to discolor or rust.
- Q. Identify electrical equipment and components in accordance with Specification Section 10 14 00.

## **SECTION 26 05 00 - ELECTRICAL - BASIC REQUIREMENTS**

- R. Provide field markings and/or documentation of available short-circuit current (available fault current) and related information for equipment as required by the NFPA 70 and other applicable codes.
- S. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
  - 1. Determine the SCCR rating by the following method:
    - a. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
  - 2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
  - 3. Provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

### **3.2 FIELD QUALITY CONTROL**

- A. Verify exact rough-in location and dimensions for connection to electrified equipment, provided by others.
  - 1. See Specification Section 01 73 20 for openings and penetrations in structures.
- B. Replace equipment and systems found inoperative or defective and re-test.
- C. The protective coating integrity of support structures and equipment enclosures shall be maintained.
  - 1. Repair galvanized components utilizing a zinc rich paint.
  - 2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
  - 3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the component.
  - 4. Repair surfaces which will be inaccessible after installation prior to installation.
  - 5. See Specification Section 26 05 33 for requirements for conduits and associated accessories.
- D. Replace nameplates damaged during installation.

**END OF SECTION 26 05 00**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Induction motors.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 26 05 26 - Grounding.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Bearing Manufacturers Association (ABMA).
  - 2. National Electrical Manufacturers Association (NEMA):
    - a. MG 1, Motors and Generators.
  - 3. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  
- B. Miscellaneous:
  - 1. Variable speed equipment applications: The driven equipment manufacturer shall have single source responsibility for coordination of the equipment and VFD system and ensure their compatibility.

**1.3 DEFINITIONS**

- A. Inverter Duty Motor: An AC induction motor complying with all requirements of NEMA MG 1 Part 31 for definite-purpose inverter-fed motors.
  
- B. Abbreviations:
  - 1. DPGF - Dripproof Fully Guarded.
  - 2. ODP - Open Dripproof.
  - 3. RTD - Resistance Temperature Detector.
  - 4. TEFC - Totally Enclosed Fan Cooled.
  - 5. TENV - Totally Enclosed Non-ventilated.
  - 6. WP-I - Weather Protected Type I.
  - 7. WP-II - Weather Protected Type II.
  - 8. Motor controllers:
    - a. FVNR - Full Voltage Non-Reversing.
    - b. RVAT - Reduced Voltage Autotransformer.
    - c. RVPR - Reduced Voltage Primary Reactor.
    - d. RVSS - Reduced Voltage Solid State.
    - e. VFD - Variable Frequency Drive.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data:

- a. Identify each motor by driven machine identification.
  - b. Motor manufacturer and model number.
  - c. Complete motor nameplate data.
  - d. Weight.
  - e. NEMA design type.
  - f. Enclosure type.
  - g. Frame size.
  - h. Winding insulation class and temperature rise.
  - i. Starts per hour.
  - j. Performance data:
    - 1) Guaranteed minimum efficiencies at 100%, 75% and 50% of full load.
    - 2) Guaranteed minimum power factor at 100%, 75% and 50% of full load.
    - 3) Locked rotor and full load current at rated terminal voltage and minimum permissible or specified terminal voltage.
    - 4) Starting, full load and breakdown torque at rated terminal voltage and minimum permissible or specified terminal voltage.
  - k. Bearing data and lubrication system.
  - l. Thermal protection system including recommended alarm and trip settings for winding and bearing RTDs.
  - m. .
  - 2. Fabrication and/or layout drawings:
    - a. Dimensioned outline Drawing.
    - b. Connection diagrams including accessories (strip heaters, thermal protection, etc.).
  - 3. Certifications:
    - a. When utilized with a reduced voltage starter, certify that motor and driven equipment are compatible.
  - 4. Test reports:
    - a. Motor test reports for all testing required in this Specification Section.
- B. Contract Closeout Information:
- 1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
  - 2. Installation instructions.
  - 3. Operation and maintenance instructions.
  - 4. Recommended spare parts list.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Protect equipment during shipment, handling, and storage by suitable boxes, crates, or other complete enclosures.
  - 1. Protect equipment from exposure to elements and keep thoroughly dry.
- B. Protect painted surfaces against impact, abrasion, discoloration, and other damage.
  - 1. Repaint damaged painted surfaces to satisfaction of Engineer.
- C. Store all motors in a clean and dry indoor location until final installation.
- D. Where space heaters are provided in motors, provide temporary electrical power and operate heaters during storage and after motors are installed in permanent location until equipment is placed in service.
- E. For storage longer than one month, see manufacturer's storage instructions.

**1.6 site conditions**

- A. Ambient air temperature: DEGF.
- B. Altitude: 700 feet above sea level.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. ABB Baldor-Reliance.
  - 2. General Electric.
  - 3. Hyundai Heavy Industries.
  - 4. Marathon.
  - 5. Siemens.
  - 6. TECO-Westinghouse Motor Company.
  - 7. Toshiba U.S.
  - 8. Toshiba Mitsubishi-Electric Industrial Systems Corporation (TMEIC).
  - 9. U.S. Motors by Nidec Motor Corporation.
  - 10. WEG.

**2.2 EQUIPMENT**

- A. General Requirements:
  - 1. Standards: NEMA MG 1.
  - 2. Identify each motor by the driven machine identification.
  - 3. An embossed or engraved stainless steel nameplate, with the required NFPA 70 and NEMA data, to be permanently attached to the motor.
  - 4. Maximum motor loading shall not exceed motor nameplate horsepower rating, exclusive of service factor.
  - 5. All motors shall be sized to carry continuously all loads, which may be imposed through their full range of operation.
  - 6. NEMA MG 1, Design B (unless otherwise required), constant speed squirrel-cage induction type having normal starting torque with low starting current.
  - 7. Suitable for the starting method indicated (e.g., full voltage, autotransformer, solid state reduced voltage, VFD, etc.).
  - 8. Where frequent starting occurs, design for frequent starting duty equivalent to duty service required by driven equipment.
  - 9. Lifting devices: Motors weighing 265 pounds or more shall have suitable lifting eyes for installation and removal.
  - 10. Grounding:
    - a. Lug suitable to terminate ground wire in terminal box, sized as indicated on the Drawings.
  - 11. Stator windings: Copper.
  - 12. Rotor cage: Copper.
  - 13. Motor leads shall be non-wicking with permanent identifiers.
  - 14. Totally enclosed motor to have one-way breather drains.
  - 15. Efficiency:
    - a. Meet NEMA MG 1 (NEMA Premium) efficiencies.

- b. If motor type, horsepower or speed is not included in the NEMA requirements for NEMA Premium, provide manufacturers "premium energy efficient" design.
- 16. Power factor:
  - a. Minimum of 80% lagging at full load, except on motors with speed slower than 900 rpm.
  - b. Power factor correction capacitors to be utilized when indicated on the Drawings.
- 17. Service factor:
  - a. 100 hp or less: 1.15.
  - b. Greater than 100 hp: 1.0 unless noted otherwise.
  - c. Inverter duty: 1.0.
- 18. Standards: NEMA MG 1, UL 674 .

**2.3 FRACTIONAL INDUCTION MOTORS**

- A. Electrical Ratings:
  - 1. Appropriate for the voltage system indicated, single phase, 60 Hz.
  - 2. Dual voltage rated motors (e.g., 115/230 V) are acceptable, provided all leads are brought out to the terminal box and permanently marked.
- B. Enclosure: TENV or TEFC, rolled steel enclosure permitted.
- C. Bearings: Lubricated-for-Life ball bearings.
- D. Insulation: Class F insulation with temperature rise not to exceed the insulation class.
- E. Thermal Protection: Integral manual or automatic reset thermal protector.

**2.4 INDUCTION MOTORS, 600 VOLT AND LESS**

- A. Horizontal Shaft:
  - 1. Electrical rating:
    - a. Appropriate for the voltage system indicated, 3 PH, 60 Hz.
    - b. Dual voltage rated motors (e.g., 230/460 V) are acceptable, provided all leads are brought out to the terminal box and permanently marked.
  - 2. Enclosure:
    - a. Cast iron (exception: fan covers can be steel).
    - b. Type: DPF, TEFC, WP-I or WP-II as indicated in the schedule.
  - 3. Terminal box:
    - a. Gasketed.
    - b. Diagonally split.
    - c. Field adjustable in 90 degrees increments.
    - d. Oversized to accept the required conductors and conduits.
    - e. Located on "F1" side unless specifically indicated to be on the "F2" side.
    - f. Separate terminal box with terminal blocks for winding thermal protection devices (RTD and thermocouples). Condulets with terminal blocks at bearing thermal protection devices.
  - 4. Bearings:
    - a. 5 hp and less: Lubricated-for-Life ball bearings.
    - b. Greater than 5 hp:
      - 1) Relubricatable.
      - 2) Antifriction.
      - 3) Minimum rated ABMA L-10 life of 10 years or 100,000 hours.
  - 5. Insulation:



- a. Class F insulation with Class B temperature rise.
- b. Dipped and baked with non-hydroscopic varnish or epoxy.
- 6. Accessories: See the ACCESSORIES Article in PART 2 and the SCHEDULES Article in PART 3.
- 7. Modifications:
  - a. Inverter duty:
    - 1) At a minimum, applied to motors connected to a VFD.
    - 2) Windings insulated for 1600 peak volts and voltage rise times of 0.1 microseconds.
    - 3) Nameplate identification of meeting NEMA MG 1 Part 31 requirements.
    - 4) Have the following minimum turndown ratio without the use of a blower to provide continuous supply of cooling air over the motor.
      - a) Variable torque: 10:1.
      - b) Constant torque: 6:1.
    - 5) Insulated drive end bearing on all motors.
    - 6) Motors 100 hp and larger, insulated non-drive and bearings.
    - 7) Shaft grounding ring on all motors:
      - a) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
      - b) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.
  - b. Severe duty:
    - 1) Standard: IEEE 841.
    - 2) All cast iron enclosure.
    - 3) Terminal box threaded and gasketed.
    - 4) Internal and external epoxy base paint system.
    - 5) Drain and breather.
- B. Vertical Solid or Hollow Shaft:
  - 1. Electrical rating:
    - a. Appropriate for the voltage system indicated, 3 PH, 60 Hz.
    - b. Dual voltage rated motors (e.g., 230/460 V) are acceptable, provided all leads are brought out to the terminal box and permanently marked.
  - 2. Enclosure:
    - a. Cast iron.
    - b. Type: DPGF, TEFC, WP-I or WP-II as indicated in the schedule.
  - 3. Terminal box:
    - a. Gasketed.
    - b. Diagonally split.
    - c. Oversized to accept the required conductors and conduits.
    - d. Separate terminal box with terminal blocks for winding thermal protection devices. Condulets with terminal blocks at bearing thermal protection devices.
  - 4. Bearings (Solid Shaft):
    - a. Relubricatable.
    - b. Antifriction.
    - c. Minimum rated AMBA L-10 life of 10 years or 100,000 hours.
  - 5. Bearings (Hollow Shaft):
    - a. Relubricatable.
    - b. Antifriction.
    - c. Oil or grease lubricated thrust bearings.
    - d. Grease lubricated guide bearings.
    - e. Minimum rated ABMA L-10 life of 10 years or 100,000 hours.
  - 6. Insulation:
    - a. Class F insulation with Class B temperature rise.
    - b. Dipped and baked with non-hydroscopic varnish or epoxy.

7. Accessories: See the ACCESSORIES Article in PART 2 and the SCHEDULES Article in PART 3.
8. Modifications:
  - a. Inverter duty:
    - 1) At a minimum, applied to motors connected to a VFD.
    - 2) Windings insulated for 1600 peak volts and voltage rise times of 0.1 microseconds.
    - 3) Nameplate identification of meeting NEMA MG 1 Part 31 requirements.
    - 4) Have the following minimum turndown ratio without the use of a blower to provide continuous supply of cooling air over the motor.
      - a) Variable torque: 10:1.
      - b) Constant torque: 6:1.
    - 5) Insulated drive end bearing on all motors.
    - 6) Motors 100 hp and larger the non-drive end shall have an insulated bearing carrier.
    - 7) Shaft grounding ring on all motors:
      - a) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
      - b) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.
  - b. Severe duty:
    - 1) Standard: IEEE 841.
    - 2) All cast iron enclosure.
    - 3) Terminal box threaded and gasketed.
    - 4) Internal and external epoxy base paint system.
    - 5) Drain and breather.

## **2.5 ACCESSORIES**

- A. Thermal Protection:
  1. Thermocouples:
    - a. Two winding thermocouples per phase for alarm/shutdown mounted in end turns.
    - b. Two bearing oil thermocouples for alarm/shutdown.
    - c. Copper constantan type.
  2. RTDs:
    - a. Two winding RTDs per phase imbedded in windings.
    - b. Two bearing RTD per bearing.
    - c. 100 OHM platinum.
- B. Space Heaters:
  1. Silicone rubber strip type, 120 V rated.
  2. Provided on:
    - a. All motors 10 hp and larger mounted outdoors.
    - b. Indoor motors in humid environments as indicated.

## **2.6 SOURCE QUALITY CONTROL**

- A. Test motors in accordance with NEMA, IEEE and manufacturer procedures.
  1. The test shall include but not necessarily be limited to the following:
    - a. Routine test:
      - 1) No-load current and speed at rated voltage and frequency.
      - 2) Locked rotor current.
      - 3) Winding resistance.
      - 4) Vibration check.

- 5) High potential.
- b. Complete test (in addition to the routine tests):
  - 1) Rated load temperature rise.
  - 2) Winding resistance.
  - 3) Slip test, measured in percent slip.
  - 4) Locked rotor amperes (3 PH, full voltage).
  - 5) Locked rotor torque.
  - 6) Breakdown torque.
  - 7) Efficiencies tabulated at 100, 75, and 50% of full load.
  - 8) Power factor tabulated at 100, 75, and 50% of full load.
- B. Motors to be tested:
  1. As indicated in the schedule.
  2. All motors, at a minimum, to receive a routine test.
- C. The Owner reserves the right to select and have tested any motor included within the project.
  1. If motor passes testing requirements, the Owner shall be responsible for any shipping and testing costs incurred.
  2. Costs shall be determined by current freight rates and manufacturer's published rates at the time of the test.
  3. If motor fails test, Supplier shall be responsible for all costs incurred.
  4. If two successive motors fail the test, the Owner has the right to reject any or all motors from that manufacturer.
  5. The Owner also reserves the right to witness any routine or complete tests at the Owner's expense.
  6. Notify the Owner a minimum of 14 days in advance of the testing.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Ground all motors in accordance with Specification Section 26 05 26.

**3.2 FIELD QUALITY CONTROL**

- A. See Specification Section 26 08 13 for acceptance testing requirements.

**END OF SECTION 26 05 09**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for:
    - a. Building wire.
    - b. Power cable.
    - c. Control cable.
    - d. Shielded VFD cable.
    - e. Instrumentation cable.
    - f. Wire connectors.
    - g. Insulating tape.
    - h. Pulling lubricant.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.
  - 2. Section 26 08 13 - Acceptance Testing.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Insulated Cable Engineers Association (ICEA):
    - a. S-58-679, Standard for Control Cable Conductor Identification.
  - 2. National Electrical Manufacturers Association (NEMA):
    - a. ICS 4, Industrial Control and Systems: Terminal Blocks.
  - 3. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
    - a. WC 57/S-73-532, Standard for Control Cables.
    - b. WC 70/S-95-658, Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
  - 4. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
    - b. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
  - 5. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
    - a. 568, Commercial Building Telecommunications Cabling Standard.
  - 6. Underwriters Laboratories, Inc. (UL):
    - a. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
    - b. 83, Standard for Safety Thermoplastic-Insulated Wires and Cables.
    - c. 467, Standard for Safety Grounding and Bonding Equipment.
    - d. 486A, Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors.
    - e. 486C, Standard for Safety Splicing Wire Connections.
    - f. 510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
    - g. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
    - h. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.

## **SECTION 26 05 19 - WIRE AND CABLE - 600 VOLT AND BELOW**

- i. 2250, Standard for Safety Instrumentation Tray Cable.

### **1.3 DEFINITIONS**

- A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
- B. Instrumentation Cable:
  - 1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
  - 2. The following are specific types of instrumentation cables:
    - a. Analog signal cable:
      - 1) Used for the transmission of low current (e.g., 4-20mA DC) or low voltage (e.g., 0-10 VDC) signals, using No. 16 AWG and smaller conductors.
      - 2) Commonly used types are defined in the following:
        - a) TSP: Twisted shielded pair.
        - b) TST: Twisted shielded triad.
    - b. Digital signal cable: Used for the transmission of digital signals between computers, PLC's, RTU's, etc.
- C. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 8 AWG and larger.
- D. Shielded VFD Cable: Multi-conductor, insulated, with shield, drain wire and building wires, No. 12 and larger.
- E. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 14, No. 12 or No. 10 AWG.
- F. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
      - 1) Wire connectors.
      - 2) Insulating tape.
      - 3) Cable lubricant.
    - b. See Specification Section 26 05 00 for additional requirements.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. See Specification Section 26 05 00.

## **SECTION 26 05 19 - WIRE AND CABLE - 600 VOLT AND BELOW**

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Building wire, power and control cable:
    - a. Aetna Insulated Wire.
    - b. Alphawire.
    - c. Cerrowire.
    - d. Encore Wire Corporation.
    - e. General Cable.
    - f. Okonite Company.
    - g. Southwire Company.
  2. Shielded VFD cable:
    - a. Belden Inc.
    - b. General Cable.
    - c. Okonite Company.
    - d. Olfex Wire and Cable, Inc.
    - e. Priority Wire and Cable (Prysmian).
    - f. Rockbestos-Surprenant Cable Corp.
    - g. Southwire Company.
  3. Instrumentation cable:
    - a. Analog cable:
      - 1) Alphawire.
      - 2) Belden Inc.
      - 3) General Cable.
  4. Wire connectors:
    - a. Burndy Corporation.
    - b. Buchanan.
    - c. Ideal.
    - d. IlSCO.
    - e. 3M Co.
    - f. Teledyne Penn Union.
    - g. Thomas and Betts.
    - h. Phoenix Contact.
  5. Insulating and color coding tape:
    - a. 3M Co.
    - b. Plymouth Bishop Tapes.
    - c. Red Seal Electric Co.

#### **2.2 MANUFACTURED UNITS**

- A. Building Wire:
1. Conductor shall be copper with 600 V rated insulation.
  2. Conductors shall be stranded, except for conductors used in lighting and receptacle circuits which may be stranded or solid.
  3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
  4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 for type THHN/THWN and THHN/THWN-2 insulation.
  5. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 for type XHHW-2 insulation.

## **SECTION 26 05 19 - WIRE AND CABLE - 600 VOLT AND BELOW**

- B. Power Cable:
1. Conductor shall be copper with 600 V rated insulation.
  2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
  3. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 and UL 1277 for type THHN/THWN insulation with an overall PVC jacket.
  4. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 and UL 1277 for type XHHW-2 insulation with an overall PVC jacket.
  5. Number of conductors as required, including a bare ground conductor.
  6. Individual conductor color coding:
    - a. ICEA S-58-679, Method 4.
    - b. See PART 3 of this Specification Section for additional requirements.
  7. Conform to NFPA 70 Type TC and IEEE 1202 or CSA FT-4.
- C. Control Cable:
1. Conductor shall be copper with 600 V rated insulation.
  2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
  3. Conform to NEMA/ICEA WC 57/S-73-532 and UL 83 and UL 1277 for type THHN/THWN insulation with an overall PVC jacket.
  4. Conform to NEMA/ICEA WC 57/S-73-532 and UL 44 and UL 1277 for type XHHW-2 insulation with an overall PVC jacket.
  5. Number of conductors as required, provided with or without bare ground conductor of the same AWG size.
    - a. When a bare ground conductor is not provided, an additional insulated conductor shall be provided and used as the ground conductor (e.g., 6/c No. 14 w/g and 7/c No. 14 are equal).
  6. Individual conductor color coding:
    - a. ICEA S-58-679, Method 1, Table E-2.
    - b. See PART 3 of this Specification Section for additional requirements.
  7. Conform to NFPA 70 Type TC and IEEE 1202, CSA FT-4 or NFPA 262.
- D. Electrical Equipment Control Wire:
1. Conductor shall be copper with 600 V rated insulation.
  2. Conductors shall be stranded.
  3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
  4. Conform to UL 44 for Type SIS insulation.
  5. Conform to UL 83 for Type MTW insulation.
- E. Shielded VFD Cable:
1. Conductor shall be copper, stranded with 600 V rated insulation.
  2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
  3. Cables No. 1 AWG and less:
    - a. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 and UL 1277 for type RHW-2 or XHHW-2 insulation with an overall PVC jacket.
    - b. Shielding: 85% tinned copper braid, full size tinned copper drain wire and 100% foil shield.
    - c. Number of conductors: 3 PH and 1 full size ground.
  4. Cables No. 12 through 750 kcmil:
    - a. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 type XHHW-2 insulation.
    - b. Shielding: Continuous corrugated copper-free aluminum sheath covered with a PVC jacket.
    - c. Number of conductors: 3 PH and 3 equally spaced ground conductors.

## **SECTION 26 05 19 - WIRE AND CABLE - 600 VOLT AND BELOW**

5. Individual conductor color coding:
    - a. ICEA S-58-679, Method 4.
    - b. See PART 3 of this Specification Section for additional requirements.
  6. When installed exposed outdoors, UL listed and marked as sunlight resistant.
  7. For continuously corrugated cable, use manufacturer approved fittings.
  8. Conform to NFPA 70, Type TC and IEEE 1202 or CSA FT-4.
- F. Instrumentation Cable:
1. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
  2. Analog cable:
    - a. Tinned copper conductors.
    - b. 300 V or 600 V PVC insulation with PVC jacket.
    - c. Twisted with 100% foil shield coverage with drain wire.
    - d. Six (6) twists per foot minimum.
    - e. Individual conductor color coding: ICEA S-58-679, Method 1, Table E-2.
    - f. Conform to IEEE 1202 or CSA FT-4 or NFPA 262, UL 2250, UL 1581 and NFPA 70 Type ITC.
  3. Digital cable:
    - a. As recommended by equipment (e.g., PLC, RTU) manufacturer.
    - b. Horizontal voice and data cable:
      - 1) Category 6 per TIA/EIA/ANSI 568.
      - 2) Cable shall be label-verified.
      - 3) Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level.
      - 4) Conductors: No. 24 AWG solid untinned copper.
      - 5) Rated CMP per NFPA 70.
    - c. Conform to IEEE 1202 or CSA FT-4 or NFPA 262 and NFPA 70 Type ITC.
- G. Wire Connectors:
1. Twist/screw on type:
    - a. Insulated pressure or spring type solderless connector.
    - b. 600 V rated.
    - c. Ground conductors: Conform to UL 486C and/or UL 467 when required by local codes.
    - d. Phase and neutral conductors: Conform to UL 486C.
  2. Compression and mechanical screw type:
    - a. 600 V rated.
    - b. Ground conductors: Conform to UL 467.
    - c. Phase and neutral conductors: Conform to UL 486A.
  3. Terminal block type:
    - a. High density, screw-post barrier-type with white center marker strip.
    - b. 600 V and ampere rating as required, for power circuits.
    - c. 600 V, 20 ampere rated for control circuits.
    - d. 300 V, 15 ampere rated for instrumentation circuits.
    - e. Conform to NEMA ICS 4 and UL 486A.
- H. Insulating and Color Coding Tape:
1. Pressure sensitive vinyl.
  2. Premium grade.
  3. Heat, cold, moisture, and sunlight resistant.
  4. Thickness, depending on use conditions: 7, 8.5, or 10 mil.
  5. For cold weather or outdoor location, tape must also be all-weather.
  6. Color:
    - a. Insulating tape: Black.
    - b. Color coding tape: Fade-resistant color as specified herein.



**SECTION 26 05 19 - WIRE AND CABLE - 600 VOLT AND BELOW**

- 7. Comply with UL 510.
- I. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Permitted Usage of Insulation Types:
  - 1. Type XHHW-2:
    - a. Building wire and power and control cable in architectural and non-architectural finished areas.
    - b. Building wire and power and control cable in conduit in outdoor areas and below grade.
    - c. Building wire and power and control cable in cable tray in outdoor areas.
  - 2. Type THHN/THWN and THHN/THWN-2:
    - a. Building wire and power and control cable No. 8 AWG and smaller in architectural and non-architectural finished areas.
  - 3. Type SIS and MTW:
    - a. For the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers.
- B. Shielded VFD Cable:
  - 1. For wiring between a VFD and motor when routing in cable trays or conduit other than RGS or RAC.
- C. Conductor Size Limitations:
  - 1. Feeder and branch power conductors shall not be smaller than No. 12 AWG unless otherwise indicated on the Drawings.
  - 2. Control conductors shall not be smaller than No. 14 AWG unless otherwise indicated on the Drawings.
  - 3. Instrumentation conductors shall not be smaller than No. 18 AWG unless otherwise indicated on the Drawings.
- D. Color Code All Wiring as Follows:
  - 1. Building wire:

	<u>240 V, 208 V, 240/120 V, 208/120 V</u>	<u>480 V, 480/277 V</u>
Phase 1	Black	Brown
Phase 2	Red *	Orange
Phase 3	Blue	Yellow
Neutral	White	White or Gray
Ground	Green	Green

**\* Orange when it is a high leg of a 120/240 V Delta system.**

- a. Conductors No. 6 AWG and smaller: Insulated phase, neutral and ground conductors shall be identified by a continuous colored outer finish along its entire length.
- b. Conductors larger than No. 6 AWG:

## **SECTION 26 05 19 - WIRE AND CABLE - 600 VOLT AND BELOW**

- 1) Insulated phase and neutral conductors shall be identified by one of the following methods:
    - a) Continuous colored outer finish along its entire length.
    - b) 3 inches of colored tape applied at the termination.
  - 2) Insulated grounding conductor shall be identified by one of the following methods:
    - a) Continuous green outer finish along its entire length.
    - b) Stripping the insulation from the entire exposed length.
    - c) Using green tape to cover the entire exposed length.
  - 3) The color coding shall be applied at all accessible locations, including but not limited to: Junction and pull boxes, wireways, manholes and handholes.
  2. Power cables ICEA S-58-679, Method 4 with:
    - a. Phase and neutral conductors identified with 3 inches of colored tape, per the Table herein, applied at the terminations.
    - b. Ground conductor: Bare.
  3. Shielded VFD cable ICEA S-58-679, Method 4 with:
    - a. Phase conductors identified with 3 inches of colored tape, per the Table herein, applied at the terminations.
    - b. Ground conductor: Green color insulation or bare.
  4. Control cables ICEA S-58-679, Method 1, Table E-2:
    - a. When a bare ground is not provided, one of the colored insulated conductors shall be re-identified by stripping the insulation from the entire exposed length or using green tape to cover the entire exposed length.
    - b. When used in power applications the colored insulated conductors used as phase and neutral conductors may have to be re-identified with 3 inches of colored tape, per the Table herein, applied at the terminations.
- E. Install all wiring in raceway unless otherwise indicated on the Drawings.
- F. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway, cable tray, junction or pull box, except as permitted in the following:
1. Where specifically indicated on the Drawings.
  2. Where field conditions dictate and written permission is obtained from the Engineer.
  3. Control circuits shall be isolated from feeder and branch power and instrumentation circuits but combining of control circuits is permitted.
    - a. The combinations shall comply with the following:
      - 1) 12 VDC, 24 VDC and 48 VDC may be combined.
      - 2) 125 VDC shall be isolated from all other AC and DC circuits.
      - 3) AC control circuits shall be isolated from all DC circuits.
  4. Instrumentation circuits shall be isolated from feeder and branch power and control circuits but combining of instrumentation circuits is permitted.
    - a. The combinations shall comply with the following:
      - 1) Analog signal circuits may be combined.
      - 2) Digital signal circuits may be combined but isolated from analog signal circuits.
  5. Multiple branch circuits for similar loads may be combined in a common raceway, such as multiple lighting circuits or multiple receptacle circuits or other 120Vac circuits. Do not combine lighting and receptacle circuits.
    - a. Do not combine control device circuits with lighting or receptacle circuits.
    - b. Contractor is responsible for making the required adjustments in conductor and raceway size, in accordance with all requirements of the NFPA 70, including but not limited to:
      - 1) Up sizing conductor size for required ampacity de-ratings for the number of current carrying conductors in the raceway.
      - 2) The neutral conductors may not be shared.
      - 3) Up sizing raceway size for the size and quantity of conductors.

## **SECTION 26 05 19 - WIRE AND CABLE - 600 VOLT AND BELOW**

- G. Ground the drain wire of shielded instrumentation cables at one end only.
  - 1. The preferred grounding location is at the load (e.g., control panel), not at the source (e.g., field mounted instrument).
  
- H. Splices and terminations for the following circuit types shall be made in the indicated enclosure type using the indicated method.
  - 1. Feeder and branch power circuits:
    - a. Device outlet boxes:
      - 1) Twist/screw on type connectors.
    - b. Junction and pull boxes and wireways:
      - 1) Twist/screw on type connectors for use on No. 8 and smaller wire.
      - 2) Compression, mechanical screw or terminal block or terminal strip type connectors for use on No. 6 AWG and larger wire.
    - c. Motor terminal boxes:
      - 1) Twist/screw on type connectors for use on No. 10 AWG and smaller wire.
      - 2) Insulated mechanical screw type connectors for use on No. 8 AWG and larger wire.
    - d. Manholes or handholes:
      - 1) Twist/screw on type connectors pre-filled with epoxy for use on No. 8 AWG and smaller wire.
      - 2) Watertight compression or mechanical screw type connectors for use on No. 6 AWG and larger wire.
  - 2. Control circuits:
    - a. Junction and pull boxes: Terminal block type connector.
    - b. Manholes or handholes: Twist/screw on type connectors pre-filled with epoxy.
    - c. Control panels and motor control centers: Terminal block or strips provided within the equipment or field installed within the equipment by the Contractor.
  - 3. Instrumentation circuits can be spliced where field conditions dictate and written permission is obtained from the Engineer.
    - a. Maintain electrical continuity of the shield when splicing twisted shielded conductors.
    - b. Junction and pull boxes: Terminal block type connector.
    - c. Control panels and motor control centers: Terminal block or strip provided within the equipment or field installed within the equipment by the Contractor.
  - 4. Non-insulated compression and mechanical screw type connectors shall be insulated with tape or hot or cold shrink type insulation to the insulation level of the conductors.
  
- I. Insulating Tape Usage:
  - 1. For insulating connections of No. 8 AWG wire and smaller: 7 mil vinyl tape.
  - 2. For insulating splices and taps of No. 6 AWG wire or larger: 10 mil vinyl tape.
  - 3. For insulating connections made in cold weather or in outdoor locations: 8.5 mil, all weather vinyl tape.
  
- J. Color Coding Tape Usage: For color coding of conductors.

### **3.2 FIELD QUALITY CONTROL**

- A. Acceptance Testing:
  - 1. See Specification Section 26 08 13.

**END OF SECTION 26 05 19**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for grounding and bonding system(s).
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.
  - 2. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
  - 3. Section 26 05 33 - Raceways and Boxes.
  - 4. Section 26 08 13 - Acceptance Testing.
  - 5. Section 26 41 13 - Lightning Protection System.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. ASTM International (ASTM):
    - a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
  - 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.
  - 3. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 4. Underwriters Laboratories, Inc. (UL):
    - a. 467, Grounding and Bonding Equipment.
- B. Assure ground continuity is continuous throughout the entire Project.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data.
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
      - 1) Grounding clamps, terminals and connectors.
      - 2) Exothermic welding system.
    - b. See Specification Section 26 05 00 for additional requirements.
  - 2. Fabrication and/or layout drawings:
    - a. Plan drawing(s) showing type, size and locations of all grounding system components.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

## SECTION 26 05 26 - GROUNDING AND BONDING

1. Ground rods and bars and grounding clamps, connectors and terminals:
  - a. ERICO by Pentair.
  - b. Harger Lightning & Grounding.
  - c. Heary Bros. Lightning Protection Co. Inc..
  - d. Burndy by Hubbell.
  - e. Robbins Lightning, Inc.
  - f. Blackburn by Thomas & Betts.
  - g. Thompson Lightning Protection, Inc.
2. Exothermic weld connections:
  - a. ERICO by Pentair - Cadweld.
  - b. Harger Lightning & Grounding - Ultraweld.
  - c. Burndy by Hubbell - Thermoweld.
  - d. FurseWELD by Thomas & Betts.
3. Prefabricated composite test stations:
  - a. Armorcast Products Company.
  - b. MacLean Highline.
  - c. Quazite by Hubbell

### 2.2 COMPONENTS

- A. Wire and Cable:
  1. Bare conductors: Soft drawn stranded copper meeting ASTM B8.
  2. Insulated conductors: Color coded green, per Specification Section 26 05 19.
- B. Conduit: As specified in Specification Section 26 05 33.
- C. Ground Bars:
  1. Solid copper:
    - a. 1/4 inches thick.
    - b. 2 or 4 inches wide.
    - c. 24 inches long minimum in main service entrance electrical rooms, 12 inches long elsewhere.
  2. Predrilled grounding lug mounting holes.
  3. Stainless steel or galvanized steel mounting brackets.
  4. Insulated standoffs.
- D. Ground Rods:
  1. 3/4 inches x 10 feet.
  2. Copper-clad:
    - a. 10 mil minimum uniform coating of electrolytic copper molecularly bonded to a rigid steel core.
    - b. Corrosion resistant bond between the copper and steel.
    - c. Hard drawn for a scar-resistant surface.
- E. Grounding Clamps, Connectors and Terminals:
  1. Mechanical type:
    - a. Standards: UL 467.
    - b. High copper alloy content.
  2. Compression type for interior locations:
    - a. Standards: UL 467.
    - b. High copper alloy content.
    - c. Non-reversible.
    - d. Terminals for connection to bus bars shall have two bolt holes.

3. Compression type suitable for direct burial in earth or concrete:
  - a. Standards: UL 467, IEEE 837.
  - b. High copper alloy content.
  - c. Non-reversible.
  - d. Factory filled with oxide inhibiting compound.
  
- F. Exothermic Weld Connections:
  1. Copper oxide reduction by aluminum process.
  2. Molds properly sized for each application.
  
- G. Prefabricated Composite Material Test Stations:
  1. Body and cover: Fiberglass reinforced polymer concrete conforming to all test provisions of SCTE 77.
  2. Minimum load ratings: SCTE 77 Tier 15.
  3. Open bottom.
  4. Stackable design as required for 3 feet depth.
  5. Cover:
    - a. Engraved legend of "GROUND".
    - b. Lay-in non-bolt down.
  6. Size: 12 inches round or 12 inches square.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. General:
  1. Install products in accordance with manufacturer's instructions.
  2. Size grounding conductors and bonding jumpers in accordance with NFPA 70, Article 250, except where larger sizes are indicated on the Drawings.
  3. Remove paint, rust, or other non-conducting material from contact surfaces before making ground connections. After connection, apply manufacturers approved touch-up paint to protect metallic surface from corrosion.
  4. Where ground conductors pass through floor slabs or building walls provide nonmetallic sleeves and install sleeve per Specification Section 01 73 20.
    - a. Seal the sleeve interior to stop water penetration.
  5. Do not splice grounding electrode conductors except at ground rods.
  6. Install ground rods and grounding electrode conductors in undisturbed, firm soil.
    - a. Provide excavation required for installation of ground rods and conductors.
    - b. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
    - c. Unless otherwise specified, connect conductors to ground rods with compression type connectors or exothermic weld.
    - d. Provide sufficient slack in conductor to prevent conductor breakage during backfill or due to ground movement.
    - e. Backfill excavation completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.
  7. Do not use exothermic welding if it will damage the structure the grounding conductor is being welded to.
  
- B. Grounding Electrode System:
  1. Provide a grounding electrode system in accordance with NFPA 70, Article 250 and as indicated on the Drawings.

## **SECTION 26 05 26 - GROUNDING AND BONDING**

- a. All grounding electrode conductors terminate on a main ground bar located adjacent to the service entrance equipment.
  2. Grounding electrode conductor terminations:
    - a. Ground bars mounted on wall: Use a two-hole compression type conductor terminal and bolt it to the ground bar with two bolts.
    - b. Ground bars in electrical equipment: Use compression type conductor terminal and bolt it to the ground bar or manufacturer's provided mechanical type termination device.
    - c. Piping systems: Use mechanical type connections.
    - d. Building steel, below grade and encased in concrete: Use compression type connector or exothermic weld.
    - e. Building steel, above grade: Use a two-hole compression type conductor terminal and bolt to the steel with two bolts or exothermic weld.
    - f. Ground rod: Compression type or exothermic weld, unless otherwise specified.
    - g. At all above grade terminations, the conductors shall be labeled per Specification Section 10 14 00.
  3. Ground ring grounding system:
    - a. Ground ring consists of ground rods and a conductor looped around the structure.
    - b. Placed at a minimum of 10 feet from the structure foundation and 2 feet-6 inches below grade.
    - c. Provide a minimum of four ground rods placed at the corners of the structure and additional rods so that the maximum distance between ground rods does not exceed 50 FT.
    - d. Building/Structure grounding:
      - 1) Bond building/structure metal support columns to the ground ring at all corners of the structure.
    - e. Grounding conductor: Bare conductor, size as indicated on the Drawings.
    - f. Ground rod test stations:
      - 1) Provided where indicated on the Drawings.
      - 2) Grounding conductors connected to ground rod with removable ground clamps.
  4. Triad grounding system:
    - a. Triad consists of three ground rods arranged in a triangle separated by 20 feet and a conductor interconnecting each ground rod.
    - b. Place first ground rod a minimum of 10 feet from the structure foundation and 2 FT-6 IN below grade.
    - c. Grounding conductor: Bare conductor, size as indicated on the Drawings.
    - d. Ground rod test stations:
      - 1) Provided where indicated on the Drawings.
      - 2) Grounding conductors connected to ground rod with removable ground clamps.
- C. Supplemental Grounding Electrode:
1. Provide the following grounding in addition to the equipment ground conductor supplied with the feeder conductors whether or not shown on the Drawings.
    - a. See Grounding Electrode System paragraph for conductor termination requirements.
  2. Metal light poles:
    - a. Connect metal pole and pole base reinforcing steel to a ground rod.
    - b. Grounding conductor: Bare #6 AWG minimum.
  3. Equipment support rack and pedestals mounted outdoors:
    - a. Connect metallic structure to a ground rod.
    - b. Grounding conductor: #6 AWG minimum.
  4. Engine generator:
    - a. Connect generator frame to the ground ring at two locations (opposite corners of frame).
    - b. Grounding conductor: Bare conductor, size as indicated on the Drawings.
  5. Ground cranes and hoists in accordance with NFPA 70, Article 610.

## SECTION 26 05 26 - GROUNDING AND BONDING

- D. Other Bonding Requirements:
1. Other metal piping:
    - a. Connect in a daisy chain or radial fashion: Interior hot and cold water piping system to the service entrance electrical equipment ground bus as indicated on the Drawings.
    - b. See Grounding Electrode System paragraph for conductor termination requirements.
  2. Lightning protection system:
    - a. Connect to ground ring.
    - b. See Specification Section 26 41 13.
- E. Transformer Separately Derived Grounding System:
1. Install the System Bonding Jumper at the transformer. At the first disconnect, ensure the neutral is isolated from ground.
  2. Structures with a single electrical room/area:
    - a. Connect grounding electrode conductor to the Grounding Electrode System main ground bar.
  3. Structures with multiple electrical rooms/areas:
    - a. Provide a ground bar mounted in each electrical room/area.
    - b. Interconnect all ground bars in a daisy chain or radial fashion to the main ground bar as indicated on the Drawings.
    - c. Connect grounding electrode conductor to the electrical room/area ground bar.
  4. See Grounding Electrode System paragraph for conductor termination requirements.
- F. Telecommunications Grounding System:
1. Coil 5 feet of insulated #6 AWG conductor at each telephone terminal board and mechanically connected to the service entrance electrical equipment.
  2. Grounding bar: Mounted on or adjacent to telephone terminal board.
  3. Interconnect all telecommunication ground bars in a daisy chain or radial fashion to the service entrance electrical equipment ground bus using mechanical type connectors.
    - a. Grounding conductor: Bare conductor, size as indicated on the Drawings.
- G. Raceway Bonding/Grounding:
1. Install all metallic raceway so that it is electrically continuous.
  2. Provide an equipment grounding conductor in all raceways with insulation identical to the phase conductors, unless otherwise indicated on the Drawings.
  3. NFPA 70 required grounding bushings shall be of the insulating type.
  4. Provide double locknuts at all panels.
  5. Bond all conduits, at entrance and exit of equipment, to the equipment ground bus or lug.
  6. Provide bonding jumpers if conduits are installed in concentric knockouts.
  7. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.
- H. Equipment Grounding:
1. Ground all utilization equipment with an equipment grounding conductor.
- I. Cable Tray Grounding:
1. Make metal cable tray electrically continuous by one of the following methods:
    - a. Tray sections and fittings suitable for grounding purposes.
    - b. Provide bonding jumpers at discontinuous joints.
    - c. Lay a grounding conductor within the tray for bonding of each individual tray section.
      - 1) Provide a minimum of one ground lug per tray section.
      - 2) Grounding conductor: [Bare #4 AWG minimum] [Insulated #4 AWG minimum with green marking tape every 10 feet] [Sized in accordance with the largest conductors run within the tray].



## SECTION 26 05 26 - GROUNDING AND BONDING

- 3) Securely tie the grounding conductor to cable tray every 10 feet. Bond the grounding conductor to the cable tray run a minimum of every 50 feet with a UL listed connector.
  2. Bond the tray or tray grounding conductor to every electrical equipment ground bus or telecomm backboard ground bus where conductors terminate.
  3. Bond all conduits to the tray that extend the conductors to field equipment.
- J. Manhole and Handhole Grounding:
1. Provide a ground rod and ground bar, when indicated or as needed, in each manhole and handhole with exposed metal parts.
    - a. Expose a minimum of 4 inches of the rod above the floor for field connections to the rod.
  2. Connect all exposed metal parts (e.g., conduits and cable racks) to the ground rod.
- K. Pad Mounted Transformer Grounding:
1. Per detail on the Drawings.
  2. Provide a ground ring around transformer with:
    - a. A minimum of four ground rods located at the corners.
    - b. A ground rod connected to the ring and located in the conduit stub up area.
    - c. Or as indicated on the Drawings.
  3. Connect medium voltage cable shields to the ground rod.
  4. Connect surge arrestor to the ground rod.
  5. Connect the XO and ground pad to the ground rod.
  6. Connect exposed metallic conduits to the ground rod.
- L. Prefabricated Composite Material Test Station:
1. Place test station on a foundation of compacted 1/4 to 1/2 inches crushed rock or gravel a minimum of 8 inches thick and 6 inches larger than handholes footprint on all sides.
  2. Provide concrete encasement ring around test station per manufacturers installation instructions (minimum of 10 inches wide x 12 inches deep).

### 3.2 FIELD QUALITY CONTROL

- A. Leave grounding system uncovered until observed by Owner.
- B. Acceptance testing:
1. See Specification Section 26 08 13.
- C. Provide a continuity test on the components of the grounding electrode system.
- D. Complete grounding system: Resistance of 5 ohms or less.
- E. Test resistance of installed ground system after backfilling and before connection to any other grounded system including underground piping, utility services or other building ground systems.
1. Test ground grid resistance by fall-of-potential method.
  2. Perform test at the main ground bar.

**END OF SECTION 26 05 26**

**SECTION 26 05 26 - GROUNDING AND BONDING**

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**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for:
    - a. Conduits.
    - b. Conduit fittings.
    - c. Conduit supports.
    - d. Wireways.
    - e. Outlet boxes.
    - f. Pull and junction boxes.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.
  - 2. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
  - 3. Section 26 05 43 - Electrical - Exterior Underground.
  - 4. Section 26 27 26 - Wiring Devices.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Aluminum Association (AA).
  - 2. American Iron and Steel Institute (AISI).
  - 3. ASTM International (ASTM):
    - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    - c. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
  - 4. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
    - c. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
    - d. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
    - e. TC 14.AG, Aboveground Reinforced Thermosetting Resin Conduit and Fittings.
    - f. TC 14.BG, Belowground Reinforced Thermosetting Resin Conduit and Fittings.
  - 5. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
    - a. C80.1, Electric Rigid Steel Conduit (ERSC).
    - b. C80.3, Steel Electrical Metallic Tubing (EMT).
    - c. C80.5, Electrical Aluminum Rigid Conduit (ERAC).
    - d. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
  - 6. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 7. Underwriters Laboratories, Inc. (UL):
    - a. 1, Standard for Flexible Metal Conduit.
    - b. 6, Electrical Rigid Metal Conduit - Steel.

## SECTION 26 05 33 - RACEWAYS AND BOXES

- c. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
- d. 360, Standard for Liquid-Tight Flexible Metal Conduit.
- e. 467, Grounding and Bonding Equipment.
- f. 514A, Metallic Outlet Boxes.
- g. 514B, Conduit, Tubing, and Cable Fittings.
- h. 651, Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
- i. 797, Electrical Metallic Tubing - Steel.
- j. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
- k. 1203, Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.
- l. 2420, Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
- m. 2515, Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

### 1.3 SUBMITTALS

- A. Shop Drawings:
  - 1. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
      - 1) Conduit fittings.
      - 2) Support systems.
    - b. See Specification Section 26 05 00 for additional requirements.
  - 2. Fabrication and/or layout drawings:
    - a. Proposed routing of raceways buried under concrete floors and embedded in concrete walls.
      - 1) Identify conduit by tag number of equipment served or by circuit schedule number.
    - b. Proposed routing and details of construction, including raceway and rebar, for raceways embedded in floor slabs, walls and columns.
      - 1) Identify conduit by tag number of equipment served or by circuit schedule number.
    - c. Identify dimensional size of pull and junction boxes to be used.

### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 26 05 00.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Rigid metal conduits and electrical metallic tubing:
    - a. Allied Tube and Conduit.
    - b. Western Tube and Conduit Corporation.
    - c. Wheatland Tube.
    - d. Patriot Aluminum Products, LLC.
  - 2. PVC coated rigid metal conduits:
    - a. Robroy Industries.
    - b. Atkore - Calbond
  - 3. Rigid nonmetallic conduit:

- a. Prime Conduit.
- b. Cantex, Inc.
- c. Osburn Associates, Inc.
- d. Champion Fiberglass, Inc.
- e. United Fiberglass of America, Inc.
- 4. Flexible conduit:
  - a. AFC Cable Systems.
  - b. Anamet, Inc.
  - c. Electri-Flex Company.
  - d. International Metal Hose Company.
  - e. Southwire Company, LLC.
- 5. Wireway:
  - a. Hoffman Engineering.
  - b. Wiegmann by Hubbell.
  - c. Square D by Schneider Electric.
- 6. Conduit fittings and accessories:
  - a. Appleton by Emerson Electric Co.
  - b. Carlon by Thomas & Betts.
  - c. Cantex, Inc.
  - d. Crouse-Hinds by Eaton.
  - e. Killark by Hubbell.
  - f. Osburn Associates, Inc.
  - g. O-Z/Gedney by Emerson Electric Co.
  - h. Raco by Hubbell.
  - i. Steel City by Thomas & Betts.
  - j. Thomas & Betts.
- 7. Support systems:
  - a. Unistrut by Atkore International, Inc.
  - b. B-Line by Eaton.
  - c. Kindorf by Thomas & Betts.
  - d. Minerallac Company.
  - e. CADDY by Pentair.
  - f. Superstrut by Thomas & Betts.
- 8. Outlet, pull and junction boxes:
  - a. Appleton by Emerson Electric Co.
  - b. Crouse-Hinds by Eaton
  - c. Killark by Hubbell.
  - d. O-Z/Gedney by Emerson Electric Co.
  - e. Steel City by Thomas & Betts.
  - f. Raco by Hubbell
  - g. Bell by Hubbell.
  - h. Hoffman Engineering.
  - i. Wiegmann by Hubbell.
  - j. B-Line by Eaton.
  - k. Adalet.
  - l. RITTAL North America LLC.
  - m. Stahlin by Robroy Enclosures.

## **2.2 RIGID METAL CONDUITS**

- A. Rigid Galvanized Steel Conduit (RGS):
  - 1. Mild steel with continuous welded seam.
  - 2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
  - 3. Threads galvanized after cutting.

4. Internal coating: Baked lacquer, varnish or enamel for a smooth surface.
5. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6.

**B. Rigid Aluminum Conduit (RAC):**

1. AA Type 6063 aluminum alloy, T-1 temper.
2. Maximum copper content of 0.10%.
3. Extruded, seamless.
4. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.5, UL 6.

**2.3 ELECTRICAL METALLIC TUBING (EMT)**

- A. Mild steel with continuous welded seam.
- B. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
- C. Internal coating: Baked lacquer, varnish, or enamel for a smooth surface.
- D. Standards: NFPA 70 Type EMT, NEMA/ANSI C80.3, UL 797.

**2.4 RIGID NONMETALLIC CONDUIT**

- A. Schedules 40 (PVC-40) and 80 (PVC-80):
  1. Polyvinyl-chloride (PVC) plastic compound which includes inert modifiers to improve weatherability and heat distribution.
  2. Rated for direct sunlight exposure.
  3. Fire retardant and low smoke emission.
  4. Shall be suitable for use with 90 degrees C wire and shall be marked "maximum 90 degrees C".
  5. Standards: NFPA 70 Type PVC, NEMA TC 2, UL 651.

**2.5 FLEXIBLE CONDUIT**

- A. Flexible Galvanized Steel Conduit (FLEX):
  1. Formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
  2. Standard: NFPA 70 Type FMC, UL 1.
- B. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (FLEX-LT):
  1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
  2. Extruded PVC outer jacket positively locked to the steel core.
  3. Liquid and vaportight.
  4. Standard: NFPA 70 Type LFMC, UL 360.

**2.6 WIREWAY**

- A. General:
  1. Suitable for lay-in conductors.
  2. Designed for continuous grounding.
  3. Covers:

## SECTION 26 05 33 - RACEWAYS AND BOXES

- a. Hinged or removable in accessible areas.
  - b. Non-removable when passing through partitions.
  4. Finish: Rust inhibiting primer and manufacturer's standard paint inside and out except for stainless steel type.
  5. Standards: UL 870, NEMA 250.
- B. General Purpose (NEMA 1 rated) Wireway:
1. 14 or 16 gage steel without knockouts.
  2. Cover: Solid, non-gasketed and held in place by captive screws.
- C. Raintight (NEMA 3R) Wiring Trough:
1. 14 or 16 GA galvanized steel without knockouts.
  2. Cover: Non-gasketed and held in place by captive screws.
- D. Watertight (NEMA 4X rated) Wireway:
1. 14 GA Type 304 or 316 stainless steel bodies and covers without knockouts and 10 GA stainless steel flanges.
  2. Cover: Fully gasketed and held in place with captive clamp type latches.
  3. Flanges: Fully gasketed and bolted.
- E. Dusttight (NEMA 12 rated) Wireway:
1. 14 GA steel bodies and covers without knockouts and 10 GA steel flanges.
  2. Cover: Fully gasketed and held in place with captive clamp type latches.
  3. Flanges: Fully gasketed and bolted.

### 2.7 CONDUIT FITTINGS AND ACCESSORIES

- A. Fittings for Use with RGS:
1. General:
    - a. In hazardous locations listed for use in Class I, Groups C and D locations.
  2. Locknuts:
    - a. Threaded steel or malleable iron.
    - b. Gasketed or non-gasketed.
    - c. Grounding or non-grounding type.
  3. Bushings:
    - a. Threaded, insulated metallic.
    - b. Grounding or non-grounding type.
  4. Hubs: Threaded, insulated and gasketed metallic for raintight connection.
  5. Couplings:
    - a. Threaded straight type: Same material and finish as the conduit with which they are used on.
    - b. Threadless type: Gland compression or self-threading type, concrete tight.
  6. Unions: Threaded galvanized steel or zinc plated malleable iron.
  7. Conduit bodies (ells and tees):
    - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
    - b. Standard and mogul size.
    - c. Cover:
      - 1) Clip-on type with stainless steel screws.
      - 2) Gasketed or non-gasketed galvanized steel, zinc plated cast iron or cast copper free aluminum.
  8. Conduit bodies (round):
    - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.

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- b. Cover: Threaded screw on type, gasketed, galvanized steel, zinc plated cast iron or cast copper free aluminum.
  - 9. Sealing fittings:
    - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
    - b. Standard and mogul size.
    - c. With or without drain and breather.
    - d. Fiber and sealing compound: UL listed for use with the sealing fitting.
  - 10. Hazardous location flexible coupling (HAZ-FLEX):
    - a. Liquid tight and arc resistant.
    - b. Electrically conductive so no bonding jumper is required.
    - c. Dry and wet areas:
      - 1) Bronze braided covering over flexible brass core.
      - 2) Bronze end fittings.
      - 3) Zinc-plated steel or malleable iron unions and nipples.
    - d. Corrosive areas:
      - 1) Stainless steel braided covering over flexible stainless steel core.
      - 2) Stainless steel end fittings.
      - 3) Aluminum unions and nipples.
  - 11. Service entrance head:
    - a. Malleable iron, galvanized steel or copper free aluminum.
    - b. Insulated knockout cover for use with a variety of sizes and number of conductors.
  - 12. Expansion couplings:
    - a. 2 inches nominal straight-line conduit movement in either direction.
    - b. Galvanized steel with insulated bushing.
    - c. Gasketed for wet locations.
    - d. Internally or externally grounded.
  - 13. Expansion/deflection couplings:
    - a. 3/4 inches nominal straight-line conduit movement in either direction.
    - b. 30 degrees nominal deflection from the normal in all directions.
    - c. Metallic hubs, neoprene outer jacket and stainless steel jacket clamps.
    - d. Internally or externally grounded.
    - e. Watertight, raintight and concrete tight.
  - 14. Standards: UL 467, UL 514B, UL 1203.
- B. Fittings for Use with EMT:
- 1. Connectors:
    - a. Straight, angle and offset types furnished with locknuts.
    - b. Zinc plated steel.
    - c. Insulated gland compression type.
    - d. Concrete and raintight.
  - 2. Couplings:
    - a. Zinc plated steel.
    - b. Gland compression type.
    - c. Concrete and raintight.
  - 3. Conduit bodies (ells and tees):
    - a. Body: Copper free aluminum with threaded hubs.
    - b. Standard and mogul size.
    - c. Cover:
      - 1) Screw down type with steel screws.
      - 2) Gasketed or non-gasketed galvanized steel or copper free aluminum.
  - 4. Standard: UL 514B.
- C. Fittings for Use with FLEX:
- 1. Connector:
    - a. Zinc plated malleable iron.



- b. Squeeze or clamp-type.
- 2. Standard: UL 514B.
  
- D. Fittings for Use with FLEX-LT and FLEX-NM:
  - 1. Connector:
    - a. Straight or angle type.
    - b. Metal construction, insulated and gasketed.
    - c. Composed of locknut, grounding ferrule and gland compression nut.
    - d. Liquid tight.
  - 2. Standards: UL 467, UL 514B.
  
- E. Fittings for Use with Rigid Nonmetallic PVC Conduit:
  - 1. Coupling, adapters and conduit bodies:
    - a. Same material, thickness, and construction as the conduits with which they are used.
    - b. Homogeneous plastic free from visible cracks, holes or foreign inclusions.
    - c. Bore smooth and free of blisters, nicks or other imperfections which could damage the conductor.
  - 2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.
  - 3. Standards: ASTM D2564, NEMA TC 3, UL 651, UL 514B.
  
- F. Weather and Corrosion Protection Tape:
  - 1. PVC based tape, 10 mils thick.
  - 2. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct bury.
  - 3. Used with appropriate pipe primer.

## **2.8 ALL RACEWAY AND FITTINGS**

- A. Mark Products:
  - 1. Identify the nominal trade size on the product.
  - 2. Stamp with the name or trademark of the manufacturer.

## **2.9 OUTLET BOXES**

- A. Metallic Outlet Boxes:
  - 1. Hot-dip galvanized steel.
  - 2. Conduit knockouts and grounding pigtail.
  - 3. Styles:
    - a. 2 inches x 3 inches rectangle.
    - b. 4 inches square.
    - c. 4 inches octagon.
    - d. Masonry/tile.
  - 4. Accessories:
    - a. Flat blank cover plates.
    - b. Barriers.
    - c. Extension, plaster or tile rings.
    - d. Box supporting brackets in stud walls.
    - e. Adjustable bar hangers.
  - 5. Standards: NEMA/ANSI OS 1, UL 514A.
  
- B. Cast Outlet Boxes:
  - 1. Zinc plated cast iron or die-cast copper free aluminum with manufacturer's standard finish.

2. Threaded hubs and grounding screw.
3. Styles:
  - a. "FS" or "FD".
  - b. "Bell".
  - c. Single or multiple gang and tandem.
  - d. "EDS" or "EFS" for hazardous locations.
4. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.
5. Standards: UL 514A, UL 1203.

C. See Specification Section 26 27 26 for wiring devices, wallplates and coverplates.

## **2.10 PULL AND JUNCTION BOXES**

- A. NEMA 1 Rated:
1. Body and cover: 14 GA minimum, galvanized steel or 14 GA minimum, steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
  2. With or without concentric knockouts on four sides.
  3. Flat cover fastened with screws.
- B. NEMA 3R Rated:
1. Body and cover: 14 GA minimum, steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
  2. Drip shield top and seam-free sides, front and back.
  3. With or without concentric knockouts on bottom.
  4. Slip-on removable cover fastened on bottom edge with screws or continuous hinged cover fastened with screws.
- C. NEMA 3RX Rated:
1. Body and cover: 14 GA Type 304 or 316 stainless steel.
  2. Drip shield top and seam-free sides, front and back.
  3. With or without concentric knockouts on bottom.
  4. Slip-on removable cover fastened on bottom edge with screws or continuous hinged cover fastened with screws.
- D. NEMA 4 Rated:
1. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
  2. Seams continuously welded and ground smooth.
  3. No knockouts.
  4. External mounting flanges.
  5. Hinged or non-hinged cover held closed with stainless steel screws and clamps.
  6. Cover with oil resistant gasket.
- E. NEMA 4X Rated (metallic):
1. Body and cover: 14 GA Type 304 or 316 stainless steel.
  2. Seams continuously welded and ground smooth.
  3. No knockouts.
  4. External mounting flanges.
  5. Hinged door and stainless steel screws and clamps.
  6. Door with oil-resistant gasket.
- F. NEMA 4X Rated (Nonmetallic):
1. Body and cover: Ultraviolet light protected fiberglass-reinforced polyester boxes.

2. No knockouts.
  3. External mounting flanges.
  4. Hinged door with quick release latches and padlocking hasp.
  5. Door with oil resistant gasket.
- G. NEMA 7 and NEMA 9 Rated:
1. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
  2. Drilled and tapped openings or tapered threaded hub.
  3. Cover bolted-down with stainless steel bolts or threaded cover with neoprene gasket.
  4. External mounting flanges.
  5. Grounding lug.
  6. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.
- H. NEMA 12 Rated:
1. Body and cover:
    - a. 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
    - b. Type 5052 H-32 aluminum, unpainted.
  2. Seams continuously welded and ground smooth.
  3. No knockouts.
  4. External mounting flanges.
  5. Non-hinged cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.
  6. Flat door with oil resistant gasket.
- I. Miscellaneous Accessories:
1. Rigid handles for covers larger than 9 square feet or heavier than 25 pounds.
  2. Split covers when heavier than 25 pounds.
  3. Weldnuts for mounting optional panels and terminal kits.
  4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.
- J. Standards: NEMA 250, UL 50.

## **2.11 SPECIAL PURPOSE BOXES**

- A. Flush in Floor Duplex Receptacles:
1. Dual level, fully adjustable box with power fitting and brass carpet flange.

## **2.12 SUPPORT SYSTEMS**

- A. Multi-conduit Surface or Trapeze Type Support and Pull or Junction Box Supports:
1. Material requirements.
    - a. Galvanized steel: ASTM A123/A123M or ASTM A153/A153M.
    - b. Stainless steel: AISI Type 316.
    - c. PVC coat galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 mil PVC coating.
- B. Single Conduit and Outlet Box Support Fasteners:
1. Material requirements:
    - a. Zinc plated steel.
    - b. Stainless steel.
    - c. Malleable iron.

- d. PVC coat malleable iron or steel: 20 mil PVC coating.
- e. Steel protected with zinc phosphate and oil finish.

**2.13 OPENINGS AND PENETRATIONS IN WALLS AND FLOORS**

- A. Sleeves, smoke and fire stop fitting through walls and floors:
  - 1. See Specification Section 01 73 20.
- B. Smoke and Fire Stop Fittings:
  - 1. 3 hour UL rating.
  - 2. Flanged and segmented.
  - 3. Cast malleable iron mounting frame and pressure plate.
    - a. Elastomeric sealing material.
    - b. Steel clamping hardware.
- C. Sleeves through walls and floors:
  - 1. Uncoated or galvanized iron or steel:
  - 2. Wall thickness: Not less than standard Schedule 40 pipe.

**PART 3 - EXECUTION**

**3.1 RACEWAY INSTALLATION - GENERAL**

- A. Shall be in accordance with the requirements of:
  - 1. NFPA 70.
  - 2. Manufacturer instructions.
- B. Size of Raceways:
  - 1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with NFPA 70.
  - 2. Unless specifically indicated otherwise, the minimum raceway size shall be:
    - a. Conduit: 3/4 inches.
    - b. Wireway: 2-1/2 inches x 2-1/2 inches.
- C. Field Bending and Cutting of Conduits:
  - 1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.
  - 2. Do not reduce the internal diameter of the conduit when making conduit bends.
  - 3. Prepare tools and equipment to prevent damage to the PVC coating.
  - 4. Degrease threads after threading and apply a zinc rich paint.
  - 5. Debur interior and exterior after cutting.
- D. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.
- E. The protective coating integrity of conduits, fittings, outlet, pull and junction boxes and accessories shall be maintained.
  - 1. Repair galvanized components utilizing a zinc rich paint.
  - 2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.

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3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the conduit; or a self-adhesive, highly conformable, cross-linked silicone composition strip, followed by a protective coating of vinyl tape.
    - a. Total nominal thickness: 40 mil.
  4. Repair surfaces which will be inaccessible after installation prior to installation.
- F. Remove moisture and debris from conduit before wire is pulled into place.
1. Pull mandrel with diameter nominally 1/4 inches smaller than the interior of the conduit, to remove obstructions.
  2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
  3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.
- G. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.
- H. Where portions of a raceway are subject to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder section of the raceway.
- I. All exposed conduit, fittings, supports, hardware, junction boxes, covers, and visible components of the raceway system shall be painted white.
- J. Fill openings in walls, floors, and ceilings and finish flush with surface.
1. See Specification Section 01 73 20.
  2. Use the following to seal fire-rated walls:
    - a. For single conduit penetrations:
      - 1) Flanged and segmented to install around in-place conduits.
    - b. For blockouts:
      - 1) Mounting frame and elastomeric sealing material to be set in place prior to installation of conduits.
- K. Where conduit terminates at a cable tray system, fit conduit with an insulated bushing.

### 3.2 RACEWAY ROUTING

- A. Raceways shall be routed in the field unless otherwise indicated.
1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.
  2. Run in straight lines parallel to or at right angles to building lines.
  3. Do not route conduits:
    - a. Through areas of high ambient temperature or radiant heat.
    - b. In suspended concrete slabs.
    - c. In concrete members including slabs, slabs on grade, beams, walls, and columns unless specifically located and detailed on structural Drawings.
  4. Locate sleeves or conduits penetrating floors, walls, and beams so as not to significantly impair the strength of the construction. Do not place conduit penetrations in columns.
  5. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.
  6. Provide pull boxes or conduit bodies as needed so that there is a maximum of 360 degrees of bends in the conduit run or in long straight runs to limit pulling tensions.
- B. All conduits within a structure shall be installed exposed except as follows:

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1. As indicated on the Drawings.
  2. Concealed above gypsum wall board or acoustical tile suspended ceilings.
  3. Conduits in architecturally finished areas shall be concealed.
  4. Embedded in floor slabs or buried under floor serving equipment in non-architecturally finished areas that are not located on or near a wall or column and the ceiling height is greater than 12 feet.
- C. Maintain minimum spacing between parallel conduit and piping runs in accordance with the following when the runs are greater than 30 feet:
1. Between instrumentation and telecommunication: 1 inch.
  2. Between instrumentation and 125 V, 48 V and 24 VDC, 2 inches.
  3. Between instrumentation and 600 V and less AC power or control: 6 inches.
  4. Between instrumentation and greater than 600 VAC power: 12 inches.
  5. Between telecommunication and 125 V, 48 V and 24 VDC, 2 inches.
  6. Between telecommunication and 600 V and less AC power or control: 6 inches.
  7. Between telecommunication and greater than 600 VAC power: 12 inches.
  8. Between 125 V, 48 V and 24 VDC and 600 V and less AC power or control: 2 inches.
  9. Between 125 V, 48 V and 24 VDC and greater than 600 VAC power: 2 inches.
  10. Between 600 V and less AC and greater than 600 VAC: 2 inches.
  11. Between process, gas, air and water pipes: 6 inches.
- D. Conduits shall be installed to eliminate moisture pockets.
1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.
- E. Conduit shall not be routed on the exterior of structures except as specifically indicated on the Drawings.
- F. Where sufficient room exists within the housing of roof-mounted equipment, the conduit shall be stubbed up inside the housing.
- G. Provide all required openings in walls, floors, and ceilings for conduit penetration.
1. See Specification Section 01 73 20.
  2. New construction:
    - a. Sleeves and blockouts:
      - 1) Set in masonry walls during erection.
      - 2) Set in concrete walls and floors during forming.
    - b. Sleeves not considered to structurally replace the displaced concrete.

### 3.3 RACEWAY APPLICATIONS

- A. Permitted Raceway Types Per Wire or Cable Types:
1. Power wire or cables: All raceway types.
  2. Control wire or cables: All raceway types.
  3. Instrumentation cables: Metallic raceway except nonmetallic may be used underground.
  4. Motor leads from a VFD: RGS, RAC or shielded VFD cables in all other raceways.
  5. Telecommunication cables: All raceway types.
- B. Permitted Raceway Types Per Area Designations:
1. Dry areas:
    - a. RGS.
    - b. RAC.
  2. Wet areas:

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- a. RGS.
  - b. RAC.
  - c. Fiberglass (above grade rated).
  3. Corrosive areas:
    - a. PVC-RGS.
    - b. RAC.
    - c. Fiberglass (above grade rated).
  4. Highly corrosive areas:
    - a. PVC-RGS.
    - b. PVC-80.
    - c. Fiberglass (above grade rated).
  5. NFPA 70 hazardous areas:
    - a. RGS.
    - b. RAC when required by other area designations.
- C. Permitted Raceway Types Per Routing Locations:
1. In stud framed walls:
    - a. EMT.
  2. In concrete block or brick walls:
    - a. PVC-40.
  3. Above acoustical tile ceilings:
    - a. EMT.
    - b. NEMA 1 rated wireway.
  4. Embedded in poured concrete walls and floors:
    - a. PVC-40.
    - b. Fiberglass (above or below grade rated).
    - c. Fiberglass (above grade rated) when emerging from concrete into areas designated as wet, corrosive or highly corrosive.
    - d. PVC-RGS when emerging from concrete into areas designated as wet, corrosive or highly corrosive.
  5. Beneath floor slab-on-grade:
    - a. PVC-40.
    - b. Fiberglass (above or below grade rated).
  6. Direct buried conduits and ductbanks:
    - a. PVC-80.
    - b. Fiberglass (above or below grade rated).
    - c. 90 degrees elbows for transitions to above grade:
      - 1) PVC-RGS.
      - 2) Fiberglass (above grade rated).
    - d. Long sweeping bends greater than 15 degrees:
      - 1) PVC-RGS.
      - 2) Fiberglass (above or below grade rated).
  7. Concrete encased ductbanks:
    - a. PVC-40.
    - b. PVC-EB.
    - c. Fiberglass (above or below grade rated).
    - d. 90 degree elbows for transitions to above grade:
      - 1) PVC-RGS.
      - 2) Fiberglass (above grade rated).
    - e. Long sweeping bends greater than 15 degrees:
      - 1) RGS for sizes 2 inches and larger.
      - 2) Fiberglass (above or below grade rated).
- D. FLEX conduits shall be installed for connections to light fixtures, HVAC equipment and other similar devices above the ceilings.

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1. The maximum length shall not exceed:
  - a. 6 feet to light fixtures.
  - b. 3 feet to all other equipment.
  
- E. FLEX-LT and FLEX-NM conduits shall be installed as the final conduit connection to light fixtures, dry type transformers, motors, electrically operated valves, instrumentation primary elements, and other electrical equipment that is liable to vibrate.
  1. The maximum length shall not exceed:
    - a. 6 feet to light fixtures.
    - b. 3 feet to motors.
    - c. 2 feet to all other equipment.
  
- F. HAZ-FLEX coupling shall be installed as the final conduit to motors, electrically operated valves, instrumentation primary elements and electrical equipment that is liable to vibrate.
  1. The maximum length shall not exceed:
    - a. 3 feet to motors.
    - b. 2 feet to all other equipment.
  
- G. NEMA 1 Rated Wireway:
  1. Surface mounted in electrical rooms.
  2. Surface mounted above removable ceilings tiles of an architecturally finished area.
  
- H. NEMA 3R Wiring Trough:
  1. Surface mounted in exterior locations.
  
- I. NEMA 4X Rated Wireway:
  1. Surface mounted in areas designated as wet and or corrosive.
  
- J. NEMA 12 Rated Wireway:
  1. Surface mounted in areas designated as dry in architecturally and non-architecturally finished areas.
  
- K. Underground Conduit: See Specification Section 26 05 43.

### 3.4 CONDUIT FITTINGS AND ACCESSORIES

- A. Conduit Seals:
  1. Installed in conduit systems located in hazardous areas as required by the NFPA 70.
  2. Fill plug and drain shall be accessible.
  3. Pour the conduit seals in a two-step process.
    - a. Pour the seal and leave cover off.
    - b. After seal is dry, inspect for proper sealing, install cover and mark (for example, paint or permanent marker) as complete.
  
- B. Rigid nonmetallic conduit and fittings shall be joined utilizing solvent cement.
  1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.
  
- C. Install Expansion Fittings:
  1. Where conduits are exposed to the sun and conduit run is greater than 200 feet.
  2. Elsewhere as identified on the Drawings.
  
- D. Install Expansion/Deflection Fittings:



1. Where conduits enter a structure.
    - a. Except electrical manholes and handholes.
    - b. Except where the ductbank is tied to the structure with rebar.
  2. Where conduits span structural expansions joints.
  3. Elsewhere as identified on the Drawings.
- E. Threaded connections shall be made wrench-tight.
- F. Conduit joints shall be watertight:
1. Where subjected to possible submersion.
  2. In areas classified as wet.
  3. Underground.
- G. Terminate Conduits:
1. In metallic outlet boxes:
    - a. RGS:
      - 1) Conduit hub and locknut.
      - 2) Insulated bushing and two locknuts.
      - 3) Use grounding type locknut or bushing when required by NFPA 70.
    - b. EMT: Compression type connector and locknut.
  2. In NEMA 1 rated enclosures:
    - a. RGS:
      - 1) Conduit hub and locknut.
      - 2) Insulated bushing and two locknuts.
      - 3) Use grounding type locknut or bushing when required by NFPA 70.
    - b. EMT: Compression type connector and locknut.
  3. In NEMA 12 rated enclosures:
    - a. Watertight, insulated and gasketed hub and locknut.
    - b. Use grounding type locknut or bushing when required by NFPA 70.
  4. In NEMA 4 and NEMA 4X rated enclosures:
    - a. Watertight, insulated and gasketed hub and locknut.
  5. In NEMA 7 and NEMA 9 rated enclosures:
    - a. Into an integral threaded hub.
  6. When stubbed up through the floor into floor mount equipment:
    - a. With an insulated grounding bushing on metallic conduits.
    - b. With end bells on nonmetallic conduits.
- H. Threadless couplings shall only be used to join new conduit to existing conduit when the existing conduit end is not threaded and it is not practical or possible to cut threads on the existing conduit with a pipe threader.

### **3.5 CONDUIT SUPPORT**

- A. Permitted multi-conduit surface or trapeze type support system per area designations and conduit types:
1. Dry or wet and/or hazardous areas:
    - a. Galvanized system consisting of: Galvanized steel channels and fittings, nuts and hardware and conduit clamps.
    - b. Aluminum system consisting of: Aluminum channels, fittings and conduit clamps with stainless steel nuts and hardware.
  2. Corrosive areas:
    - a. Aluminum system consisting of: Aluminum channels, fittings and conduit clamps with stainless steel nuts and hardware.

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- b. PVC coated steel system consisting of: PVC coated galvanized steel channels and fittings and conduit clamps with stainless steel nuts and hardware.
    3. Highly corrosive areas:
      - a. PVC coated steel system consisting of: PVC coated galvanized steel channels and fittings and conduit clamps with stainless steel nuts and hardware.
      - b. Fiberglass system consisting of: Fiberglass channels and fittings, nuts and hardware and conduit clamps.
    4. Conduit type shall be compatible with the support system material.
      - a. Galvanized steel system may be used with RGS and EMT.
      - b. Stainless steel system may be used with RGS and PVC-RGS.
      - c. PVC coated galvanized steel system may be used with PVC-RGS and PVC-40 and PVC-80.
      - d. Aluminum system may be used with RAC and PVC-RGS.
  - B. Permitted single conduit support fasteners per area designations and conduit types:
    1. Architecturally finished areas:
      - a. Material: Zinc plated steel, or steel protected with zinc phosphate and oil finish.
      - b. Types of fasteners: Spring type hangers and clips, straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
      - c. Provide anti-rattle conduit supports when conduits are routed through metal studs.
    2. Dry or wet and/or hazardous areas:
      - a. Material: Zinc plated steel, stainless steel and malleable iron.
      - b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
    3. Corrosive areas:
      - a. Material: Stainless steel and PVC coat malleable iron or steel.
      - b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
    4. Highly corrosive areas:
      - a. Material: PVC coat malleable iron or steel.
      - b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
    5. Conduit type shall be compatible with the support fastener material.
      - a. Zinc plated steel, steel protected with zinc phosphate and oil finish and malleable iron fasteners may be used with RGS and EMT.
      - b. Stainless steel system may be used with RGS and PVC-RGS and RAC.
      - c. PVC coated fasteners may be used with PVC-RGS and RAC and PVC-40 and PVC-80.
      - d. Nonmetallic fasteners may be used with PVC-40, PVC-80 and fiberglass.
  - C. Conduit Support General Requirements:
    1. Maximum spacing between conduit supports per NFPA 70.
    2. Support conduit from the building structure.
    3. Do not support conduit from process, gas, air or water piping; or from other conduits.
    4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 LBS or to the maximum uniform load recommended by the manufacturer if the support is rated less than 25 pounds.
      - a. Do not exceed maximum concentrated load recommended by the manufacturer on any support.
      - b. Conduit hangers:
        - 1) Continuous threaded rods combined with struts or conduit clamps: Do not use perforated strap hangers and iron bailing wire.
      - c. Do not use suspended ceiling support systems to support raceways.
      - d. Hangers in metal roof decks:
        - 1) Utilize fender washers.
        - 2) Not extend above top of ribs.

- 3) Not interfere with vapor barrier, insulation, or roofing.
5. Conduit support system fasteners:
  - a. Use sleeve-type expansion anchors as fasteners in masonry wall construction.
  - b. Do not use concrete nails and powder-driven fasteners.

### **3.6 OUTLET, PULL AND JUNCTION BOX INSTALLATION**

#### **A. General:**

1. Install products in accordance with manufacturer's instructions.
2. See Specification Section 26 05 00 and the Drawings for area classifications.
3. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.
4. Size boxes to accommodate quantity of conductors enclosed and quantity of conduits connected to the box.

#### **B. Outlet Boxes:**

1. Permitted uses of metallic outlet boxes:
  - a. Housing of wiring devices:
    - 1) Recessed in all stud framed walls and ceilings.
    - 2) Recessed in poured concrete, concrete block and brick walls of architecturally finished areas and exterior building walls.
  - b. Pull or junction box:
    - 1) Above gypsum wall board or acoustical tile ceilings.
    - 2) Above 10 feet in an architecturally finished area where there is no ceiling.
2. Permitted uses of cast outlet boxes:
  - a. Housing of wiring devices surface mounted in non-architecturally finished dry, wet, corrosive, highly corrosive and hazardous areas.
  - b. Pull and junction box surface mounted in non-architecturally finished dry, wet, corrosive and highly corrosive areas.
3. Mount device outlet boxes where indicated on the Drawings and at heights as scheduled in Specification Section 26 05 00.
4. Set device outlet boxes plumb and vertical to the floor.
5. Outlet boxes recessed in walls:
  - a. Install with appropriate stud wall support brackets or adjustable bar hangers so that they are flush with the face of the wall.
  - b. Locate in ungrouted cell of concrete block with bottom edge of box flush with bottom edge of block and flush with the face of the block.
6. Place barriers between switches in boxes with 277 V switches on opposite phases.
7. Back-to-back are not permitted.
8. When an outlet box is connected to a PVC coated conduit, the box shall also be PVC coated.

#### **C. Pull and Junction Boxes:**

1. Install pull or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.
  - a. Make covers of boxes accessible.
2. Permitted uses of NEMA 1 enclosure:
  - a. Pull or junction box surface mounted above removable ceiling tiles of an architecturally finished area.
  - b. Pull or junction box surface mounted above 10 feet in areas designated as dry in architecturally and non-architecturally finished areas.
3. Permitted uses of NEMA 3R enclosure:
  - a. Pull or junction box surface mounted in exterior locations.
4. Permitted uses of NEMA 4 enclosure:
  - a. Pull or junction box surface mounted in areas designated as wet.

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5. Permitted uses of NEMA 4X metallic enclosure:
  - a. Pull or junction box surface mounted in areas designated as wet and/or corrosive.
6. Permitted uses of NEMA 7 enclosure:
  - a. Pull or junction box surface mounted in areas designated as Class I hazardous.
    - 1) Provide PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.
7. Permitted uses of NEMA 12 enclosure:
  - a. Pull or junction box surface mounted in areas designated as dry.

**END OF SECTION 26 05 33**

# **SECTION 26 05 43 - ELECTRICAL - EXTERIOR UNDERGROUND**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for:
    - a. Handhole.
    - b. Underground conduits.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 26 05 26 - Grounding.
  - 2. Section 26 05 33 - Raceways and Boxes.

### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Association of State Highway and Transportation Officials (AASHTO):
    - a. HB-17, Standard Specifications for Highway Bridges.
  - 2. ASTM International (ASTM):
    - a. A536, Standard Specification for Ductile Iron Castings.
  - 3. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 4. Society of Cable Telecommunications Engineers (SCTE):
    - a. 77, Specifications for Underground Enclosure Integrity.

### **1.3 DEFINITIONS**

- A. Direct-Buried Conduit(s):
  - 1. Individual (single) underground conduit.
  - 2. Multiple underground conduits, arranged in one or more planes, in a common trench.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. Provide signed and sealed design computations for handholes indicating compliance with design load rating.
  - 2. Fabrication and/or layout drawings:
    - a. Provide dimensional drawings of each handhole indicating all specified accessories and conduit entry locations.

## **SECTION 26 05 43 - ELECTRICAL - EXTERIOR UNDERGROUND**

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Prefabricated composite handholes:
    - a. Armorcast Products Company.
    - b. Quazite by Hubbell.
    - c. Synertech by Oldcastle Enclosure Solutions.
  - 2. Handhole accessories:
    - a. Cantex, Inc.
    - b. Condux International, Inc.
    - c. Neenah Enterprises, Inc.
    - d. Prime Conduit.
    - e. Thomas and Betts.
    - f. Underground Devices, Inc.
    - g. Unistrut by Atkore International, Inc.

#### **2.2 HANDHOLES**

- A. Prefabricated Composite Material Handholes:
  - 1. Handhole body and cover: Fiberglass reinforced polymer concrete conforming to all test provisions of SCTE 77.
  - 2. Minimum load ratings: SCTE 77 Tier 8.
  - 3. Open bottom.
  - 4. Stackable design as required for specified depth.
  - 5. Cover:
    - a. Engraved legend of "ELECTRIC" or "COMMUNICATIONS".
    - b. Non-gasketed bolt down with stainless steel penta head bolts.
    - c. Lay-in non-bolt down, when cover is over 100 pounds.
    - d. One or multiple sections so the maximum weight of a section is 125 pounds.
  - 6. Cover lifting hook: 24 inches minimum in length.

#### **2.3 CONCRETE HANDHOLE ACCESSORIES**

- A. Cover and Frame:
  - 1. Cast ductile iron: ASTM A536.
  - 2. AASHTO live load rating: H-20.
  - 3. Diameter: 30 inches.
  - 4. Cast the legend "ELECTRICAL" or "COMMUNICATIONS" into handhole covers.
- B. Cable Racks and Hooks:
  - 1. Material: Heavy-duty nonmetallic (glass reinforced nylon).
  - 2. Hook loading capacity: 400 pounds minimum.
  - 3. Rack loading capacity: Four hooks maximum.
  - 4. Hook deflection: 0.25 inches maximum.
  - 5. Hooks: Length, as required, with positive locking device to prevent upward movement.
  - 6. Mounding hardware: Stainless steel.
- C. Cable Pulling Irons:

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1. 7/8 inches diameter hot-dipped galvanized steel.
2. 6000 pound minimum pulling load.

D. Ground Rods and Grounding Equipment: See Specification Section 26 05 26.

### **2.4 UNDERGROUND CONDUIT and ACCESSORIES**

A. Concrete and reinforcing steel: See Division 03 Specifications.

B. Conduit: See Specification Section 26 05 33.

C. Duct Spacers/Supports:

1. High density polyethylene or high impact polystyrene.
2. Interlocking web or mesh design.
3. Provide 3 inches minimum spacing between conduits.
4. Accessories, as required:
  - a. Hold down bars.

## **PART 3 - EXECUTION**

### **3.1 GENERAL**

A. Drawings indicate the intended location of hand holes and routing of ductbanks and direct buried conduit.

1. Field conditions may affect actual routing.

B. Handhole Locations:

1. Approximately where shown on the Drawings.
2. As required for pulling distances.
3. As required to keep pulling tensions under allowable cable tensions.
4. Shall not be installed in a swale or ditch.
5. Determine the exact locations after careful consideration has been given to the location of other utilities, grading, and paving.
6. Locations are to be approved by the Engineer prior to excavation and placement or construction of handholes.

C. Install products in accordance with manufacturer's instructions.

D. Install handholes in conduit runs where indicated or as required to facilitate pulling of wires or making connections.

### **3.2 HANDHOLES**

A. Prefabricated Composite Material Handholes:

1. For use in areas subjected to occasional non-deliberate vehicular traffic.
2. Place handhole on a foundation of compacted 1/4 to 1/2 inches crushed rock or gravel a minimum of 8 inches thick and 6 inches larger than handholes footprint on all sides.
3. Provide concrete encasement ring around handhole per manufacturers installation instructions (minimum of 10 inches wide x 12 inches deep).
4. Install so that the surrounding grade is 1 inch lower than the top of the handhole.

## **SECTION 26 05 43 - ELECTRICAL - EXTERIOR UNDERGROUND**

5. Size: 24" x 24" x 24" or as required for the number and size of conduits.
6. Provide cable rails and pulling eyes as needed.

### **3.3 UNDERGROUND CONDUITS**

#### **A. General Installation Requirements:**

1. During construction and after conduit installation is complete, plug the ends of all conduits.
2. Make conduit joints watertight and in accordance with manufacturer's recommendations.
3. Accomplish underground changes in direction of runs exceeding a total of 15 degrees by long sweep bends having a minimum radius of 10 feet.
  - a. Sweep bends may be made up of one or more curved or straight sections or combinations thereof.
4. Furnish manufactured elbows at end of runs as the conduit transitions to above grade.
  - a. Minimum radius of 18 inches for conduits less than 3 inches trade size and 36 inches for conduits 3 inches trade size and larger.
5. Field cuts requiring tapers shall be made with the proper tools and shall match factory tapers.
6. After the conduit run has been completed:
  - a. Prove joint integrity and test for out-of-round duct by pulling a test mandrel through each conduit.
    - 1) Test mandrel:
      - a) Length: Not less than 12 inches.
      - b) Diameter: Approximately 1/4 inches less than the inside diameter of the conduit.
    - b. Clean the conduit by pulling a heavy duty wire brush mandrel followed by a rubber duct swab through each conduit.
7. Pneumatic rodding may be used to draw in lead wire.
  - a. Install a heavy nylon cord free of kinks and splices in all unused new ducts.
  - b. Extend cord 3 feet beyond ends of conduit.
8. Transition from rigid nonmetallic conduit to rigid metallic conduit, per Specification Section 26 05 33, prior to entering a structure or going above ground.
  - a. Except rigid nonmetallic conduit may be extended directly to handholes, pad mounted transformer boxes and other exterior pad mounted electrical equipment where the conduit is concealed within the enclosure.
  - b. Terminate rigid PVC conduits with end bells.
  - c. Terminate steel conduits with insulated bushings.
9. Place warning tape in trench directly over direct-buried conduit.
10. Placement of conduits stubbing into handholes shall be located to allow for proper bending radiuses of the cables.

#### **B. Direct-Buried Conduit(s):**

1. Install so that the top of the uppermost conduit, at any point:
  - a. Is not less than 30 inches below grade.
  - b. Is below pavement sub-grading.
2. Provide a uniform minimum clearance of 3 inches between conduits.
  - a. Maintain the separation of multiple planes of conduits by one of the following methods:
    - 1) Install multilevel conduits with the use of conduit supports and separators to maintain the required separations, and backfill with flowable fill.
    - 2) Install the multilevel conduits one level at a time.
      - a) Each level is backfilled with the appropriate amount of soil and compaction.

**END OF SECTION 26 05 43**



**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes
  - 1. Short-circuit, selective coordination, and arc flash study. The power system study shall be provided by either the supplying distribution equipment manufacturer or an engineering firm with experience in industrial power systems.
- B. Related Specification Sections include but are not necessarily limited to
  - 1. Section 26 05 00 – Common Work Results for Electrical

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards
  - 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
    - b. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
    - c. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
    - d. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
    - e. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
    - f. IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations.
  - 2. American National Standards Institute (ANSI):
    - a. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
    - b. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
    - c. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
    - d. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
  - 3. The National Fire Protection Association (NFPA):
    - a. NFPA 70 - National Electrical Code, latest edition.
    - b. NFPA 70E – Standard for Electrical Safety in the Workplace.

**1.3 SUBMITTALS**

- A. Data Collection
  - 1. Contractor shall furnish tabulations of all as-built power system conduit types, cable types, size and lengths to be used as input in the electrical system studies.
  - 2. Contractor shall furnish tabulations of all make and model of as-constructed overcurrent protective devices.

- B. Power System Study Report
  - 1. The results of the short-circuit, selective coordination, and arc flash hazard studies shall be summarized in a final report. Three (3) bound copies of the complete final report shall be submitted. Additional copies of the Power System Study report shall be provided on two (2) CDs in PDF format.
  - 2. Equipment and component titles used in the studies shall be identical to the equipment and component titles shown on the Drawings.
  - 3. Upon completion of power system study, a copy of the SKM Power\*tools project files in native format shall be turn over to the owner on two (2) USB storage drives.
- C. Miscellaneous
  - 1. Sequence and Scheduling
    - a. An initial short-circuit and coordination study must be submitted and reviewed prior to approval of the electrical equipment shop drawings.
    - b. The Arc Flash Study shall be completed prior to contract substantial completion. Arc Flash data component entry shall be reflective of actual installed equipment.

## **PART 2 - PRODUCTS**

### **2.1 COMPUTER ANALYSIS SOFTWARE**

- A. General
  - 1. The studies shall be performed using the latest revision of SKM Systems Analysis Power\* Tools for Windows (PTW) software program.

### **2.2 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY**

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993
- B. Transformer design impedances shall be used when test impedances are not available.
- C. Provide the following:
  - 1. Calculation methods and assumptions.
  - 2. Selected base per unit quantities.
  - 3. One-line diagram of the system being evaluated.
  - 4. Source impedance data, including electric utility system and motor fault contribution characteristics.
  - 5. Tabulations of calculated quantities.
  - 6. Results, conclusions, and recommendations.
- D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
  - 1. Utility transformer secondaries.
  - 2. Incoming main circuit breaker.
  - 3. Main distribution panels.
  - 4. Motor control centers.
  - 5. Generator.
  - 6. Automatic transfer switch.
  - 7. Transformers.

8. Branch circuit panelboards.
  9. Local control panels.
  10. Other significant locations throughout the system.
- E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- F. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short circuit ratings
  2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
  3. Notify the Engineer if circuit protective devices are improperly rated for the calculated available fault current.

### **2.3 PROTECTIVE DEVICE COORDINATION STUDY (Selective Coordination)**

- A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
1. Electric utility's overcurrent protective device.
  2. Medium voltage equipment overcurrent relays.
  3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
  4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
  5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
  6. Conductor damage curves.
  7. Ground fault protective devices, as applicable.
  8. Pertinent motor starting characteristics and motor damage points, where applicable.
  9. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

### **2.4 ARC FLASH HAZARD ANALYSIS**

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in the latest version of NFPA70E.

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- B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchgear, motor-control center and panelboards) where work could be performed on energized parts.
- C. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.
- D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of  $1.2 \text{ cal/cm}^2$ .
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
  - 1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
  - 2. Fault contribution from synchronous motors should be decayed to match the actual decrement of each as closely as possible.
- H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

**2.5 REPORT SECTIONS**

- A. The report shall include the following sections:
  - 1. Executive Summary.
    - a. Descriptions, purpose, basis and scope of the study.
  - 2. Short Circuit Study.
    - a. Describe general procedure. Identify source data and component data used in calculations. Analysis of results and tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties (pass/fail table).
  - 3. Protective Device Coordination Study.
    - a. Describe general procedure. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection. Provide table listing Protective Device settings.
  - 4. Arc Flash Hazard Analysis.
    - a. Describe general procedure and methodology. Provide fault current calculations including a definition of terms and guide for interpretation of the computer printout.
    - b. Arc Flash Results. Details of the incident energy and flash protection boundary calculations.
      - 1) Provide AF result table with the following output:
        - a) Component name
        - b) Bus voltage
        - c) Bolted fault (kA)
        - d) Arcing Fault (kA)
        - e) Trip time (s)
        - f) Equipment type
        - g) Gap (mm)
        - h) AF Boundary (in)
        - i) Working distance (in)
        - j) Incident Energy (Cal/cm<sup>2</sup>)
        - k) PPE Category
        - l) Scenerio
  - 5. Input data shall include, but not be limited to the following:
    - a. Overcurrent protective device data component name, description, manufacturer, type, frame/model, frame rating, interrupting rating, and sensor/plug trip rating.
  - 6. Equipment Fault Contribution Report shall include, but not be limited to the following:
    - a. Provide outputs in a table format:
      - 1) Fault location bus name
      - 2) Bus Voltage
      - 3) Calculated bolted fault 3-phase amps
      - 4) 3-phase X/R ratio
      - 5) SLG amps
      - 6) SLG X/R ratio
      - 7) 3-phase Asym. Amps; 3 cycles, 5 cycles, and 8 cycles.
  - 7. Arc Flash Labels (PDF format), the labels shall include the following information, at a minimum:
    - a. Location designation
    - b. Nominal voltage
    - c. Flash hazard boundary
    - d. Flash risk at 18IN (Cal/cm<sup>2</sup>)
    - e. PPE level and gear
    - f. Glove class
    - g. Limited approach (IN)
    - h. Restricted approach (IN)
    - i. Minimum Arc rating (Cal/cm<sup>2</sup>)
    - j. Issue data

8. One Line Diagram, to include the following:
  - a. Component designations.
  - b. Incident Energy at 18IN and PPE level for each work location analyzed.
  - c. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance ( $X''d$ ), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
  - d. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
  - e. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance.
  - f. Motor contribution data (induction motors and synchronous motors), rated horsepower.

### **PART 3 - EXECUTION**

#### **3.1 FIELD ADJUSTMENTS**

- A. Adjust relay and protective device settings according to the recommended settings table provided in the final coordination study, where needed. Field adjustments to be completed by the Contractor.

#### **3.2 ARC FLASH WARNING LABELS**

- A. Arc Flash Warning Labels shall be printed on a minimum size (3.5 in. x 5 in.) thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system, if needed.
- C. Labels shall be machine printed, with no field markings
- D. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
  1. For the service main, automatic transfer switch and generator an arc flash label shall be provided.
  2. For each 480 and applicable 208 volt panelboard, one arc flash label shall be provided.
  3. For each motor control center, one arc flash label shall be provided.
  4. For each switchboard, one arc flash label shall be provided.
  5. For each local control panel, one arc flash label shall be provided.
- E. Labels shall be field installed by the Contractor.

**END OF SECTION 26 05 73**

## **SECTION 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Contract Drawings and provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections apply to this Section.
- B. Section 019113 – Commissioning General Requirements
- C. Section 230800 – Commissioning of Mechanical Systems
- D. Section 230901 – Commissioning of Integrated Automation Systems
- E. Commissioning Plan

#### **1.2 DESCRIPTION OF WORK**

- A. An independent third-party Commissioning Agent has been retained to lead the project participants through the commissioning process. The section below is provided for informational purposes and to inform the contractor of the extent of the commissioning process and the involvement required. The Commissioning Agent is RMF Engineering, Inc.
- B. The purpose of this section is to specify commissioning responsibilities directly related to the Division 26 contractors and vendors. All contractors responsible for Division 26 installation or other activities shall have commissioning responsibilities described herein.
- C. The majority of the Commissioning Requirements apply to all trades and therefore are defined within Section 019113 – Commissioning General Requirements. Specific requirements herein apply generally to the Electrical Contractors alone.
- D. Work under this contract shall conform to requirements of Division 1, General Requirements, Conditions of the Contract, and Supplementary Conditions. This specification covers Commissioning of Electrical Systems, which are a part of this project.
- E. Commissioning shall be a team effort to ensure that all equipment and systems have been completely and properly installed and function together correctly to meet the design intent. Additionally, system performance parameters shall be monitored and documented for verification of proper loading and unloading, fine tuning of control sequences and operational procedures. Commissioning shall coordinate and document equipment installation, quality control, equipment start-up, third party testing, final verification and performance testing, training, turn-over and possible deferred or seasonal testing including a final warranty verification.
- F. The Commissioning Team is defined in Specification 019113 Section 1.3 – Definitions. The electrical trades represented on the Commissioning Team shall include but not be limited to; raceway, pipe and fitting, controls, NETA test, electrical, vendors, manufacturers and thermographer. The lead person for each trade who will actually perform or supervise the work is to be designated as the representative to the Commissioning Team. Responsibility for various steps of the commissioning process shall be divided among the members of the Commissioning Team, as described in this section.

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- G. Electrical Contractor(s) are responsible for electrical system installation, start-up, testing, preparation of O&M manuals, and operator training as defined in various Division 1 and Division 26 specification sections. Electrical Contractor(s) are responsible for coordination, observation, and verification of commissioning as defined in this section and Section 019113.
- H. Sections 019113 - Commissioning General Requirements and 260800 – Commissioning of Electrical Systems DO NOT relieve the Electrical Contractor(s) from their obligations to complete all portions of work in a satisfactory and fully operational manner. Furthermore, Section 260800 – Commissioning of Electrical Systems shall not relieve any other discipline or trade contractor from any obligations set forth within other divisions of the specifications.

### **1.3 DEFINITIONS**

- A. Electrical Contractor(s): The term Electrical Contractor(s) utilized herein refers to any and all subcontracting companies or vendors who are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning and are defined within Division 26 of the specifications. Subcontracting parties outside of the scope of the Systems to be Included in Commissioning or outside of the scope of Division 26 are not included.
- B. Equipment Manufacturer(s): The term Equipment Manufacturer(s) utilized herein refers to any and all subcontracting companies who are responsible for the provision of equipment or components which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are defined within Division 26 of the specifications. Equipment Manufacturer(s) shall refer to the direct representative of the maker and/or distributor of the equipment or component being provided. This may include either the actual equipment manufacturer or the supplier thereof, under the provisions that the supplier has a thorough knowledge of the equipment or component and is recognized by the actual equipment manufacturer as being a proper representative.
- C. Third Party Testing Agencies: The term Third Party Testing Agency utilized herein refers to any and all subcontracting companies who are responsible for performing testing or other quality control activities which do not necessarily involve installation activities, such as a company performing NETA testing or a company performing arc hazard analysis or short circuit study.
- D. See specification 019113 – General Commissioning Requirements for additional definitions utilized herein.

### **1.4 ROLES AND RESPONSIBILITIES**

- A. In addition to the Commissioning Agent, Owner and System Design Professional(s), the Commissioning Team is comprised of a minimum of one individual to represent each contracting company, vendor or manufacturer whom are responsible for the construction or other provisions regarding any of the systems which are being commissioned, as outlined in Specification 019113 Section 1.5 – Systems to be Included in Commissioning, and are further defined within Division 26 of the specifications and project drawings.
- B. Every Electrical Contractor, Subcontractor, Vendor, etc. is responsible for providing a minimum of one team member to participate in the Commissioning Process for the duration of the project. This team member shall be labeled as that company's Commissioning Representative. Each Contractor is responsible for ensuring re the subcontractors under their contract have included the same representation.



## **SECTION 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS**

- C. All Division 26 Contractors are responsible for the requirements defined in section 019113 section 1.4-D – Subcontractors.
- D. Electrical Contractor(s)
  - 1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
  - 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
  - 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
  - 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
  - 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.
- E. Controls Contractor(s)
  - 1. Controls Contractors may be a subcontractor to the Electrical Contractor but their responsibilities are defined in specification 230901 – Commissioning of Integrated Automation Systems. Controls Contractors installing controls under Division 26 shall follow the requirements set forth in specification 230901 – Commissioning of Integrated Automation System but will apply the same requirements to the Division 26 installations for which they are responsible.
- F. Equipment Manufacturer(s)
  - 1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
  - 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
  - 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
  - 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
  - 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.
- G. Third Party Testing Agencies
  - 1. Read, understand and follow the Commissioning Plan as a guideline for the Commissioning Process implemented into this construction project.
  - 2. Read, understand and include all roles, responsibilities, products and services included within specification 019113 for your specific trade, installation or service being provided within this project.
  - 3. Provide all work products related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 2 – Products.
  - 4. Execute all actions related to your specific trade as listed within specification 019113 – General Commissioning Requirements under Part 3 - Execution
  - 5. Coordinate all Commissioning Activities through the Construction Manager/General Contractor as well as with the other various Subcontractors on the project.

### **1.5 SYSTEMS INCLUDED IN COMMISSIONING**

- A. See specification 019113 section 1.5 – Systems Included in Commissioning for the full list of Division 26 Electrical Systems included within the Commissioning Scope.

## **SECTION 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS**

### **1.6 COORDINATION**

- A. Overall Coordination of Commissioning Tasks is the responsibility of the Construction Manager/General Contractor. The Commissioning Agent does not have any direct control over contractors or the construction schedule and therefore, cannot dictate task schedule. However, the Commissioning Agent typically has the most Commissioning Experience and will assist with coordination of Commissioning Tasks by providing input and feedback to the Commissioning Team.
- B. The Owner, System Design Professionals, Commissioning Agent, Contractors, Sub-Contractors, Vendors and 3rd Part Test Agencies are all required to assist with Coordination. General coordination is required by the Owner, Architect, System Design Professional(s), Contractor(s) and the Commissioning Agent to maintain an efficient commissioning process.
- C. Various tasks included as part of the commissioning process must be coordinated by the Cx Team. These tasks require advance notification by the subcontractors to the Owner, Designers and Commissioning Agent for planning and participation. Tasks required to be coordinated with the Commissioning Team include but are not limited to:
  - 1. Submittal Reviews
  - 2. Quality Control Plans and Tests
  - 3. Equipment and Systems Start-Up
  - 4. Third Party Testing
  - 5. Pre-Verification Testing
  - 6. Functional Performance Testing
  - 7. Close-Out Inspections
  - 8. Close-Out Document Review (O&M's, As-Builts, Warranties)

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Work products to be provided by the Electrical Contractors are defined within Specification 019113 – General Commissioning Requirements part 2. Work products specific to the Electrical Contractors, Manufacturers and Third-Party Test Agencies Include:
  - 1. 2.1 - Project Schedule
  - 2. 2.2 - Schedule of Values
  - 3. 2.3 - Submittals
  - 4. 2.4 - Quality Control Plan
  - 5. 2.5 - Quality Control Reports
  - 6. 2.6 - Systems and Equipment Start-Up Plan
  - 7. 2.8 - Start-Up Reports
  - 8. 2.9 - Preventative Maintenance Plan
  - 9. 2.10 - Pre-Verification Tests
  - 10. 2.11 - Functional Performance Tests
  - 11. 2.12 - Test and Proprietary Equipment
- B. Work products under the Construction Manager/General Contractor purview are to be coordinated with the Electrical Contractors, Manufacturers and Third-Party Test Agencies to ensure products are up to date and accurate.

## **SECTION 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS**

- C. Work products under the Contractors purview outside of Division 26 are to be coordinated with the Electrical Contractors, Manufacturers and Third-Party Test Agencies to ensure related tasks and activities to not impede Division 26 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 26 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

### **PART 3 - EXECUTION**

#### **3.1 GENERAL**

- A. Execution of Commissioning Activities to be performed by the Electrical Contractors are defined within Specification 019113 – General Commissioning Requirements part 3. Execution Activities specific to the Electrical Contractors, Manufacturers and Third-Party Test Agencies Include:
1. 3.1 – Commissioning Plan and Kick-Off Meeting
  2. 3.2 – Construction Observations
  3. 3.3 – Systems and Equipment Start-Up
  4. 3.4 – Temporary Utilization
  5. 3.5 – Quality Control and Start-Up Reporting
  6. 3.6 – Pre-Verification Tests
    - a. Electrical PVT's are primarily the responsibility of the Electrical Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to participate in portions of the Electrical PVT's. For these activities, the Electrical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
    - b. Electrical Contractors are responsible for portions of PVT's which are primarily the responsibility of other Contractors such as Plumbing or Controls. For these items, the Electrical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure PVT completion and accuracy.
  7. 3.7 – Functional Performance Tests
    - a. Electrical PFT's are primarily the responsibility of the Electrical Contractors. Other Contractors such as Electrical or Controls or Manufacturers may be required to participate in portions of the Electrical FPT's. For these activities, the Electrical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.
    - b. Electrical Contractors are responsible for portions of FPT's which are primarily the responsibility of other Contractors such as Plumbing or Controls. For these items, the Electrical Contractor is to coordinate with the CM/GC and other Division Contractors to ensure FPT completion and accuracy.
  8. 3.9 – Integrated Systems Test
  9. 3.10 – Operations and Maintenance Manuals
  10. 3.11 – Exclusions
  11. 3.12 – Prerequisites to Substantial Completion
- B. Execution of Commissioning Activities under the Construction Manger/General Contractor purview are to be coordinated with the Electrical Contractors, Manufacturers and Third-Party Test Agencies to ensure activities are executed without any impedance or interference by Division 26 or any other contractors.

## **SECTION 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS**

- C. Execution of Commissioning Activities under the Contractors purview outside of Division 26 are to be coordinated with the Electrical Contractors, Manufacturers and Third-Party Test Agencies to ensure related tasks and activities to not impede Division 26 tasks and responsibilities. The lack of coordination on the part of any project contractor shall not be grounds for cost or schedule modifications. It is the responsibility of the Division 26 Contractors to seek out all other contractors with whom coordination must occur through the Construction Manager/General Contractor.

### **3.2 SCHEDULE**

- A. The Electrical Contractor(s) shall complete all phases of work so the systems can be started, tested, balanced, and acceptance procedures undertaken. This includes the complete installation of all equipment, materials, pipe, duct, wire, insulation, controls, etc., per the contract documents and related directives, clarifications, and change orders.
- B. Work is to be scheduled and completed such that all Commissioning Activities including Pre-Verification Tests and Functional Performance Tests can be executed with sufficient time for issue resolution prior to Beneficial Occupancy. It is the Contractors responsibility to determine the amount of time needed to test, troubleshoot and retest the Electrical Systems such that all deficiencies are resolved prior to Final Acceptance.

### **3.3 PARTICIPATION IN ACCEPTANCE PROCEDURES**

- A. The Electrical Contractor(s) shall provide skilled technicians to start-up and debug all systems within Division 26. These same technicians shall be made available to assist the Commissioning Agent in completing the commissioning program. Work schedules, time required for testing, etc., shall be requested by the Commissioning Agent and coordinated by the Electrical Contractor(s). Electrical Contractor(s) shall ensure that the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- B. System performance problems and discrepancies may require additional technician time, Commissioning Agent time, reconstruction of systems, and/or replacement of system components. The additional technician time shall be made available for subsequent commissioning periods until the required system performance is obtained, at no cost to the Owner.
- C. The Commissioning Agent reserves the right to question the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians shall include expert knowledge relative to the specific equipment involved and willingness to work with the Commissioning Agent. The Electrical Contractor(s) shall provide adequate documentation and tools to start-up and test the equipment, system, and/or sub-system.

## **SECTION 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS**

### **3.4 DEFICIENCIES AND FAILURES**

- A. Deficiencies are installations which do not comply with either the Construction Documents or the Manufacturer's Installation Requirements. Where the Construction Documents and the Manufacturer's Installation Requirements are in direct conflict, the Design Professional shall make the final decision regarding which requirement to follow. Deficiencies can be documented upon discovery if the installation appears to be progressed past the point of temporary work. If installation progress is such that the installation may not be complete and the deficiency may resolve itself as the installation progresses, the deficiency should be documented as a observations and not a true deficiency.
- B. Deficiencies found during an inspection for wall or ceiling closure or upon a final inspection or otherwise noted to be complete by the Contractors shall be required to have the associated progress or closure delayed until such time as the deficiency can be corrected and reinspected. All deficiencies must be reinspected unless otherwise proven beyond a doubt that the deficiency was resolved. Time and expenses related to additional site visits, re-inspections or extended inspection time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- C. Test failures are those that occur during Quality Control Testing or Functional Performance Testing which require any level of rework. This may include the addition of sealant to reduce leakage or a slight setting adjustment such that a sequence of operations will work. These deficiencies should have been previously discovered and addressed by the Contractors and should not be found during observation or witnessing by the Commissioning Agent.
- D. While minor issues can occur despite previous testing and some minor adjustments may be required during the final test, these should be minimized through the pre-test requirements of the Pre-Verification Tests. Therefore, an increase of more than five percent (5%) of the time associated with witnessing a Quality Control Test or Functional Performance Test shall be grounds for a test failure and/or termination of the test. Whether the test is terminated and fully repeated at a later date/time or the test is extended until deficiencies are resolved, time and expenses related to this additional time shall be accrued by the Commissioning Agent. See specification 019113 – 1.6-D for cost incursions.
- E. A test failure of a reading may vary depending upon the criticality of the reading. For example, space temperature within an open office space may be allowed to be within 10% of the expected value without being considered a failure. However, space temperature within a BSL laboratory has a much smaller tolerance due to the criticality of the space. Values such as gauge and sensor readings must be calibrated to within their specified tolerances.
- F. For general purposes or unless otherwise specified, a total number of test failures that comprise 10% of the total test readings shall be considered a fully failed test. 9% or fewer reading failures can be individually logged as deficiencies and the associated test can be documented as completed with issues. This does not supersede any Quality Control Test requirements set forth within other specification sections.
- G. There may be cases during testing where the final pass/fail decision cannot be made on the spot and values must be calculated, reviewed and assessed to determine if they are acceptable. In these cases, the testing will capture all of the needed values which will then be provided to the entire Commissioning Team. The Design Professional and the Commissioning Agent will perform the necessary calculation and analysis. Ultimately, the Design Professional will determine if the contract requirements have been met or if there is any deficiency. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner.

## **SECTION 26 08 00 – COMMISSIONING OF ELECTRICAL SYSTEMS**

### **3.5 DEFICIENCY RESOLUTION**

- A. In some systems, miss-adjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. All members shall have input and the opportunity to discuss, debate, and work out problems. Final direction for issue resolution is to come from the responsible Design Professional. The Commissioning Agent may agree or disagree but will ultimately report their professional opinion and/or recommendations to the Owner. The Commissioning Agent does NOT have final authority over the acceptance of systems or equipment.
- B. Corrective work shall be completed in a timely fashion to permit the completion of the commissioning process. Any and all schedule items affected by this work shall be reflected on the Commissioning and Overall Project Schedules.

### **3.6 ADDITIONAL COMMISSIONING**

- A. The Electrical Contractor, and associated sub-contractors, shall include time for additional commissioning required as a result of failure of a pre-functional or a functional test. Incomplete or incorrect Pre-Functional Checklists reviewed by the Commissioning Agent shall require an additional inspection to verify the re-completed PFC is complete and accurate. Functional Performance Tests witnessed by the Commissioning Agent which fail, shall require retesting, again witnessed by the Commissioning Agent. These documents must be re-checked or re-witnessed in order for the system to be approved and accepted by the Commissioning Agent.
- B. The Commissioning Agent will continue to serve the construction project if the schedule is extended, will repeat site visits and inspections if such activities prove deficiencies and attend additional testing to re-witness previously failed tests. For these services, the Commissioning Agent will invoice the Owner for additional time required for commissioning activities including additional meetings, additional site visits, or additional witnessing of retests due to failed FPT's. It is the Construction Manager/General Contractor and Sub-Contractor's responsibility to maintain scheduled, verify completion prior inviting the Commissioning Agent to inspect work, and properly de-bug systems and verify successful system performance prior to inviting the Commissioning Agent to witness testing.

### **3.7 SEASONAL COMMISSIONING**

- A. Seasonal commissioning pertains to testing under full load conditions during peak heating and peak cooling seasons, as well as part load or shoulder season conditions in the spring and fall. Initial commissioning shall be done as soon as contract work is completed, regardless of season. Subsequent commissioning may be undertaken at any time thereafter to ascertain adequate performance during the different seasons. Depending upon project schedule, some seasonal testing may be captured during the project acceptance phase, prior to Final Acceptance. Any seasonal testing left incomplete must be accommodated by the Contractors, coordinated with the Commissioning Team and will be witnessed by the Commissioning Agent.
- B. Outdoor generators shall be tested during winter design extremes. Interior electrical equipment shall be verified during peak electrical load whether it be summer or winter. Electrical equipment will be scanned with thermal imaging with a fully occupied building. Each contractor and supplier shall be responsible to participate in the initial and the alternate peak season tests of the systems as required to demonstrate performance.

**END OF SECTION 260800**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Basic requirements for acceptance testing.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. InterNational Electrical Testing Association (NETA):
    - a. ATS, Standard for Acceptance Testing Specifications for Electric Power Equipment and Systems.
  - 2. Nationally Recognized Testing Laboratory (NRTL).
  - 3. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
    - a. 455-78-B, Optical Fibres - PART 1-40: Measurement Methods and Test Procedures - Attenuation.
- B. Qualifications:
  - 1. Testing firm:
    - a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration , and adjusting of systems.
    - b. Must have an established monitoring and testing equipment calibration program with accuracy traceable in an unbroken chain, according to NIST.
  - 2. Field personnel:
    - a. Minimum of one year field experience covering all phases of electrical equipment inspection, testing, and calibration.
    - b. Relay test technician having previous experience with testing and calibration of relays of the same manufacturer and type used on project and proficient in setting and testing the types of protection elements used.
    - c. Supervisor certified by NETA or NICET.
      - 1) As an alternative, supervising technician may be certified by the equipment manufacturer.
  - 3. Analysis personnel:
    - a. Minimum three years combined field testing and data analysis experience.
    - b. Supervisor certified by NETA or NICET.
      - 1) As an alternative, supervising technician may be certified by the equipment manufacturer.
- C. Phasing Diagram:
  - 1. Coordinate with Utility Company for phase rotations and Phase A, B and C markings.
    - a. Create a phasing diagram showing the coordinated phase rotations with generators and motors through the transformers.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Equipment Monitoring and Testing Plan.

- B. Informational Submittals:
  - 1. Prior to energizing equipment:
    - a. Coordinated phasing diagram.
  - 2. Within two weeks after successful completion of Demonstration Period (Commissioning Period):
    - a. Single report containing information including:
      - 1) Summary of Project.
      - 2) Information from pre-energization testing.
      - 3) Testing and monitoring reports.

**PART 2 - PRODUCTS**

**2.1 FACTORY QUALITY CONTROL**

- A. Provide Electrical equipment with all factory tests required by the applicable industry standards or NRTL.
- B. Factory testing will not be accepted in lieu of specified field acceptance testing requirements.

**PART 3 - EXECUTION**

**3.1 FIELD QUALITY CONTROL**

- A. General:
  - 1. Complete electrical testing in three phases:
    - a. Pre-energization testing phase.
    - b. Equipment energized with no load.
    - c. Equipment energized under load.
  - 2. Perform testing in accordance with this Specification Section and NETA ATS.
  - 3. Provide field setting and programming of all adjustable protective devices and meters to settings as determined by the approved coordination study.
  - 4. Equip testing and analysis personnel with all appropriate project related reference material required to perform tests, analyze results, and provide documentation including, but not limited to:
    - a. Contract Drawings and Specifications.
    - b. Related construction change documentation.
    - c. Approved Shop Drawings.
    - d. Approved Operation and Maintenance Manuals.
    - e. Other pertinent information as required.
- B. Equipment Monitoring and Testing Plan:
  - 1. Approved in accordance with Shop Drawing submittal schedule.
  - 2. Included as a minimum:
    - a. Qualifications of firm, field personnel, and analysis personnel doing the Work.
    - b. List and description of testing and analysis equipment to be utilized.
    - c. List of all equipment to be testing, including:
      - 1) Name and tag numbers identified in the Contract Documents.
      - 2) Manufacturer's serial numbers.
      - 3) Other pertinent manufacturer identification,



- C. Instruments Used in Equipment and Connections Quality Control Testing:
  - 1. Minimum calibration frequency:
    - a. Field analog instruments: Not more than 6 months.
    - b. Field digital instruments: Not more than 12 months.
    - c. Laboratory instruments: Not more than 12 months.
    - d. If instrument manufacturer's calibration requirements are more stringent, those requirements shall govern.
  - 2. Carry current calibration status and labels on all testing instruments.
  - 3. See individual testing programs for additional instrumentation compliance requirements.
  
- D. Testing and Monitoring Program Documentation:
  - 1. Provide reports with tabbed sections for each piece of equipment tested.
  - 2. Include all testing results associated with each piece of equipment under that equipment's tabbed section.
    - a. Include legible copies of all forms used to record field test information.
  - 3. Prior to start of testing, submit one copy of preliminary report format for Engineer review and comment.
    - a. Include data gathering and sample test report forms that will be utilized.
  - 4. In the final report, include as a minimum, the following information for all equipment tested:
    - a. Equipment identification, including:
      - 1) Name and tag numbers identified in the Contract Documents.
      - 2) Manufacturer's serial numbers.
      - 3) Other pertinent manufacturer identification,
    - b. Date and time of each test.
    - c. Ambient conditions including temperature, humidity, and precipitation.
    - d. Visual inspection report.
    - e. Description of test and referenced standards, if any, followed while conducting tests.
    - f. Results of initial and all retesting.
    - g. Acceptance criteria.
    - h. "As found" and "as left" conditions.
    - i. Corrective action, if required, taken to meet acceptance.
    - j. Verification of corrective action signed by the Contractor, equipment supplier, and Owner's representative.
    - k. Instrument calibration dates of all instruments used in testing.
  - 5. Provide three (3) bound final reports prior to Project final completion.
  
- E. Electrical Equipment and Connections Testing Program:
  - 1. See individual Division 26 Specification Sections for equipment specific testing requirements.
  - 2. Test all electrical equipment.
    - a. Perform all required NETA testing.
    - b. Perform all required NETA testing plus the optional testing identified with each specific type of equipment in Article 3.2 of this Specification Section.

**3.2 SPECIFIC EQUIPMENT TESTING REQUIREMENTS**

- A. Transformers - Small Dry Type:
  - 1. Perform inspections and tests per NETA ATS 7.2.1.1.
  - 2. Perform the following additional tests:
    - a. Record phase-to-phase, phase-to-neutral, and neutral-to-ground voltages at no load after energizing, and at operating load after startup.
  - 3. Adjust tap connections as required to provide secondary voltage within 2-1/2% of nominal under normal load after approval of Engineer.
  - 4. Record as-left tap connections.

- B. Cable - Low Voltage:
  - 1. Perform inspections and tests per NETA ATS 7.3.2.
  
- C. Low Voltage Power Circuit Breakers:
  - 1. Perform inspections and tests per NETA ATS 7.6.1.2.
    - a. Tests shall include primary current injection testing of all breakers at final settings.
    - b. Where short-time or instantaneous settings on large frame breakers are beyond the current capability of field testing, primary injection tests at reduced currents shall be permitted if combined with secondary injection calibration test of trip unit at final settings.
  - 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
  - 3. Perform the following additional tests:
    - a. Shunt trip devices minimum tripping voltage.
  - 4. Record as-left settings.
  
- D. Low Voltage Molded Case Circuit Breakers:
  - 1. Perform inspections and tests per NETA ATS 7.6.1.1.
  - 2. Components:
    - a. Test all components per applicable paragraphs of this Specification Section and NETA ATS.
    - b. Thermal magnetic breakers: Visual and mechanical inspection per NETA ATS only.
    - c. Solid state trip type: Visual and mechanical inspection and electrical tests per NETA ATS.
  - 3. Record as-left settings.
  
- E. Instrument Transformers:
  - 1. Perform inspections and tests per NETA ATS 7.10.
  - 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
  - 3. Perform the following optional tests per NETA ATS:
    - a. Dielectric withstand test on potential transformers.
  - 4. Perform the following additional tests:
    - a. .
  
- F. Metering:
  - 1. Perform inspections and tests per NETA ATS 7.11.
  - 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
  - 3. Perform the following additional tests:
    - a. .
  
- G. Grounding:
  - 1. Perform inspections and tests per NETA ATS 7.13.
  - 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
  
- H. Motors:
  - 1. Perform inspections and tests per NETA ATS 7.15.
  - 2. Testing of motors:
    - a. After installation and prior to energizing the motor, perform inspections and tests per NETA ATS 7.15 for all motors   5   HP or above.
    - b. Ensure motor has been lubricated.
    - c. Bump motor to check for correct rotation.

## **SECTION 26 08 13 - ACCEPTANCE TESTING**

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- I. Motor Controllers:
  - 1. Perform inspections and tests per NETA ATS 7.16.
  - 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
  
- J. Generators:
  - 1. Perform inspections and tests per NETA ATS 7.15.2.
  - 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
  - 3. Perform the following additional tests:
    - a. Load and cycle crank test per Specification Section 26 32 14.
    - b. \_\_\_\_\_.
  
- K. Control System Functional Test:
  - 1. Perform test upon completion of equipment acceptance tests.
  - 2. The test is to prove the correct interaction of all sensing, processing and action devices.
  - 3. Develop a test plan and parameters for the purpose of evaluating the performance of the system.
  - 4. Perform the following tests:
    - a. Verify the correct operation of all interlock safety devices for fail-safe functions in addition to design function.
    - b. Verify the correct operation of all sensing devices, alarms and indicating devices.

**END OF SECTION 26 08 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Digital metering equipment.
  
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.
  - 2. Section 26 08 13 - Acceptance Testing.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 2. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
    - a. C12.20, For Electricity Meter - 0.2 and 0.5 Accuracy Classes.
  - 3. Underwriters Laboratories, Inc. (UL):
    - a. 508, Standard for Safety Industrial Control Equipment.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Provide submittal data for all products specified in PART 2 of this Specification:
    - b. See Section 26 05 00 for additional requirements.
  - 2. Fabrication and/or layout drawings.
    - a. Electrical wiring/connection diagrams.
  
- B. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. Content of Operation and Maintenance Manual:
      - 1) Data sheet of the meters electrical parameters, configuration and characteristics including a complete model number and associated equipment connected too.
      - 2) Operating instructions of the meter(s) supplied.
      - 3) Operating instructions of the Power Management software.
      - 4) Maintenance instructions.
      - 5) As-constructed electrical wiring/connection diagrams.
      - 6) Acceptance testing data.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Allen-Bradley.
  2. Eaton.
  3. Electro Industries.
  4. GE by ABB.
  5. Power Measurement.
  6. Square D Company.
  7. Siemens.

**2.2 DIGITAL METERING DEVICES**

- A. General:
1. Direct reading metered or calculated values.
  2. Microprocessor based.
  3. Integral LED or LCD display.
  4. Current and potential transformers as required.
  5. Integral fusing.
  6. Operating temperature: 0 degrees F to 150 degrees F.
  7. Standards:
    - a. NEMA/ANSI C12.20.
    - b. UL 508.
- B. Type 'A' Low Range Meter:
1. Display the following minimum electrical parameters (accuracy):
    - a. RMS current per phase (+0.3% full scale).
    - b. RMS voltage line-to-line and line-to-neutral (+0.3% full scale).
  2. Communication ports and protocols: Ethernet TCP/IP.
  3. Supply voltage: 120 VAC.
- C. Type 'B' Midrange Meter:
1. Display the following minimum electrical parameters (accuracy):
    - a. RMS current per phase (+0.3% full scale).
    - b. RMS voltage line-to-line and line-to-neutral (+0.3% full scale).
    - c. Real power (W): 3 PH total (+0.6% full scale).
    - d. Apparent power (VA): 3 PH total (+0.6% full scale).
    - e. Reactive power (VAR): 3 PH total (+0.6% full scale).
    - f. Power factor (+1.0%).
    - g. Frequency (+0.17%).
    - h. Percent current total harmonic distortion (31st).
    - i. Percent voltage total harmonic distortion (31st).
  2. Data logging:
    - a. 128 KB.
    - b. Selectable for parameters listed above for display.
    - c. Software for configuration, retrieval, and trending.
  3. Communication ports and protocols: Ethernet TCP/IP.
  4. Supply voltage: 120 VAC.

- D. Type 'C' High Range Meter:
1. Display the following minimum electrical parameters (accuracy):
    - a. RMS current per phase (+0.2% full scale).
    - b. RMS voltage line-to-line and line-to-neutral (+0.2% full scale).
    - c. Real power (W): 3 PH total (+0.4% full scale).
    - d. Apparent power (VA): 3 PH total (+0.4% full scale).
    - e. Reactive power (VAR): 3 PH total (+0.4% full scale).
    - f. Power factor (+1.0%).
    - g. Frequency (+0.04%).
    - h. Percent current individual harmonic and total harmonic distortion (50th).
    - i. Percent voltage individual harmonic and total harmonic distortion (50th).
    - j. Watt-hours (0.5%).
    - k. VAR-hours (1.0%).
    - l. VA-hours (0.5%).
    - m. Ampere demand (+0.2% full scale).
    - n. Watt demand (+0.4% full scale).
    - o. VAR demand (+0.4% full scale).
    - p. VA demand (+0.4% full scale).
    - q. Phaser diagram.
  2. Data logging:
    - a. 128 KB.
    - b. Selectable for parameters listed above for display.
    - c. Software for configuration, retrieval, and trending.
  3. NEMA/ANSI C12.20, Class 0.2 revenue accuracy.
  4. Communication ports and protocols: Ethernet TCP/IP.
  5. Supply voltage: 120 VAC.

### **2.3 ACCESSORIES**

- A. Operator Interface Personal Computer:
1. Computer to be industry standard office type with the following minimum features:
    - a. Processor: Intel or clone.
    - b. USB ports.
    - c. Hard drive.
    - d. CD/DVD drive.
    - e. Keyboard.
    - f. Mouse.
    - g. 17 inches LCD Monitor:
    - h. Operating System: Microsoft Windows.
    - i. Compatible with the Power Management and Control Software.
- B. Power Management and Control Software:
1. Manufacturer's standard, see Part 3 for minimum functionality.
- C. Separately Mounted Enclosure:
1. NEMA 12 rated for indoor locations.
  2. NEMA 4 rated for outdoor locations.
  3. Hinged front opening door with padlockable latch.
  4. Input/output terminal blocks and wiring.
  5. Separate control voltage source disconnect switch and wiring.
  6. 600 Volt rated power voltage terminal blocks and wiring.
  7. Current transformer shorting terminal blocks and wiring.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
  - 1. Provide all equipment as necessary to provide a complete and functioning system.
  - 2. Coordinate with the Owner on final computer screen layouts, trending requirements and printouts.
  
- B. Meter Type Application:
  - 1. Type A meters: Integral to equipment as indicated on the Drawings.
  - 2. Type B meters: Integral to equipment as indicated on the Drawings.
  - 3. Type C meters: Integral to equipment as indicated on the Drawings.
  
- C. Communication Configuration:
  - 1. As indicated on the Drawings.
  - 2. The main breaker meter shall be connected to the nearest plant control system Ethernet switch.
  
- D. Computer Screen Configuration:
  - 1. Each Type A, B and C meter shall have a data screen with the following minimum data as applicable for the capabilities of that type of meter:
    - a. Voltage line-to-line for each phase and an average.
    - b. Voltage line-to-neutral for each phase and an average.
    - c. Current for each phase, neutral and average and peak demands.
    - d. Kilowatts (kW) for each phase, total, demand and peak demand.
    - e. Kilovolt-amperes (kVA) for each phase, total, demand and peak demand.
    - f. Kilovolt-amperes reactive (kVAR) for each phase, total, demand and peak demand.
    - g. Power factor for each phase and total.
    - h. Frequency.
    - i. Voltage total harmonic distortion for each phase.
    - j. Current total harmonic distortion for each phase.
    - k. Energy (kWhr) for each phase and total.
    - l. A seven day kW, kVA and kVAR trend average.
    - m. Peak demands shall be resettable by the operator.

**3.2 FIELD QUALITY CONTROL**

- A. Acceptance Testing: See Section 26 08 13.

**3.3 TRAINING**

- A. A qualified factory-trained manufacturer's representative shall provide the Owner with 8 hours of on-site training in the operation and maintenance of the metering system and its components.

**END OF SECTION 26 09 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Operator control devices (selector switches, pushbuttons, indicator lights, etc.).
  - 2. Control devices (timers, relays, contactors, etc.).
  
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. ICS 2, Industrial Control and System Controllers, Contactors and Overload Relays Rated 600 Volts.
    - c. ICS 5, Control Circuit and Pilot Devices.
  - 2. Underwriters Laboratories, Inc. (UL):
    - a. 508, Standard for Safety Industrial Control Equipment.
    - b. 508A, Standard for Industrial Control Panels.
    - c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.

**1.3 SYSTEM DESCRIPTION**

- A. This Specification specifies components used within other equipment as referenced in other technical specifications.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification:
      - 1) When components are used within equipment specified in another Section, submittal data for components specified herein shall be included with the submittal for the equipment the components are used in.
  
- B. Informational Submittals:
  - 1. Functional Test Plan.
  
- C. Contract Closeout Information:
  - 1. Operation and Maintenance Data:
    - a. Content of Operation and Maintenance Manual:
      - 1) Operating instructions for time clocks, .
      - 2) Functional Test Report.



**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Pilot devices, relays, contactors, and termination equipment:
    - a. Allen-Bradley by Rockwell Automation, Inc.
    - b. ATC Diversified Electronics by Bellofram Group of Companies.
    - c. ASCO by Emerson Electric Co.
    - d. c3controls.
    - e. Eaton.
    - f. GE/ABB.
    - g. IDEC Corporation.
    - h. Phoenix Contact.
    - i. Potter and Brumsfield (P&B) by TE Connectivity.
    - j. Schneider Electric.
    - k. Siemens Corporation.
    - l. Time Mark Corporation.
  2. Photocells and time clocks:
    - a. Grasslin by Intermatic.
    - b. Tork by NSi Industries.
    - c. Intermatic.
    - d. Paragon Auto Control.
  3. Alarm devices:
    - a. Edwards Signaling by United Technologies Corp.
    - b. Federal Signal Corporation.
  4. Enclosures:
    - a. Hoffman Engineering.
    - b. Wiegmann by Hubbell.
    - c. B-Line by Eaton.
    - d. Adalet.
    - e. Stahlin by Robroy Enclosures.

**2.2 PILOT DEVICES**

- A. General Requirements:
1. Standards: NEMA ICS 5, UL 508.
  2. Heavy-duty NEMA 4/13 watertight/oiltight.
  3. Heavy-duty NEMA 4/4X corrosion resistant.
  4. Heavy-duty factory sealed, explosion-proof and dust ignition-proof (Class I and II).
  5. Mounting hole: 30.5 mm.
  6. Contact blocks: 10 amp, NEMA A600 rated, number as required to fulfill functions shown or specified.
  7. Legend plate marked as indicated on Drawings or specified.
- B. Selector Switches:
1. Two, three- or four-position rotary switch as required to fulfill functions shown or specified.
  2. Maintained contact type.
  3. Knob or lever type operators.
- C. Pushbuttons:

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1. Non-illuminated type:
    - a. Protective boot.
    - b. Momentary contact.
    - c. Standard flush and mushroom operators.
    - d. Green colored buttons for START or ON and red color for STOP or OFF.
    - e. Emergency stop pushbuttons: Mushroom head operator and maintained contact.
  2. Illuminating type:
    - a. Protective boot.
    - b. Momentary contact.
    - c. Standard flush operator.
    - d. Serves as both pushbutton control and indicating light.
    - e. Green colored lenses: START or ON.
    - f. Red colored lenses: STOP or OFF.
    - g. Resistor-type full voltage light unit with lens and panel gasket.
- D. Indicating Lights:
1. Allowing replacement of bulb without removal from control panel.
  2. Lamp: LED, 120 V or 24 V as required.
  3. Full voltage type.
  4. Push-to-test indicating lights.
  5. Plastic lens.
  6. Color code lights as follows:
    - a. Green: ON or running.
    - b. Amber: Standby; auto mode; ready.
    - c. Red: OFF or stopped.

### 2.3 RELAYS

- A. General Requirements:
1. Standards: NEMA ICS 5, UL 508.
- B. Control Relays:
1. General purpose (ice cube) type:
    - a. Plug-in housing.
    - b. Clear polycarbonate dust cover with clip fastener.
    - c. Coil voltage: 120 VAC or as required.
    - d. Contacts:
      - 1) 10 amp continuous.
      - 2) Silver cadmium oxide.
      - 3) Minimum of 3 SPDT contacts.
    - e. Sockets: DIN rail mounted.
    - f. Internal neon or LED indicator is lit when coil is energized.
    - g. Manual operator switch.
  2. Industrial type:
    - a. Coil voltage: 120 VAC or as required.
    - b. Contacts:
      - 1) 10 amp, NEMA A600 rated.
      - 2) Double break, silver alloy.
      - 3) Convertible from normally open to normally closed or vice versa, without removing any wiring.
      - 4) Expandable from 2 poles to 12 poles.
    - c. Provide contacts for all required control plus two spares.
- C. Time Delay Relays:

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1. General purpose type:
  - a. Timing modes: On and Off delay, interval, one shot and repeat cycle.
  - b. Plug-in housing.
  - c. Polycarbonate dust cover with clip fastener.
  - d. Coil voltage: 120 VAC or as required.
  - e. Contacts:
    - 1) 10 amp continuous.
    - 2) Silver cadmium oxide.
    - 3) Two normally open and two normally closed DPDT contacts.
  - f. Sockets: DIN rail mounted.
  - g. External timing adjustment knob.
  - h. Timing ranges: 0.05 seconds to 16.65 hours.
  - i. Repeat accuracy: +1%.
2. Solid State industrial type:
  - a. Timing modes: On and Off delay and repeat cycle.
  - b. Industrial housing.
  - c. Coil voltage: 120 VAC or as required.
  - d. Contacts:
    - 1) 5 amp, NEMA B150 rated.
    - 2) Silver alloy.
    - 3) Convertible On Delay and Off Delay contacts.
    - 4) One normally open and one normally closed timed contacts.
    - 5) One normally open and one normally closed instantaneous contacts.
  - e. Furnish with "on" and "timing out" indicators.
  - f. External timing adjustment knob.
  - g. Timing ranges: 0.05 seconds to 10 hours.
  - h. Repeat accuracy: +1%.
3. Mechanical industrial type:
  - a. Timing modes: On and Off delay.
  - b. Coil voltage: 120 VAC or as required.
  - c. Contacts:
    - 1) 10 amp, NEMA A600 rated.
    - 2) Double break, silver alloy.
    - 3) Convertible On Delay and Off Delay contacts.
    - 4) Convertible normally open and normally closed timed contacts.
    - 5) Convertible normally open instantaneous contacts.
  - d. External timing adjustment knob.
  - e. Timing ranges: 0.2 - 60 seconds or 5 - 180 seconds.
  - f. Repeat accuracy: Greater than +10%.

### 2.4 CONTACTORS

- A. General Requirements:
  1. Standards: NEMA ICS 2, UL 508.
- B. Lighting and Remote Control Switches:
  1. Electrically operated, electrically held.
  2. Coil voltage: 120 VAC or as required.
  3. Contacts: Totally enclosed, double-break silver-cadmium-oxide.
  4. Rated for ballasted lighting, tungsten and general use loads.
  5. Number of poles, continuous ampere rating and voltage, as indicated on Drawings or as specified.
  6. Auxiliary control relays, as indicated on Drawings or as specified.
  7. Auxiliary contacts, as indicated on Drawings or as specified.

- C. Definite Purpose:
  - 1. Coil voltage: 120 VAC or as required.
  - 2. Contacts: Totally enclosed, double-break silver-cadmium-oxide.
  - 3. Resistive load and horsepower rated.
  - 4. Number of poles, continuous ampere rating and voltage, as indicated on Drawings or as specified.
  - 5. Auxiliary contacts, as indicated on Drawings or as specified.

## **2.5 PHOTOCELLS AND TIME CLOCKS**

- A. Photocells:
  - 1. Weatherproof enclosure.
  - 2. Adjustable turn-on range, initially set at 1.0 foot-candles.
    - a. Turn-off level approximately three times turn-on.
  - 3. Provide time delay device to eliminate nuisance switching.
  - 4. Voltage, amperage and/or wattage ratings as required for the application.
- B. General Requirements for Time Clocks:
  - 1. Separate manual on-off operation without disturbing automatic settings.
  - 2. Enclosure:
    - a. NEMA 1 for indoor locations.
    - b. Stand alone or DIN rail for mounting in control panel.
    - c. NEMA 3R or 4 for exterior locations.
  - 3. Voltage, amperage and/or wattage ratings as required for the application.
- C. Electronic:
  - 1. 365 day programmable using solid state technology with block programming.
  - 2. Minimum of 72 hour carryover power utilizing rechargeable battery or capacitor.
  - 3. Minimum of 48 events per week, 16 individual holiday overrides, daylight savings or standard time selectable, automatic leap year correction.
- D. Astronomical Clocks:
  - 1. Adjustable for the installed latitude.
    - a. Settings for astro on/astro off, astro on/time off or time on/astro off.
  - 2. 365 day programmable using solid state technology with block programming.
  - 3. Minimum of 72 hour carryover power utilizing rechargeable battery or capacitor.
  - 4. Minimum of 48 events per week, 16 individual holiday overrides daylight savings or standard time selectable, automatic leap year correction.

## **2.6 ALARM DEVICES**

- A. Alarm Horns:
  - 1. Vibrating horn type.
  - 2. PLC compatible as required.
  - 3. Heavy-duty die cast housing with corrosion resistant finish.
  - 4. Adjustable volume: 78 to 103 dB at 10 feet.
  - 5. Voltage: 120 VAC or as required.
  - 6. Enclosures/mountings:
    - a. Flush wall or panel mounting in dry areas.
    - b. NEMA 4X panel mounting in wet areas.
    - c. Surface mounting in dry areas.
    - d. NEMA 4X surface mounting in wet areas.

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- e. NEMA 4X, hazardous location surface mounting in wet and hazardous areas.
  - 1) Fixed volume: 97 dB at 10 feet.

### B. Alarm Lights:

- 1. Panel mounted:
  - a. Strobe type.
  - b. Shatter resistant polycarbonate lens and base.
  - c. Lens color as indicated on Drawings.
  - d. NEMA 4X enclosure.
  - e. PLC compatible.
  - f. Voltage: 120 VAC.
- 2. Wall mounted:
  - a. Heavy-duty strobe type.
  - b. Weatherproof shatter resistant polycarbonate lens and cast base.
  - c. Optically designed fresnel lens with color as indicated on Drawings.
  - d. Immune to shock and vibration, no moving parts.
  - e. Xenon flash tube providing a minimum of 65 single flashes per minute.
  - f. Mounting: Wall or corner wall brackets.
- 3. Hazardous and corrosive locations:
  - a. Heavy-duty strobe type.
  - b. Weatherproof and rated for the indicated hazardous location.
  - c. Body: Zinc plated cast iron or cast copper free aluminum and/or coated with 20 mils of PVC.
  - d. High impact glass dome with guard.
  - e. Shatter resistant polycarbonate lens with color as indicated on Drawings.
  - f. Immune to shock and vibration, no moving parts.
  - g. Xenon flash tube providing a minimum of 65 single flashes per minute.
  - h. Mounting: Wall bracket or pendant.

## 2.7 MISCELLANEOUS DEVICES

### A. Run Time Meters:

- 1. Six-digit wheels including a 1/10 digit.
- 2. Non-reset type.
- 3. Time range in hours.
- 4. Automatic recycle at zero.
- 5. Accuracy: 1%.
- 6. Sealed against dirt and moisture.
- 7. Tamperproof.

## 2.8 TERMINATION EQUIPMENT

### A. General Requirements:

- 1. Modular type with screw compression clamp.
- 2. Screws: Stainless steel.
- 3. Current bar: Nickel-plated copper alloy.
- 4. Thermoplastic insulation rated for -40 to +90 degrees C.
- 5. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
- 6. End sections and end stops at each end of terminal strip.
- 7. Machine-printed terminal markers on both sides of block.
- 8. Spacing: 6 mm.
- 9. Wire size: 22-12 AWG.

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10. Rated voltage: 600 V.
  11. DIN rail mounting.
- B. Standard-Type Block:
1. Rated current: 30 A.
  2. Color: Gray body.
- C. Bladed-Type Disconnect Block:
1. Terminal block with knife blade disconnect which connects or isolated the two sides of the block.
  2. Rated current: 10 A.
  3. Color:
    - a. Panel control voltage leaves enclosure - normal: Gray body, orange switch.
    - b. Foreign voltage entering enclosure: Orange body, orange switch.
- D. Grounded-Type Block:
1. Electrically grounded to mounting rail.
  2. Terminal ground wires and analog cable shields.
  3. Color: Green and yellow body.
- E. Fuse Holders:
1. Blocks can be ganged for multi-pole operation.
  2. Spacing: 9.1 mm.
  3. Wire size: 30-12 AWG.
  4. Rated voltage: 300 V.
  5. Rated current: 12 A.
  6. Fuse size: 1/4 x 1-1/4.
  7. Blown fuse indication.
  8. DIN rail mounting.

### 2.9 ENCLOSURES

- A. Industrial Control Panels:
1. NEMA 4 rated:
    - a. Seams continuously welded and ground smooth.
    - b. No knockouts.
    - c. External mounting flanges.
    - d. Hinged or non-hinged cover held closed with stainless steel screws and clamps.
    - e. Cover with oil resistant gasket.
  2. NEMA 4X rated:
    - a. Body and cover: 14 GA Type 304 or 316 stainless steel.
    - b. Seams continuously welded and ground smooth.
    - c. No knockouts.
    - d. External mounting flanges.
    - e. Hinged door and stainless steel screws and clamps.
    - f. Door with oil-resistant gasket.
  3. NEMA 7 and 9 rated:
    - a. Cast gray iron alloy or copper-free aluminum.
    - b. Drilled and tapped openings or tapered threaded hub.
    - c. Cover bolted-down with stainless steel bolts or threaded cover with neoprene gasket.
    - d. External mounting flanges.
    - e. Grounding lug.
    - f. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.

## **SECTION 26 09 16 - CONTROL EQUIPMENT ACCESSORIES**

4. NEMA 12 enclosure:
  - a. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
  - b. No knockouts.
  - c. External mounting flanges.
  - d. Non-hinged stainless steel cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.
  - e. Flat door with oil resistant gasket.
5. Control panel miscellaneous accessories:
  - a. Back plane mounting panels: Steel with white enamel finish or Type 304 stainless steel.
  - b. Interiors shall be white or light gray in color.
  - c. Wire management duct:
    - 1) Bodies: PVC with side holes.
    - 2) Cover: PVC snap-on.
    - 3) Size as required.
  - d. Rigid handles for covers larger than 9 square feet or heavier than 25 pounds.
  - e. Split covers when heavier than 25 pounds.
  - f. Floor stand kits made of same material as the enclosure.
  - g. Weldnuts for mounting optional panels and terminal kits.
  - h. Ground bonding jumper from door, across hinge, to enclosure body.
6. Standards: NEMA 250, UL 508.

### **2.10 FABRICATION**

- A. Supplier of Industrial Control Panels shall build control panel under the provisions of UL 508A or UL 698A.
  1. Entire assembly shall be affixed with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to shipment to the jobsite.
  2. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
    - a. Determine the SCCR rating by one of the following methods:
      - 1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
      - 2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
      - 3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
    - b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
  3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions.

## **SECTION 26 09 16 - CONTROL EQUIPMENT ACCESSORIES**

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### **3.2 FIELD QUALITY CONTROL**

A. See Section 26 05 00.

**END OF SECTION 26 09 16**



**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Dry-type transformers, 1000 kVA and less.
  
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.
  - 2. Section 26 05 26 - Grounding.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Department of Energy (DOE):
    - a. 10 CFR 431, Energy Conservation Program: Energy Conservation Standards for Distribution Transformers.
  - 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. C57.96, Guide for Loading Dry-Type Distribution and Power Transformers.
  - 3. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. ST 20, Dry Type Transformers for General Applications.
  - 4. Underwriters Laboratories, Inc. (UL):
    - a. 506, Standard for Specialty Transformers.
    - b. 1561, Standard for Dry-Type General Purpose and Power Transformers.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. See Specification Section 26 05 00 for additional requirements.
  - 2. Fabrication and/or layout drawings.
    - a. Nameplate drawing.
  - 3. Certifications:
    - a. Sound level certifications.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Eaton.
  - 2. GE by ABB.
  - 3. Square D by Schneider Electric.
  - 4. Siemens.

## SECTION 26 22 13 - DRY-TYPE TRANSFORMERS

5. SolaHD by Emerson Electric Co.

### 2.2 GENERAL PURPOSE DRY-TYPE TRANSFORMERS

- A. Ventilated or non-ventilated, air cooled, two winding type.
- B. Cores:
  1. High grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses.
  2. Magnetic flux densities are to be kept well below the saturation point.
- C. Coils: Continuous wound with electrical grade aluminum.
- D. Ventilated Units:
  1. Core and coils assembly impregnated with non-hygroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture and completely isolated from the enclosure by means of vibration dampening pads.
  2. Dripproof, NEMA 1, steel enclosure finished with a weather-resistant enamel and ventilation openings protected from falling dirt.
- E. Furnish Taps for Transformers as follows:
  1. 1 PH, 2 kVA and below: None.
  2. 1 PH, 3 to 25 kVA: Two, 5% FCBN.
  3. 1 PH, 25 kVA and above: Two, 2.5% FCAN and four, 2.5% FCBN.
  4. 3 PH, 3 to 15 kVA: Two, 5% FCBN.
  5. 3 PH, 15 kVA and above: Two, 2.5% FCAN and four, 2.5% FCBN.
- F. Sound Levels:
  1. Manufacturer shall guarantee not to exceed the following:
    - a. Up to 9 kVA: 40 dB.
    - b. 10 to 50 kVA: 45 dB.
    - c. 51 to 150 kVA: 50 dB.
    - d. 151 to 300 kVA: 55 dB.
- G. Efficiency (minimum):
  1. Ventilated:
    - a. 1 PH, 15 - 333 kVA: DOE 2016 Efficiency.
    - b. 3 PH, 15 - 1000 kVA: DOE 2016 Efficiency.
- H. Insulating Material (600 V and below):
  1. 3 to 15 kVA units: 185 degrees C insulation system with a 115 degrees C rise.
  2. 15 kVA and above units: 220 degrees C insulation system with a 150 degrees C rise.
- I. Ratings: 60 Hz, voltage, KVA and phase, as indicated on the Drawings.
- J. Finish: Rust inhibited primer and manufacturers standard paint inside and out.
- K. Standards: IEEE C57.96, NEMA ST 20, UL 506, UL 1561.

## **SECTION 26 22 13 - DRY-TYPE TRANSFORMERS**

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### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Indoor Locations:
  - 1. Provide ventilated type for 15 kVA units and above.
  - 2. Provide non-ventilated type for 9 kVA units and below and were indicated on the Drawings.
  - 3. Mount 9 kVA units and below on wall.
  - 4. Mount 15 kVA units and above on chamfered 4 inches high concrete housekeeping pad or from wall and/or ceiling, at 7 feet above finished floor, using equipment support brackets per Section 26 05 00.
  - 5. Provide rubber vibrations isolation pads.
- C. Enclosures: Painted steel in all areas except stainless steel in highly corrosive areas.
- D. Ground in accordance with Section 26 05 26.

**END OF SECTION 26 22 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Branch circuit panelboards.
  - 2. Distribution panelboards.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.
  - 2. Section 26 09 13 – Electrical Metering Devices.
  - 3. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.
  - 4. Section 26 43 13 - Low Voltage Surge Protective Devices (SPD).

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. PB 1, Panelboards.
  - 2. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 3. Underwriters Laboratories, Inc. (UL):
    - a. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
    - b. 67, Standard for Panelboards.

**1.3 DEFINITIONS**

- A. Branch Circuit Panelboard: Bus rating of 400A and less or where labeled as Branch Circuit Panelboard on the Drawings.
  
- B. Distribution Panelboard: Bus rating of 600A and greater or where labeled as Distribution Panelboard on the Drawings.

**1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data.
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. See Specification Section 26 05 00 for additional requirements.
  - 2. Fabrication and/or layout drawings:
    - a. Panelboard layout with alphanumeric designation, branch circuit breakers size and type, as indicated in the panelboard schedules.
  
- B. Contract Closeout Information:
  - 1. Panelboard schedules with as-built conditions.
  
- C. Informational Submittals:

1. Service equipment marking and documentation.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Eaton.
  2. GE by ABB.
  3. Square D by Schneider Electric.
  4. Siemens Corporation.

### **2.2 MANUFACTURED UNITS**

- A. Standards: NEMA PB 1, NFPA 70, UL 50, UL 67.
- B. Ratings:
1. Current, voltage, number of phases, number of wires as indicated on the Drawings.
  2. Short Circuit Current Rating (SCCR) and/or Ampere Interrupting Current (AIC) ratings equal to or greater than the interrupting rating indicated on the Drawings or in the schedule.
    - a. Series rating is not acceptable.
    - b. When fault current or minimum interrupting rating is not indicated, use rating of upstream equipment or infinite bus calculation of transformer secondary.
  3. Service Entrance Equipment rated when indicated on the Drawings or when shown to be fed from a utility source.
- C. Construction:
1. Interiors factory assembled and designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
  2. Multi-section panelboards: Feed-through or sub-feed lugs.
  3. Main lugs: Solderless type approved for copper and aluminum wire.
- D. Bus Bars:
1. Main bus bars:
    - a. Tin plated aluminum or tin plated copper sized to limit temperature rise to a maximum of 65 degrees C above an ambient of 40 degrees C.
    - b. Drilled and tapped and arranged for sequence phasing of the branch circuit devices.
  2. Ground bus and isolated ground bus, when indicated on the Drawings: Solderless mechanical type connectors.
  3. Neutral bus bars: Insulated 100% rated or 200% rated, when indicated on the Drawings and with solderless mechanical type connectors.
- E. Overcurrent and Short Circuit Protective Devices:
1. Main overcurrent protective device:
    - a. Molded case circuit breaker.
  2. Branch overcurrent protective devices:
    - a. Molded case circuit breaker.
  3. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.
  4. Factory installed.

- F. Integral surge protective device:
  - 1. Provide for panelboards where indicated on the Drawings
  - 2. See Specification Section 26 43 13.
  
- G. Enclosure:
  - 1. Boxes: Code gage galvanized steel, furnish without knockouts.
  - 2. Trim assembly: Code gage steel finished with rust inhibited primer and manufacturers standard paint inside and out.
  - 3. Branch circuit panelboard:
    - a. Trims supplied with hinged door-in-door construction.
      - 1) Outer door:
        - a) Allows access to the interior of the enclosure.
        - b) Hinged to the enclosure.
        - c) Opened by removal of screws or by operating a mechanical latch located behind the inner door.
      - 2) Inner door:
        - a) Allows access to breakers (non-live parts).
        - b) Hinged to outer door.
        - c) Opened by operation of a keyed corrosion resistant chrome-plated combination lock and catch. Locks for all branch circuit panelboards keyed alike.
    - b. Trims for surface mounted panelboards, same size as box.
    - c. Trims for flush mounted panelboards, overlap the box by 3/4 inches on all sides.
    - d. Nominal 20 inches wide and 5-3/4 inches deep with gutter space in accordance with NFPA 70.
    - e. Clear plastic cover for directory card mounted on the inside of each door.
    - f. Where NEMA 3R or NEMA 12 rating is indicated: Door gasketed.
    - g. Where NEMA 4X is indicated: Stainless Steel.
  - 4. Distribution panelboard:
    - a. Trims cover all live parts with switching device handles accessible.
    - b. Minimum 8 inches deep and less than or equal to 12 inches deep with gutter space in accordance with NFPA 70.
    - c. Clear plastic cover for directory card mounted front of enclosure.
    - d. Where NEMA 3R or NEMA 12 rating is indicated: Doors gasketed and lockable with corrosion resistant chrome-plated combination lock and catch, all locks keyed alike, or provisions for padlocks.
    - e. Where NEMA 4X is indicated: Stainless Steel.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Install as indicated on the Drawings, in accordance with the NFPA 70, and in accordance with manufacturer's instructions.
  
- B. Support panelboard enclosures from wall studs or modular channels support structure, per Specification Section 26 05 00.
  
- C. Provide NEMA rated enclosure as indicated on the Drawings. Where enclosure type is not indicated, provide enclosure rating suitable for the atmosphere where equipment is installed.
  
- D. Equipment Marking and Documentation:
  - 1. Provide labeling per NFPA 70 and other applicable codes.

## **SECTION 26 24 16 - PANELBOARDS**

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2. Service equipment:
    - a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A) and (B))
    - b. Available fault current label and documentation of the calculations made for compliance with marking requirements. (Ref. NFPA 70 Article 110.24)
  3. Other than service equipment:
    - a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A))
    - b. Available fault current label. (Ref. NFPA 70 Article 408.6)
  4. Identify (tag) all equipment and equipment components.
  5. Available fault current and other required label data from Coordinated Power System Study as required by the contract documents.
- E. Provide each panelboard with a typed directory:
1. Identify all circuit locations in each panelboard with the load type and location served.
  2. Use Owner-furnished mechanical equipment designation if different than designation indicated on the Drawings.
  3. Use final building room names and numbers as identified by the Owner if different than designation indicated on the Drawings.
  4. Identify spare overcurrent devices.

**END OF SECTION 26 24 16**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Motor control centers.
  - 2. Separately mounted motor starters (including those supplied with equipment).
  - 3. Manual motor starters.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.
  - 2. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.
  - 3. Section 26 43 13 - Surge Protection Devices for Low-Voltage Electrical Power Circuits.
  - 4. Section 26 09 13 - Electrical Metering Devices.
  - 5. Section 26 09 16 - Control Equipment Accessories.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. International Electrotechnical Commission (IEC).
  - 2. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).
    - b. ICS 2, Controllers, Contactors and Overload Relays Rated 600 V.
    - c. ICS 18, Motor Control Centers.
  - 3. Underwriters Laboratories, Inc. (UL):
    - a. 508, Standard for Industrial Control Equipment.
    - b. 845, Motor Control Centers.
  
- B. Miscellaneous:
  - 1. Verify motor horsepower loads, other equipment loads, and controls from approved shop drawings and notify Engineer of any discrepancies.
  - 2. Verify the required instrumentation and control wiring for a complete system and notify Engineer of any discrepancies.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. See Specification Section 26 05 00 for additional requirements.
  - 2. Fabrication and/or layout drawings:
    - a. Separately mounted combination starters:
      - 1) Unit ladder logic wiring for each unit depicting electrical wiring and identification of terminals where field devices or remote control signals are to be terminated including industry standard symbology of the field devices as indicated on the Drawings, specification and/or loop descriptions. Drawings indicate basic control functionality, provide diagrams for the manufacturer's product(s) meeting the required functionality.



## **SECTION 26 24 19 - MOTOR CONTROL EQUIPMENT**

- 2) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
- B. Contract Closeout Information:
  1. Operation and Maintenance Data:
    - a. Fabrication and/or layout drawings updated with as-built conditions.
- C. Informational Submittals:
  1. Equipment marking and documentation.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Allen-Bradley by Rockwell Automation, Inc.
  2. c3controls.
  3. Eaton.
  4. GE by ABB.
  5. Square D by Schneider Electric.
  6. Siemens Corporation.

#### **2.2 SEPARATELY MOUNTED COMBINATION STARTERS**

- A. Standards:
  1. NEMA 250, NEMA ICS 2.
  2. UL 508.
- B. Enclosure:
  1. NEMA 4 rated:
    - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
    - b. No knockouts, external mounting flanges, hinged and gasketed door.
  2. NEMA 4X rated:
    - a. Body and cover: Type 304 or 316 stainless steel.
    - b. No knockouts, external mounting flanges, hinged and gasketed door.
  3. NEMA 7 and NEMA 9 rated:
    - a. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
    - b. Drilled and tapped openings or tapered threaded hub.
    - c. Gasketed cover bolted-down with stainless steel bolts.
    - d. External mounting flanges.
    - e. Front operating handle padlockable in the OFF position.
    - f. Accessories: 40 mil PVC exterior coating.
  4. NEMA 12 rated:
    - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
    - b. No knockouts, external mounting flanges, hinged and gasketed door.
- C. Operating Handle:

## SECTION 26 24 19 - MOTOR CONTROL EQUIPMENT

1. With the door closed the handle mechanism allows complete ON/OFF control of the unit disconnect and clear indication of the disconnect status.
  2. Circuit breaker and MCP operators includes a separate TRIPPED position.
  3. Mechanical interlock to prevent to prevent the opening of the door when the disconnect is in the ON position with a defeater mechanism for use by authorized personnel.
  4. Mechanical interlock to prevent the placement of the disconnect in the ON position with the door open with a defeater mechanism for use by authorized personnel.
  5. Padlockable in the OFF position.
  6. Exceptions: NEMA 7 and NEMA 9 enclosures.
- D. External mounted overload relay pushbutton.
- E. Control Devices:
1. Provide control devices as indicated on the Drawings per Specification Section 26 09 16.
  2. Devices will be accessible with the door closed.
- F. Control Power Transformer:
1. 120V secondary.
  2. Fused on primary and secondary side.
  3. Sized for 140% of required load.
- G. Fault Current Withstand Rating: Equal to the rating of the electrical gear from which it is fed.
- H. Motor Starters: See requirements within this Specification Section.
- I. Disconnect Switch, Overcurrent and Short Circuit Protective Devices:
1. Motor circuit protector.
  2. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.
  3. Factory installed.

### 2.3 MOTOR STARTERS

- A. Standards:
1. NEMA ICS 2.
  2. UL 508.
- B. Full Voltage Non-Reversing (FVNR) Magnetic Starters:
1. NEMA full size rated contactor.
    - a. NEMA half sizes and IEC contactors are not permitted.
  2. Double-break silver alloy contacts.
  3. Overload relays:
    - a. Ambient compensated, bimetallic type with interchangeable heaters, 24% adjustability, single phase sensitivity, an isolated arm contact and manual reset.
  4. Interlock and auxiliary contacts, wired to terminal blocks:
    - a. Holding circuit contact, normally open.
    - b. Overload alarm contact, normally open.
    - c. Normally open auxiliary contact, for remote run status.
    - d. Additional field replaceable auxiliary contacts as required per the Sequence of Operation.
    - e. One additional normally open spare field replaceable auxiliary contacts.
- C. Full Voltage Reversing (FVR) Magnetic Starters:

## SECTION 26 24 19 - MOTOR CONTROL EQUIPMENT

1. Two FVNR starters with one overload relay assembled together.
  2. Mechanically and electrically interlocked to prevent line shorts and the energizing of both contactors simultaneously.
  3. See FVNR paragraph for additional requirements.
- D. Full Voltage Two-Speed (FV2S) Magnetic Starters:
1. Two FVNR starters with two overload relays assembled together.
  2. Configured for two winding or one winding consequent pole motors.
  3. See FVNR paragraph for additional requirements.
- E. Reduced Voltage Autotransformer (RVAT) Starter:
1. Closed transition design using three contactors and two or three autotransformers.
  2. Transformer taps: 50, 65 and 80%, factory set at 65%.
  3. NEMA full size rated contactor.
    - a. NEMA half sizes and IEC contactors are not permitted.
  4. Double-break silver alloy contacts.
  5. Overload relays:
    - a. Ambient compensated, bimetallic type with interchangeable heaters, 24% adjustability, single phase sensitivity, an isolated arm contact and manual reset.
    - b. Ambient insensitive, adjustable solid state type with phase loss protection, phase imbalance protection and manual reset.
  6. Interlock and auxiliary contacts, wired to terminal blocks:
    - a. Holding circuit contact, normally open.
    - b. Overload alarm contact, normally open.
    - c. Normally open auxiliary contact, for remote run status.
    - d. Additional field replaceable auxiliary contacts as required per the Sequence of Operation.
    - e. Two additional normally open spare field replaceable auxiliary contacts.

### 2.4 MANUAL MOTOR STARTERS

- A. Standards:
1. NEMA 250, NEMA ICS 2.
  2. UL 508.
- B. Quick-make, quick-break toggle mechanism that is lockable in the OFF position.
- C. Types:
1. Horsepower rated, for ON/OFF control.
  2. Horsepower rated, for ON/OFF control and thermal overload protection.
    - a. Switch to clearly indicate ON, OFF, and TRIPPED position.
- D. Voltage and current ratings and number of poles as required for the connected motor.
- E. Enclosures:
1. NEMA 1 rated:
    - a. Galvanized steel or steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
    - b. With or without concentric knockouts.
  2. NEMA 4 rated:
    - a. Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out or cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.

## SECTION 26 24 19 - MOTOR CONTROL EQUIPMENT

- b. No knockouts, external mounting flanges.
3. NEMA 4X rated:
  - a. Type 304 or 316 stainless steel.
  - b. No knockouts, external mounting flanges.
4. NEMA 7 and NEMA 9 rated:
  - a. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
  - b. Drilled and tapped openings or tapered threaded hub, external mounting flanges.
  - c. Accessories: 40 mil PVC exterior coating.
5. NEMA 12 rated:
  - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
  - b. No knockouts, external mounting flanges.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install as indicated on the Drawings and in accordance with manufacturer's recommendations and instructions.
- B. Mounting height for surface mounted equipment: See Specification Section 26 05 00.
- C. Equipment Marking and Documentation:
  1. Provide labeling per NFPA 70 and other applicable codes.
  2. Service equipment:
    - a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A) and (B))
    - b. Available fault current label and documentation of the calculations made for compliance with marking requirements. (Ref. NFPA 70 Article 110.24)
  3. Other than service equipment:
    - a. Arc-flash hazard warning label. (Ref. NFPA 70 Article 110.16(A))
    - b. Available fault current label. (Ref. NFPA 70 Article 408.6)
  4. Identify (tag) all equipment and equipment components.
  5. Available fault current and other required label data from Coordinated Power System Study as required by the contract documents.
- D. Provide separately mounted combination starters with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
  1. Determine the SCCR rating by the following method:
    - a. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
  2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
  3. Provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.
- E. Overload Heaters:
  1. Size for actual motor full load current of the connected motor.
  2. For motors with power factor correction capacitors, size to compensate for the capacitors effect on load current.
- F. Combination and Manual Starter Enclosures:
  1. Permitted uses of NEMA 1 enclosure:

## **SECTION 26 24 19 - MOTOR CONTROL EQUIPMENT**

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- a. Surface or flush mounted in architecturally finished areas.
- b. Surface mounted above 10 feet in areas designated as dry in architecturally and non-architecturally finished areas.
2. Permitted uses of NEMA 4 enclosure:
  - a. Surface mounted in areas designated as wet.
3. Permitted uses of NEMA 4X enclosure:
  - a. Surface mounted in areas designated as wet and/or corrosive.
4. Permitted uses of NEMA 7 enclosure:
  - a. Surface mounted in areas designated as Class I hazardous.
  - b. Provide PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.
5. Permitted uses of NEMA 9 enclosure:
  - a. Surface mounted in areas designated as Class II hazardous.
  - b. Provide PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.
6. Permitted uses of NEMA 12 enclosure:
  - a. Surface mounted in areas designated as dry.

### **3.2 FIELD QUALITY CONTROL**

- A. Acceptance Testing: See Specification Section 26 08 13.

**END OF SECTION 26 24 19**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for:
    - a. Wall switches.
    - b. Receptacles.
    - c. Device wallplates and coverplates.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.
  - 2. Section 26 05 33 - Raceways and Boxes.
  - 3. Section 26 24 19 - Motor Control Equipment.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. WD 1, General Color Requirements for Wiring Devices.
    - c. WD 6, Wiring Devices - Dimensional Requirements.
  - 2. Underwriters Laboratories, Inc. (UL):
    - a. 20, General-Use Snap Switches.
    - b. 498, Standard for Attachment Plugs and Receptacles.
    - c. 514A, Metallic Outlet Boxes.
    - d. 894, Standard for Switches for Use in Hazardous (Classified) Locations.
    - e. 943, Ground-Fault Circuit-Interrupters.
    - f. 1010, Standard for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
    - g. 1310, Standard for Class 2 Power Units.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. See Specification Section 26 05 00 for additional requirements.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Wall switches and receptacles:
    - a. Bryant Electric.

- b. Cooper Wiring Devices by Eaton.
- c. Hubbell Incorporated Wiring Device-Kellems.
- d. Leviton Manufacturing Company.
- e. Legrand/Pass & Seymour.
- f. Eaton Crouse-Hinds.
- g. Appleton Electric Co.
- h. Hubbell Killark.

## **2.2 WALL SWITCHES**

- A. Basic requirements unless modified in specific requirements paragraph of switches per designated areas or types:
  - 1. Industrial Specification Grade.
  - 2. Quiet action, snap switch.
  - 3. Self-grounding with grounding terminal.
  - 4. Back and side wired.
  - 5. Solid silver cadmium oxide contacts.
  - 6. Rugged thermoplastic and/or nylon housing and one-piece switch arm.
  - 7. Ratings: 20 A, 120/277 VAC.
  - 8. Switch handle type: Toggle.
  - 9. Switch handle color: Gray.
  - 10. Types as indicated on the Drawings:
    - a. Single-pole.
    - b. Double-pole.
    - c. 3-way.
    - d. 4-way.
    - e. Momentary contact.
  - 11. Standards: UL 20, UL 514A, NEMA WD 1, NEMA WD 6.
- B. Specialty Switch Specific Requirements:
  - 1. Momentary Contact Switch for Lighting Control:
    - a. SPDT, 3-position, center "off".
    - b. Rating: 20A, 120/277VAC.
- C. Architecturally Finished Area Specific Requirements:
  - 1. Commercial Specification Grade.
  - 2. Wallplate:
    - a. 302 or 304 brushed finish stainless steel.
    - b. Single or multiple gang as required.
- D. Dry Non-architecturally Finished Area Specific Requirements:
  - 1. Coverplate for use on surface mounted outlet boxes:
    - a. Raised steel, galvanized.
    - b. Single or multiple gang as required.
  - 2. Wallplate for use on recessed outlet boxes:
    - a. Steel, galvanized.
    - b. 302 or 304 brushed finish stainless steel.
    - c. Single or multiple gang as required.
- E. Dry and Dusty Non-Architecturally Finished Area Specific Requirements:
  - 1. Coverplate:
    - a. Cast aluminum, gasketed, stainless steel hardware, natural, lacquer, or factory painted finish.

- b. Operator type:
    - 1) Side mounted rocker type handle to operate snap switch.
    - 2) Front mounted lever type handle to operate snap switch.
    - 3) Push/pull operator to operate snap switch.
    - 4) Spring type door to cover snap switch.
  - c. Single or multiple gang as required.
- F. Wet or Damp Non-Architecturally Finished or Exterior Area Specific Requirements:
- 1. Coverplate:
    - a. Cast aluminum, gasketed, stainless steel hardware, natural, lacquer, or factory painted finish.
    - b. Operator type:
      - 1) Side mounted rocker type handle to operate snap switch.
      - 2) Front mounted lever type handle to operate snap switch.
      - 3) Push/pull operator to operate snap switch.
      - 4) Spring type door to cover snap switch.
    - c. Wet location rated.
    - d. Single or multiple gang as required.
- G. Corrosive and Dry Area Specific Requirements:
- 1. Corrosion resistant nickel plated metal parts.
  - 2. Coverplate for use on metallic outlet boxes:
    - a. Cast aluminum, stainless steel hardware, natural, lacquer, or factory painted finish.
    - b. Single or multiple gang as required.
  - 3. Coverplate for use on non-metallic outlet boxes:
    - a. High impact thermoplastic or nylon, color to match handle, stainless steel screws.
    - b. Single or multiple gang as required.
- H. Corrosive and Wet or Damp Area Specific Requirements:
- 1. Corrosion resistant nickel plated metal parts.
  - 2. Coverplate for use on metallic outlet boxes:
    - a. Cast aluminum, gasketed, stainless steel hardware, natural, lacquer, or factory painted finish.
    - b. Operator type:
      - 1) Front mounted lever to operate snap switch.
      - 2) Push/pull operator to operate snap switch.
      - 3) Spring type door to cover snap switch.
    - c. Wet location rated.
    - d. Single or multiple gang as required.
  - 3. Coverplate for use on non-metallic outlet boxes:
    - a. High impact thermoplastic, gasketed, stainless steel screws.
      - 1) Front mounted lever to operate snap switch.
      - 2) Spring type door to cover snap switch.
    - b. Wet location rated.
    - c. Single or multiple gang as required.
- I. Highly Corrosive and Dry Area Specific Requirements:
- 1. Corrosion resistant nickel plated metal parts.
  - 2. Coverplate for use on PVC coated metallic outlet boxes:
    - a. PVC coated galvanized cast iron alloy, stainless steel hardware.
    - b. PVC coated cast aluminum, stainless steel hardware.
    - c. Single or multiple gang as required.
  - 3. Coverplate for use on non-metallic outlet boxes:
    - a. High impact thermoplastic or nylon, color to match handle, stainless steel screws.
    - b. Single or multiple gang as required.



## SECTION 26 27 26 - WIRING DEVICES

- J. Highly Corrosive and Wet or Damp Area Specific Requirements:
1. Corrosion resistant nickel plated metal parts.
  2. Coverplate for use on PVC coated metallic outlet boxes:
    - a. PVC coated galvanized iron alloy, gasketed, stainless steel hardware.
    - b. PVC coated aluminum, gasketed, stainless steel hardware.
    - c. Operator Type:
      - 1) Front mounted lever to operated snap switch.
      - 2) Push/pull operator to operate snap switch.
      - 3) Spring type door to cover snap switch.
    - d. Wet location rated.
    - e. Single or multiple gang as required.
  3. Coverplate for use on non-metallic outlet boxes:
    - a. High impact thermoplastic, gasketed, stainless steel hardware.
      - 1) Front mounted lever to operate snap switch.
      - 2) Spring type door to cover snap switch.
    - b. Wet location rated.
    - c. Single or multiple gang as required.
- K. Hazardous and Dry Area Specific Requirements:
1. Rated for Class I, Division 1 and 2, Groups C and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
  2. Assembly consists of outlet box, snap switch and coverplate.
    - a. NEMA 7 and 9 rated.
  3. Outlet box:
    - a. Cast iron alloy, galvanized and factory painted finish.
    - b. Cast aluminum, natural, lacquer, or factory painted finish.
  4. Snap switch (EDS Type):
    - a. Enclosed in separate sealing chamber and approved for installation without additional external sealing fittings.
    - b. Sealing chamber has prewired factory sealed pigtail leads.
  5. Snap switch (EFS Type):
    - a. Not enclosed in separate sealing chamber requiring external sealing fittings.
  6. Coverplate:
    - a. Cast iron alloy, stainless steel hardware, galvanized and factory painted finish.
    - b. Cast aluminum, stainless steel hardware, natural, lacquer, or factory painted finish.
    - c. Operator type:
      - 1) Front mounted lever to operate snap switch.
      - 2) Side rocker arm operator to operate snap switch.
  7. Standards: UL 894.
- L. Hazardous and Wet or Damp Area specific requirements:
1. Rated for Class I, Division 1 and 2, Groups C and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
  2. Assembly consists of outlet box, snap switch and coverplate.
    - a. NEMA 3, 7 and 9 rated.
  3. Outlet box:
    - a. Cast aluminum, natural, lacquer, or factory painted finish.
  4. Snap switch (EDS Type):
    - a. Enclosed in separate sealing chamber and approved for installation without additional external sealing fittings.
    - b. Sealing chamber has prewired factory sealed pigtail leads.
  5. Snap switch (EFS Type):
    - a. Not enclosed in separate sealing chamber requiring external sealing fittings.
  6. Coverplate:
    - a. Cast aluminum, stainless steel hardware, natural, lacquer, or factory painted finish.

- b. Operator type:
  - 1) Front mounted lever to operate snap switch.
  - 2) Side rocker arm operator to operate snap switch.
- 7. Standards: UL 894.
  
- M. Hazardous and Corrosive or Highly Corrosive and Dry, Wet or Damp Area Specific Requirements:
  - 1. Rated for Class I, Division 1 and 2, Groups C and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
  - 2. Assembly consists of outlet box, snap switch and coverplate.
    - a. NEMA 3, 7 and 9 rated.
  - 3. Outlet box:
    - a. PVC coated galvanized cast iron alloy.
  - 4. Snap switch (EDS Type):
    - a. Enclosed in separate sealing chamber and approved for installation without additional external sealing fittings.
    - b. Sealing chamber has prewired factory sealed pigtail leads.
  - 5. Snap switch (EFS Type):
    - a. Not enclosed in separate sealing chamber requiring external sealing fittings.
  - 6. Coverplate:
    - a. PVC coated galvanized cast iron alloy, gasketed, stainless steel hardware.
    - b. Operator type:
      - 1) Front mounted lever to operate snap switch.
      - 2) Side rocker arm operator to operate snap switch.
  - 7. Standards: UL 894.
  
- N. Hazardous and Corrosive or Highly Corrosive and Dry, Wet or Damp Area Specific Requirements:
  - 1. Rated for Class I, Division 1 and 2, Groups C and D.
  - 2. Assembly consists of outlet box, snap switch and coverplate.
    - a. NEMA 3X, 7 and 9 rated.
  - 3. Outlet box:
    - a. High strength glass reinforced non-metallic compound.
    - b. Aluminum grounding grid imbedded into enclosure.
  - 4. Snap switch (EFS Type):
    - a. Not enclosed in separate sealing chamber. External sealing fittings required.
  - 5. Coverplate:
    - a. High strength glass reinforced non-metallic compound, gasketed and coated stainless steel hardware.
    - b. Operator type: Non-metallic, front mounted lever to operate snap switch.
  - 6. Standards: UL 894.

### **2.3 Receptacles**

- A. Basic requirements unless modified in specific requirements paragraph of receptacles and per designated areas:
  - 1. Industrial Specification Grade.
  - 2. Straight blade.
  - 3. Brass triple wipe line contacts.
  - 4. One-piece grounding system with double wipe brass grounding contacts and self-grounding strap with grounding terminal.
  - 5. Back and side wired.
  - 6. Rating: 20 A, 125 VAC.
  - 7. High impact nylon body.

8. Receptacle body color:
    - a. Normal power: Gray.
    - b. Generator or UPS power: Red.
  9. Duplex or simplex as indicated on the Drawings.
  10. Configuration: NEMA 5-20R.
  11. Standards: UL 498, UL 514A, NEMA WD 1, NEMA WD 6.
- B. Receptacle Type Specific Requirements:
1. Basic receptacles:
    - a. Weather-resistant when located in exterior locations or interior damp or wet areas as indicated on the Drawings.
      - 1) Identification: Letters "WR" on face of receptacle.
  2. Ground Fault Circuit Interrupter (GFCI):
    - a. Specification Grade.
    - b. Class A protection.
    - c. Feed through type.
    - d. Test and reset buttons.
    - e. Self-testing.
    - f. Visual indicator light.
    - g. Weather-resistant when located in exterior locations or interior damp or wet areas as indicated on the Drawings.
      - 1) Identification: Letters "WR" on face of receptacle.
    - h.
    - i. Additional standards: UL 943.
  3. Plug load (PL) control receptacle.
    - a. Commercial Specification Grade.
    - b. Dual controlled (PLD) or half controlled (PLH) as indicated on the Drawings.
    - c. Identification: NEMA approved controlled receptacle marking on face of receptacle.
  4. Combination receptacle and USB charging station:
    - a. Commercial Specification Grade.
    - b. Compatible with USB 2.0 and 3.0 devices.
    - c. USB ports ratings: 5 VDC, 2.1A minimum total charging capacity.
    - d. Configurations as indicated on the drawings:
      - 1) Simplex receptacle with two (2) USB ports.
      - 2) Duplex receptacle with two (2) USB ports.
    - e. Additional standards: UL 1310.
  5. USB charging station:
    - a. Compatible with USB 2.0 and 3.0 devices.
    - b. USB ports ratings: 5 VDC, 4.2A minimum total charging capacity.
    - c. Configuration: Four (4) USB ports.
    - d. Additional standards: UL 1310.
- C. Architecturally Finished Areas Specific Requirements:
1. Wallplate:
    - a. 302 or 304 brushed finish stainless steel.
    - b. Single or multiple gang as required.
- D. Dry Non-Architecturally Finished Areas Specific Requirements:
1. Coverplate for use on surface mounted outlet boxes:
    - a. Raised steel, galvanized.
    - b. Single or multiple gang as required.
  2. Wallplate for use on recessed outlet boxes:
    - a. Steel, galvanized.
    - b. Single or multiple gang as required.

- E. Dry and Dusty Non-Architecturally Finished Areas Specific Requirements:
  - 1. Coverplate:
    - a. Cast aluminum, gasketed, self-closing cover, stainless steel hardware, natural, lacquer or factory painted finish.
    - b. Single or multiple gang, as required.
  
- F. Damp Non-Architecturally Finished Areas Specific Requirements:
  - 1. Coverplate:
    - a. Cast aluminum, gasketed, self-closing cover, stainless steel hardware, natural, lacquer or factory painted finish.
    - b. Weatherproof when receptacle is covered.
    - c. Single or multiple gang as required.
  
- G. Wet Non-architecturally Finished Areas Specific Requirements:
  - 1. Coverplate:
    - a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, copper-free aluminum, 3.2 inches minimum cover depth for #12 AWG cords.
  
- H. Exterior Locations Specific Requirements:
  - 1. Coverplate:
    - a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, copper-free aluminum, 3.2 inches minimum cover depth for #12 AWG cord.
  
- I. Corrosive and Dry Area Specific Requirements:
  - 1. Corrosion resistant nickel plated metal parts.
  - 2. Receptacle body color: Gray.
  - 3. Coverplate for use on metallic outlet boxes:
    - a. Cast aluminum, stainless steel hardware, natural, lacquer or factory painted finish.
    - b. Single or multiple gang as required.
  - 4. Coverplate for use on non-metallic outlet boxes:
    - a. Single or multiple gang as required.
  
- J. Corrosive and Wet or Damp Area Specific Requirements:
  - 1. Corrosion resistant nickel plated metal parts.
  - 2. Receptacle body color: Gray.
  - 3. Weather-resistant.
    - a. Identification: Letters "WR" on face of receptacle.
  - 4. Coverplate for use on metallic outlet boxes:
    - a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, copper-free aluminum, 3.2 inches minimum cover depth for #12 AWG cord.
  - 5. Coverplate for use on non-metallic outlet boxes:
    - a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, flame retardant, UV stabilized polycarbonate, 3.2 inches minimum cover depth for #12 AWG cords.
  
- K. Highly Corrosive and Dry Area Specific Requirements:
  - 1. Corrosion resistant nickel plated metal parts.
  - 2. Receptacle body color: Gray.
  - 3. Coverplate for use on PVC coated metallic outlet boxes:
    - a. PVC coated galvanized cast iron alloy, stainless steel hardware.
    - b. PVC coated cast aluminum, stainless steel hardware.
  - 4. Coverplate for use on non-metallic outlet boxes:
    - a. High impact thermoplastic or nylon, gray in color, stainless steel screws.

## SECTION 26 27 26 - WIRING DEVICES

- L. Highly Corrosive and Wet or Damp Area Specific Requirements:
1. Corrosion resistant nickel plated metal parts.
  2. Receptacle body color: Gray.
  3. Weather-resistant.
    - a. Identification: Letters "WR" on face of receptacle.
  4. Coverplate for use on PVC coated metallic outlet boxes:
    - a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, flame retardant, UV stabilized polycarbonate, 3.2 inches minimum cover depth for #12 AWG cords.
  5. Coverplate for use on non-metallic outlet boxes:
    - a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, flame retardant, UV stabilized polycarbonate, 3.2 inches minimum cover depth for #12 AWG cords.
- M. Hazardous and Dry Area Specific Requirements:
1. Rated for Class I, Division 1 and 2, Groups C and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
  2. Assembly consists of outlet box and a combination receptacle/switch and housing.
    - a. NEMA 3, 7 and 9 rated.
  3. Outlet box (EDS Type):
    - a. Cast iron alloy, galvanized and factory painted finish.
    - b. Cast aluminum, natural, lacquer, or factory painted finish.
  4. Receptacle/switch and housing:
    - a. Receptacle and switch enclosed in a factory sealed chamber and approved for installation without additional external sealing fittings.
    - b. Insertion of "interchanger" plug and plug rotation will close the switch to energize receptacle and lock plug into the receptacle.
    - c. "Interchanger" plug to be compatible with other manufacturers hazardous receptacle and work in ordinary convenience receptacles.
    - d. Ordinary equipment plugs will not active the hazardous receptacle.
    - e. Housing:
      - 1) Cast iron alloy, stainless steel hardware, galvanized and factory painted finish.
      - 2) Cast aluminum, stainless steel hardware, natural, lacquer, or factory painted finish.
      - 3) Spring-loaded door seats against neoprene gasket. Stainless steel spring.
  5. Standards: UL 894 and 1010.
- N. Hazardous and Wet or Damp Area Specific Requirements:
1. Rated for Class I, Division 1 and 2, Groups C and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
  2. Assembly consists of outlet box and a combination receptacle/switch and housing.
    - a. NEMA 3, 7 and 9 rated.
  3. Outlet box (EDS Type):
    - a. Cast aluminum, natural, lacquer, or factory painted finish.
  4. Receptacle/switch and housing:
    - a. Receptacle and switch enclosed in a factory sealed chamber and approved for installation without additional external sealing fittings.
    - b. Insertion of "interchanger" plug and plug rotation will close the switch to energize receptacle and lock plug into the receptacle.
    - c. "Interchanger" plug to be compatible with other manufacturers hazardous receptacle and work in ordinary convenience receptacles.
    - d. Ordinary equipment plugs will not active the hazardous receptacle.
    - e. Housing:
      - 1) Cast aluminum, stainless steel hardware, natural, lacquer, or factory painted finish.
      - 2) Spring-loaded door seats against neoprene gasket. Stainless steel spring.
  5. "Interchanger" plug:

- a. Aluminum housing.
  - b. 30% Glass-reinforced thermoplastic polyester housing.
  - 6. Standards: UL 894 and 1010.
- O. Hazardous and Corrosive or Highly Corrosive and Dry, Wet or Damp Area Specific Requirements:
- 1. Rated for Class I, Division 1 and 2, Groups C and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
  - 2. Assembly consists of outlet box and a combination receptacle/switch and housing.
    - a. NEMA 3, 7 and 9 rated.
  - 3. Outlet box (EDS Type):
    - a. PVC coated galvanized cast iron alloy.
  - 4. Receptacle/switch and housing:
    - a. Receptacle and switch enclosed in a factory sealed chamber and approved for installation without additional external sealing fittings.
    - b. Insertion of "interchanger" plug and plug rotation will close the switch to energize receptacle and lock plug into the receptacle.
    - c. "Interchanger" plug to be compatible with other manufacturers hazardous receptacle and work in ordinary convenience receptacles.
    - d. Ordinary equipment plugs will not active the hazardous receptacle.
    - e. Housing:
      - 1) Cast iron alloy, stainless steel hardware, galvanized and factory painted finish.
      - 2) Cast aluminum, stainless steel hardware, natural, lacquer, or factory painted finish.
      - 3) Spring-loaded door seats against neoprene gasket. Stainless steel spring.
  - 5. "Interchanger" plug:
    - a. Aluminum housing.
  - 6. Standards: UL 894 and 1010.
- P. Hazardous and Corrosive or Highly Corrosive and Dry, Wet or Damp Area Specific Requirements:
- 1. Rated for Class I, Division 1 and 2, Groups C and D.
  - 2. Assembly consists of outlet box and a combination receptacle/switch and housing.
    - a. NEMA 3, 7 and 12 rated.
  - 3. Outlet box (EDS Type):
    - a. High strength glass reinforced non-metallic compound.
    - b. Aluminum grounding grid imbedded into enclosure.
  - 4. Receptacle/switch and housing:
    - a. Receptacle and switch not enclosed in separate sealing chamber. External sealing fittings required.
    - b. Insertion of "interchanger" plug and plug rotation will close the switch to energize receptacle and lock plug into the receptacle.
    - c. "Interchanger" plug to be compatible with other manufacturers hazardous receptacle and work in ordinary convenience receptacles.
    - d. Ordinary equipment plugs will not active the hazardous receptacle.
    - e. Housing:
      - 1) Cast aluminum, stainless steel hardware, factory epoxy painted finish.
      - 2) Spring-loaded door seats against neoprene gasket. Stainless steel spring.
  - 5. "Interchanger" plug:
    - a. 30% Glass-reinforced thermoplastic polyester housing.
  - 6. Standards: UL 894 and 1010.
- Q. Special Purpose Receptacles:
- 1. NEMA configuration as indicated on the Drawings.
  - 2. Coverplate: See requirements per area designations herein.
  - 3. 30 A, 250 V, 2-pole, 3-wire, 1 PH, grounding, simplex, twist-lock; NEMA L6-30R; black.

4. 50 A, 250 V, 2-pole, 3-wire, 1 PH, grounding, simplex; NEMA 6-50R; black.

## **2.4 MISCELLANEOUS WIRING DEVICES**

- A. Manual Motor Starters: Horsepower rated with or without thermal overloads, see Specification Section 26 24 19.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Mount devices where indicated on the Drawings and as scheduled in Specification Section 26 05 00.
- C. See Specification Section 26 05 33 for device outlet box requirements.
- D. Where more than one receptacle is installed in a room, they shall be symmetrically arranged.
- E. Provide blank plates for empty outlets.
- F. Momentary contact switches shall be installed and connected such that the up position is 'on only' and the down position is 'off only.'

**END OF SECTION 26 27 26**

# **SECTION 26 28 00 - OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Low voltage circuit breakers.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.
  - 2. Section 26 08 13 - Acceptance Testing.

### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. C37.13, Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.
    - b. C37.16, Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations.
    - c. C37.17, Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers.
  - 2. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 3. Underwriters Laboratories, Inc. (UL):
    - a. 489, Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
    - b. 943, Standard for Safety for Ground-Fault Circuit-Interrupters.
    - c. 1053, Standard for Ground-Fault Sensing and Relaying Equipment.
    - d. 1066, Standard for Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.

### **1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data including:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. See Specification Section 26 05 00 for additional requirements.
  
- B. Informational Submittals:
  - 1. Reports:
    - a. Short circuit study report.
    - b. Protective coordination study report.
    - c. As-left condition of all circuit breakers that have adjustable settings.



# **SECTION 26 28 00 - OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES**

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Circuit breakers:
    - a. Eaton.
    - b. GE by ABB.
    - c. Square D Company.
    - d. Siemens.

### **2.2 CIRCUIT BREAKERS**

- A. Molded Case Type:
  - 1. General:
    - a. Standards: UL 489.
    - b. Unit construction.
    - c. Over-center, toggle handle operated.
    - d. Quick-make, quick-break, independent of toggle handle operation.
    - e. Manual and automatic operation.
    - f. All poles open and close simultaneously.
    - g. Three position handle: On, off and tripped.
    - h. Molded-in ON and OFF markings on breaker cover.
    - i. One-, two- or three-pole as indicated on the Drawings.
    - j. Current and interrupting ratings as indicated on the Drawings.
  - 2. Thermal magnetic type:
    - a. Inverse time overload and instantaneous short circuit protection by means of a thermal magnetic element.
    - b. Frame size 150 amp and below:
      - 1) Non-interchangeable, non-adjustable thermal magnetic trip units.
    - c. Frame sizes 225 to 400 amp (trip settings less than 400A):
      - 1) Interchangeable and adjustable instantaneous thermal magnetic trip units.
    - d. Ground Fault Circuit Interrupter (GFCI) Listed:
      - 1) Standard: UL 943.
      - 2) One- or two-pole as indicated on the Drawings.
      - 3) Class A ground fault circuit.
      - 4) Trip on 5 mA ground fault (4-6 mA range).
    - e. Ground Fault Equipment Protective Circuit Interrupter (GFEPIC) Listed:
      - 1) Standard: UL 1053.
      - 2) Trip on 30 mA ground fault (6-50 mA range).
  - 3. Solid state trip type:
    - a. Inverse time overload, instantaneous short circuit and ground fault protection by means of a solid state trip element, associated current monitors and flux shunt trip mechanism.
    - b. Frame size 400 amp to 1200 amp (trip settings between 400 and 1200A):
      - 1) Standard rating.
      - 2) Interchangeable current sensor or rating plug.
      - 3) Adjustable long time pick-up setting.
        - a) Adjustable from 50 to 100% of the current sensor or rating plug.
      - 4) Adjustable short time pick-up setting.
      - 5) Adjustable instantaneous pick-up.
      - 6) Fixed ground fault pick-up, when indicated on the Drawings.

## **SECTION 26 28 00 - OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES**

- c. Adjustable arc energy-reducing maintenance system.
  - 1) Frame size 1200A or when indicated on the Drawings for less than 1200A frame size.
  - 2) Activate and deactivate without opening door and exposing operators to energized parts.
  - 3) System status indicator adjacent to activation switch.
- d. Adjustable arc energy-reducing maintenance system.
  - 1) Activate and deactivate without opening door and exposing operators to energized parts.
  - 2) System status indicator adjacent to activation switch.
- 4. Motor circuit protector:
  - a. Adjustable instantaneous short circuit protection by means of a magnetic or solid state trip element.
  - b. Sized for the connected motor.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Current and interrupting ratings as indicated on the Drawings.
- B. Series rated systems not acceptable.
- C. Devices shall be ambient temperature compensated.
- D. Circuit Breakers:
  - 1. Molded case circuit breakers shall incorporate the following, unless indicated otherwise on the Drawings:
    - a. Frame sizes 400 amp and less with trip setting less than 400A shall be thermal magnetic type.
    - b. Frame sizes 400 amp and larger shall be solid state trip type.
    - c. Motor circuit protectors sized for the connected motor.

#### **3.2 FIELD QUALITY CONTROL**

- A. Coordinated Power System Protection:
  - 1. Prepare a study to demonstrate that the equipment and system constructed meet the specified requirements for equipment ratings, coordination and protection.
  - 2. Perform the studies in accordance with IEEE 242 and IEEE 399.
  - 3. Include the name of the software developer, software package and software version number in the computer generated studies.
  - 4. System short circuit study report:
    - a. Begin the study at the main service electrical gear and extend down the system through all buses.
      - 1) Perform a balanced three-phase fault, bolted line-to-line fault and line-to-ground fault study.
    - b. Prepare a one-line diagram to show the electrical system buses, transformers and all sources of fault current including generators and motors.
    - c. Utilize manufacturer's data for the actual proposed equipment (e.g., transformer impedance).
    - d. Coordinate the available utility fault current with the power utility company.

## **SECTION 26 28 00 - OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES**

- e. Show input data in tabular form in the report and/or on the one-line diagram.
  - 1) Input data shall include but is not limited to:
    - a) Utility fault current or MVA and X/R ratio.
    - b) Bus voltages.
    - c) Conductor sizes and type of conduit.
    - d) Generator and motor sizes and contributions.
    - e) Transformer sizes and impedances.
  - f. Show available fault current at each bus in tabular form in the report and/or on the one-line diagram.
  - g. Perform studies for both normal power and emergency/standby power scenarios.
- 5. System protective coordination study report:
  - a. Begin the study at the main service electrical gear and extend down the system through all buses as required to ensure a coordinated power system.
  - b. Demonstrate that the maximum possible degree of selectivity has been obtained between devices specified for the protection of equipment and conductors from damage from overloads and fault conditions.
    - 1) Where necessary, an appropriate compromise shall be made between system protection and service continuity.
    - 2) Consider system protection and service continuity to be of equal importance.
  - c. Prepare a one-line diagram to show the electrical system buses, transformers and protective devices.
  - d. Utilize manufacturer's data for the actual proposed protective devices.
  - e. Summarize the coordination study, conclusions and recommendations.
    - 1) As a minimum, include the following:
      - a) The manufacturer's information used to prepare the study.
      - b) Assumptions made during the study.
      - c) Recommended taps and settings of all adjustable devices in tabulated form.
      - d) Composite coordination time-current curves on log-log paper showing:
        - (1) That the settings for each protective device will provide protection and selectivity.
        - (2) Identify each curve.
        - (3) Cable and equipment damage points.
        - (4) Circuit interrupting device operating and interrupting times.
        - (5) One-line sketch of the part of the system being investigated.
        - (6) Include as many curves as possible on a graph while maintaining readability.
      - e) Position time-current curves for each device to provide for maximum selectivity to minimize system disturbances during fault clearing.
      - f) Advise the Engineer of potential coordination problems discovered during the study and include recommendations to resolve the problem.
        - (1) Provide time-current curves for the "as found" and "proposed" conditions for upgrade/retrofit projects.
      - g) Submit the report for approval 90 days prior to equipment energization.
- B. Adjustable Circuit Breakers:
  - 1. Set all circuit breaker adjustable taps as defined on the Drawings, except adjust motor circuit protectors per the motor nameplate and NFPA 70 requirements.
- C. Ground Fault Protection System:
  - 1. Single source system:
    - a. Main breaker using the residual sensing method system coordinated with individual feeder breakers using the residual sensing method.
- D. Testing:
  - 1. Acceptance testing: See Specification Section 26 08 13.

**SECTION 26 28 00 - OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES**

2. Adjustable circuit breakers:
  - a. Test and verify all circuit breaker trip functions using a test set provided by the manufacturer for that purpose for circuit breakers 1200 A and above.
3. Ground fault protection system testing:
  - a. Performance test installed ground fault protection system as required by the NFPA 70.
  - b. Use high current injection method to test system.
  - c. Test report shall indicate:
    - 1) Device settings.
    - 2) Tripping time in cycles for each device.
    - 3) Test current.
    - 4) Date of test.
    - 5) Name of certified testing firm that performed the test.

**END OF SECTION 26 28 00**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Safety switches.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.
  - 2. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. KS 1, Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
  - 2. Underwriters Laboratories, Inc. (UL):
    - a. 98, Enclosed and Dead-Front Switches.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. Provide a Summary Table or use Exhibit A that associates the safety switch features with connected equipment tag number. Exhibit A indicates minimum data required.
    - c. See Specification Section 26 05 00 for additional requirements.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following safety switch manufacturers are acceptable:
  - 1. Eaton.
  - 2. GE by ABB.
  - 3. Square D by Schneider Electric.
  - 4. Siemens Corporation.
  - 5. Appleton by Emerson Electric Co.
  - 6. Crouse-Hinds by Eaton.
  - 7. Killark by Hubbell.

**2.2 SAFETY SWITCHES**

- A. General:

## SECTION 26 28 16 - SAFETY SWITCHES

1. Non-fusible or fusible as indicated on the Drawings.
  2. Suitable for service entrance when required.
  3. NEMA Type HD heavy-duty construction.
  4. Switch blades will be fully visible in the OFF position with the enclosure door open.
  5. Quick-make/quick-break operating mechanism.
  6. Deionizing arc chutes.
  7. Manufacture double-break rotary action shaft and switchblade as one common component.
  8. Clear line shields to prevent accidental contact with line terminals.
  9. Operating handle (except NEMA 7 and NEMA 9 rated enclosures):
    - a. Red and easily recognizable.
    - b. Padlockable in the OFF position.
    - c. Interlocked to prevent door from opening when the switch is in the ON position with a defeater mechanism.
- B. Ratings:
1. Horsepower rated of connected motor.
  2. Voltage and amperage: As indicated on the Drawings.
  3. Short circuit withstand:
    - a. Non-fused: 10,000A.
    - b. Fused: 200,000A.
- C. Accessories, when indicated in PART 3 of this Specification Section or on the Drawings:
1. Neutral kits.
  2. Ground lug kits.
  3. Auxiliary contact kits:
    - a. Opens before main switch.
    - b. Rated 10A at 125/250 VAC.
    - c. One N.O. and one N.C. contact.
- D. Enclosures:
1. NEMA 1 rated:
    - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
    - b. With or without knockouts, hinged and lockable door.
  2. NEMA 3R rated:
    - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
    - b. With or without knockouts, hinged and lockable door.
  3. NEMA 4 rated:
    - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
    - b. No knockouts, external mounting flanges, hinged, gasketed and lockable door.
  4. NEMA 4X rated (metallic):
    - a. Body and cover: Type 304 or 316 stainless steel.
    - b. No knockouts, external mounting flanges, hinged and gasketed door.
  5. NEMA 4X rated (nonmetallic):
    - a. Body and cover: Ultraviolet light protected fiberglass-reinforced polyester boxes.
    - b. No knockouts, external mounting flanges, hinged, gasketed and lockable door.
  6. NEMA 7 and NEMA 9 rated:
    - a. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
    - b. Drilled and tapped openings or tapered threaded hub.
    - c. Gasketed cover bolted-down with stainless steel bolts.
    - d. External mounting flanges.
    - e. Operating handle padlockable in the OFF position.
  7. NEMA 12 rated:

- a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
  - b. No knockouts, external mounting flanges, hinged and gasketed door.
- E. Overcurrent and short circuit protective devices:
- 1. Fuses.
  - 2. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.
- F. Standards: NEMA KS 1, UL 98.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install as indicated and in accordance with manufacturer's instructions and recommendations.
- B. Install switches adjacent to the equipment they are intended to serve unless otherwise indicated on the Drawings.
- C. Provide auxiliary contact kit on local safety switches for motors being controlled by a variable frequency drive.
- 1. The VFD is to be disabled when the switch is in the open position.
- D. Permitted uses of NEMA 1 enclosure:
- 1. Surface or flush mounted in areas designated dry in architecturally finished areas.
- E. Permitted uses of NEMA 3R enclosure:
- 1. Surface mounted in exterior location for HVAC equipment only.
- F. Permitted uses of NEMA 4 enclosure:
- 1. Surface mounted in areas designated as wet.
- G. Permitted uses of NEMA 4X metallic enclosure:
- 1. Surface mounted in areas designated as wet and/or corrosive.
- H. Permitted uses of NEMA 4X nonmetallic enclosure:
- 1. Surface mounted in areas designated as corrosive.
  - 2. Surface mounted in areas designated as highly corrosive.
- I. Permitted uses of NEMA 7 enclosure:
- 1. Surface mounted in areas designated as Class I hazardous.
  - 2. Provide PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.
- J. Permitted uses of NEMA 9 enclosure:
- 1. Surface mounted in areas designated as Class II hazardous.
  - 2. Provide PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.
- K. Permitted uses of NEMA 12 enclosure:
- 1. Surface mounted in areas designated as dry in non-architecturally finished areas.

**END OF SECTION 26 28 16**





**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Engine generator equipment.
  - 2. Fuel storage tanks.
  - 3. Engine generator enclosures and accessories.
  - 4. Access stairs and platforms, including performance and design criteria for required delegated design services.
  
- B. Related Requirements: Include, but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.

**1.2 REFERENCES**

- A. Reference Standards:
  - 1. Environmental Protection Agency (EPA):
    - a. 40 CFR Part 60, Subpart IIII, Protection of Environment, Standards of Performance for New Stationary Sources, Standards for Performance for Stationary Compression Ignition Internal Combustion Engines.
  - 2. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. MG 1, Motors and Generators.
  - 3. National Fire Protection association (NFPA):
    - a. 70, National Electrical Code (NEC):
      - 1) Article 700, Emergency Systems.
      - 2) Article 702, Optional Standby Systems.
  - 4. Underwriters Laboratories, Inc. (UL):
    - a. 2200, Standard for Stationary Engine Generator Assemblies.

**1.3 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Supplier:
    - a. The engine generator equipment manufacturer or other authorized Supplier has unit responsibility for furnishing all components of required engine generator systems and proper, initial operation of systems required by this Section.

**1.4 SUBMITTALS**

- A. Action Submittals: Submit the following:
  - 1. Shop Drawings:
    - a. Schedule: Where the Work includes furnishing more than one engine generator system, submit schedule of engine generator systems, indicating for each engine generator system: identification or tag number, engine generator size, location, enclosure type, fuel storage tank capacity, and other pertinent data.

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- b. Dimensioned plan, elevation, sections, and detail drawings for engine generator equipment, enclosures, and other components furnished by engine generator manufacturer.
  - c. Fuel storage tank.
  - d. Wire interconnection drawings.
  - e. Control panel layout drawings and internal wiring diagrams.
  2. Product Data:
    - a. Manufacturer's literature and published data for all components and accessories of engine generator systems.
    - b. Comply with Section 26 05 00 - Electrical - Basic Requirements, regarding required Submittals.
    - c. Engine/generator performance curves.
  3. Delegated Design Instruments of Service Submittals:
    - a. For access stairs and platforms, submit the following documents prepared, sealed, and signed by licensed, registered delegated design professional retained by Contractor, Subcontractor, or Supplier:
      - 1) Design drawings.
      - 2) Design specifications.
      - 3) Certificate of Compliance.
  4. Testing Plans, Procedures, and Testing Limitations:
    - a. Testing procedure, apparatus, and limitations of apparatus and procedure, for:
      - 1) Source quality control activities indicated in this Section.
      - 2) Field quality control activities indicated in this Section.
- B. Informational Submittals: Submit the following:
1. Certificates:
    - a. Generator equipment manufacturer's documentation of engine USEPA certification including USEPA family name and generator equipment model designation.
  2. Other Required Delegated Design Submittals for access stairs and platforms:
    - a. Delegated Design Calculations:
      - 1) Complete design calculations, sealed and signed by delegated design professional, indicating: Basis of design, including list of Laws and Regulations (including code) and standards used for design.
      - 2) Delegated Design Calculations will not be checked and are submitted for record purposes only.
    - b. Shop Drawings bearing delegated design professional's approval stamp. Alternatively, such drawings may be submitted as delegated design professional's "instruments of service" design drawings, required above, when such drawings are sealed and signed by the delegated design professional.
    - c. Product data bearing delegated design professional's approval stamp.
  3. Supplier Instructions:
    - a. Serial numbers of items furnished, equipment nameplate information, and similar information for all items furnished.
    - b. Instructions for handling, installing, and startup.
  4. Source Quality Control Submittals:
    - a. Results of tests, inspections, and other quality control activities required by the Contract Documents and performed at the place of production or fabrication.
  5. Field Quality Control Submittals:
    - a. Results of tests, inspections, and other quality control activities required by the Contract Documents and performed at the Site.
  6. Supplier Site Visit Reports:
    - a. Report of each visit to the Site by Supplier, summarizing purpose of visit, activities while onsite, problems encountered, advice given to Contractor or Subcontractor, and actions taken.
  7. Qualifications:

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- a. Contractor's, Subcontractor's, or Supplier's delegated design professional.
- C. Closeout Submittals: Submit the following:
  - 1. Operation and Maintenance Data:
  - 2. Post-Startup Statement:
    - a. Equipment installation, startup, and operational statement for each engine generator system provided.
  - 3. Keying:
    - a. Upon Substantial Completion, furnish to Owner or facility manager (if any) not less than two sets of keys for locks on generator system enclosures.
- D. Maintenance Material Submittals:
  - 1. Furnish the following items and submit documentation of delivery to and acceptance of such items by Owner or facility manager (if any):
    - a. Spare Parts and Extra Materials:
      - 1) Furnish spare parts and extra materials sufficient for one year of operation as recommended by generator system manufacturer, for each generator system furnished.

### **1.5 FIELD conditions**

- A. Ambient Conditions:
  - 1. Ambient Air Temperature:
  - 2. Minimum: 20 degrees F.
  - 3. Maximum: 120 degrees F.
- B. Existing Conditions:
  - 1. Site Elevation: 700 feet above sea level.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Engine generator unit:
    - a. Blue Star Power Systems.
    - b. Caterpillar.
    - c. Cummins.
    - d. Generac.
    - e. Kohler.
    - f. MTU, a Rolls Royce Solution.
    - g. Taylor Power Systems.
    - h. Or equal.
  - 2. Silencers:
    - a. Generator equipment manufacturer's standard.
    - b. Or equal.
  - 3. Battery charger:
    - a. Generator equipment manufacturer's standard.
  - 4. Governor:
    - a. Generator equipment manufacturer's standard.

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- b. Or equal.
- 5. Radiator:
  - a. Generator equipment manufacturer's standard.
- 6. Vibration isolators:
  - a. Generator equipment manufacturer's standard.
  - b. Or equal.
- 7. Day tank:
  - a. Generator equipment manufacturer's standard.
  - b. Or equal.

### **2.2 DESCRIPTION**

- A. Engine generators will be used and rated for:
  - 1. Emergency power during a power outage, NFPA 70, Article 700.
  - 2. Optional standby power during a utility power outage, NFPA 70, Article 702.

### **2.3 EQUIPMENT**

- A. Emissions Requirements:
  - 1. Each generator system's exhaust emissions shall comply with Laws and Regulations. Federal, State and Local government requirements, including but not limited to:
    - a. Environmental Protection Agencies (USEPA) New Source Performance Standards (NSPS), 40 CFR Part 60, Subpart IIII.

### **2.4 COMPONENTS**

- A. Engine Generator Unit General:
  - 1. Diesel engine direct-connected to alternating current generator mounted on suitable rigid steel skid supports.
  - 2. Mount unit on skid suitable for installation on concrete foundation.
  - 3. Base rating on operation at rated RPM when equipped with all operating accessories.
  - 4. Standards: UL 2200.
- B. Engine:
  - 1. Four-cycle, full compression ignition, single acting, solid-injection unit, either vertical or V-type pistons turbo charged with inter and after cooling.
  - 2. Fuel supply: No. 2 Diesel.
  - 3. Removable full wet-type cylinder liners of close grained alloy iron, heat treated for proper hardness to obtain maximum life.
  - 4. Capable of operating at idle or light loads for extended periods of time.
- C. Injection Pumps and Valves:
  - 1. Type not requiring adjustment in service, which may be individually removed and replaced.
  - 2. Individual injection pump and valve for each cylinder.
  - 3. Fuel injection pumps: Positive action, constant-stroke, actuated by cam driven by gears from engine crankshaft.
  - 4. Fuel lines between injection pumps and valves: Heavy seamless steel tubing.
  - 5. Flexible fuel line connectors for supply and return connections at pump.
- D. Oil Pump:

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1. Gear-type lubricating oil pump to supply oil under pressure to main bearings, crank pin bearings, pistons, timing gears, camshaft bearings and valve rocker mechanism.
  2. Spray cool and lubricate pistons.
  3. Oil filters so located that lubricating oil is continuously filtered, except during periods when oil is automatically by-passed to protect vital parts when filters are clogged.
  4. Filter elements accessible and easily removable.
  5. Filter elements: Effective full flow, replaceable resin-impregnated cellulose type.
  6. Equip filter system with spring-loaded by-pass valve.
  7. Oil cooler: Water-cooled, engine-mounted.
- E. Fuel System:
1. Fuel pump: Built-in gear-type, engine-driven fuel transfer pump, capable of supplying fuel at constant pressure against head of feet.
  2. Equip fuel system with replaceable fuel filter elements arranged for easy removal without breaking any fuel line connections or disturbing fuel pumps or any other part of engine.
  3. Locate all fuel filters in an accessible housing, ahead of injection pumps to thoroughly filter fuel before it reaches the pump.
  4. Use no screens or filters requiring cleaning or replacement of injection pumps or valve assemblies.
- F. Governor: Fully enclosed electronic type governor with actuator capable of providing accurate speed control within 1% of rated speed, complete with panel-mounted electronic assembly with ramp generator and speed-sensing modules.
- G. Air Cleaners: Engine-mounted, dry type air cleaners of sufficient capacity.
- H. Electric Starting System:
1. Sufficient capacity to crank at speed which will start engine under normal operating conditions.
  2. Controls to provide automatic cranking of engine when generator is called to start.
  3. Prevent excessive cranking which could damage cranking motor.
  4. Automatic stop controls.
  5. Starter motors with positive-engagement feature.
- I. Cooling System:
1. Capacity for cooling engine at the specified operating conditions.
  2. Engine driven, centrifugal type water circulating pump and thermostatic valve to maintain the engine at recommended temperature level.
  3. Unit mounted radiator.
    - a. Core guard flexible duct adapter.
    - b. Site glass at top of unit.
    - c. Engine driven blower fan.
    - d. Low water level cutoff switch.
  4. Provide fan guards.
- J. Heater:
1. Thermostatically controlled jacket water heater(s) to maintain cooling jacket at the manufacturer's recommended temperature at the specified low ambient temperature.
  2. 120 V, single phase.
- K. Silencer:
1. Suitable type for industrial silencing.
  2. Seamless, stainless steel, flexible, exhaust adapter for exhaust outlet to silencer.

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- L. Engine Instruments and Controls:
  - 1. Engine-mounted instruments:
    - a. Fuel pressure gage.
    - b. Oil pressure gage.
    - c. Oil temperature gage.
    - d. Water temperature gage.
    - e. Run time meter.
    - f. Battery voltage meter.
  - 2. Automatic cycle cranking and over-crank protection.
  - 3. Safety controls: Equip engine with automatic safety controls to shut down engine in event of low lubricating oil pressure, high jacket water temperature, overspeed or overcrank.
  - 4. Auxiliary control devices: Either integral with specified engine instruments, control, and safety devices or as separate devices as required to operate various signal circuits specified for remote annunciator panel.
  - 5. Three NO auxiliary contacts for interface with louvers, fans or other miscellaneous equipment.
    - a. Contacts shall close when generator is started.
  
- M. Main Fuel Tank: See Specification Section 33 56 13 Aboveground Fuel Storage Tank.
  
- N. Sub-base ("Belly") Fuel Day Tank:
  - 1. Double wall sub-base day tank mounted underneath engine generator unit.
  - 2. Steel construction, top and bottom baffles, steel channel side supports, weatherproof secondary containment, rust preventive interior coating, rust-proofed, and finish painted exterior.
  - 3. Tank connections: Fuel level gauge, supply and return fuel lines to generator, fill line from main tank, return line for packaged pumpset to main tank, atmospheric vent riser, emergency vents, drain and pressure relief.
  - 4. Manual overfill protection.
  - 5. Low level warning with contacts for remote alarm.
    - a. Set to alarm at 50% of capacity.
  - 6. Critical low level shutoff with contacts for remote alarm.
  - 7. Leak detection alarm with contacts for remote alarm.
  - 8. Capacity: 3,600 GAL (48 hours at 1,000-kW generator full load, approximate fuel consumption of 72 GAL per hour).
  - 9. Tank shall be supplied by submersible turbine pump at the Main Fuel Tank.
    - a. Refer to Specification Section 33 57 10 Fuel Dispensing Equipment.
    - b. Install flow limiter valve to restrict supply flow rate to approximately 30 GPM.
  - 10. Tank shall feature a packaged pump set to return excess fuel from Sub-Base Tank to Main Tank. Fuel transfer return pump shall be horizontal, positive displacement type. Direct connect pump to motor through a flexible coupling.
    - a. Fuel transfer pump shall have a minimum rated flow of 50 GPM and suction lift capabilities of 15 feet minimum. Ideal rated minimum flow shall be 150 percent of supply pump flow rate.
    - b. High-high level setting shall start the fuel return pump at 95 percent of normal liquid level. Fuel return pump shall continue operation until the return armed setting (80 percent level) clears.
    - c. Equip each pump with a bypass relief valve if not provided with an internal relief valve.
    - d. Pump motors shall be TEFC construction, NEMA Type B, continuous duty at 40 degrees C, and 1.15 service factor.
  
- O. Batteries:
  - 1. Nickel cadmium type.
  - 2. Furnish electrolyte separately for use when installation is complete and unit is ready for testing.

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### P. Battery Charger:

1. Output current rating of at least 1/20th of ampere hour capacity of battery and capable of automatically switching between low rate (float) mode and high rate (equalize) mode.
2. Solid state rectifiers, DC voltmeter and ammeter, fuse input and output, and 115 VAC input.
3. Malfunction alarm contacts (minimum): low and high battery voltage, weak battery and charger failure.

### Q. Generator:

1. Brushless, 4-pole drip-proof revolving field type with permanent magnet, 2/3 pitch stator, direct-coupled rotor, Class H insulation.
2. Minimum continuous standby ratings:
  - a. As indicated on the Drawings, substantiated by manufacturer's standard published curves and conform to NEMA MG 1 specification.
  - b. Special ratings or maximum ratings are not acceptable.
3. Rated to serve up to 50% non-linear load without exceeding rated temperature rise.
4. Minimum efficiency: 92% at 50 to 110% of nominal standby rating, less than 30% instantaneous voltage dip at full load and rated power factor and suitable for simultaneous operation with other future units connected in parallel.
5. Stator and rotor: 130 degrees C temperature rise with minimum Class H insulated with 100 percent epoxy impregnation and overcoat of resilient insulating material to reduce possible fungus and/or abrasive deterioration.
6. Directly connect stator to engine flywheel housing.
7. Drive rotor through semiflexible driving flange to ensure permanent alignment.
8. Self-ventilating with suitable blower, air inlet and outlet openings.
9. Provide terminal box of adequate size for entrance of conduit and termination of conductors.
10. Generator drive free from critical torsional vibration within operating range.
11. Provide generator mounted main circuit breaker:
  - a. Solid state molded case type.
  - b. Ratings as indicated.

### R. Voltage Regulator:

1. SCR type, to maintain 2% voltage regulation from 0 to full load with steady state modulation not exceeding plus 1/2% including cross-current compensation to provide maximum of 5% unbalance in kVA load sharing between this unit and possible future generators.
2. Automatic protection against short circuits on system.
3. Permit unit to operate at no load below rated frequency for engine start up and shut down procedures.
4. Provide voltage level and gain controls for normal operating adjustments.
5. Provide voltage level control with minimum range of plus or minus 5% from rated voltage.
6. Mount regulator, volts per hertz type, in generator housing on suitable vibration isolators.

### S. Generator Instruments and Controls:

1. Generator mounted NEMA 1 type, illuminated vibration isolated instrument and control panel(s).
2. AC voltmeter and phase selector switch.
3. AC ammeter and phase selector switch.
4. Frequency meter.
5. Run-off-auto engine, start-stop control switch.
6. Emergency stop.
7. Run time meter.
8. Governor control rheostat.
9. Voltage level adjustment rheostat.
10. Cool down time delay 0-15 minute adjustable.
11. Cycle cranking control.



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12. Minimum red shut down indicating lights as follows:
    - a. Overcrank.
    - b. Overspeed.
    - c. Low lubricating oil pressure.
    - d. High engine water temperature.
  13. Minimum amber alarm indicator lights as follows:
    - a. Control switch not in auto position.
    - b. Low engine water temperature (less than 70 degrees F).
    - c. Low fuel in day tank.
    - d. Day tank leak.
    - e. Battery charger malfunctioning.
    - f. Low battery voltage.
  14. Minimum amber prealarm indicator lights as follows:
    - a. High engine water temperature.
    - b. Low lubricating oil pressure.
  15. Common dry contact and audible alarm to indicate when one or more alarm or prealarm conditions exist.
- T. Vibration Isolators: Vibration system shall consist of engine and generator mount isolators with or without additional mechanical spring isolators rubber pads to control both high and low frequency vibrations between major components, sub-base and structural foundation and to provide required vibration isolation for the seismic zone of the Project.

### 2.5 ACCESSORIES

- A. Provide interposing relays (24 VDC to 120 VAC) as required for interfacing with customer's 120 Vac monitoring system.
- B. Generator remote annunciator panel:
  1. Surface mounted NEMA 1 enclosure. .
  2. Circuits:
    - a. 24 VDC powered from starting batteries.
    - b. Verify circuit voltage to match battery voltage.
  3. Provide red and green signal lamps, buzzer, silencing switch, lamp test switch, relays, solid-state components, and engraved function identifications.
  4. Annunciator functions:
    - a. Green light "ON" to indicate generator is operating to supply power to load.
    - b. Separate red light for each shutdown or alarm condition and amber light for each prealarm condition and common buzzer with silence/ acknowledge switch.
    - c. Shut down indicating lights as follows:
      - 1) Overcrank.
      - 2) Overspeed.
      - 3) Low lubricating oil pressure.
      - 4) High engine water temperature.
    - d. Alarm indicator lights as follows:
      - 1) Control switch not in auto position.
      - 2) Low engine water temperature (less than 70 degrees F).
      - 3) Low fuel in day tank.
      - 4) Fuel in day tank rupture basin.
      - 5) Battery charger malfunctioning.
      - 6) Low battery voltage.
    - e. Prealarm indicator lights as follows:
      - 1) High engine water temperature.
      - 2) Low lubricating oil pressure.

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- C. Manual stop break glass station:
  - 1. Shuts down generator from remote location.
- D. Generator set non-walk-in weather protective enclosure:
  - 1. Sheet steel with side servicing panels, air intake louvers and rear control panel access door.
  - 2. Side servicing panels shall have two locking points; all panels and doors shall be key lockable.
  - 3. Pitched roof with silencing exhaust muffler mounted inside or outside the enclosure.
  - 4. Completely install enclosure on generator set mounting base.
- E. Generator Access Stairs and Platforms:
  - 1. Description:
    - a. Access stairs and platforms shall be designed and provided by generator manufacturer.
    - b. Provide access stairs and platforms around all sides of generator requiring access to service panels or access doors.
    - c. Coordinate and provide foundations required by design of generator access stairs and platforms.
  - 2. Performance and Design Criteria for access stairs and platforms:
    - a. Platforms shall be level with top of fuel tank and not less than four feet wide.
    - b. Live loading:
      - 1) 100 pounds per square foot, uniform load.
      - 2) 300 pounds concentrated load on four-inch by four-inch area.
      - 3) Components shall be adequate for uniform load, concentrated load, and loads required by Laws and Regulations, whichever requires the stronger component.
    - c. Maximum deflection: 1/300 of span under superimposed live load of 100 pounds per square foot.

### 2.6 SOURCE QUALITY CONTROL

- A. Individually test each prime mover.
  - 1. Apply derating factors for the proposed site to test data.
  - 2. Continuously test for a period not less than two hours.
  - 3. Test procedure shall be as follows:
    - a. Start prime mover and upon reaching rated RPM, pick up 100 percent of nameplate KW rating at rated power factor in one step.
    - b. Observe and record the cranking time(s) required to start and run for each prime mover.
    - c. Observe and record the time required to come up to operating speed for each prime mover.
    - d. Record voltage and frequency overshoot for each prime mover.
    - e. Record voltage, frequency and amperes.
    - f. Record oil pressure, water temperature where applicable and battery charge rate at first load acceptance and at 15 minute intervals thereafter for each prime mover.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install all components as indicated and in accordance with manufacturer's recommendations and instructions.

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- B. Fill cooling system with solution of 50-50 water and ethylene glycol anti-freeze to prevent freezing at temperatures as low as minus 30 degrees F.
- C. Provide fuel for a full day tank.
- D. Install all wiring to engine in conduit.
  - 1. Control wiring on engine may be factory installed in high temperature loom.
- E. Provide control wiring in conduit between generator control panel , remote annunciator panel(s) and remote devices as described under generator instrument and controls paragraph and remote annunciator paragraph of this Specification.
- F. Mount on concrete pad utilizing vibration/seismic isolators, see structural drawings for pad detail.
- G. Sound attenuating engine generator enclosure:
  - 1. Field test installation under load.
  - 2. Use a precision sound measuring instrument meeting ANSI S1.4 Type 1.
  - 3. Provide measurements to Architect.

### 3.2 FIELD QUALITY CONTROL

- A. Field Tests and Inspections:
  - 1. Provide two load tests and one cycle crank test.
  - 2. Tests one and two shall be for continuous period of no less than two hours each.
  - 3. Engineer and Owner shall be notified seven days prior to testing.
  - 4. Test number one:
    - a. With prime mover(s) in a "cold start" condition and emergency load at normal operating level, initiate a normal power failure by opening all switches or breakers supplying normal power to facility.
    - b. Observe and record the time delay on engine start.
    - c. Observe and record the cranking time(s) required to start and run for each prime mover.
    - d. Observe and record the time required to come up to operating speed for each prime mover.
    - e. Record voltage and frequency overshoot for each prime mover.
    - f. Observe and record time required to achieve steady-state condition with all switches transferred to emergency position.
    - g. Record voltage, frequency and amperes.
    - h. Record oil pressure, water temperature where applicable and battery charge rate at 5-minute intervals for the first 15 minutes and at 15 minute intervals thereafter for each prime mover.
    - i. Return normal power to facility, record time delay on retransfer to normal for each switch and cooldown time delay for each prime mover.
  - 5. Test number two:
    - a. Immediately after completion of test number one, start prime mover and upon reaching rated RPM, pick up 100% of nameplate KW rating in one step.
      - 1) Unity power factor is acceptable for on-site testing
    - b. Observe and record the cranking time(s) required to start and run for each prime mover.
    - c. Observe and record the time required to come up to operating speed for each prime mover.
    - d. Record voltage and frequency overshoot for each prime mover.
    - e. Observe and record time required to achieve steady-state condition.
    - f. Record voltage, frequency and amperes.

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- g. Record oil pressure, water temperature where applicable and battery charge rate at first load acceptance and at 15 minute intervals thereafter for each prime mover.
  - 6. Cycle crank test:
    - a. Perform test for each prime mover.
      - 1) Utilize any method recommended by manufacturer to prevent prime mover(s) from running.
      - 2) Put control switch into "run" position to cause prime mover to crank.
    - b. A complete cranking cycle shall consist of an automatic crank period of approximately 15 seconds duration followed by a rest period of approximately 15 seconds duration.
      - 1) Upon starting and running of the prime mover, further cranking shall cease.
      - 2) Two means of cranking termination shall be utilized so that one will act as a backup to the other to prevent inadvertent starter engagement.
      - 3) Cranking limiter time shall be 75 seconds for cycle crank.
  - 7. Furnish load banks of required ratings necessary for tests.
  - 8. Record engine fuel consumption by means of test equipment.
  - 9. Test all safeties specified for generator instruments and controls and generator remote annunciator panel as recommended by manufacturer and as required to verify proper operation.
  - 10. The Contractor shall be responsible for fuel and all consumables use during the test.
- B. Supplier's onsite services: Employ and pay for services of equipment manufacturer's field service representative(s) to:
- 1. Inspect equipment covered by this Specification Section.
  - 2. Supervise pre-startup adjustments and installation checks.
  - 3. Conduct initial startup of equipment and perform operational checks.
  - 4. Provide Owner written statement that manufacturer's equipment has been installed properly, started up, tested, and is ready for operation by facilities operations and maintenance personnel.
  - 5. Provide 6 hours of training of facility operation and maintenance personnel.

**END OF SECTION 26 32 14**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Generator Connection Cabinet.
  
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 2. Underwriters Laboratories, Inc. (UL):
    - a. 1773, Standard for Termination Boxes.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. See Specification Section 26 05 00 for additional requirements.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. See Specification Section 26 05 00.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Generator Connection Cabinet:
    - a. Gus Berthold Electric Co.

**2.2 GENERATOR CONNECTION CABINET**

- A. Ratings:
  - 1. Voltage and amperage: As indicated on the Drawings.
  - 2. Short circuit withstand: Equal to or greater than the upstream equipment.
  
- B. Construction:

## **SECTION 26 32 90 - GENERATOR CONNECTION CABINET**

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1. Bus material: Silver plated copper.
  2. Bus supported with UL Recognized Component insulators.
  3. Permanent bus connection:
    - a. Mechanical set screw lugs
    - b. Quantity: As required for the number of conductors indicated on the Drawings.
  4. Field wiring connection:
    - a. Color coded male 150 Amp Cooper Cam-Loks with caps.
    - b. Quantity: As required for the number of conductors indicated on the Drawings.
- C. Enclosure:
1. Wall mount.
  2. NEMA 3R rated.
  3. Material: Aluminum.
  4. Lockable latches on front door.
  5. Independent access panel door for field terminated cables.
  6. Welded construction.
  7. Drip hood.
- D. Cables:
1. Provide 150A rated color coded cables with female ends to connect to Male Cam-Loks of Connection cabinet, and male ends to connect to Portable Generator.
  2. Quantity: As required for the number of conductors indicated on the Drawings.
  3. Length: Each cable shall be 30' long.
- E. Standards: UL 1773.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
- B. Connect as indicated in one-line diagram.

**END OF SECTION 26 32 90**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Automatic transfer switches.
  
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 26 05 00 - Electrical - Basic Requirements.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
  - 2. Underwriters Laboratories, Inc. (UL):
    - a. 98, Standard for Safety Enclosed and Dead-Front Switches.
    - b. 1008, Standard for Safety Switch Equipment.

**1.3 SUBMITTALS**

- A. Shop Drawings:
  - 1. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification:
    - b. See Section 26 05 00 for additional requirements.

**1.4 DELIVERY, STORAGE, AND HANDLING**

- A. See Section 26 05 00.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the listed manufacturers are acceptable:
  - 1. Automatic transfer switches:
    - a. Automatic Switch Company.
    - b. Kohler.
    - c. Onan.
    - d. Russelectric.
    - e. ABB Zenith.

**2.2 AUTOMATIC TRANSFER SWITCH**

- A. Construction:
  - 1. Electrically operated mechanically held, double throw, air-break type.
  - 2. Silver-surface main contacts and protect by arcing contacts.
  - 3. Switch shall have provisions for visual inspection of switch blades and contacts.
  - 4. Mechanical design will positively open all ungrounded conductors from normal source before connection is made to alternate source and will positively open alternate source before connection is made to normal source.
  - 5. Mechanical interlock to ensure the switch cannot be readily disabled, disconnected, improperly adjusted, removed or otherwise made inoperative.
  - 6. Make all contacts and coils readily accessible for replacement from front of panel without major disassembly.
  - 7. Ratings:
    - a. Continuous duty in both normal and emergency.
    - b. Three-phase, three-pole, four-wire.
    - c. Voltage and current ratings as indicated on the Drawings.
    - d. Short circuit withstand rating equal to or greater than the normal source electrical gear.
  - 8. Standards: UL 1008.
  
- B. Operation:
  - 1. Microprocessor based control module.
  - 2. Open transition.
  - 3. Red and green indicating lights with fuses, identification nameplates, and test switch on front to simulate normal power failure at switch.
  - 4. Engine starting contacts and all other auxiliary contacts and accessory devices for functions to be performed.
  - 5. Supervisory voltage relays on each phase of normal source and single phase supervisory voltage and frequency relay for emergency source.
    - a. Normal source voltage sensing.
      - 1) Adjustable pickup from 85-100% of rated voltage, factory set 90%.
      - 2) Adjustable dropout from 75-98% of pickup setting, factory set 85%.
    - b. Emergency source voltage and frequency sensing:
      - 1) Adjustable pickup from 85-100% of rated voltage, factory set 90%.
      - 2) Fixed voltage dropout at 85% of pickup setting.
      - 3) Adjustable pickup from 90-100% of rated frequency, factory set 95%.
      - 4) Fixed frequency dropout at 88% of pickup setting.
  - 6. Time delays:
    - a. Engine start, adjustable from 0 to 10 seconds, factory set at 4 seconds, to avoid unnecessary starting caused by short time outages.
    - b. Transfer to generator, adjustable from 0 to 120 seconds, factory set at 10 seconds.
    - c. Retransfer to normal, adjustable from 2 to 30 minutes, factory set at 15 minutes to avoid erratic operation caused by short time reestablishment of normal source.
      - 1) Automatically bypassed when emergency source fails and normal source is available.
    - d. Generator cool down, adjustable from 0 to 60 minutes, factory set at 10 minutes.
  - 7. Exerciser timer:
    - a. Enable and disable function.
    - b. Selectable to exercise with or without transferring load.
    - c. Adjustable exercise duration from 1 minute to 24 hours, factory set at 15 minutes.
    - d. Adjustable day of the week exercise setting, factory set for Monday.
  - 8. Inphase monitor:
    - a. Compare the phase relationship and frequency difference between the normal and emergency sources and permit transfer the first time the sources are within 15 electrical



## **SECTION 26 36 00 - TRANSFER SWITCHES**

degrees and only if transfer can be accomplished within 60 electrical degrees as determined by monitoring the frequency differences.

- b. Inphase transfer accomplished if both sources are within 2 Hz of rated frequency and 70% or more of rated voltage.

C. Enclosure:

1. NEMA 1 rated.
2. Body and cover: Sheet steel finished with a rust inhibiting primer and manufacturers standard paint inside and out.
3. No knockouts, hinged and lockable door.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
- B. Connect as indicated in one-line diagram.
- C. Mounting of automatic transfer switches:
  1. Wall-mounted or floor mounted on 4 inches high concrete pad.

#### **3.2 FIELD QUALITY CONTROL**

- A. Automatic Transfer Switch Testing:
  1. Simulate power outage by opening normal source overcurrent device.
    - a. Verify engine generator starts and switch transfers in the specified time.
  2. Close normal source overcurrent device to simulate the return of normal power.
    - a. Verify the switch retransfers and engine generator shuts down in the specified time.
  3. Perform a manual transfer and retransfer.
  4. Verify the indicator lights function properly.

**END OF SECTION 26 36 00**

## SECTION 26 41 13 - LIGHTNING PROTECTION SYSTEM

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Lightning protection systems using lightning rods.
- B. Scope:
  - 1. Contractor shall provide all labor, materials, equipment, tools, services, and incidentals necessary and required to provide lightning protection systems of the type indicated.
  - 2. Contractor shall furnish the services of individual possessing required qualifications, as indicated in this Section, to prepare the final design of the lightning protection systems required, in accordance with this Section and other Contract Documents. Such services are not delegated design.
  - 3. Provide lightning protection systems for the following buildings and structures:
    - a. Fleet Maintenance Facility
    - b. Fuel Island Canopy.
- C. Related Requirements include but are not necessarily limited to:
  - 1. Section 26 05 26 - Grounding and Bonding.

#### 1.2 REFERENCES

- A. Terminology: In this Section and relative to lightning protection system Work, the terminology indicated below has the following meaning, regardless of whether indicated with initial capital letters:
  - 1. Classification of Buildings in accordance with NFPA 780:
    - a. Class I: Any commercial, industrial, or residential building less than 75 feet in height.
    - b. Class II: Any commercial, industrial, or residential building 75 feet or taller.
    - c. Heavy-duty stacks: Any smokestack or venting stack with a flue cross-section area greater than 500 square inches and stack height greater than 75 feet.
- B. Reference Standards:
  - 1. ASTM International (ASTM):
    - a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
  - 2. Lightning Protection Institute (LPI):
    - a. 175, Standard for the Design - Installation - Inspection of Lightning Protection Systems.
  - 3. National Fire Protection Association (NFPA):
    - a. 780, Standard for the Installation of Lightning Protection Systems.
  - 4. National Electrical Manufacturers Association (NEMA):
    - a. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
  - 5. Underwriters Laboratories, Inc. (UL):
    - a. 96, Standard for Safety Lightning Protection Components.
    - b. 96A, Standard for Installation Requirements for Lightning Protection Systems.
    - c. 651, Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.

## **SECTION 26 41 13 - LIGHTNING PROTECTION SYSTEM**

### **1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:
  - 1. Coordination – General:
    - a. Contractor shall coordinate the services of lightning protection system designer with all other elements of the Work.
    - b. Contractor has full responsibility for scheduling lightning protection system designs and all related Work.
    - c. Allow sufficient time in Progress Schedule for performance of lightning protection system services, including requests for interpretation or clarification between lightning protection system designer and Contractor and between Contractor and Engineer.
  - 2. Coordination of Lightning Protection System Work's Connections to Other Work:
    - a. Where lightning protection system Work connects to other Work designed by Engineer, existing construction, or both, the lightning protection system Work shall be consistent with the other Work and existing construction to which lightning protection system Work connects, and adjacent construction.
    - b. Submit details, loading, anchorage, and other coordinating information necessary for the lightning protection system Work to properly interface with Work designed by Engineer.
    - c. Changes in the Work, whether designed by Engineer, designed by lightning protection system designer, or existing construction, necessary as a result of the lightning protection system are ineligible for increase in Contract Price or Contract Times, unless: (1) otherwise agreed by both Engineer and Owner, or (2) expressly indicated otherwise elsewhere in the Contract Documents for the lightning protection system Work.
    - d. Changes requiring extra compensation, time, or both arising from lightning protection system design aspects needed for convenience of Contractor, Subcontractor, or Supplier, are not grounds for increase in Contract Price or Contract Times.
  - 3. Coordination of Submittals, Fabrication, Production, and Shipment:
    - a. Do not release for raw materials procurement, fabrication, production, and shipment to the Site materials, equipment, or systems designed by lightning protection system designer until the associated lightning protection system designer has completed the design and Engineer has reviewed and approved all associated Shop Drawings, product data Submittals, Samples, and such Submittals have been delivered to and accepted by Engineer.
    - b. Allow sufficient time in the Progress Schedule for required Submittals and required actions by lightning protection system designer and Engineer.

### **1.4 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Lightning Protection System Designer:
    - a. One individual, acceptable to Engineer, shall design or directly supervise preparation of the final design of all lightning protection systems required for the Work.
    - b. Individual preparing, or directly supervising preparation of, final design of lightning protection systems shall possess current, valid "Designer Inspector" (DI) certification from Lightning Protection Institute (LPI) or "Lightning Protection Master Certification" (LPMC) from Underwriters Laboratories (UL) or other, similar certification acceptable to Engineer.
    - c. In addition, individual performing, or directly supervising preparation of, final design of lightning protection system shall be able to furnish documentation indicating possession of not less than ten years' experience personally designing or supervising the preparation of lightning protection systems similar to that required for the Work.
    - d. Designer may be employee of lightning protection system Supplier or individual or entity retained by lightning protection system Supplier.

## SECTION 26 41 13 - LIGHTNING PROTECTION SYSTEM

- e. Submit to Engineer copy of current certification as LPI DI or UL LPMC or other similar certification accepted by Engineer and record documenting experience of lightning protection system designer. Indicate designer's current employer and employment history.
  - f. Upon Engineer's request, submit information for not less than prior lightning protection systems, similar in type, scope, and extent to that required for the Work. Construction of each lightning protection system on each such project shall have been substantially complete for not less than one year at the time such documentation is submitted to Engineer. Such information shall include, for each project, the following: project name and location (city, state or province, country); project owner; designer's employer and their role in the project (prime contractor, subcontractor, or supplier); name of project's design professional (company name) and location; year lightning protection system was completed; and general description of scope and extent of lightning protection system work.
2. Installer:
- a. Installer of lightning protection system may be Contractor or Subcontractor.
  - b. Throughout the Work, installer shall be a current, "UL Listed Lightning Protection Contractor" or other, similar certification or listing acceptable to Engineer.
  - c. Installer's project manager or site superintendent shall possess a current, valid certification as "Master Installer" from LPI. Such individual shall be actively involved in managing and supervising installation of the lightning protection system Work.
  - d. Installer shall furnish valid "UL Master Label" for the substantially completed lightning protection system Work.
  - e. In addition, installer shall possess not less than five years' relevant experience performing lightning protection system construction and shall be able to document not less than [five] completed, prior projects or similar scope and complexity to the lightning protection system Work within the most-recent five-year period.
  - f. Submit to Engineer documentation of installer's current status as "UL Listed Lightning Protection Contractor" or other similar certification acceptable to Engineer and copy of required LPI "Master Installer" certification or other similar certification acceptable to Engineer.
  - g. Upon Engineer's request, submit documentation of required experience.

### 1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
- 1. Shop Drawings:
    - a. Drawings of entire lightning protection system for each building and structure for which lightning protection system is required. Include plans, sections, schematics, and details as appropriate.
    - b. Plan drawings showing type, size, and locations of all lightning protection materials and equipment. Roof penetration detail drawings.
    - c. Submit schedules (tables) of materials and equipment as appropriate, indicating type, size, materials, and location of each, together with other pertinent information.
    - d. "Certificate of Compliance" by lightning protection system designer, in accordance with this Section's Article, "Responsibilities of Lightning Protection System Designer".
  - 2. Product Data:
    - a. Data for all materials and equipment required by "Part 2 – Products" of this Section. Submit material and equipment manufacturers' published product data such as catalog pages, standard drawings, expected performance data, specifications, and the like.
    - b. Submit data sheets that include manufacturer's name and product model number. Clearly identify all optional accessories.
    - c. Certification that materials and equipment proposed submitted are in accordance with applicable standards of LPI or UL.

## **SECTION 26 41 13 - LIGHTNING PROTECTION SYSTEM**

- B. Informational Submittals: Submit the following:
1. Certifications and Notices:
    - a. Roofing system manufacturer written consent to installer's proposed penetrations (if any) through roofing system.
  2. Roofing System Manufacturer's Instructions:
    - a. When Contractor proposes mechanically fastening lightning protection system components to, or providing penetrations through, roofing, obtain and submit to Engineer the roofing system manufacturer's:
    - b. Written concurrence with proposed installation methods.
    - c. Written instructions for sealing penetrations into or through roofing system.
  3. Supplier's Instructions:
    - a. Manufacturer's written instructions for handling, storage, and installation for all materials and equipment furnished.
  4. Field Quality Control Results:
    - a. Submit results of field quality control activities required in this Section.
  5. Supplier's Reports:
    - a. Submit written report of each visit to the Site by manufacturer's factory-trained representative.
    - b. Submit written report of each visit to the Site by lightning protection system designer.
  6. Qualifications Statements:
    - a. Lightning protection system designer.
    - b. Installer.
- C. Closeout Submittals: Submit the following:
1. Post-Installation Certifications:
    - a. Installer's written certification that the substantially completed lightning protection system Work complies with the Contract Documents.
    - b. "UL Master Label" certificate.
  2. Operation and Maintenance Data:
    - a. Manufacturer's operation and maintenance manual for each building's or structure's lightning protection system provided or modified.
    - b. Indicate requirements for, and frequency of, periodic inspections.
  3. Record Documents:
    - a. Prepare and submit drawings, including plans of roof or top of each building and structure for which lightning protection system was provided or modified, indicating as-constructed conditions. Include appropriate sections, details, and schematics.
    - b. Record drawings shall expressly indicate their status as "as-constructed" drawings with an appropriate revision date.

### **1.6 RESPONSIBILITIES OF LIGHTNING PROTECTION SYSTEM DESIGNER**

- A. Responsibilities of lightning protection system designer employed on the Work include, but are not necessarily limited to, the following, unless specifically indicated otherwise in the associated elements of the Contract Documents where the lightning protection system is required:
1. Ethical Conduct and Professionalism: Comply with Laws and Regulations, and standards and guidelines regarding codes of ethics and codes of conduct published by relevant industry organizations, including LPI and UL.
  2. Comply with Laws and Regulations and relevant design standards applicable to the subject lightning protection system Work.
  3. Performance and Design Criteria Indicated in the Contract Documents and Other Information:
    - a. Review performance and design criteria, indicated in the Contract Documents, that the lightning protection system Work must satisfy.

## **SECTION 26 41 13 - LIGHTNING PROTECTION SYSTEM**

- b. Prepare written requests for interpretations or clarifications of performance or design criteria.
    - c. Review existing information about the Site that constitutes Technical Data (if any, applicable to the subject lightning protection system Work), as indicated in the Supplementary Conditions.
  4. Site Information and Investigations: With Contractor, obtaining all other necessary dimensions, field information, and other information necessary for preparing lightning protection system Shop Drawings.
  5. Design Services: Personally, perform and prepare, or actively exercise direct, personal, supervisory control over others performing or preparing:
    - a. Necessary design evaluations of conditions, materials, and equipment.
    - b. Prepare the Shop Drawings and product data Submittals, and related design documents such as calculations, for the subject lightning protection system Work.
    - c. Assist Contractor with applying for and obtaining permits and approvals (not previously obtained by Owner or those for whom Owner is responsible) necessary for the lightning protection system Work.
    - d. Preparing modifications of the lightning protection system design documents as necessary.
  6. Certification of Compliance by Lightning protection system designer:
    - a. Through Contractor, submit to Engineer, lightning protection system designer's written certification indicating:
    - b. General Information: (1) Project name and designation, (2) Contractor name and Contract designation, (3) Subcontractor or Supplier name (when applicable), (4) full name of lightning protection system designer's business entity under which the lightning protection system services were performed, (5) full name and certification number of the individual responsible for the final design of the subject lightning protection system Work, (6) specific elements of lightning protection system Work to which the certification applies, and (7) lightning protection system designer's signature, and date of signature; apply lightning protection designer's seal when applicable.
    - c. Explicit certification that the subject lightning protection system complies with:
      - 1) All applicable performance and design criteria indicated in the Contract Documents. Expressly indicate on certification of compliance the specific performance and design criteria used in the lightning protection system design.
      - 2) All Laws and Regulations.
      - 3) Applicable design standards commonly applicable to such types of construction. Expressly indicate such design standards on the certification of compliance.
  7. Progress and Quality of Construction of Lightning protection system Work:
    - a. Where appropriate for the subject lightning protection system Work, periodically visit the Site at appropriate intervals to observe the progress and quality of the subject lightning protection system Work.
    - b. Where lightning protection system designer does not visit the Site during construction, keep informed of the progress and quality of the subject lightning protection system Work via discussions with Contractor, Subcontractor, and Suppliers, via photographic documentation, and other means acceptable to lightning protection system designer.
    - c. Advise Contractor in writing when the subject lightning protection system Work is not in accordance with the lightning protection system designer's design documents (approved by Engineer) and related Submittals approved by lightning protection system designer.
    - d. Furnish to entity that retained lightning protection system designer copy of lightning protection system designer's written report of each visit to the Site.
  8. Modifications to Design:
    - a. Design appropriate modifications to the lightning protection system Work, including preparing new or revised certifications, reports, design drawings, sketches, design specifications, and calculations, as appropriate.

## **SECTION 26 41 13 - LIGHTNING PROTECTION SYSTEM**

- b. Such design documents and calculations shall be submitted to Engineer through Contractor to same extent original design documents Submittals and calculations, if any, where required by the Contract Documents for the subject lightning protection system Work.
9. Other services, as mutually agreed upon by lightning protection system designer and its client, or as required elsewhere in the Contract Documents.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. A/C Lightning Protection, Inc.
  2. Harger Lightning & Grounding.
  3. Heary Bros. Lightning Protection Co. Inc.
  4. National Lightning Protection Corporation.
  5. Preferred Lightning Protection, Inc.
  6. Thompson Lightning Protection, Inc.
  7. VFC Lightning Protection.
  8. East Coast Lightning Equipment, Inc.
  9. Robbins Lightning, Inc.
  10. Or equal.

#### **2.2 PERFORMANCE AND DESIGN CRITERIA.**

- A. Provide lightning protection systems Work in accordance with NFPA 780, UL 96A, and LPI 175.
- B. Material for air terminals, main conductors and bonding conductors: Copper or aluminum.
- C. Size of air terminals, main conductors, and bonding conductors shall be in accordance with NFPA 780.

#### **2.3 MATERIALS**

- A. Unless otherwise expressly indicated in the Contract Documents, lightning protection system materials shall be compatible with materials of construction for the building or structure being protected and meet the requirements of UL 96.
- B. Provide lightning protection system with Class I or Class II materials, in accordance with NFPA 780.
- C. Ground Rods:
  1. 3/4-inch diameter by 10 feet long.
  2. Copper-clad:
    - a. Uniform coating, not less than 10 mils thick, of electrolytic copper molecularly bonded to rigid steel core.
    - b. Corrosion resistant bond between copper and steel.
    - c. Hard drawn, scar-resistant surface.

## SECTION 26 41 13 - LIGHTNING PROTECTION SYSTEM

- D. Material for conductor fasteners, connector fittings, bonding fittings, conductor splicers and through-wall or through-roof assemblies shall be cast bronze, brass, or copper, with bolt pressure connectors.
- E. Material for bolts, nuts, and screws shall be stainless steel.
- F. Underground conductors shall be bare, soft-drawn, stranded copper in accordance with ASTM B8.
- G. Raceways:
  - 1. Indicated as Schedules 40 ("PVC-40") or Schedule 80 ("PVC-80");
    - a. PVC thermoplastic, with inert modifiers to improve weatherability and heat distribution.
    - b. Rated for direct sunlight exposure.
    - c. Fire retardant and low smoke emission.
    - d. In accordance with NFPA 70 Type PVC, NEMA TC 2, UL 651.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Installation – General:
  - 1. Design and provide lightning protection system Work in accordance with LPI 175, NFPA 780, and UL 96A.
  - 2. Install lightning protection system in accordance with the Contract Documents and Shop Drawings approved by Engineer.
  - 3. Roofing System and Installation of Lightning Protection System:
    - a. Adhesively fasten lightning protection system components to roof system unless expressly shown or indicated otherwise in the Contract Documents.
    - b. Do not mechanically fasten lightning protection system components to metal coping or penetrate roof membrane without written consent of both roofing system manufacturer and Engineer. Submit to Engineer written consent of roofing system manufacturer.
    - c. Seal all penetrations in accordance with roofing system manufacturer's written instructions and details. Obtain such instructions and details from roofing system manufacturer.
  - 4. Surge protective devices to be provided, by others, as shown on the Drawings.
- B. Structures and Buildings:
  - 1. Lightning protection system shall include:
    - a. Roof-mounted air terminals.
    - b. Interconnecting conductors.
      - 1) Steel roof beams and trusses may be utilized as the main and secondary conductors.
    - c. Downleads: Provide the following type(s) of conductor downleads:
      - 1) Conductors surface-mounted on the building's or structure's exterior wall. Route conductor in PVC-80 conduit for a minimum of 1'-0" below grade and 4'-0" above grade.
    - d. Ground terminations.
    - e. Bonding of other grounded systems of building or structure.
    - f. Bonding to grounding electrode system.
  - 2. Connect downleads to the grounding electrode system ground ring.
  - 3. Underground connections shall be via exothermic weld.



## SECTION 26 41 13 - LIGHTNING PROTECTION SYSTEM

- C. Aluminum Domes:
1. Lightning protection system shall utilize Class I or Class II materials in accordance with NFPA 780.
  2. Lightning protection system shall include:
    - a. Dome-mounted air terminals, connected through the dome to dome structural strut.
    - b. Dome struts shall be utilized as interconnecting conductors.
    - c. Downleads connected to dome structural struts (at dome base), penetrate through dome, then routed in PVC-80 conduit on exterior wall to not less than two feet below finished grade.
    - d. Bonding of other grounded dome systems.
  3. Connect down leads to a #4/0 AWG ground ring.
  4. Ground ring consists of ground rods and a conductor looped around the structure.
    - a. Installed not less than five feet from structure foundation and 2.5 feet below finished grade (finished ground surface).
    - b. Provide a not less than four ground rods, equally spaced around structure.
  5. Provide underground connections by exothermic welds.
- D. Stacks:
1. For heavy-duty stacks, provide lightning protection system of materials in accordance with NFPA 780.
  2. Provide lightning protection systems with:
    - a. Roof-mounted air terminals.
    - b. Interconnecting conductors.
    - c. Downleads: Provide conductors surface-mounted on exterior surface of stack and protected by PVC-80 raceways for not less than two feet above and below finished grade (finished ground surface).
    - d. Ground terminations.
    - e. Bonding of other grounded systems.
  3. Connect downleads to a #4/0 AWG ground ring.
  4. Ground ring shall include ground rods and conductor provided around structure.
    - a. Installed not less than five feet from structure foundation and 2.5 feet below finished grade (finished surface of ground).
    - b. Provide a not less than four ground rods equally spaced around the structure.
  5. Underground connections to be made by exothermic welds.
  6. Provide lightning protection system components with corrosion protection coating of lead.

### 3.2 FIELD QUALITY CONTROL

- A. Field Tests and Inspections:
1. Perform fall-of-potential ground resistance test on each ground rod or ground ring.
    - a. When resistance exceeds 25 ohms for individual ground rod:
      - 1) Provide additional ground rod so they are 20 feet apart, interconnect with #4/0 AWG and retest.
      - 2) If retest exceeds 25 ohms, contact Engineer.
    - b. When resistance exceeds 25 ohms for a ground ring, contact Engineer.
  2. Perform continuity test for system elements concealed with in structure.
  3. Perform continuity test for system elements utilized structural steel as downconductors.
  4. Submit to Engineer written results of required field quality control activities expressly indicating building or structure name, and Project, type of test or inspection performed, results obtained, problems observed or noted during the test or inspection, and whether results obtained indicate successful completion (i.e., acceptance). The Work will not be eligible for inspection for Substantial Completion until such results are submitted to and accepted by Engineer.

## **SECTION 26 41 13 - LIGHTNING PROTECTION SYSTEM**

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### **3.3 CLOSEOUT**

#### **A. Documentation and Nameplates.**

1. Prior to requesting inspection for Substantial Completion of lightning protection system Work, provide the following for each lightning protection system provided or modified:
  - a. Nameplate, securely fastened to building or structure, indicating: "Lightning protection system provided by", followed by company name and address of lightning protection system installer. Name plate shall be resistant to corrosion and deterioration (to which it may be subject at its installed location), including deterioration and fading due to exposure to sunlight.
  - b. Submit "UL Master Label" certification.
  - c. Deliver final operation and maintenance manuals for the lightning protection system.
2. Prior to requesting final payment, deliver to Engineer the following for each lightning protection system provided or modified:

As-constructed record drawings, in accordance with this Section's "Submittals" Article. Such as-constructed drawings shall be developed from Shop Drawings approved by Engineer and those of the Drawings showing the lightning protection system.

**END OF SECTION 26 41 13**

# **SECTION 26 43 13 - SURGE PROTECTION DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Type PC1 SPD - High exposure locations (switchgear, switchboard, panelboard or motor control center), integrally mounted.
  
- B. Related Sections include but are not necessarily limited to:

### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
    - b. C62.41.1, Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits.
    - c. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
    - d. C62.45, Recommended Practice on Surge Testing For Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits.
  - 2. Military Standard:
    - a. MIL-STD-220B, Method of Insertion Loss Measurement.
  - 3. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 4. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 5. Underwriters Laboratories, Inc. (UL):
    - a. 1283, Standard for Electromagnetic Interference Filters.
    - b. 1449, Standard for Surge Protective Devices.
  
- B. Qualifications:
  - 1. Provide devices from a manufacturer who has been regularly engaged in the development, design, testing, listing and manufacturing of SPDs of the types and ratings required for a period of 10 years or more and whose products have been in satisfactory use in similar service.
    - a. Upon request, suppliers or manufacturers shall provide a list of not less than three customer references showing satisfactory operation.

### **1.3 DEFINITIONS**

- A. Clamping Voltage:
  - 1. The applied surge shall be induced at the 90 degrees phase angle of the applied system frequency voltage.
  - 2. The voltage measured at the end of the 6 inches output leads of the SPD and from the zero voltage reference to the peak of the surge.
  
- B. Let-Through Voltage:

## **SECTION 26 43 13 - SURGE PROTECTION DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS**

1. The applied surge shall be induced at the 90 degrees phase angle of the applied system frequency voltage.
  2. The voltage measured at the end of the 6 inches output leads of the SPD and from the system peak voltage to the peak of the surge.
- C. Maximum Continuous Operating Voltage (MCOV): The maximum steady state voltage at which the SPD device can operate and meet its specification within its rated temperature.
- D. Maximum Surge Current:
1. The maximum 8 x 20 microsecond surge current pulse the SPD device is capable of surviving on a single-impulse basis without suffering either performance degradation or more than 10% deviation of clamping voltage at a specified surge current.
  2. Listed by mode, since number and type of components in any SPD may vary by mode.
- E. MCC: Motor Control Center.
- F. Protection Modes: This parameter identifies the modes for which the SPD has directly connected protection elements, i.e., line-to-neutral (L-N), line-to-line (L-L), line-to-ground (L-G), neutral-to-ground (N-G).
- G. Surge Current per Phase:
1. The per phase rating is the total surge current capacity connected to a given phase conductor.
    - a. For example, a wye system surge current per phase would equal L-N plus L-G; a delta system surge current per phase would equal L-L plus L-G.
    - b. The N-G mode is not included in the per phase calculation.
- H. System Peak Voltage: The electrical equipment supply voltage sine wave peak (i.e., for a 480/277 V system the L-L peak voltage is 679V and the L-N peak voltage is 392 V).

### **1.4 SUBMITTALS**

- A. Shop Drawings:
1. Product technical data including:
    - a. Manufacturer's qualifications.
    - b. Standard catalog cut sheet.
    - c. Electrical and mechanical drawing showing unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.
    - d. Testing procedures and testing equipment data.
    - e. Create a Product Data Sheet for each different model number of SPD provided (i.e., Model XYZ with disconnect and Model XYZ without disconnect, each require a Product Data Sheet).
      - 1) Data in the Product Data Sheet heading:
        - a) SPD Type Number per PART 2 of the Specification.
        - b) Manufacturer's Name.
        - c) Product model number.
      - 2) Data in the Product Data Sheet body:
        - a) Column one: Specified value/feature of every paragraph of PART 2 of the Specification.
        - b) Column two: Manufacturer's certified value confirming the product meets the specified value/feature.
        - c) Name of the nationally recognized testing laboratory that preformed the tests.
        - d) Warranty information.

## **SECTION 26 43 13 - SURGE PROTECTION DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS**

- 3) Data in the Product Data Sheet closing:
  - a) Signature of the manufacturer's official (printed and signed).
  - b) Title of the official.
- 4) Date of signature.

- B. Operation and Maintenance Manuals:
1. Warranty.

### **1.5 WARRANTY**

- A. Minimum of a five year Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. Standards: IEEE C62.41.1, IEEE C62.41.2, IEEE C62.45, MIL-STD 220B, UL 1283, UL 1449.

### **2.2 TYPE PC1 SPD**

- A. Product:
1. SPD tag number or electrical equipment tag number SPD is connected to \_\_MDP\_\_.
  2. Hybrid solid-state high performance suppression system.
    - a. Do not use a suppression system with gas tubes, spark gaps or other components which might short or crowbar the line resulting in interruption of normal power flow to connected loads.
  3. Do not connect multiple SPD modules in series to achieve the specified performance.
  4. Designed for parallel connection.
  5. Field connection: Use mechanical or compression lugs for each phase, neutral and ground that will accept bus bar or #10 through #1/0 conductors.
  6. Device monitor:
    - a. Long-life, solid state, externally visible indicators and Form C dry contact(s) that monitors the on-line status of each mode of the units suppression filter system and power loss in any of the phases.
    - b. A fuse status only monitor system is not acceptable.
- B. Operating Voltage: The nominal unit operating voltage and configuration as indicated on Drawings.
- C. Modes of Protection: All modes.
  1. Three phase (delta): L-L, L-G.
  2. Three phase (wye): L-N, L-L, L-G and N-G.
  3. Single phase (2-pole): L-L, L-N, L-G and N-G.
  4. Single phase: L-N, L-G and N-G.
- D. Maximum Continuous Operating Voltage: Less than 130% of system peak voltage.
- E. Operating Frequency: 45 to 65 Hz.

**SECTION 26 43 13 - SURGE PROTECTION DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS**

- F. Short Circuit Rating: Equal to or greater than rating of equipment SPD is connected to.
- G. Maximum Surge Current: 240,000 A per phase, 120,000 A per mode minimum.
- H. Minimum Repetitive Surge Current Capacity: 4000 IEEE C High waveform impulses with no degradation greater than 10% deviation of the clamping voltage.
- I. SPD Protection:
  - 1. Integral unit level and/or component level overcurrent fuses and sustained overvoltage thermal cutout device.
  - 2. An IEEE C High waveforms shall not cause the fuse to open and render the SPD inoperable.
- J. Maximum Clamping Voltages: Dynamic test at the 90 degree phase angle including 6 inches lead length and measured from the zero voltage reference:

<u>System Voltage</u>	<u>Test Mode</u>	<u>IEEE C62.41</u>		<u>UL 1449</u>
		<u>C High V &amp; I Wave</u>	<u>B Combination Wave</u>	
L-L < 250 V L-N < 150 V	L-L	1470 V	1000 V	800 V
	L-N	850 V	600 V	500 V
	L-G	1150 V	800 V	600 V
	N-G	1150 V	800 V	600 V
L-L > 250 V L-N > 150 V	L-L	2700 V	2000 V	1800 V
	L-N	1500 V	1150 V	1000 V
	L-G	2000 V	1550 V	1200 V
	N-G	2000 V	1550 V	1200 V

- K. EMI-RFI Noise Rejection: Attenuation greater than 30 dB for frequencies between 100 kHz and 100 MHz.

**2.3 SOURCE QUALITY CONTROL**

- A. SPD approvals and ratings shall be obtained by manufacturers from nationally recognized testing laboratories.
- B. The SPD are to be tested as a complete SPD system including:
  - 1. Integral unit level and/or component level fusing.
  - 2. Neutral and ground shall not be bonded during testing.
  - 3. 6 inches lead lengths.
  - 4. Integral disconnect switch when provided.
- C. The “as installed” SPD system including the manufacturers recommended circuit breaker, the SPD is connected to, will not open when tested with a IEEE C3 combination waveform.
- D. Tests to be performed in accordance with IEEE C62.45:
  - 1. Clamping voltage performance testing using IEEE C62.41 Category waveforms.

## **SECTION 26 43 13 - SURGE PROTECTION DEVICES FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS**

2. Single pulse surge current capacity test.
3. Repetitive surge current capacity testing.
4. Spectrum analysis for EMI-RFI noise rejection.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install products in accordance with manufacturer's instructions.
- B. Type PC1 and PC3 SPD:
  1. Connected in parallel to the equipment.
  2. Install in dedicated electrical equipment compartment, bucket or panelboard box at the factory before shipment.
  3. Provide leads that are as short and straight as possible.
  4. Maximum lead length: 12 inches.
  5. Minimum lead size: #2 stranded AWG or bus bar.
  6. Connect leads to the equipment to be protected by one of the following means:
    - a. Through a circuit breaker or molded case switch mounted in the equipment.
    - b. Use manufacturer recommended circuit breaker size.
    - c. Circuit breaker or switch to be operable from the equipment exterior or from behind a hinged door.
- C. Type PC2, PC4 and PC5 SPD:
  1. Mounting options:
    - a. On wall or support structure adjacent to the equipment to be protected with leads routed through conduit. [OR]
    - b. Nipple connection directly to the equipment to be protected.
  2. Install leads as short and straight as possible.
  3. Maximum lead length: 5 feet.
  4. Minimum lead size:
    - a. Type PC2 and PC4 SPD: #2 stranded AWG.
    - b. Type PC5: #10 stranded AWG.
  5. When conduit connection is used, provide a minimum of four twists per foot in the lead conductors and install in NFPA 70 sized conduit.
  6. Connect leads to the equipment to be protected by one of the following means:
    - a. Through a circuit breaker or molded case switch mounted in the equipment.
      - 1) Use manufacturer recommended circuit breaker size.
    - b. Directly to the protected equipment bus, when SPD has integral disconnect switch.
    - c. To the load side of field mounted equipment's local disconnect switch.
      - 1) Provide taps or lugs as required to provide a UL and NFPA 70 compliant connection.

**END OF SECTION 26 43 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for:
    - a. Interior building and exterior building mounted luminaires.
    - b. Exterior and site luminaires.
    - c. LEDs.
    - d. Drivers.
    - e. Light poles.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 03 - Concrete.
  - 2. Section 26 05 00 - Electrical - Basic Requirements.
  - 3. Section 26 05 19 - Wire and Cable - 600 Volt and Below.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American National Standards Institute (ANSI):
    - a. C78.377, Specification for the Chromaticity of Solid State Lighting Products.
  - 2. Federal Communications Commission (FCC):
    - a. Code of Federal Regulations (CFR), 47 CFR 18, Industrial, Scientific and Medical Equipment.
  - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
  - 4. Illuminating Engineering Society of North America (IESNA):
    - a. LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products.
    - b. LM-80, Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules.
  - 5. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. 410, Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.
    - c. LE 4, Recessed Luminaires, Ceiling Compatibility.
  - 6. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
    - a. SSL 1, Electronic Drivers for LED Devices, Arrays or Systems.
  - 7. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
    - b. 101, Life Safety Code.
  - 8. Underwriters Laboratories, Inc. (UL):
    - a. 248-4, Low-Voltage Fuses - Part 4: Class CC Fuses.
    - b. 844, Standard for Luminaires for Use in Hazardous (Classified) Locations.
    - c. 924, Standard for Emergency Lighting and Power Equipment.
    - d. 1012, Power Units Other Than Class 2.
    - e. 1310, Standard for Class 2 Power Units.
    - f. 1598, Luminaires.
    - g. 8750, Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products.



## **SECTION 26 50 00 - INTERIOR AND EXTERIOR LIGHTING**

9. United States Department of Energy (USDOE):
  - a. EPAAct, the National Energy Policy Act.

### **1.3 DEFINITIONS**

- A. Useful Life for LED luminaire light sources:
  1. The operating hours before reaching 70% of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions.
  2. This is also known as 70% "Rated Lumen Maintenance Life" as defined in IESNA LM-80.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
  1. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. Identify luminaire by Luminaire Schedule designation.
    - c. Luminaire data sheet:
      - 1) Name of manufacturer.
      - 2) Complete order information (catalog number).
      - 3) Description of construction and optics.
      - 4) Total input wattage.
      - 5) Luminous efficacy (lumens/Watt).
      - 6) Photometric performance data including candlepower distribution and coefficient of utilization (CU) table.
      - 7) Dimensional size.
      - 8) Weight.
      - 9) UL nameplate data for luminaires used in Class 1, Division 1 and 2 areas.
      - 10) Effective Projected Areas (EPA) for pole mounted luminaires.
    - d. Solid state Luminaire additional data:
      - 1) Voltage.
      - 2) Initial and IES L70 lumens.
      - 3) Luminous efficacy (lumens/Watt).
      - 4) Correlated Color Temperature (CCT).
      - 5) Color Rendering Index (CRI).
      - 6) Total Harmonic Distortion (THD).
      - 7) Lamp life.
      - 8) Driver manufacturer and model number.
      - 9) Driver life.
      - 10) Driver type (0-10V, constant voltage, constant current).
      - 11) Dimming range and control device compatibility.
      - 12) Remote driver: Maximum wire length to luminaire.
      - 13) Emergency battery driver:
        - a) Compatibility with lighting module.
        - b) Lumen output of lighting module in emergency operation.
        - c) Battery life.
        - d) Description of testing.
        - e) Ambient operating temperature.
      - 14) Toxicity Characteristic Leaching Procedure (TCLP) compliance.
      - 15) DesignLights Consortium (DLC) Listing.
      - 16) Warranty information.
    - e. See Specification Section 26 05 00 for additional requirements.
  2. Test Reports:
    - a. IESNA LM-79 Test Report for Solid-State Luminaire.

## **SECTION 26 50 00 - INTERIOR AND EXTERIOR LIGHTING**

- b. IESNA LM-80 Test Report Solid-State Light Source.
- 3. Certifications: Solid-state Luminaire Useful Life Certificate.

### **B. Contract Closeout Information:**

- 1. Operation and Maintenance Data:
  - a. Submittal data for each component covered by warranty.
  - b. Warranty.

## **1.5 WARRANTY**

- A. Minimum of a five year Warranty from date of manufacture against failure for solid-state luminaire including LED arrays, LED drivers and integral control devices. The solid-state product is considered defective if more than 15% of the individual light emitting diodes fail to illuminate.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Luminaires: Per Luminaire Schedule or equal.
  - 2. Solid State Light Sources:
    - a. Cree.
    - b. Xicato.
    - c. Luminaire manufacturer's proprietary system.
  - 3. LED Driver: Luminaire manufacturer's standard.

### **2.2 GENERAL REQUIREMENTS**

- A. Luminaires complete with LED modules and drivers.
- B. Rated for area classification as indicated on the Drawings.
  - 1. In Class I, Division 1 and 2 areas, the temperature rating of the luminaires and LED combination shall not exceed the auto-ignition temperature of the atmosphere in which the Luminaire is used.
- C. Provide all recessed luminaires with gaskets of rubber, fiberglass, or equivalent material to prevent light leaks around flush trim.
  - 1. Provide recessed luminaires with trim gaskets cemented in proper position.
- D. Provide standard plaster frame for all recessed luminaires installed in plaster walls or ceilings.
  - 1. Design, finish and fabricate material to preclude possibility of rust stain in plaster.
- E. Coordinate luminaire mounting where recessed into building canopies prior to Submitting Shop Drawings. Confirm clearances and luminaire flange compatibility with construction.
- F. Electrical components of recessed luminaires shall be accessible and removable through luminaire without having to remove luminaire from ceiling.

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- G. No live parts normally exposed to contact.
- H. When intended for use in wet areas: Mark luminaire "Suitable for wet locations."
- I. When intended for use in damp areas: Mark luminaire "Suitable for damp locations" or "Suitable for wet locations."

### **2.3 LUMINAIRES**

- A. Standards and Listings:
  - 1. DesignLights Consortium (DLC).
  - 2. UL 1598.
  - 3. UL 844 for hazardous locations.
  - 4. NEMA LE 4 for recessed locations.
- B. Housings:
  - 1. As indicated in the Luminaire Schedule and the following:
    - a. Troffer luminaires:
      - 1) Minimum 22 gage sheet steel.
      - 2) Integral end plates and trim flanges to suit ceiling construction.
      - 3) Wire way covers with captive retainers to allow access to electrical components without use of tools.
    - b. Down Light luminaires:
      - 1) Minimum 22 gage sheet steel, or minimum 16 gage sheet aluminum, unless noted otherwise.
      - 2) Auxiliary junction box secured to mounting frame.
    - c. Extruded aluminum housings, where scheduled, shall be at least 1/8 inches thick.
    - d. Punch and form housings prior to finishing (post-paint).
- C. Trim (Recessed Mounted):
  - 1. As indicated in the Luminaire Schedule and the following:
    - a. For square and rectangular luminaires, miter and continuously weld corners.
    - b. Miter perimeter inverted T-Bar angles at corners.
    - c. Do not butt or overlap squared ends.
    - d. Finish joints smooth.
- D. Castings:
  - 1. As indicated in the Luminaire Schedule and the following:
    - a. Uniform quality, free from imperfections affecting strength and appearance.
    - b. Exterior surfaces, if not receiving a finish coat, shall be smooth and match adjacent surfaces. At least one coat of clear methacrylate lacquer shall be applied unless a painted finish is specified.
- E. Fasteners:
  - 1. As indicated in the Luminaire Schedule and the following:
    - a. Aluminum or steel luminaires: Zinc-Nickel plated, stainless steel, or equivalent.
    - b. Stainless steel luminaires: Stainless steel.
    - c. Bronze luminaires: Bronze or stainless steel.
    - d. Non-metallic luminaires: Stainless steel.
- F. Finishes:
  - 1. As indicated in the Luminaire Schedule and the following:
    - a. Painted surfaces:

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- 1) Manufacturer's standard metal pretreatment and baked or air-dried, light-stabilized enamel finish, acrylic, alkyd, epoxy, polyester, or polyurethane.
  - 2) White finishes shall have minimum 85% reflectance.
  - b. Unpainted surfaces:
    - 1) Interior: Clear anodic coating, satin finish.
    - 2) Exterior: Clear anodic coating.
- G. Lens/Louver Frames:
1. As indicated in the Luminaire Schedule and the following:
    - a. Extruded aluminum with mitered corners.
    - b. Hinging or other normal motion shall not cause lens or louver to drop out.
    - c. No light leak between frame and housing.
- H. Lenses:
1. As Indicated in the Luminaire Schedule and the Following:
    - a. 100% virgin, UV stabilized acrylic.
    - b. Held securely in place but must also be removable for cleaning and servicing.
    - c. Luminaires with directional lenses shall include a lens orientation device to ensure that lens installation provides light distribution as designed.
    - d. No light leaks between the lens and the luminaire.
- I. Reflectors:
1. As Indicated in the Luminaire Schedule and the Following:
    - a. Down Light Reflector and Baffle Finishes: First-quality "Alzak" anodized specular finish.
    - b. Troffer reflector finish: Integral reflectors shall be painted white after fabrication with a minimum reflectance value of 90%.
- J. Gaskets:
1. As Indicated in the Luminaire Schedule and the Following:
    - a. Gaskets at face plates or frames of recessed luminaires which serve as ceiling trim and allow interior access.
    - b. Moisture seal gaskets at exterior locations and in other designated wet areas.
    - c. Secure frames to luminaire bodies with screws or other means, to result in tight installation, without light leaks.
- K. Ventilation:
1. Ventilation openings of adequate size and quantity to permit operation of driver without affecting rated output or life expectancy. Include wire mesh screens.
- L. Mounting Accessories:
1. Provide appropriate mounting accessories for each luminaire, compatible with various structural conditions encountered.
  2. All luminaires with adjustable beam angles shall have a locking device to ensure that the beam distribution is not affected during servicing or cleaning.
  3. Recessed Luminaires:
    - a. Plaster Frames: Provide frames for luminaires installed in gypsum board and concealed suspension system ceiling tile. Make frames of non-ferrous metal or suitably rustproof after fabrication.
    - b. Baffles and Gaskets: As required to prevent light leakage.
    - c. Flanged luminaires are required in all ceiling systems except exposed grid lay-in panel type.
  4. Luminaire Suspension Material:
    - a. Unfinished Spaces:
      - 1) 1/2 inches minimum diameter swivel stem, unless otherwise noted.
      - 2) Safety chain on high bay type.

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- b. Finished Spaces: Unless otherwise noted.
  - 1) Manufactured cable or stem and outlet box canopy.
    - a) Contemporary design with swivel self-aligning features.
    - b) Size canopy to cover outlet box, minimize size of canopy not associated with outlet box.
    - c) Finish to match luminaire.
  - 2) Coordinate pendant location with ceiling tiles/ceiling grid.
    - a) Submit coordinated mounting accessories as part of Shop Drawing submission.
  - 3) Luminaires mounted on suspended ceiling grids should be provided with outlet box designed for grid mounting with direct cord entry and supported by outlet box.

### 2.4 SOLID-STATE LUMINAIRES - ADDITIONAL REQUIREMENTS

- A. Standards:
  - 1. IESNA LM-79, IESNA LM-80.
  - 2. NEMA SSL 1.
  - 3. UL 1012, 1310, and 8750.
  - 4. UL 844 for hazardous locations.
- B. Solid state modules and driver to be provided and warranted by luminaire manufacturer.
- C. Solid-State Modules:
  - 1. Uniform color temperature of 4000K unless otherwise noted on the Luminaire schedule.
    - a. Color temperature measurement shall have a maximum 3 SDCM on the MacAdam Ellipse for frosted lensed luminaires, and 2 SDCM for other luminaire types (ANSI C78.377).
  - 2. Minimum color rendering index (CRI) of 80 for indoor and 70 for outdoor applications.
  - 3. LED module light output and efficacy: Measured in accordance with IESNA LM-79 standards.
  - 4. LED useful life and lumen maintenance: Measured in accordance with IESNA LM-80 standards.
  - 5. Driver and LED module: Minimum useful life of 50,000 hours (L70).
  - 6. Individual LEDs connected such that a failure of one LED will not result in a light output loss of the entire luminaire.
- D. Driver:
  - 1. Compatible with solid-state modules and control devices specified.
  - 2. Operate from 60 Hz input source of 120V through 277V with sustained variations of  $\pm 10\%$  (voltage and frequency).
  - 3. Input current Total Harmonic Distortion (THD): Less than 20% when operated at nominal line voltage.
  - 4. Power Factor: Greater than 0.90.
  - 5. Avoid interference with infrared devices and eliminate visible flicker.
  - 6. Comply with ANSI C62.41 Category A for Transient protection.
  - 7. Comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
  - 8. Dimmable drivers capable of continuous dimming over a range of 100% to 10% of rated lumen output, unless otherwise specified in Luminaire Schedule. Dimming controlled by a 0 - 10 VDC signal, unless otherwise specified in Luminaire Schedule.
  - 9. Control device must be compatible with type of driver and coordinated prior to submission of Shop Drawings. List of compatible dimming controllers must include the range of perceived brightness. No visible flicker throughout the dimming range.
  - 10. Remote-mounting:

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- a. Provide maximum allowable distances for secondary wire runs to luminaires.
  - b. Provide remote mounting hardware and enclosures as required.
11. Operating temperature range must be suitable for site temperature conditions within exterior and gasketed luminaires.
- E. Emergency Battery Driver:
1. UL 924.
  2. Confirm compatibility with LED modules utilized.
  3. Consist of a high temperature, maintenance-free nickel cadmium battery, charger, and electronic circuitry.
  4. A solid state charging indicator light to monitor the charger and battery.
  5. Single-pole test switch.
  6. The following product family shall be selected based on coordination with LED lamp type:
    - a. Philips Bodine "BSL23C": can operate up to 4.5W at 410mA.
    - b. Philips Bodine "BSL26C": can operate up to 5.1W at 265mA.
    - c. Philips Bodine "BSL722 inches": can operate up to 23W at 770mA.
    - d. Philips Bodine "BSL23C": can operate up to 23W at 770mA in operating conditions ranging from -20 degrees C (-4 degrees F) to 60 degrees C (140 degrees F).
    - e. Alternate manufacturer: Iota.
- F. Luminaire properly heat sunk to assure LED junction temperature ratings are not exceeded.
1. Provide ambient operating temperature range for which product is warranted.

### 2.5 EXIT SIGNS

- A. Standards:
1. UL 924.
  2. NFPA 101.
  3. Local State or City requirements.
- B. Exit Signs:
1. Housing and finish: As indicated in the Luminaire Schedule.
  2. LED illuminated with integral driver.
  3. AC powered or AC and battery powered: As indicated in the Luminaire Schedule.
  4. Battery powered units:
    - a. Battery type: As indicated in the Luminaire Schedule.
    - b. Self-testing/self-diagnostic.
      - 1) Electronic circuitry automatically test emergency lighting for a minimum of 30 seconds every 30 days and 90 minutes once a year.
    - c. Consist of battery, charger, and electronic circuitry.
    - d. Solid state charging indicator light to monitor the charger and battery.
    - e. Single-pole test switch.
    - f. A user selectable audible alarm. The alarm shall be engaged unless noted otherwise on the Drawings.

### 2.6 MAINTENANCE MATERIALS

- A. Furnish a minimum of 10% of total of each type and amperage of fuses for fixtures indicated to be fused.
- B. Spare parts are to be stored in a box clearly labeled as to its contents.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Coordinate Luminaire Types with Ceiling Construction:
  - 1. Provide mounting hardware for the ceiling system in which the luminaire is to be installed.
- B. Fasten luminaires supported by suspended ceiling systems to ceiling framing system with hold down clips.
- C. Provide mounting brackets and/or structural mounting support for wall-mounted luminaires.
  - 1. Do not support luminaire from conduit system.
  - 2. When luminaire is supported from outlet boxes, install per NFPA 70.
  - 3. Supports for luminaire mounted on exterior walls shall not be attached to exterior face of the wall.
- D. Support surface mounted luminaires from the building structure and not from the ceiling suspension system.
  - 1. Luminaires up to 4 feet wide and 4 feet long: A minimum of four supporting points, one at each corner.
  - 2. Luminaires 8 feet long: A minimum of five support points, one at center of luminaire and one at each corner.
  - 3. Luminaires smaller than 2 feet in length: A minimum of two supporting points.
- E. Provide pendant luminaires with swivel hangers which will allow luminaire to swing in any direction but will not permit stem to rotate.
  - 1. Provide hangers with enclosure rating (NEMA 1, 4, or 7) equal to enclosure requirements of area in which they are installed.
  - 2. Swivel hangers for luminaires in mechanical equipment areas: Shock absorbing type.
  - 3. Secure low and high bay luminaires with safety chain or safety aircraft cable to the building structure.
    - a. Chain or cable to prevent luminaire from falling more than 3 inches before the luminaire is caught by the chain or cable.
- F. Pendant Mounted, Open, Industrial Luminaire:
  - 1. Not in continuous rows:
    - a. Supported by conduit or by approved chains or cable:
    - b. Hardwired to ceiling mounted junction box.
  - 2. In continuous rows:
    - a. Supported rigidly with conduit and fasten luminaire to each other or mount on continuous metal channel per Specification Section 26 05 00.
    - b. Hardwired to ceiling mounted junction box.
    - c. Provide reflector alignment clips.
- G. Provide access panels for recessed luminaires that require access for maintenance when such access is not provided for in design of luminaire.
  - 1. Locate luminaires in accordance with reflected ceiling plans.
- H. Locate luminaire in exact center of ceiling tile unless otherwise indicated.
  - 1. Relocate incorrectly installed luminaire and replace damaged ceiling materials.
- I. Mount luminaire at heights indicated in Specification Section 26 05 00 or per Luminaire Schedule or as indicated on the Drawings.

## **SECTION 26 50 00 - INTERIOR AND EXTERIOR LIGHTING**

- J. Install exterior luminaires so that water cannot enter or accumulate in the wiring compartment.
- K. Ground luminaire.

### **3.2 LIGHTING CONTROL**

- A. See Specification Section 26 09 16 for lighting control equipment.
- B. Exterior wall mounted and pole mounted fixtures controlled as detailed on the Drawings.
- C. Exterior wall mounted fixtures.
  - 1. Major equipment:
    - a. Lighting control panel.
    - b. Electrically held lighting contactor.
      - 1) Mounted in control panel.
      - 2) Quantity of contactors and number of poles as required.
      - 3) Auxiliary contact.
    - c. Photocell mounted on roof.
  - 2. Sequence of operation:
    - a. Program lighting control panel channels per owner requested schedule.
    - b. When the HOA switch is in the HAND position
      - 1) Contactor is energized and the exterior lights are ON.
      - 2) Contactor auxiliary contact is energized and the indicator light is ON.
    - c. When the HOA switch is in the OFF position:
      - 1) Contactor is de-energized and the exterior lights are OFF.
      - 2) Contactor auxiliary contact is de-energized and the indicator light is OFF.
    - d. When the HOA switch is in the AUTO position:
      - 1) Contactor is energized and de-energized according to the light level as seen by the photocell.
      - 2) Contactor auxiliary contact is energized and de-energized according to the light level as seen by the photocell.

### **3.3 ADJUST AND CLEAN**

- A. Aim all emergency lighting units, so that, the path of egress is illuminated.

**END OF SECTION 26 50 00**



# **SECTION 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. All labor, materials, tools, equipment, and services for Basic Materials and Methods for Communications Systems, as indicated, in accordance with provisions of Contract Documents to provide a full and operating communications system as described within Division 27 documents.
  
- B. Related Requirements: Include but are not necessarily limited to:
  - 1. Section 26 08 13 - Acceptance Testing
  - 2. Section 26 43 13 - Surge Protection Devices for Low-Voltage Electrical Power Circuits
  - 3. Section 27 05 28 - Pathways for Communications Systems
  - 4. Section 27 05 36 - Cable Trays for Communications Systems
  - 5. Section 27 05 43 - Communications – Exterior Underground
  - 6. Section 27 10 00 - Structured Cabling

### **1.2 REFERENCES**

- A. Reference Standards: Standards referenced in this section include, but are not necessarily limited to the following:
  - 1. AMP NETCONNECT
    - a. Design Installer Agreement (ND&I).
  - 2. ASTM International:
    - a. A36/A36M - Standard Specification for Carbon Structural Steel.
  - 3. BICSI®
    - a. Telecommunications Distribution Methods Manual (TDMM).
  - 4. Code of Federal Regulations
    - a. Title 47 – Telecommunication.
  - 5. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
    - a. C2 – National Electrical Safety Code (NESC).
  - 6. ISO/IEC
    - a. 11801 Generic Cabling for Customer Premises.
  - 7. National Fire Protection Association® (NFPA)
    - a. 70 – National Electrical Code (NEC).
  - 8. TIA - Telecommunications Industry Association.
    - a. 568.1 - Commercial Building Telecommunications Infrastructure Standard.
    - b. 569 – Telecommunications Pathways and Spaces.
    - c. 606 - Administration Standard for Telecommunications Infrastructure.
    - d. 607 - Generic Telecommunications Bonding & Grounding (Earthing) for Customer Premises.
  - 9. UL Solutions (UL).
    - a. 1863 - UL Standard for Safety Communications-Circuit Accessories.

### **1.3 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination:

**SECTION 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS**

1. Build-out of all telecommunications areas, entrance facility, building distribution, floor distribution and data/telecommunication outlets meeting the requirements of TIA.
2. Adherence to the design guidelines for installation of cabling in pathways and spaces as defined by TIA 569
3. Complete bonding of all systems components and cabinets to the telecommunication's primary busbar in compliance with TIA 607.
4. Coordination of the entire installation with all other divisions.

**1.4 QUALITY ASSURANCE**

A. Qualifications:

1. Manufacturers:
  - a. Five continuous years, minimum, design and manufacture of the materials and equipment specified herein.
  - b. Products and equipment specified herein shall demonstrate that they have a quality assurance program in place to assure that the specifications are met. Include in the program, at a minimum, provisions for:
    - 1) Incoming inspection of raw materials.
    - 2) In-process inspection and final inspection of the cable product.
    - 3) Calibration procedures of test equipment to be used in the qualifications of the product.
    - 4) Recall procedures in the event that out of calibration equipment is identified.
    - 5) Conform to government standards on quality assurance for applications within these specifications.
  - c. Material and equipment shall be new, and conform to grade, quality, and standards specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout.
  - d. Equipment and materials of the type for which there are independent standard testing requirements, listings, and labels, shall be listed and labeled by the independent testing laboratory.
2. Installers:
  - a. The intent of these specifications is to ensure the systems described in this division are provided and installed by a technically experienced installer and, further, that the work is fully coordinated between the various systems by a single installer who is technically qualified as described herein.
  - b. Company specializing in installation of structured data/telecom cabling systems networks for a minimum of five years. Experience shall include the following:
    - 1) List at least 10 facilities of equal size, complexity and technical requirements utilizing the equipment submitted.
    - 2) For each facility, list:
      - a) Name and location of facility.
      - b) Date of occupancy by Owner.
      - c) Owner's representative to contact and telephone number.
      - d) Construction Manager or General Contractor.
      - e) Architect.
  - c. Where the installer is a branch office or other division of a larger organization, the qualifications of the branch office or other division shall meet the requirements of the Contract Documents. The installer incorporated under the same name, shall have successfully completed a minimum of three similar communications construction projects, both in scope and system types.
  - d. The work of this division shall be managed and supervised by a full-time site communications superintendent who shall have the following qualifications:
    - 1) Experience in the applications engineering, installation, and supervision of similar construction projects both in scope and system type for a minimum of five years.

**SECTION 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS**

- 2) Full time employee of the installer.
- 3) Have a working knowledge of all systems installed under this division.
- e. Project superintendent shall be on site full time through duration of construction.

**1.5 SUBMITTALS**

**A. General:**

- 1. Provide complete submittal package (shop drawings/product data) per individual Division 27 specification section. Information contained within each submittal package shall only pertain to the referenced specification section.
- 2. All submittal documents shall be submitted as pdf files. Drawings shall be produced on 30-inch x 42-inch format and product data shall be produced on 8.5 inch x 11 inch format.

**B. Action Submittals: Submit the following:**

**1. Shop Drawings:**

**a. General:**

- 1) Drawing comparison:
  - a) Copy of drawing annotated where proposed system layout differs from designed system. Any differences to be explained.

**b. Custom assembly diagrams:**

- 1) For each custom assembly such as a receptacle assembly, control panel or the like, provide an assembly drawing illustrating the appearance of the assembled device including dimensions, assembly components and functional attributes.

**c. Drawing comparison:**

- 1) Copy of drawing annotated where proposed system layout differs from designed system. Any differences to be explained.

**d. Submit for review the following submittal components (as applicable) for each system for evaluation of the proposed system with respect to project design requirements:**

- 1) Provide complete floor plans. Each plan shall show proposed device locations.
  - a) Show pull boxes, equipment enclosures and terminal cabinets.
  - b) Show conduits and fill (optional if lateral conduits are shown with size and fill on the riser).
- 2) Provide complete enlarged scale equipment room plans. Each plan shall show proposed "head-end" equipment type and locations.
  - a) Plan layout showing all system requirements within room with device notations.
  - b) Elevations of each wall within equipment room depicting equipment locations, notations, and dimensioning.
- 3) Riser diagram:
  - a) Illustrate conduit relationships between devices shown on the floor plans.
  - b) (Lateral conduits are optional if shown on the plans).
  - c) Show actual device nomenclature as illustrated on the plans and breaker number where the power will be sourced.

**C. Product Data:**

- 1. Cover page: Each product shall have a cover page with the following information:
  - a. Submitting Contractor's Logo.
  - b. Specification Section.
  - c. Specification Reference.
  - d. Manufacturer Name.
  - e. Manufacturer Part Number.
  - f. Brief Description.
- 2. Product Information: Include manufacturer's technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary) to clearly

**SECTION 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS**

describe the product's characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color & finish, and other relevant information such as test data, typical usage examples, independent test agency information, and storage requirements. Clearly indicate by highlighting, arrows or brackets precisely what is being submitted on and those optional accessories, which are included and those which are excluded. At a minimum, include products listed in Division 27. Include relevant products that will be provided, which are not listed in the specifications.

- a. Do not include sheets that are not relevant to the product data or the project.
  - 3. Specification comparison:
    - a. Copy of specification annotated on a line-by-line basis where proposed product or system differs from specified product or system. Any differences to be explained.
  - 4. Product list for Division 27 equipment per specified system.
  - 5. Description of system operation indicating overall system operation and purpose and capabilities of each component within system.
  - 6. Cross reference data sheets to components shown on shop drawings.
  - 7. Samples:
    - a. As indicated in each Division 27 section.
  - 8. Testing Plans, Procedures, and Testing Limitations:
    - 1) Testing procedure, apparatus, and limitations of apparatus and procedure, for:
      - a) Source quality control activities indicated in each Division 27 section.
      - b) Field quality control activities indicated in each Division 27 section.
- D. Informational Submittals: Submit the following:
- 1. Certificates.
  - 2. Manufacturer Instructions:
    - a. Serial numbers of items furnished, equipment nameplate information, and similar information for all items furnished.
    - b. Instructions for handling, installation, startup.
- E. Qualifications Statements:
- 1. Manufacturer.
  - 2. Installer.
- F. Contract closeout information:
- 1. As indicated in each Division 27 section.
- G. Maintenance Material Submittals: Furnish the items and submit documentation of delivery to and acceptance of such items by Owner or facility manager (as applicable) as defined in each Division 27 section.

**1.6 WARRANTY**

- A. Manufacturer's Special or Extended Warranty:
  - 1. In addition to manufacturer's general, standard printed warranty, furnish any manufacturer's special warranty coverage. Special warranty shall remain in effect as indicated commencing on the date of Substantial Completion for the associated Work.

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

- A. Acceptable manufacturers:

## **SECTION 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS**

1. As noted in each Division 27 section.
- B. Use UL labeled electrical materials where listing has been established for materials or devices in question.
- C. Structural steel for supports: ASTM-A36/A36M.
  1. Stainless steel members installed in all corrosive areas, including locations less than 10 miles from a saltwater source.
  2. Galvanize members installed in areas of high humidity or condensation.
  3. Furnish other members with shop coat of rust inhibiting primer.
  4. Shop fabricate for field assembly using bolts.
  5. Minimize field welding.
  6. Retouch primer and galvanizing after field welding.

### **2.2 EXTRA MATERIALS**

- A. Furnish spare parts required in each Division 27 section.
- B. All spare parts shall be new and in original packaging from manufacturer.
- C. Ensure parts are packaged to protect from damage and to allow for easy storage.
- D. Provide inventory of all spare parts.

### **2.3 EQUIPMENT ENCLOSURE RATING**

- A. Use equipment enclosures suitable for the environment.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF COMMUNICATIONS INFRASTRUCTURE**

- A. Provide access panels in any area where equipment is located which requires accessibility for service and/or maintenance.
- B. Do not change indicated sizes or configuration without written approval of Architect/Engineer.
- C. Conduit verification:
  1. Verify that all conduit is clear of foreign matter and substances prior to pulling of wire or cable.
  2. Apply a chemically inert conduit lubricant to all wire and cable prior to pulling. Do not subject wire and cable to tension greater than recommended by the manufacturer. Under no circumstances shall wire or cable be attached to any mechanical pulling device which exerts excessive force, shear or tensile.
  3. Secure all wire and cable runs vertically in conduit for continuous distances greater than thirty (30) feet at the vertical run terminations. Non-coaxial cables shall be secured by screw-flange nylon cable ties or similar devices. Symmetrical clamping devices with split, circular or other wire conforming, non-metallic bushings shall be provided for all other cables.

## **SECTION 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS**

- D. Structured cabling systems shall not occupy the same conduit/raceway with any other system or power cables.
- E. Provide installation, including electrical connections, cable pulling, testing and interfacing of systems.
- F. Deliver materials and equipment to project and store in original containers or cartons, properly protected from elements.
- G. Execute all work described in this specification and shown on drawings and all work dependent upon, and necessary to, complete finish of the work so described or shown, in a skillful manner using materials best adapted to purposes where such work or material is not specifically mentioned.
- H. Labeling:
  - 1. All labeling shall be in accordance with TIA-606-D requirements and Owner's labeling convention.

### **3.2 INSTALLATION OF EQUIPMENT**

- A. Install all equipment and infrastructure in accord with manufacturer's recommendations.
- B. Provide all necessary anchoring devices and supports.
  - 1. Use structural supports suitable for equipment.
  - 2. Check loadings and dimensions of equipment with shop drawings.
  - 3. Do not cut, or weld to, building structural members.
- C. Verify that equipment will fit support layouts indicated.
  - 1. Where substitute equipment is used, revise indicated supports to fit at no additional expense.
- D. Arrange for necessary openings to allow entry of equipment.
  - 1. Where equipment cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves or other devices to allow later installation.
- E. Installation of communications equipment shall not proceed until the progress of construction has reached the following status in the area of installation:
  - 1. Temperature and humidity are controlled.
  - 2. Finished ceiling is installed.
  - 3. Walls are finish coated with final paint treatment.
  - 4. Floors are finished and sealed.
  - 5. Millwork is completely installed, approved and signed off.
- F. Equipment installed in areas where the previously described conditions have not been met and maintained after equipment installation shall be removed and either cleaned or replaced at the Architect/Engineer's discretion.
- G. Install equipment to permit easy access for normal maintenance.
  - 1. Maintain easy access to switches, pull boxes, panels, receptacles, etc.
  - 2. Relocate items which interfere with access.

## **SECTION 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS**

### **3.3 COORDINATION**

- A. General:
  - 1. Coordinate the work with the other trades to assure that where this work interfaces to other trades, those interfaces are provided, complete and functional.
  - 2. Verify all field conditions.
  - 3. Positioning Members: Provide additional support or positioning members as required for the proper installation and operation of equipment, materials and devices provided as part of this work as approved by the Architect or Owner without additional expense.
  - 4. Interface Devices: Provide all items necessary to complete this work in conformance with the Contract Documents or the satisfaction of the Owner without any additional expense.

### **3.4 FIELD QUALITY CONTROL**

- A. Perform indicated tests to demonstrate workmanship, operation, and performance.
  - 1. Conduct tests in presence of Architect/Engineer, Owner and, if required inspectors of agencies having jurisdiction.
  - 2. Arrange date of tests in advance with Architect/Engineer, manufacturer and installer.
  - 3. Give minimum of 1 week notice to all inspectors.
  - 4. Furnish or arrange for use of electrical energy, steam, water, diesel fuel, or gas required for tests.
- B. Repair or replace equipment and systems found inoperative or defective and retest.
  - 1. If equipment or system fails retest, replace it with products conforming to Contract Documents.
  - 2. Continue remedial measures and retests until satisfactory results are obtained.
- C. Test equipment and systems as indicated for each item, unless otherwise recommended by manufacturer.

### **3.5 SYSTEMS OPERATIONAL TESTS**

- A. Prior to the time of substantial completion, an operational test, witnessed by a representative of the Architect/Engineer and Owner, shall be held of each system comprising the total communications systems to determine full compliance with the contract drawings. Provide all personnel, equipment, instrumentation, and communication equipment and include all costs of testing in the contract.
- B. The installer shall certify in writing that the systems are installed in compliance with the manufacturer's recommendations, refer to the requirements of the contract documents and are operating correctly. These written certifications shall be submitted to the Architect/Engineer and shall signify that the total communications system is operationally tested and ready for final acceptance testing by the Architect/Engineer.
- C. Final acceptance tests of the total communications systems shall be conducted as directed by the Architect/Engineer.
- D. It shall be the responsibility of the Installer to submit for the Architect/Engineer's approval, a proposed systems check list for use in final acceptance testing. This checklist shall consist of a list of individual tasks on a device-by-device basis, organized into logical groups per system being supplied. The checklist shall be submitted not later than 90 days prior to the scheduled

## **SECTION 27 05 01 - COMMON WORK RESULTS FOR COMMUNICATIONS SYSTEMS**

start of acceptance testing. Acceptance testing may not begin until the Architect/Engineer has approved the form and content of the acceptance checklist.

### **3.6 ADJUST AND CLEAN**

- A. Inspect all equipment and put in good working order.
- B. Clean all exposed and concealed items.
- C. All equipment shall be clean and dust free.

### **3.7 PUTTING SYSTEMS IN OPERATION - START UP**

- A. All systems shall be in satisfactory operation prior to final acceptance, at time agreed to by Owner and Architect/Engineer.
- B. Operate all systems in good working order for period of 10 working days prior to final acceptance testing.

### **3.8 DEVICE MOUNTING**

- A. Dimensions are to center of device unless otherwise indicated.

**END OF SECTION 27 05 01**



# **SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for grounding and bonding of communication system(s).
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 27 05 01 – Basic Materials and Methods for Communications Systems.
  - 2. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
  - 3. Section 26 08 13 – Acceptance Testing.
  - 4. Section 27 05 28 – Pathways for Communications Systems.
  - 5. Section 27 05 36 – Cable Trays for Communications Systems.
  - 6. Section 27 10 00 – Structured Cabling.

### **1.2 references**

- A. Reference Standards: Standards referenced in this section include, but are not necessarily limited to the following:
  - 1. ASTM International (ASTM):
    - a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
  - 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - a. 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.
    - b. C2 – National Electrical Code.
  - 3. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 4. Telecommunications Industry Association (TIA):
    - a. 606-D - Administration Standard for the Telecommunications Infrastructure.
    - b. 607-D - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
  - 5. UL Solutions. (UL):
    - a. 467, Grounding and Bonding Equipment.

### **1.3 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Manufacturers:
    - a. See Specification Section 27 05 01 for requirements.
  - 2. Installers:
    - a. See Specification Section 27 05 01 for requirements.
  
- B. Assure ground continuity is continuous throughout the entire Project.

### **1.4 SUBMITTALS**

- A. Product data.

## **SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

1. Provide submittal data for all products specified in PART 2 of this Specification Section except:
  - a. Grounding clamps, terminals, and connectors.
  - b. Exothermic welding system.
- B. See Specification Section 27 05 01 for additional requirements.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Ground rods and bars and grounding clamps, connectors, and terminals:
    - a. ERICO by Pentair.
    - b. Harger Lightning & Grounding.
    - c. Heary Bros. Lightning Protection Co. Inc.
    - d. Burndy by Hubbell.
    - e. Robbins Lightning, Inc.
    - f. Blackburn by Thomas & Betts.
    - g. Thompson Lightning Protection, Inc.
  2. Exothermic weld connections:
    - a. ERICO by Pentair - Cadweld.
    - b. Harger Lightning & Grounding - Ultraweld.
    - c. Burndy by Hubbell - Thermoweld.
    - d. FurseWELD by Thomas & Betts.

#### **2.2 COMPONENTS**

- A. Wire and Cable:
  1. Bare conductors: Soft drawn stranded copper meeting ASTM B8.
  2. Insulated conductors: Color coded green, per Specification Section 26 05 19.
- B. Conduit: As specified in Specification Section 27 05 28.
- C. Ground Bars:
  1. Solid copper:
    - a. 1/4 inches thick.
    - b. 2 or 4 inches wide.
    - c. 24 inches long minimum in main service entrance electrical rooms, 12 inches long elsewhere.
  2. Predrilled grounding lug mounting holes.
  3. Stainless steel or galvanized steel mounting brackets.
  4. Insulated standoffs.
- D. Grounding Clamps, Connectors and Terminals:
  1. Mechanical type:
    - a. Standards: UL 467.
    - b. High copper alloy content.
  2. Compression type for interior locations:

## **SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

- a. Standards: UL 467.
- b. High copper alloy content.
- c. Non-reversible.
- d. Terminals for connection to bus bars shall have two bolt holes.
3. Compression type suitable for direct burial in earth or concrete:
  - a. Standards: UL 467, IEEE 837.
  - b. High copper alloy content.
  - c. Non-reversible.
  - d. Factory filled with oxide inhibiting compound.
- E. Exothermic Weld Connections:
  1. Copper oxide reduction by aluminum process.
  2. Molds properly sized for each application.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. General:
  1. Install products in accordance with manufacturer's instructions.
  2. Size grounding conductors and bonding jumpers in accordance with NFPA 70, Article 250, except where larger sizes are indicated on the Drawings.
  3. Remove paint, rust, or other non-conducting material from contact surfaces before making ground connections. After connection, apply manufacturers approved touch-up paint to protect metallic surface from corrosion.
  4. Do not splice grounding electrode conductors except at ground rods.
  5. Install ground rods and grounding electrode conductors in undisturbed, firm soil.
    - a. Provide excavation required for installation of ground rods and conductors.
    - b. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
    - c. Unless otherwise specified, connect conductors to ground rods with compression type connectors or exothermic weld.
    - d. Provide sufficient slack in conductor to prevent conductor breakage during backfill or due to ground movement.
    - e. Backfill excavation completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.
    - f. Labeling will comply with TIA-606-D.
  6. Do not use exothermic welding if it will damage the structure the grounding conductor is being welded to.
- B. Grounding Electrode System:
  1. Provide a grounding electrode system in accordance with NFPA 70, Article 250 and as indicated on the Drawings.
    - a. All grounding electrode conductors terminate on a main ground bar located adjacent to the service entrance equipment.
  2. Grounding electrode conductor terminations:
    - a. Ground bars mounted on wall: Use a two-hole compression type conductor terminal and bolt it to the ground bar with two bolts.
    - b. Ground bars in electrical equipment: Use compression type conductor terminal and bolt it to the ground bar or manufacture's provided mechanical type termination device.
    - c. Piping systems: Use mechanical type connections.

**SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

- d. Building steel, below grade and encased in concrete: Use compression type connector or exothermic weld.
- e. Building steel, above grade: Use a two-hole compression type conductor terminal and bolt to the steel with two bolts or exothermic weld.
- f. Ground rod: Compression type or exothermic weld, unless otherwise specified.
- 3. Ground ring grounding system:
  - a. Ground ring consists of ground rods and a conductor looped around the structure.
  - b. Placed at a minimum of 10 feet from the structure foundation and 2 feet-6 inches below grade.
  - c. Provide a minimum of four ground rods placed at the corners of the structure and additional rods so that the maximum distance between ground rods does not exceed 50 FT.
  - d. Building/Structure grounding:
    - 1) Bond building/structure metal support columns to the ground ring at all corners of the structure.
  - e. Grounding conductor: Bare conductor, size as indicated on the Drawings.
- C. Supplemental Grounding Electrode:
  - 1. Provide the following grounding in addition to the equipment ground conductor supplied with the feeder conductors whether or not shown on the Drawings.
    - a. See Grounding Electrode System paragraph for conductor termination requirements.
  - 2. Metal poles:
    - a. Connect metal pole and pole base reinforcing steel to a ground rod.
    - b. Grounding conductor: Bare #6 AWG minimum.
  - 3. Equipment support rack and pedestals mounted outdoors:
    - a. Connect metallic structure to a ground rod.
    - b. Grounding conductor: #6 AWG minimum.
- D. Raceway Bonding/Grounding:
  - 1. Install all metallic raceway so that it is electrically continuous.
  - 2. Provide an equipment grounding conductor in all raceways with insulation identical to the phase conductors, unless otherwise indicated on the Drawings.
  - 3. NFPA 70 required grounding bushings shall be of the insulating type.
  - 4. Provide double locknuts at all panels.
  - 5. Bond all conduits, at entrance and exit of equipment, to the equipment ground bus or lug.
  - 6. Provide bonding jumpers if conduits are installed in concentric knockouts.
  - 7. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.
- E. Equipment Bonding
  - 1. Ground all utilization equipment with an equipment grounding conductor in accordance with TIA-607-D.
- F. Handhole Grounding:
  - 1. Provide a ground rod and ground bar, when indicated or as needed, in each manhole and handhole with exposed metal parts.
    - a. Expose a minimum of 4 inches of the rod above the floor for field connections to the rod.
  - 2. Connect all exposed metal parts (e.g., conduits and cable racks) to the ground rod.

**SECTION 27 05 26 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS**

**3.2 FIELD QUALITY CONTROL**

- A. Leave grounding system uncovered until observed by Owner.
- B. Acceptance testing:
  - 1. Provide a continuity test on the components of the grounding electrode system.
  - 2. Complete grounding system: Resistance of 5 ohms or less.
  - 3. Test resistance of installed ground system after backfilling and before connection to any other grounded system including underground piping, utility services or other building ground systems.
  - 4. Test ground grid resistance by fall-of-potential method.

**END OF SECTION 27 05 26**

# **SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for pathways of communications system(s).
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 27 05 01 – Common Work Results for Communications Systems.
  - 2. Section 27 05 43 – Communications – Exterior Underground.
  - 3. Section 27 05 36 – Cable Trays for Communications Systems.
  - 4. Section 27 10 00 – Structured Cabling.

### **1.2 REFERENCES**

- A. Reference Standards: Standards referenced in this section include, but are not necessarily limited to the following:
  - 1. BICSI®
    - a. Telecommunications Distribution Methods Manual (TDMM).
  - 2. National Electrical Manufacturers Association (NEMA):
    - a. C80 - Electrical Intermediate Metal Conduit.
    - b. TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit.
  - 3. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 4. Telecommunications Industry Association (TIA):
    - a. 569-E - Telecommunications Pathways and Spaces.
    - b. 606-D Administration the Telecommunications Infrastructure.
  - 5. UL Solutions (UL):
    - a. 1 - Safety Flexible Metal Conduit.
    - b. 6 - Safety Electrical Rigid Metal Conduit – Steel.
    - c. 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations.
    - d. 360 - Liquid-Tight Flexible Metal Conduit.
    - e. 467 - Grounding and Bonding Equipment
    - f. 514A - Metallic Outlet Boxes.
    - g. 514B - Conduit, Tubing, and Cable Fittings.
    - h. 651 - Schedule 40 and 80 Rigid PVC Conduit and Fittings.
    - i. 797 - Safety Electrical Metallic Tubing – Steel.
    - j. 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations
    - k. 1242 - Safety Electrical Intermediate Metal Conduit – Steel.
    - l. 2420 – Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
    - m. 2515 - Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
    - n. 2515A - Supplemental Requirements for Extra Heavy Wall Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

### **1.3 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Manufacturers:

## **SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS**

- a. See Specification Section 27 05 01 for additional requirements.
2. Installers:
  - a. Comply with TIA-569E Standard and the BICSI Telecommunications Distribution Methods Manual (TDMM) for the installation of Communication Pathways.
  - b. See Specification Section 27 05 01 for additional requirements.

### **1.4 SUBMITTALS**

- A. Product data:
  1. Provide submittal data for all products specified in PART 2 of this Specification Section except:
    - a. Conduit fittings.
    - b. Support systems.
- B. See Section 27 05 01 for additional requirements.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Wheatland
  2. Allied Tube & Conduit
  3. Western Tube

### **2.2 RIGID METAL CONDUITS**

- A. Rigid Galvanized Steel Conduit (RGS):
  1. Mild steel with continuous welded seam.
  2. Metallic zinc applied by hot dip galvanizing or electro-galvanizing.
  3. Threads galvanized after cutting.
  4. Internal coating: Baked lacquer, varnish, or enamel for a smooth surface.
  5. Standards: NFPA 70 Type RMC, NEMA C80.1, UL 6.
- B. Intermediate Metal Conduit (IMC):
  1. Mild steel with continuous welded seam.
  2. Metallic zinc applied by hot dip galvanizing or electro-galvanizing.
    - a. Threads galvanized after cutting.
  3. Internal coating: Baked lacquer, varnish, or enamel for a smooth surface.
  4. Standards: NFPA 70 Type IMC, NEMA C80.6, UL 1242.
- C. Rigid Aluminum Conduit (RAC):
  1. AA Type 6063 aluminum alloy, T-1 temper.
  2. Maximum copper content of 0.10%.
  3. Extruded, seamless.
  4. Standards: NFPA 70 Type RMC, NEMA C80.5, UL 6.

## **SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS**

### **2.3 ELECTRICAL METALLIC TUBING (EMT)**

- A. Mild steel with continuous welded seam.
- B. Internal coating: Baked lacquer, varnish, or enamel for a smooth surface.
- C. Standards: NFPA 70 Type EMT, NEMA C80.3, UL 797.

### **2.4 RIGID NONMETALLIC CONDUIT**

- A. Schedules 40 (PVC-40) and 80 (PVC-80):
  - 1. Polyvinyl-chloride (PVC) plastic compound which includes inert modifiers to improve weatherability and heat distribution.
  - 2. Rated for direct sunlight exposure.
  - 3. Fire retardant and low smoke emission.
  - 4. Shall be suitable for use with 90 degrees C wire and shall be marked "maximum 90 degrees C".
  - 5. Standards: NFPA 70 Type PVC, NEMA TC 2, UL 651.
- B. Fiberglass:
  - 1. Epoxy based resin system using an anhydride curing agent.
  - 2. Continuous E-glass roving.
  - 3. Winding angle approximately 54.75 degrees.
  - 4. Smooth internal walls with all fibers imbedded in the epoxy.
  - 5. Above grade rated: Halogen free additive for flame spread and smoke control.
  - 6. Ultraviolet inhibitor: Carbon black.
  - 7. Two-step curing process.
  - 8. Tensile strength: 11,000 psi per ASTM D2105.
  - 9. Dimensions: Iron Pipe Size (IPS).
  - 10. Wall thickness:
    - a. Standard: 3/4 inches to 4 inches nominal size.
    - b. Medium: 5 inches to 6 inches nominal size.
    - c. Extra Heavy for "bullet proof" and Class 1, Division 2 areas: 3/4 inches to 6 inches nominal size.
  - 11. Integral bell and spigot.
  - 12. Conduits and fittings to be joined with an interference joint and epoxy adhesive creating a concrete and watertight connection.
  - 13. Standard: NFPA 70 Type RTRC, NEMA TC14.AG, NEMA TC14.BG, [NEMA TC.XW,] UL 2420, UL 2515 [, UL 2515A].

### **2.5 FLEXIBLE CONDUIT**

- A. Flexible Galvanized Steel Conduit (FLEX):
  - 1. Formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
  - 2. Standard: NFPA 70 Type FMC, UL 1.
- B. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (FLEX-LT):
  - 1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
  - 2. Extruded PVC outer jacket positively locked to the steel core.
  - 3. Liquid and vapor tight.



## **SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS**

4. Standard: NFPA 70 Type LFMC, UL 360.

### **2.6 CONDUIT FITTINGS AND ACCESSORIES**

- A. Fittings for Use with RGS and IMC:
  1. General:
    - a. In hazardous locations listed for use in Class I, Groups C and D locations.
  2. Locknuts:
    - a. Threaded steel or malleable iron.
    - b. Gasketed or non-gasketed.
    - c. Grounding or non-grounding type.
  3. Bushings:
    - a. Threaded, insulated metallic.
    - b. Grounding or non-grounding type.
  4. Hubs: Threaded, insulated and gasketed metallic for raintight connection.
  5. Couplings:
    - a. Threaded straight type: Same material and finish as the conduit with which they are used on.
    - b. Threadless type: Gland compression or self-threading type, concrete tight.
  6. Unions: Threaded galvanized steel or zinc plated malleable iron.
  7. Sealing fittings:
    - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
    - b. Standard and mogul size.
    - c. With or without drain and breather.
    - d. Fiber and sealing compound: UL listed for use with the sealing fitting.
  8. Expansion couplings:
    - a. 2 inches nominal straight-line conduit movement in either direction.
    - b. Galvanized steel with insulated bushing.
    - c. Gasketed for wet locations.
    - d. Internally or externally grounded.
  9. Expansion/deflection couplings:
    - a. 3/4 inches nominal straight-line conduit movement in either direction.
    - b. 30 degrees nominal deflection from the normal in all directions.
    - c. Metallic hubs, neoprene outer jacket and stainless-steel jacket clamps.
    - d. Internally or externally grounded.
    - e. Watertight, raintight and concrete tight.
  10. Standards: UL 467, UL 514B, UL 1203.
- B. Fittings for Use with EMT:
  1. Connectors:
    - a. Straight, angle and offset types furnished with locknuts.
    - b. Zinc plated steel.
    - c. Insulated gland compression type.
    - d. Concrete and raintight.
  2. Couplings:
    - a. Zinc plated steel.
    - b. Gland compression type.
    - c. Concrete and raintight.
  3. Standard: UL 514B.
- C. Fittings for Use with Rigid Nonmetallic PVC Conduit:
  1. Coupling, adapters, and conduit bodies:
    - a. Same material, thickness, and construction as the conduits with which they are used.
    - b. Homogeneous plastic free from visible cracks, holes, or foreign inclusions.

## **SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS**

- c. Bore smooth and free of blisters, nicks or other imperfections which could damage the conductor.
  2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.
  3. Standards: ASTM D2564, NEMA TC 3, UL 651, UL 514B.
- D. Fittings for Use with Rigid Nonmetallic Fiberglass Conduit:
1. Coupling and adapters shall be interference joint type and of the same material, thickness, and construction as the conduit.
  2. Epoxy adhesive for joining conduits and fittings shall be supplied by the same manufacturer as the conduit and fittings and shall provide a concrete and watertight connection.
  3. Standard: NFPA 70 Type RTRC, NEMA TC14.AG, NEMA TC14.BG, UL 2420, UL 2415.

### **2.7 OUTLET BOXES**

- A. Metallic Outlet Boxes:
1. Hot-dip galvanized steel.
  2. Conduit knockouts and grounding pigtail.
  3. Styles:
    - a. 4-11/16 inches square.
    - b. Masonry/tile.
  4. Accessories:
    - a. Flat blank cover plates.
    - b. One or two gang extension, plaster, or tile rings.
    - c. Box supporting brackets in stud walls.
    - d. Adjustable bar hangers.
  5. Standards: NEMA/ANSI OS 1, UL 514A.
- B. Cast Outlet Boxes:
1. Zinc plated cast iron or die-cast copper free aluminum with manufacturer's standard finish.
  2. Threaded hubs and grounding screw.
  3. Styles:
    - a. "FS" or "FD".
    - b. "Bell".
    - c. Single or multiple-gang and tandem.
    - d. "EDS" or "EFS" for hazardous locations.
  4. Standards: UL 514A, UL 1203.

### **2.8 PULL AND JUNCTION BOXES**

- A. NEMA 1 Rated:
1. Body and cover: 14 GA minimum, galvanized steel or 14 GA minimum, steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
  2. With or without concentric knockouts on four sides.
  3. Flat cover fastened with screws.
- B. NEMA 4 Rated:
1. Body and cover: 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
  2. Seams continuously welded and ground smooth.
  3. No knockouts.
  4. External mounting flanges.

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5. Hinged or non-hinged cover held closed with stainless steel screws and clamps.
  6. Cover with oil resistant gasket.
- C. NEMA 4X Rated (metallic):
1. Body and cover: 14 GA Type 304 or 316 stainless steel.
  2. Seams continuously welded and ground smooth.
  3. No knockouts.
  4. External mounting flanges.
  5. Hinged door and stainless-steel screws and clamps.
  6. Door with oil-resistant gasket.
- D. NEMA 4X Rated (Nonmetallic):
1. Body and cover: Ultraviolet light protected fiberglass-reinforced polyester boxes.
  2. No knockouts.
  3. External mounting flanges.
  4. Hinged door with quick release latches and padlocking hasp.
  5. Door with oil resistant gasket.
- E. NEMA 7 and NEMA 9 Rated:
1. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
  2. Drilled and tapped openings or tapered threaded hub.
  3. Cover bolted down with stainless steel bolts or threaded cover with neoprene gasket.
  4. External mounting flanges.
  5. Grounding lug.
  6. Accessories: 40 mil PVC exterior coating and 2 mil urethane interior coating.
- F. NEMA 12 Rated:
1. Body and cover:
    - a. 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
    - b. Type 5052 H-32 aluminum, unpainted.
  2. Seams continuously welded and ground smooth.
  3. No knockouts.
  4. External mounting flanges.
  5. Non-hinged cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.
  6. Flat door with oil resistant gasket.
- G. Miscellaneous Accessories:
1. Rigid handles for covers larger than 9 square feet or heavier than 25 pounds.
  2. Split covers when heavier than 25 pounds.
  3. Weldnuts for mounting optional panels and terminal kits.
  4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.
- H. Standards: NEMA 250, UL 50.

### **2.9 SUPPORT SYSTEMS**

- A. Multi-conduit Surface or Trapeze Type Support and Pull or Junction Box Supports:
1. Material requirements.
    - a. Galvanized steel: ASTM A123/A123M or ASTM A153/A153M.
    - b. Aluminum: AA Type 6063 T6.

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- B. Single Conduit and Outlet Box Support Fasteners:
  - 1. Material requirements:
    - a. Zinc plated steel.
    - b. Stainless steel.
    - c. Malleable iron.
    - d. Steel protected with zinc phosphate and oil finish.

### **2.10 OPENINGS AND PENETRATIONS IN WALLS AND FLOORS**

- A. Sleeves, smoke and fire stop fitting through walls and floors:
  - 1. See Specification Section 01 73 20.

### **2.11 TELECOMM BACKBOARDS**

- A. 3/4 x 48 x 96 inches fire retardant treated plywood rough side against wall.
- B. Paint with two coats of white or similar light color paint prior to installation of equipment.
- C. Do not paint over fire rating seal on plywood.
- D. Provide height of 8 feet and mount 6 inches off floor.

### **2.12 SLEEVES**

- A. Provide 4 x 4 inches EZ Paths through telecom room wall into space above corridor ceiling.

### **2.13 ASSEMBLY**

- A. Mark Products:
  - 1. Identify the nominal trade size on the product.
  - 2. Stamp with the name or trademark of the manufacturer.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Shall be in accordance with the requirements of:
  - 1. NFPA 70.
  - 2. TIA 569-E.
  - 3. TIA 606-D.
  - 4. Manufacturer instructions.
- B. Size of Raceways:
  - 1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with ANSI/TIA 569-E.
  - 2. Unless specifically indicated otherwise, the minimum raceway size shall be:
    - a. Conduit: 1 inch.

## **SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS**

- C. Fill percentage: Pathways fill shall not exceed 40 percent.
- D. Field Bending and Cutting of Conduits:
  - 1. Minimum radius of bend as recommended by ANSI/TIA 569-E for size of conduit.
  - 2. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.
  - 3. Do not reduce the internal diameter of the conduit when making conduit bends.
  - 4. Degrease threads after threading and apply a zinc rich paint.
  - 5. Debur interior and exterior after cutting.
- E. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.
- F. The protective coating integrity of conduits, fittings, outlet, pull and junction boxes and accessories shall be maintained.
  - 1. Repair galvanized components utilizing a zinc rich paint.
  - 2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
  - 3. Repair surfaces which will be inaccessible after installation prior to installation.
- G. Remove moisture and debris from conduit before cable is pulled into place.
  - 1. Pull mandrel with diameter nominally 1/4 inches smaller than the interior of the conduit, to remove obstructions.
  - 2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
  - 3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.
- H. Provide pull wire in each conduit with minimum tensile strength of 200LB. Only nylon or polyethylene rope shall be used to pull cable in conduit systems.
- I. Where portions of a raceway are subject to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder section of the raceway.
- J. Fill openings in walls, floors, and ceilings and finish flush with surface.
  - 1. See Specification Section 01 73 20 for openings and penetrations.
- K. Where conduit terminates at a cable tray system, fit conduit with an insulated bushing.

### **3.2 RACEWAY ROUTING**

- A. Raceways shall be routed in the field unless otherwise indicated.
  - 1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and follows all applicable codes.
  - 2. Run in straight lines parallel to or at right angles to building lines.
  - 3. Do not route conduits:
    - a. Through areas of high ambient temperature or radiant heat.
    - b. In suspended concrete slabs.
    - c. In concrete members including slabs, slabs on grade, beams, walls, and columns unless specifically located and detailed on structural Drawings.
  - 4. Locate sleeves or conduits penetrating floors, walls, and beams so as not to significantly impair the strength of the construction. Do not place conduit penetrations in columns.

## **SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS**

5. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance, and repair.
- B. All conduits within a structure shall be installed concealed except as follows:
  1. As indicated on the Drawings.
  2. Conduits in non-architecturally finished areas may be exposed.
- C. Maintain minimum spacing between parallel conduit and piping runs in accordance with the following when the runs are greater than 30 feet:
  1. Between instrumentation and telecommunication: 1 inch.
  2. Between telecommunication and 125 V, 48 V and 24 VDC, 2 inches.
  3. Between telecommunication and 600 V and less AC power or control: 6 inches.
  4. Between telecommunication and greater than 600 VAC power: 12 inches.
- D. Conduits shall be installed to eliminate moisture pockets.
  1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.
- E. Conduit shall not be routed on the exterior of structures except as specifically indicated on the Drawings.
- F. Provide all required openings in walls, floors, and ceilings for conduit penetration.
  1. See Specification Section 01 73 20 for all openings and penetrations.

### **3.3 RACEWAY APPLICATIONS**

- A. Permitted Raceway Types Per Area Designations:
  1. Dry areas:
    - a. RGS.
    - b. RAC.
    - c. IMC.
    - d. EMT.
  2. Wet areas:
    - a. RGS.
    - b. RAC.
    - c. Fiberglass (above grade rated).
  3. NFPA 70 hazardous areas:
    - a. RGS.
    - b. RAC when required by other area designations.
    - c. Fiberglass extra heavy wall, Class 1, Division 2 only.
- B. Permitted Raceway Types Per Routing Locations:
  1. In stud framed walls:
    - a. EMT.
    - b. RAC.
    - c. RGS.
    - d. IMC.
  2. In concrete block or brick walls:
    - a. PVC-40.
    - b. PVC-80.
    - c. RGS.
    - d. IMC.
    - e. EMT.

## **SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS**

3. Above acoustical tile ceilings:
  - a. EMT.
  - b. RAC.
  - c. RGS.
  - d. IMC.
  - e. NEMA 1 rated wireway.
4. Embedded in poured concrete walls and floors:
  - a. PVC-40.
  - b. PVC-80.
  - c. RGS.
  - d. Fiberglass (above or below grade rated).
  - e. RGS wrapped with factory applied weather and corrosion protection tape when emerging from concrete into areas designated as dry, wet, corrosive or, highly corrosive.
  - f. Fiberglass (above grade rated) when emerging from concrete into areas designated as wet, corrosive or, highly corrosive.
  - g. PVC-RGS when emerging from concrete into areas designated as wet, corrosive or, highly corrosive.
5. Beneath floor slab-on-grade:
  - a. PVC-40.
  - b. Fiberglass (above or below grade rated).
  - c. PVC-80.
  - d. RGS.
6. Through floor penetrations, see Specification Section 01 73 20:
  - a. RGS wrapped with factory applied weather and corrosion protection tape when emerging from concrete into areas designated as dry, wet, corrosive or, highly corrosive.
  - b. Fiberglass (above grade rated) in areas designated as wet, corrosive or, highly corrosive.
  - c. PVC-RGS in areas designated as wet, corrosive or, highly corrosive.
7. Direct buried conduits and ductbanks:
  - a. PVC-40.
  - b. PVC-80.
  - c. Fiberglass (above or below grade rated).
  - d. Coilable HDPE Conduit (Schedule 40).
  - e. Cable-In-Conduit (Schedule 40).
  - f. 90 degrees elbows for transitions to above grade:
    - 1) RGS wrapped with factory applied weather and corrosion protection tape.
    - 2) PVC-RGS.
    - 3) Fiberglass (above grade rated).
  - g. Long sweeping bends greater than 15 degrees:
    - 1) RGS wrapped with factory applied weather and corrosion protection tape.
    - 2) PVC-RGS.
    - 3) Fiberglass (above or below grade rated).
8. Concrete encased ductbanks:
  - a. PVC-40.
  - b. PVC-EB.
  - c. Fiberglass (above or below grade rated).
  - d. Coilable HDPE Conduit.
  - e. Cable-In-Conduit.
  - f. 90-degree elbows for transitions to above grade:
    - 1) RGS wrapped with factory applied weather and corrosion protection tape.
    - 2) PVC-RGS.
    - 3) Fiberglass (above grade rated).
  - g. Long sweeping bends greater than 15 degrees:

## **SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS**

- 1) RGS for sizes 2 inches and larger.
- 2) Fiberglass (above or below grade rated).

C. Underground Conduit: See Specification Section 27 05 43.

### **3.4 CONDUIT FITTINGS AND ACCESSORIES**

A. Conduit Seals:

1. Installed in conduit systems located in hazardous areas as required by the NFPA 70.
2. Fill plug and drain shall be accessible.
3. Pour the conduit seals in a two-step process.
  - a. Pour the seal and leave cover off.
  - b. After seal is dry, inspect for proper sealing, install cover and mark (for example, paint or permanent marker) as complete.

B. Rigid nonmetallic conduit and fittings shall be joined utilizing solvent cement.

1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.

C. Install Expansion Fittings:

1. Where conduits are exposed to the sun and conduit run is greater than 200 feet.
2. Elsewhere as identified on the Drawings.

D. Install Expansion/Deflection Fittings:

1. Where conduits enter a structure.
  - a. Except electrical manholes and handholes.
  - b. Except where the duct bank is tied to the structure with rebar.
2. Where conduits span structural expansions joints.
3. Elsewhere as identified on the Drawings.

E. Threaded connections shall be made wrench tight.

F. Conduit joints shall be watertight:

1. Where subjected to possible submersion.
2. In areas classified as wet.
3. Underground.

G. Terminate Conduits:

1. In metallic outlet boxes:
  - a. RGS:
    - 1) Conduit hub and locknut.
    - 2) Insulated bushing and two locknuts.
    - 3) Use grounding type locknut or bushing when required by NFPA 70.
  - b. EMT: Compression type connector and locknut.
2. In NEMA 1 rated enclosures:
  - a. RGS:
    - 1) Conduit hub and locknut.
    - 2) Insulated bushing and two locknuts.
    - 3) Use grounding type locknut or bushing when required by NFPA 70.
  - b. EMT: Compression type connector and locknut.
3. In NEMA 12 rated enclosures:
  - a. Watertight, insulated and gasketed hub and locknut.
  - b. Use grounding type locknut or bushing when required by NFPA 70.



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4. In NEMA 4 and NEMA 4X rated enclosures:
    - a. Watertight, insulated and gasketed hub and locknut.
  5. In NEMA 7 and NEMA 9 rated enclosures:
    - a. Into an integral threaded hub.
  6. When stubbed up through the floor into floor mount equipment:
    - a. With an insulated grounding bushing on metallic conduits.
    - b. With end bells on nonmetallic conduits.
- H. Threadless couplings shall only be used to join new conduit to existing conduit when the existing conduit end is not threaded, and it is not practical or possible to cut threads on the existing conduit with a pipe threader.
- I. Labeling will comply with ANSI/TIA-606-D.

### **3.5 CONDUIT SUPPORT**

- A. Permitted multi-conduit surface or trapeze type support system per area designations and conduit types:
1. Dry or wet and/or hazardous areas:
    - a. Galvanized system consisting of: Galvanized steel channels and fittings, nuts and hardware and conduit clamps.
    - b. Aluminum system consisting of: Aluminum channels, fittings and conduit clamps with stainless steel nuts and hardware.
  2. Conduit type shall be compatible with the support system material.
    - a. Galvanized steel system may be used with RGS.
    - b. Stainless steel system may be used with RGS.
    - c. Aluminum system may be used with RAC.
    - d. Fiberglass system may be used with PVC-40 and PVC-80.
- B. Permitted single conduit support fasteners per area designations and conduit types:
1. Architecturally finished areas:
    - a. Material: Zinc plated steel, or steel protected with zinc phosphate and oil finish.
    - b. Types of fasteners: Spring type hangers and clips, straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
    - c. Provide anti-rattle conduit supports when conduits are routed through metal studs.
  2. Dry or wet and/or hazardous areas:
    - a. Material: Zinc plated steel, stainless steel, and malleable iron.
    - b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
  3. Conduit type shall be compatible with the support fastener material.
    - a. Zinc plated steel, steel protected with zinc phosphate and oil finish and malleable iron fasteners may be used with RGS.
    - b. Stainless steel system may be used with RGS and RAC.
    - c. PVC coated fasteners may be used with and PVC-40.
    - d. Nonmetallic fasteners may be used with PVC-40, PVC-80 and fiberglass.
- C. Conduit Support General Requirements:
1. Maximum spacing between conduit supports per NFPA 70.
  2. Support conduit from the building structure.
  3. Do not support conduit from process, gas, air or water piping, or from other conduits.
  4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 pounds or to the maximum uniform load recommended by the manufacturer if the support is rated less than 25 pounds.

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- a. Do not exceed maximum concentrated load recommended by the manufacturer on any support.
- b. Conduit hangers:
  - 1) Continuous threaded rods combined with struts or conduit clamps: Do not use perforated strap hangers and iron bailing wire.
- c. Do not use suspended ceiling support systems to support raceways.
- d. Hangers in metal roof decks:
  - 1) Utilize fender washers.
  - 2) Not extend above top of ribs.
  - 3) Not interfere with vapor barrier, insulation, or roofing.
5. Conduit support system fasteners:
  - a. Use sleeve-type expansion anchors as fasteners in masonry wall construction.
  - b. Do not use concrete nails and powder-driven fasteners.

### **3.6 OUTLET, PULL AND JUNCTION BOX INSTALLATION**

- A. General:
  1. Install products in accordance with manufacturer's instructions.
  2. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.
  3. Size boxes to accommodate quantity of cables enclosed and quantity of conduits connected to the box.
- B. Outlet Boxes:
  1. Permitted uses of metallic outlet boxes:
    - a. Housing of wiring devices:
      - 1) Recessed in all stud framed walls and ceilings.
      - 2) Recessed in poured concrete, concrete block and brick walls of architecturally finished areas and exterior building walls.
    - b. Pull or junction box:
      - 1) Above gypsum wall board or acoustical tile ceilings.
      - 2) Above 10 feet in an architecturally finished area where there is no ceiling.
  2. Permitted uses of cast outlet boxes:
    - a. Housing of wiring devices surface mounted in non-architecturally finished dry, wet, and hazardous areas.
    - b. Pull and junction box surface mounted in non-architecturally finished dry, and wet areas.
  3. Mount device outlet boxes where indicated on the Drawings and at heights as indicated.
  4. Set device outlet boxes plumb and vertical to the floor.
  5. Outlet boxes recessed in walls:
    - a. Install with appropriate stud wall support brackets or adjustable bar hangers so that they are flush with the face of the wall.
    - b. Locate in ungrouted cell of concrete block with bottom edge of box flush with bottom edge of block and flush with the face of the block.
  6. Back-to-back are not permitted.
- C. Pull and Junction Boxes:
  1. Install pull or junction boxes in conduit runs where indicated or required to facilitate pulling of cables or making connections.
  2. Provide pull boxes as required so that there is a maximum of 180 degrees of bends or no more than 100 feet of conduit run between pull boxes. Pull boxes must be sized per TIA-569 placed in a straight section of conduit and must not be used in lieu of a conduit bend. The corresponding conduit ends are to be aligned with each other.
    - a. Make covers of boxes accessible.
  3. Permitted uses of NEMA 1 enclosure:

## **SECTION 27 05 28 - PATHWAYS FOR COMMUNICATIONS SYSTEMS**

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- a. Pull or junction box surface mounted above removable ceiling tiles of an architecturally finished area.
- b. Pull or junction box surface mounted above 10 feet in areas designated as dry in architecturally and non-architecturally finished areas.
- c. Pull or junction box surface mounted in areas designated as dry in architecturally and non-architecturally finished areas.
4. Permitted uses of NEMA 4 enclosure:
  - a. Pull or junction box surface mounted in areas designated as wet.
5. Permitted uses of NEMA 4X metallic enclosure:
  - a. Pull or junction box surface mounted in areas designated as wet and/or corrosive.
6. Permitted uses of NEMA 7 enclosure:
  - a. Pull or junction box surface mounted in areas designated as Class I hazardous.
    - 1) Provide PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.
7. Permitted uses of NEMA 12 enclosure:
  - a. Pull or junction box surface mounted in areas designated as dry.

**END OF SECTION 27 05 28**

# **SECTION 27 05 36 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for cable tray and associated fittings and supports.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 27 05 01 – Common Work Results for Communication Systems.
  - 2. Section 27 05 28 - Pathways for Communications Systems.
  - 3. Section 27 10 00 – Structured Cabling.

### **1.2 References**

- A. Reference Standards: Standards referenced in this section include, but are not necessarily limited to the following:
  - 1. ASTM International (ASTM):
    - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - b. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
    - c. B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
  - 2. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 3. National Electrical Manufacturers Association (NEMA):
    - a. VE-1, Metal Cable Tray Systems.
    - b. VE-2, Cable Tray Installation Guidelines.
  - 4. Telecommunications Industry Association (TIA):
    - a. TIA--569-E – Telecommunications Pathways and Spaces.
  - 5. Underwriters Laboratories, Inc. (UL).

### **1.3 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Manufacturers:
    - a. See Specification Section 27 05 01 for additional requirements.
  - 2. Installers:
    - a. Comply with TIA-569-E Standard and the BICSI Telecommunications Distribution Methods Manual (TDMM) for the installation of Communication Pathways.
    - b. See Specification Section 27 05 01 for additional requirements.

### **1.4 SYSTEM DESCRIPTION**

- A. The following is a brief description of the types of the trays to be used:
  - 1. Comm Rooms: Cable Ladder, size 12”.
  - 2. Vertical Transitions Greater than 6 inches: Cable Ladder.

## **SECTION 27 05 36 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS**

### **1.5 SUBMITTALS**

- A. Action Submittals:
  - 1. Shop Drawings:
    - a. Fabrication and/or layout drawings:
      - 1) Routing, size, and fittings.
      - 2) Seismic location installation details.
  - 2. Product technical data.
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. See Specification Section 26 05 01 for additional requirements.

### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. See Specification Section 27 05 01.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Ladders rack:
    - a. Cablofil by Legrand.
    - b. Ortronics by Legrand.
    - c. Middle Atlantic Products by Legrand.
  - 2. Cable tray conduit and ground clamps and brackets:
    - a. B-Line by Eaton.
    - b. Cablofil by Legrand.
    - c. O-Z/Gedney by Emerson Electric Co.
    - d. Thomas & Betts.

### **2.2 COMPONENTS**

- A. Ladder Rack:
  - 1. Materials:
    - a. Steel:
      - 1) Side channels and transverse elements: Hot rolled ASTM A1011/A1011M carbon steel galvanized per ASTM A123/A123M.
      - 2) Hardware: Galvanized steel.
  - 2. Fabrication:
    - a. Standard:
      - 1) Metallic: NEMA VE-1.
    - b. The working (allowable) load capacity: NEMA VE-1 designation.
    - c. Side rails:
      - 1) I-beam or channel.
      - 2) Flange in or out (full width top opening).
    - d. Transverse elements: Solid bar, tube, or channel with stiffened flanges.
    - e. Useable clear nominal loading width: 12 inches.
    - f. Maximum centerline rung spacing on straight sections: 12 inches.

## **SECTION 27 05 36 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS**

- g. Metallic trays shall be UL classified per NFPA 70 as an equipment grounding conductor.

### **2.3 ACCESSORIES**

- A. Accessories including but not limited to, splice plates, barrier strips, dropouts/waterfall fittings, box connector, end plate and conduit clamps to be the same material as the tray or other compatible material.
- B. Covers and Associated Accessories:
  - 1. Material: Same base material as tray.
  - 2. Types: Solid flanged (flat), ventilated flanged (flat), peak flanged.
- C. Cable Tray Ground Clamps:
  - 1. Malleable iron or tin-plated extruded aluminum with zinc-plated steel screws.
  - 2. Serrated edges to bite into and bond to the cable tray system.
- D. Support system:
  - 1. Material: See Specification Section 27 05 01 for material specifications.
  - 2. See PART 3 of this Specification Section for material type.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install products in accordance with NEMA VE-2 and as recommended by the manufacturer's instructions unless otherwise indicated on the Drawings.
- B. Install cable tray, fittings, and accessories, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.
- C. Install cable tray systems as close as practical to the locations and elevations shown on the Drawings.
  - 1. Minor changes 12 inches or less in location, or 6 inches or less elevation, may be made to avoid interference with piping, ductwork and equipment.
  - 2. Obtain Engineer's approval prior to making major changes greater than 12 inches in location, or 6 inches in elevation.
  - 3. When cable tray is located adjacent to, beneath or near large piping or major equipment, or terminates at equipment; do not install cable tray until the installation of such piping and equipment is complete.
  - 4. Provide waterfall fittings for all vertical cable transitions from cable ladder and cable tray.
  - 5. Ensure openings are provided in non-rated partitions that cable tray will penetrate.
  - 6. Sound rate penetrations in sound rated walls.
    - a. Use a removable fire stopping system such as pillows with tested sound rating.
  - 7. Cable trays shown to pass through sound rated walls will be non-continuous. Provide sound attenuating cable assemblies of equal or greater cable capacity as the cable tray. Multiple sleeves will be installed with appropriate multi-ganged wall plate. Provide STI EZPath Smoke and Acoustical Pathways or pre-approved equal.
  - 8. Firestop penetrations in fire rated walls per Specification Section 07 84 00.
    - a. Use a removable fire stopping system such as pillows.

## **SECTION 27 05 36 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS**

9. Cable trays shown to pass through fire rated walls will be non-continuous. Provide fire rated cable assemblies of equal or greater cable capacity as the cable tray. Multiple sleeves will be installed with appropriate multi-ganged wall plate. Provide STI EZPath Fire Rated Pathways or pre-approved equal. Provide radius control modules on pathways for vertical cable transitions in excess of 6 inches.
- D. Cable Tray Supports:
  1. Provide supports at required locations to provide the loading capacity per the Contractors fill calculations.
  2. Cantilever bracket type when cable tray is installed adjacent to a wall.
  3. In seismic locations provide required supports and/or sway bracing per local building codes.
- E. Permitted prefabricated support system per area designations and tray material:
  1. Dry or wet areas:
    - a. Galvanized system consisting of: Galvanized steel channels and fittings, nuts and hardware and conduit clamps.
    - b. Aluminum system consisting of: Aluminum channels and fittings with stainless steel nuts and hardware and conduit clamps.
  2. Corrosive areas:
    - a. Stainless steel system consisting of: Stainless steel channels and fittings, nuts and hardware and conduit clamps.
    - b. PVC coated steel system consisting of: PVC coated galvanized steel channels and fittings and conduit clamps with stainless steel nuts and hardware.
    - c. Fiberglass system consisting of: Fiberglass channels and fittings, nuts and hardware and conduit clamps.
  3. Tray material shall be compatible with the support system material.
    - a. Galvanized steel system may be used with zinc coated trays.
- F. Whenever cable tray system spans a structural expansion joint provide one of the following:
  1. Expansion connector allowing a minimum of 1 inch straight-line movement of sections.
  2. A 2 inch discontinuity (gap) in the cable tray to allow horizontal and vertical movement.
- G. Maintain electrical continuity of the cable tray system.
  1. Bolt connectors to each section or fitting.
  2. Span expansion connectors by a bonding jumper.
  3. Use one of the following to bond conduits to the tray:
    - a. Conduits connected to the cable tray system by a one-piece conduit clamp shall be considered bonded to the cable tray system.
    - b. Terminate conduits connected to the cable tray system by a bracket and clamp assembly in an insulated grounding bushing and bond to the cable tray system.
  4. Tighten all bolted connections to manufacturer's recommendations to ensure electrical continuity.
- H. Cable Tray System Grounding:
  1. See Specification Section 27 05 26.
- I. Conduit terminating at a cable tray system:
  1. See Specification Section 27 05 28.

### **3.2 FIELD QUALITY CONTROL**

- A. Tray Fill Calculations:
  1. Cable tray fill shall not exceed TIA-569-E requirements.

## **SECTION 27 05 36 - CABLE TRAYS FOR COMMUNICATIONS SYSTEMS**

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- a. Coordinate the installation of all cables and maintain cable fill calculations and schedule of cables in the trays.
- B. Where galvanized steel cable tray is cut, drilled, or where the protective coating has otherwise been damaged during installation, immediately coat the exposed steel surface with a rust-inhibitor and a finish coat of zinc-rich paint.
- C. Remove trash and accumulated dirt from the entire cable tray system at the completion of the project and install covers where applicable.
- D. Tagging and warning signs:
  1. See Specification Section 10 14 00.

**END OF SECTION 27 05 36**



# **SECTION 27 05 43 - COMMUNICATIONS - EXTERIOR UNDERGROUND**

## **PART 1 - GENERAL**

### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for:
    - a. Handhole.
    - b. Underground conduits and ductbanks.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Section 03 00 05 - Concrete.
  - 2. Section 27 05 01 – Basic Materials and Methods for Communications Systems.
  - 3. Section 27 05 28 – Pathways for Communication Systems.

### **1.2 REFERENCES**

- A. Reference Standards: Standards referenced in this section include, but are not necessarily limited to the following:
  - 1. ANSI/TIA 758-B – Customer-owned Outside Plant Telecommunications Infrastructure Standard.
  - 2. American Association of State Highway and Transportation Officials (AASHTO):
    - a. HB-17, Standard Specifications for Highway Bridges.
  - 3. ASTM International (ASTM):
    - a. A536, Standard Specification for Ductile Iron Castings.
  - 4. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 5. Society of Cable Telecommunications Engineers (SCTE):
    - a. 77, Specifications for Underground Enclosure Integrity.

### **1.3 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Manufacturers:
    - a. See Specification Section 27 05 01 for additional requirements.
- B. Installers:
  - a. See Specification Section 27 05 01 for additional requirements.

### **1.4 SUBMITTALS**

- A. Action Submittals:
  - 1. Shop Drawings:
    - 1. Fabrication and/or layout drawings:
      - a. Provide dimensional drawings of each manhole indicating all specified accessories and conduit entry locations.
  - 2. Product technical data:

## **SECTION 27 05 43 - COMMUNICATIONS - EXTERIOR UNDERGROUND**

- a. Provide submittal data for all products specified in PART 2 of this Specification Section.
- b. See Specification Section 27 05 01 for additional requirements.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Prefabricated composite handholes:
    - a. Armorcast Products Company.
    - b. Quazite by Hubbell.
    - c. Synertech by Oldcastle Enclosure Solutions.
  2. Precast handholes:
    - a. Lister Industries Ltd.
    - b. Oldcastle Enclosure Solutions.
    - c. Jensen Precast and Utility Concrete Products.
  3. Handhole and ductbank accessories:
    - a. Cantex, Inc.
    - b. Condux International, Inc.
    - c. Neenah Enterprises, Inc.
    - d. Prime Conduit.
    - e. Thomas and Betts.
    - f. Underground Devices, Inc.
    - g. Unistrut by Atkore International, Inc.

#### **2.2 MANHOLES AND HANDHOLES**

- A. Prefabricated Composite Material Handholes:
  1. Handhole body and cover: Fiberglass reinforced polymer concrete conforming to all test provisions of SCTE 77.
  2. Minimum load ratings: SCTE 77 Tier 5.
  3. Solid bottom.
  4. Stackable design as required for specified depth.
  5. Cover:
    - a. Engraved legend of "COMMUNICATIONS".
    - b. Non-gasketed bolt down with stainless steel penta head bolts.
    - c. Lay-in non-bolt down when cover is over 100 pounds.
    - d. One or multiple sections so the maximum weight of a section is 125 pounds.
  6. Cover lifting hook: 24 inches minimum in length.
- B. Precast Handholes:
  1. Fiberglass reinforced polymer concrete or steel reinforced cement concrete structures:
  2. AASHTO live load rating: H-20 for full deliberate vehicle traffic.
  3. Mating edges: Tongue and groove type.
  4. Solid bottom with a 12 inches x 12 inches or 12 inches diameter French drain in the bottom of each manhole.
  5. Cable pulling eyes opposite all conduit entrances.
    - a. Coordinate exact location with installation contractor.

## **SECTION 27 05 43 - COMMUNICATIONS - EXTERIOR UNDERGROUND**

### **2.3 UNDERGROUND CONDUIT AND ACCESSORIES**

- A. Concrete and reinforcing steel: See Specification Section 03 00 05.
- B. Conduit: See Specification Section 27 05 28.
- C. Warning tape: Provide as indicated.
- D. Innerduct: Provide as indicated.
- E. Duct Spacers/Supports:
  - 1. High density polyethylene or high impact polystyrene.
  - 2. Interlocking web or mesh design.
  - 3. Provide 3 inches minimum spacing between conduits.
  - 4. Accessories, as required:
    - a. Hold down bars.
    - b. Ductbank strapping.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Coordinate elevations of ducts, and duct bank entrances into handholes and boxes, with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Ductbank slopes and distances between pull points will comply with ANSI/TIA 758-B.
  - 1. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Engineer.
  - 2. Lay duct lines to minimum grade of 4 inches in 100 feet.
  - 3. Grade may be from one manhole to next, or both ways from high point between manholes, depending on contour of finished grade.
  - 4. Install duct lines so that top of concrete is not less than 30 inches below finished grade or finished paving at any point.
  - 5. Field conditions may affect actual routing, coordinate with all existing and proposed utilities.
  - 6. Note final routing and depths on record documents.
- B. Handhole Locations:
  - 1. Approximately where shown on the Drawings.
  - 2. As required for pulling distances.
  - 3. As required to keep pulling tensions under allowable cable tensions.
  - 4. As required for number of bends in ductbank routing.
  - 5. Shall not be installed in a swale or ditch.
  - 6. Determine the exact locations after careful consideration has been given to the location of other utilities, grading, and paving.
  - 7. Locations are to be approved by the Engineer prior to excavation and placement or construction of manholes and handholes.
- C. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with other utilities, site grading, and surface features as determined in the field. Notify Engineer if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

## **SECTION 27 05 43 - COMMUNICATIONS - EXTERIOR UNDERGROUND**

- D. Install products in accordance with manufacturer's instructions.

### **3.2 HANDHOLES**

- A. Prefabricated Composite Material Handholes:
1. For use in areas subjected to occasional non-deliberate vehicular traffic.
  2. Place handhole on a foundation of compacted 1/4 to 1/2 inches crushed rock or gravel a minimum of 8 inches thick and 6 inches larger than handholes footprint on all sides.
  3. Provide concrete encasement ring around handhole per manufacturers installation instructions (minimum of 10 inches wide x 12 inches deep).
  4. Install so that the surrounding grade is 1 inch lower than the top of the handhole.
  5. Size: As indicated on the Drawings or as required for the number and size of conduits.
  6. Provide cable rails and pulling eyes as needed.
- B. Precast Handholes:
1. For use in vehicular and non-vehicular traffic areas.
  2. Construction:
    - a. Grout or seal all joints, per manufacturer's instructions.
    - b. Support cables on walls by cable racks:
      - 1) Provide a minimum of two racks, install symmetrically on each wall of manholes and handholes.
        - a) Provide additional cable racks, as required, so that both ends of cable splices will be supported horizontally.
        - 2) Equip cable racks with adjustable hooks: Quantity of cable hooks as required by the number of conductors to be supported.
      - 2) Equip cable racks with adjustable hooks: Quantity of cable hooks as required by the number of conductors to be supported.
    - c. In each manhole and handhole, drive 3/4 inches x 10 feet long copper clad ground rod into the earth with approximately 6 inches exposed above finished floor.
      - 1) Drill opening in floor for ground rod.
      - 2) Connect all metallic components to ground rod by means of #8 AWG minimum copper wire and approved grounding clamps.
      - 3) Utilize a ground bar in the manhole or handhole if the quantity of ground wires exceeds three.
        - a) Connect ground bar to ground rod with a #2/0 AWG minimum copper wire.
  3. Place manhole or handhole on a foundation of compacted 1/4 to 1/2 inches crushed rock or gravel a minimum of 8 inches thick and 6 inches larger than manholes or handholes footprint on all sides.
  4. Install so that the top of cover is 1 inch above finished grade.
    - a. Where existing grades are higher than finished grades, install sufficient number of courses of curved segmented concrete block between top of handhole and manhole frame to temporarily elevate manhole cover to existing grade level.
  5. After installation is complete, backfill and compact soil around manholes and handholes.
  6. Handhole size:
    - a. As indicated on the Drawings or as required for the number and size of conduits entering or as indicated on the Drawings.
    - b. Minimum floor dimension of 4 feet x 4 feet and minimum depth of 4 feet.
  7. Manhole size:
    - a. As indicated on the Drawings or as required for the number and size of conduits entering or as indicated on the Drawings.
    - b. Minimum floor dimension of 6 feet x 6 feet and a minimum depth of 6 feet.

## **SECTION 27 05 43 - COMMUNICATIONS - EXTERIOR UNDERGROUND**

### **3.3 UNDERGROUND CONDUITS**

- A. General Installation Requirements:
1. Ductbank types per location:
    - a. Concrete encased ductbank:
      - 1) Under roads.
    - b. Direct-buried conduit(s):
      - 1) Other locations as needed.
  2. Do not place concrete or soil until conduits have been observed by the Engineer.
  3. Ductbanks shall be sloped a minimum of 4 inches per 100 feet or as detailed on the Drawings.
    - a. Low points shall be at manholes or handholes.
  4. Keep trenches free of water.
  5. Excavations will be protected per OSHA standards, including sloping, shoring, and marking.
  6. During construction and after conduit installation is complete, plug the ends of all conduits.
  7. Provide conduit supports and spacers.
    - a. Place supports and spacers for rigid nonmetallic conduit on maximum centers as indicated for the following trade sizes:
      - 1) 1 inch and less: 3 feet.
      - 2) 1-1/4 to 3 inches: 5 feet.
      - 3) 3-1/2 to 6 inches: 7 feet.
    - b. Place supports and spacers for rigid steel conduit on maximum centers as indicated for the following trade sizes:
      - 1) 1 inch and less: 10 feet.
      - 2) 1-1/4 to 2-1/2 inches: 14 feet.
      - 3) 3 inches and larger: 20 feet.
    - c. Securely anchor conduits to supports and spacers to prevent movement during placement of concrete or soil.
  8. Stagger conduit joints at intervals of 6 inches vertically.
  9. Make conduit joints watertight and in accordance with manufacturer's recommendations.
  10. Accomplish underground changes in direction of runs exceeding a total of 15 degrees by long sweep bends having a minimum radius of 10 feet.
    - a. Sweep bends may be made up of one or more curved or straight sections or combinations thereof.
  11. Furnish manufactured elbows at end of runs as the conduit transitions to above grade.
    - a. Minimum radius of 18 inches for conduits less than 3 inches trade size and 36 inches for conduits 3 inches trade size and larger.
  12. Field cuts requiring tapers shall be made with the proper tools and shall match factory tapers.
  13. After the conduit run has been completed:
    - a. Prove joint integrity and test for out-of-round duct by pulling a test mandrel through each conduit.
      - 1) Test mandrel:
        - a) Length: Not less than 12 inches.
        - b) Diameter: Approximately 1/4 inches less than the inside diameter of the conduit.
    - b. Clean the conduit by pulling a heavy-duty wire brush mandrel followed by a rubber duct swab through each conduit.
  14. Pneumatic rodding may be used to draw in lead wire.
    - a. Install a heavy nylon cord free of kinks and splices in all unused new ducts.
    - b. Extend cord 3 feet beyond ends of conduit.
  15. Transition from rigid nonmetallic conduit to rigid metallic conduit prior to entering a structure or going above ground.

## **SECTION 27 05 43 - COMMUNICATIONS - EXTERIOR UNDERGROUND**

- a. Except rigid nonmetallic conduit may be extended directly to handholes, pad mounted transformer boxes and other exterior pad mounted electrical equipment where the conduit is concealed within the enclosure.
  - b. Terminate rigid PVC conduits with end bells.
  - c. Terminate steel conduits with insulated bushings.
16. Place warning tape in trench directly over ductbanks, direct-buried conduit, and direct-buried wire and cable in accordance with Specification Section 10 14 00.
  17. Placement of conduits stubbing into handholes shall be located to allow for proper bending radiuses of the cables.
- B. Concrete Encased Ductbank:
1. Ductbank system consists of conduits completely encased in minimum 2 inches of concrete and with separations between different cabling types as required in Specification Section 26 05 33 or as detailed on the Drawings.
  2. Install so that top of concrete encased duct, at any point:
    - a. Is not less than 24inches below grade.
    - b. Is below pavement sub-grading.
  3. Where identified and for a distance 10 feet either side of the area, the concrete shall be reinforced.
    - a. The reinforcement shall consist of #4 bars and #4 ties placed 12 inches on center, in accordance with Division 03 Specification Sections or as detailed on the Drawings.
    - b. Conduit supports to be staggered to minimize weak vertical shear point.
  4. Conduit supports shall provide a uniform minimum clearance of 3 inches between the bottom of the trench and the bottom row of conduit.
  5. Conduit separators shall provide a uniform minimum clearance of 3 inches between conduits or as required in Specification Section 27 05 28 for different cabling types.
- C. Direct-Buried Conduit(s):
1. Install so that the top of the uppermost conduit, at any point:
    - a. Is not less than 30 inches below grade.
    - b. Is below pavement sub-grading.
  2. Provide a uniform minimum clearance of 3 inches between conduits or as required in Specification Section 27 05 28 for different cabling types.
    - a. Maintain the separation of multiple planes of conduits by one of the following methods:
      - 1) Install multilevel conduits with the use of conduit supports and separators to maintain the required separations and backfill with flowable fill (100 psi) concrete per Specification Section 03 00 05.
      - 2) Install the multilevel conduits one level at a time.
        - a) Each level is backfilled with the appropriate amount of soil and compaction, per Specification Section 31 23 33, to maintain the required separations.
    - b. Maintain minimum 12-inch separation between parallel runs of communications conduit and <600V power. Increase to minimum 24 inches for medium-voltage power.

**END OF SECTION 27 05 43**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for the structural cabling system such as:
    - a. Cabinets, racks, frames, and enclosures.
    - b. Cable management.
    - c. Rack mounted power strips.
- B. Related Sections include but are not necessarily limited to:
  - 1. Section 07 84 00 - Firestopping.
  - 2. Section 27 05 01 – Basic Materials and Methods for Communications Systems.
  - 3. Section 27 05 28 – Pathways for Communication Systems.
  - 4. Section 27 05 36 - Cable Trays for Communications Systems.
  - 5. Section 27 05 43 – Communications – Exterior Underground.

**1.2 REFERENCES**

- A. Reference Standards: Standards referenced in this section include, but are not necessarily limited to the following:
  - 1. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC).
  - 2. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
    - a. TIA 568-0-E – Generic Telecommunications Cabling for Customer Premises.
    - b. TIA 568-1-E – Commercial Building Telecommunications Cabling Standard Part 1: General Requirements.
    - c. TIA 569-E – Telecommunications Pathways and Spaces.
    - d. TIA-606-D Administration Standard for the Telecommunications Infrastructure.
  - 3. ASTM International (ASTM):
    - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
    - b. A1011/A1011M, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
  - 4. National Electrical Manufacturers Association (NEMA):
    - a. VE-1, Metal Cable Tray Systems.
    - b. VE-2, Cable Tray Installation Guidelines.
  - 5. Underwriters Laboratories, Inc. (UL).

**1.3 QUALITY ASSURANCE**

- A. Qualifications:
  - 1. Manufacturers:
    - a. See Specification Section 27 05 01 for additional requirements.
  - 2. Installers:
    - a. Comply with TIA-569E Standard and the BICSI Telecommunications Distribution Methods Manual (TDMM) for the installation of Communication cabling.

## SECTION 27 10 00 - STRUCTURED CABLING

- b. See Specification Section 27 05 01 for additional requirements.
- B. Qualifications:
  - 1. Telecommunications Contractor:
    - a. Shall be regularly and professionally engaged in the business of the applications, installation, and testing of telecommunications systems and equipment.
    - b. Include three references of similar scope jobs completed in the last two years.
    - c. Supervisors and Installers shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level.
    - d. In lieu of BICSI Certification, Supervisors and Installers assigned to the installation of this system or any of its components shall have:
      - 1) A minimum of five years of experience in the installation of the specified copper and fiber optic cable and components.
      - 2) Factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.
  - 2. Manufacturer:
    - a. Company specializing in manufacturing products specified in this Section with minimum 10 years documented experience in the manufacturing, assembly, and factory testing of components which comply with TIA-568-1-E, TIA-568-2-D, and TIA-568-3-D.

### 1.4 SUBMITTALS

- A. Action Submittals:
  - 1. Shop Drawings:
    - a. Fabrication and/or layout drawings, sealed and approved by a Registered Communications Distribution Designer (RCDD):
      - 1) Layout of complete building per floor:
        - a) Building area boundaries and horizontal pathways.
      - 2) Telecommunications space drawings:
        - a) Telecommunication rooms plan views, pathway layout, mechanical/electrical layout, and cabinet, rack, backboard, and wall elevations.
      - 3) Typical detail drawings:
        - a) Faceplate types, and firestopping.
  - 2. Product Data:
    - a. Submittal data for all products specified in PART 2 of this Specification.
    - b. See Specification Section 27 05 01 for additional requirements.
- B. Informational Submittals: Submit the following:
  - 1. Certificates:
    - a. Telecommunications Contractor and Installers qualifications.
    - b. Key Personnel qualifications.
    - c. Manufacturer qualifications.
  - 2. Test reports:
    - a. Testing plan and procedures.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 27 05 01 for additional requirements.



**PART 2 - PRODUCTS**

**2.1 MATERIALS AND EQUIPMENT**

- A. All Materials and equipment shall be:
  - 1. Appropriate for the intended use.
  - 2. Recognized as such by a Nationally Recognized Testing Laboratory (NRTL) such as Underwriters Laboratories (UL), ETL SEMCO (ETL), the Canadian Standards Association (CSA) or the American National Standards Institute (ANSI).
  - 3. NFPA 70 Compliant.
  - 4. Permitted by the Authority Having Jurisdiction (AHJ).
- B. All products shall be new, of the latest version at time of bid, and brought to the job site in original manufacturer's packaging. Used equipment and damaged materials will be rejected.
- C. See Specification Section 27 05 01 for additional requirements.

**2.2 SUBSTITUTION POLICY**

- A. This specification design is based on Panduit Copper Cable. As such, substitution of specified products must be submitted to, and approved by, Engineer of Record (EOR) in accordance with section 01 62 00 - Product Options. Any substitutions shall meet or exceed performance specified.

**2.3 EQUIPMENT RACKS**

- A. Floor mounted 2-post equipment racks shall be welded steel or aluminum relay racks with uprights to mount industry standard 19 inches components and equipment.
  - 1. Uprights shall be 3 inches deep channel, 1-1/4 inches wide, drilled and tapped 12 - 24 inches standard EIA pattern.
  - 2. Racks shall be provided with a standard top cross member, and predrilled base plate to allow floor fastening.
  - 3. Open frame equipment racks shall be 7 feet tall, 45U capacity.
  - 4. UL Listed.
  - 5. Load Capacity: 1500 pounds.
  - 6. Equipment mounting positions marked and numbered.
  - 7. Equipment racks shall be black powder coated.
  - 8. Chatsworth Products Inc., 48353-703 or approved equivalent.
- B. Wall mounted equipment cabinet shall be welded steel or aluminum uprights to mount industry standard 19 inches components and equipment.
  - 1. Uprights shall be 3 inches deep channel, 1-1/4 inches wide, drilled and tapped 12 - 24 inches standard EIA pattern.
  - 2. Cabinets shall be minimum 24" deep with minimum 19RU.
  - 3. UL Listed.
  - 4. Equipment mounting positions marked and numbered.
  - 5. Equipment cabinets shall be black powder coated.
  - 6. Chatsworth Products Inc., 11900-X36 or approved equivalent.
  - 7. Cable Manager
    - a. Chatsworth Products Inc., 40971-X24 or approved equal.
  - 8. Fan Kit

- a. Chatsworth Products Inc., 40972-001 or approved equal.
- 9. Power Strip
  - a. Chatsworth Products Inc., 12820-706 or approved equal.
- 10. Brush Kit
  - a. Chatsworth Products Inc., 25190-000 or approved equal
- C. Cable Management:
  - 1. Cable management shall be specifically manufactured for the purpose of routing cables, wires, and patch cords horizontally across 19 inches equipment racks.
  - 2. Cable management shall be specifically manufactured for the purpose of routing cables, wires, and patch cords vertically adjacent to equipment racks.
    - a. Vertical Cable Manager, NetRunner, Front/Rear, 45U, 4 x 5 inch, Panduit WMPV45E or equal.
    - b. Vertical Cable Manager, NetRunner, Front/Rear, 45U, 6 x 6 inch, Panduit WMPVHC45E or equal.
    - c. Vertical Cable Manager for Wall Mount Cabinet, Chatsworth Products Inc., 40971-X24 or approved equal
  - 3. Cable management shall consist of ring or bracket-like devices with removable covers.
  - 4. Cable management shall mount to racks by screws and/or nuts and lock washers.
- D. Relay Rack Grounding Strip.
  - 1. Provide Vertical Grounding Strip on the rear of the Relay Rack (right vertical rail).
  - 2. Grounding Strip shall be same Rack Unit height as Relay Rack.
  - 3. Panduit RGS134-1Y or approved equivalent.

## **2.4 EQUIPMENT MOUNTING BACKBOARD**

- A. Plywood backboards shall be provided on three adjacent walls of telecommunications spaces. (See drawings for details).
  - 1. Void-free, interior grade A-C plywood, A-side mounted facing out, 3/4 inches thick, 4 FT x 8FT sheets.
  - 2. Plywood shall be painted on all 6 sides, including cut outs for outlets, with TWO coats of Fire-Retardant Paint, (White Color)
  - 3. Mount Plywood 8 inches AFF.
  - 4. Bolts supporting Plywood to wall must be countersunk into wood, so that equipment can utilize all space of plywood.

## **2.5 TELECOMMUNICATION OUTLETS**

- A. Faceplates.
  - 1. Faceplates shall have the following attributes:
    - a. Be single-gang or double-gang blank faceplate

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown.

## SECTION 27 10 00 - STRUCTURED CABLING

- B. Components shall be labeled in accordance with TIA 606-D.
- C. Penetrations in fire-rated construction shall be firestopped.
- D. Wiring shall be installed in accordance with TIA/EIA/ANSI Standards.
  - 1. Wiring, and terminal blocks and outlets shall be marked in accordance with TIA 606-D.
- E. Equipment Racks:
  - 1. Open frame equipment racks shall be bolted to the floor.
  - 2. Cable guides shall be bolted or screwed to racks.
  - 3. Racks shall be installed level.
  - 4. Wall mounted racks shall be secured to the mounting surface to prevent fully loaded racks from separating from the mounting surface.
- F. Pathway System:
  - 1. Provide in accordance with TIA 569-E and NFPA 70.
  - 2. Provide conduits in accordance with 27 05 28 – Pathways for Communication Systems.
  - 3. Provide bonding of raceways and cable tray in accordance with TIA 607-D and NFPA 70.

### 3.2 GROUNDING

- A. Signal distribution system ground shall be installed in the telecommunications entrance facility and in each telecommunication closet in accordance with TIA607-D.
  - 1. Equipment racks shall be connected to the electrical safety ground.

### 3.3 TESTING

- A. Testing shall conform to the TIA/ANSI Standards for all test parameters.
  - 1. All test data sheets shall be downloaded from the tester, printed out and provided to the Owner.
  - 2. Provide Owner with all test results as Electronic Documents (in portable document format, PDF files) by Electronic Means
  - 3. Tester shall be capable of testing parameters for the warranted system.
- B. Materials and documentation to be furnished under this Specification are subject to inspections and tests.
  - 1. All components shall be terminated prior to testing.
  - 2. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.

**END OF SECTION 27 10 00**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish labor, materials, tools, equipment, and services for Fire Department Radio System, as indicated, in accordance with provisions of Contract Documents.
- B. Include completion of design and provide UL listed system, engineering, electrical installation, control equipment, auxiliary devices, alarm interface, functional checkout, and testing, necessary for a fully functional system.
- C. Completely coordinate with work of other trades.

**1.2 SYSTEM DESCRIPTION**

- A. Provide Fire Department with ability to use standard radios operating on specific UHF channels required by Fire Department for communication throughout building in lieu of a system of fixed telephones.
- B. The Fire Department Radio System:
  - 1. FCC type accepted UHF bidirectional amplifier and either a system of internal antennas or a radiating cable system.
  - 2. UL Listed and or FM Approved.

**1.3 QUALITY ASSURANCE**

- A. Vendor Qualifications:
  - 1. Furnish products specified, employing personnel trained by manufacturer,
  - 2. Furnished identical products for a minimum of three systems of similar scope with same equipment, which are currently in service.
  - 3. Parts and service available within a 20 mile radius of Project and available on a 24-hour, 7-day a week basis.
- B. Installer Qualifications:
  - 1. FCC licensed.
  - 2. Authorized distributor of the system manufacturer
  - 3. Installed and successfully completed a minimum of three similar systems.
  - 4. Perform work under supervision of personnel familiar with codes and standards governing installation of specified systems.
  - 5. Employ experienced personnel who are qualified to design and install systems of the type specified in this Section.
- C. Comply with following:
  - 1. AHJ Requirements.
  - 2. NFPA 72 – National Fire Alarm and Signaling Code.
  - 3. NFPA 70 – National Electrical Code.
  - 4. FCC Regulations.
  - 5. Manufacturers installation instructions.

## **SECTION 28 31 43 - FIRE DEPARTMENT RADIO SYSTEM**

### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Wiring Diagrams:
    - a. Show terminal to terminal connections between components. Indicate manufacturer's part number, conductor size, construction, insulation type and rating for conductors and cables.
  - 2. Floor Plan Layout Drawings:
    - a. Show location of equipment required for operation of the system as specified.
  - 3. Detailed Drawings:
    - a. Donor antenna mounting structure and roof/wall penetrations.
    - b. Interior antenna mounting.
- B. Product Data:
  - 1. Submit Manufacturer's original printed data sheets showing physical dimensions, power requirements, performance data and agency listings/approvals for products furnished under this Section.
  - 2. Where data sheets show multiple product items, highlight products being furnished.
- C. Project Information:
  - 1. Statement of Supplier and Installer Qualifications.
    - a. Include documentation showing persons conducting testing hold current FCC General Radiotelephone Operator Licenses.
  - 2. References from three similar completed projects using same products.
  - 3. Proof of being Authorized Distributor of system manufacturer.
  - 4. Parts and service availability.
  - 5. Manufacturer's Installation Instructions.
  - 6. Proof of system compatibility with Fire Department.
- D. Calculations
  - 1. Battery calculations.
  - 2. Field strength modeling.
- E. Contract Closeout Information:
  - 1. Operation and Maintenance Data.
    - a. See Section 01 78 23.
  - 2. Project Record Documents including test reports.

### **1.5 WARRANTY**

- A. Warrant system against system hardware and electrical defects including programming software defects for a period described in the contract general conditions, but not less than one year.
  - 1. Warranty period shall begin upon satisfactory completion and certification of final acceptance testing of the system and signed acceptance by the owner.
  - 2. Provide to owner a letter stating the start-date and end-date of warranty period.
  - 3. Provide an updated list of name(s) and phone number(s) for normal and off-hours contacts necessary to respond to warranty issues. Response to warranty notification shall require a reply within 24 hours of initial contact.

## **SECTION 28 31 43 - FIRE DEPARTMENT RADIO SYSTEM**

### **1.6 COMMISSIONING**

- A. Before commissioning begins Contractor shall certify in writing component testing and operational testing have been completed and acceptance testing forms have been submitted and approved.
- B. Contractor shall be responsible for assisting independent commissioning agent (CxA) in on-site commissioning of System.
  - 1. Provide tools and personnel needed to conduct an efficient commissioning process in accordance commissioning specifications.
  - 2. Quality Assurance.
  - 3. Provide to the CxA procedures for a commissioning plan, per area, which outlines commissioning activities and identifies each activity and test, zone specific, necessary for a complete verification of the design and operation prior to start of testing.
  - 4. Provide assistance to the CxA including review of commissioning plan and answering questions about equipment and operation sequences.
- C. Contractor shall assist commissioning agent in complete testing of devices, equipment, functions, and aspects of the System specified in this Section.
  - 1. Include but not be limited to Performance Verification requirements called for in commissioning checklists and procedures, Initial Equipment/System Verification, Power Failure/Battery Backup, Line Supervision, and interfaces to FAS.
- D. UL Certificate of Installation shall be issued by the equipment supplier after system acceptance testing, as required by Authority Having Jurisdiction.

### **1.7 MAINTENANCE CONTRACT**

- A. Beginning at Substantial Completion, provide 12 months' full maintenance service by skilled, competent personnel. Include semi-annual preventive maintenance, repair, or replacement of worn or defective components, lubrication, cleaning and adjusting as required to maintain specified or normal operation. Use only parts and supplies as used in the manufacturer and installation of the original equipment.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Base:
  - 1. Comtronics Corporation
- B. Optional:
  - 1. Honeywell
  - 2. Motorola
- C. Other manufacturers desiring approval comply with Section 01 61 00.

### **2.2 DESIGN CRITERIA**

- A. Signal transmitted from Fire Department shall produce a signal strength of at least -95dBm over 95 percent of floor area of each floor when tested according to procedure specified herein.

## **SECTION 28 31 43 - FIRE DEPARTMENT RADIO SYSTEM**

- B. Signals transmitted from 95 percent of floor area of each floor shall produce signal strength of at least -95dBm when received at Fire Department facilities when tested according to procedure specified herein.
- C. Include standby power from storage batteries to permit at least 12 hours of operation upon loss of normal AC power.
- D. Lockable, steel NEMA 4 System enclosures, painted fire engine red and labeled: "FIRE DEPT. RADIO" in bright yellow.
- E. Amplifier operation and the presence of normal operating power shall be continuously supervised.
  - 1. Failure of amplifier or loss of normal operating power shall cause an audible alarm signal (90dBA Sonalert type device) to operate and supervisory signal on building fire alarm system.
- F. Provide repeater or bi-directional amplifier with dry contacts for signaling system trouble to building fire alarm system as follows:
  - 1. Power Failure.
  - 2. Battery Low.
  - 3. Equipment Failure.
  - 4. Antennae Operational.
- G. Confirm system compatibility with existing fire department radios.

### **2.3 MATERIALS**

- A. Bidirectional Amplifier:
  - 1. FCC Type Accepted.
  - 2. Provide with supervisory electronics, power supply, standby batteries, and charger.
  - 3. Provide enclosure(s) painted, marked, and equipped as specified.
- B. Outdoor Antenna.
- C. Indoor Antennas and/or radiating cable.
- D. Cable Taps.
- E. Accessories:
  - 1. Draftstop Material: One part silicone sealant.
  - 2. Spare parts.

## **PART 3 - EXECUTION**

### **3.1 COORDINATION**

- A. Coordinate location of ceiling mounted equipment with reflected ceiling plans.

## **SECTION 28 31 43 - FIRE DEPARTMENT RADIO SYSTEM**

### **3.2 DESIGN AND INSTALLATION**

- A. Install system following applicable Building Codes and requirements in Section 01 45 00 for quality assurance and control of installation.
- B. Provide antennas and route RF cables based upon RF engineering judgment and an evaluation of construction documents including floor plans, wall, and slab construction details.
  - 1. Develop details for equipment and cable installed within confines of laboratories and clean room areas.
- C. Riser diagrams are schematic and do not show every conduit, wire box, fitting, or other accessories.
  - 1. Provide such materials as necessary for complete and functioning installation.
    - a. Install in accordance with referenced codes and these specifications.
- D. Identify cables and conductors at each connection point with tags similar to Brady B-500+/600.
- E. Label branch circuit breakers which feed system equipment "Fire Dept. Radio System" and install locking devices which prevent breakers from being inadvertently turned off but do not interfere with automatic breaker operation.
- F. Install UL Listed Firestopping Systems for through-penetrations and membrane penetrations of fire-rated construction in accordance with Section 07 84 00.
- G. Install draftstop material at penetrations in partitions not required to be firestopped.

### **3.3 SUPPLIER'S FIELD SERVICES**

- A. Refer to requirements in Section 01 45 00.
- B. Provide services of a technician, trained by manufacturer, to oversee installation, assist in locating detectors, supervise final connections, energize equipment, make adjustments, and perform manufacturer's recommended field testing and acceptance testing.
- C. Perform acceptance testing for the Fire Department and the Owner as follows:
  - 1. Talk back testing from site to Fire Alarm Office shall use a two watt portable transceiver with speaker/microphone and flexible antenna.
  - 2. Field strength testing instruments shall be frequency selective.
    - a. Use same type of flexible antenna as portable radio and be documented as having been calibrated within year prior to test.
  - 3. Divide each floor will be divided into grid of approximately 40 equal areas and transmit and receive measurements shall be made at the approximate center of each grid box.
    - a. Once a location within a grid box is selected, moving about the area to obtain a better signal is prohibited.
  - 4. To pass test, no floor shall have more than two nonadjacent grid boxes out of 40 grid boxes where signal strength is measured below specified levels.
  - 5. If any floor fails, retest using a grid pattern of 80 equal areas.
    - a. If signal strength in more than four nonadjacent grid boxes on retested floor measures below specified levels, the building has failed.
    - b. A new set of tests will be required after contractor has corrected installation.
  - 6. Arrange with manufacturer to have representative present to oversee testing.
  - 7. Record measurements and turn over to Owner.



## **SECTION 28 31 43 - FIRE DEPARTMENT RADIO SYSTEM**

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- a. Failure to turn over record of measurements to Owner will require entire acceptance testing to be repeated.

**END OF SECTION 28 31 43**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Material and installation requirements for:
    - a. Fire Alarm Control Units.
    - b. Initiating Devices.
    - c. Notification Appliances.
    - d. Miscellaneous Devices.
- B. Related Specification divisions include but are not necessarily limited to:
  - 1. Section 23 09 00 - Instrumentation and Control for HVAC Systems.
  - 2. Section 26 05 33 - Raceways and Boxes.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards (appropriate editions as adopted by Authority(ies) Having Jurisdiction (AHJ) and including all local amendments):
  - 1. Americans with Disabilities Act (ADA):
    - a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
    - b. ADA Standards for Accessible Design.
  - 2. FM Global (FM):
    - a. All applicable standards.
    - b. All components FM approved.
  - 3. National Electrical Manufacturers Association (NEMA).
  - 4. National Fire Protection Association (NFPA):
    - a. 70, National Electrical Code (NEC):
      - 1) Article 760, Fire Alarm Systems.
    - b. 72, National Fire Alarm and Signaling Code.
    - c. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
    - d. 101, Life Safety Code.
  - 5. National Institute for Certification in Engineering Technologies (NICET).
  - 6. Underwriters Laboratories, Inc. (UL):
    - a. 38, Standard for Manual Signaling Boxes for Fire Alarm Systems.
    - b. 268, Smoke Detectors for Fire Alarm Systems.
    - c. 268A, Standard for Smoke Detectors for Duct Applications.
    - d. 464, Standard for Audible Signaling Appliances.
    - e. 497B, Standard for Protectors for Data Communication and Fire Alarm Circuits.
    - f. 521, Standard for Heat Detectors for Fire Protective Signaling Systems.
    - g. 864, Standard for Control Units and Accessories for Fire Alarm Systems.
    - h. 1971, Standard for Signaling Devices for the Hearing Impaired.
- B. Design Criteria:
  - 1. Provide a complete fire alarm system as described in the Contract Documents and according to criteria of the AHJ) and all applicable national and local codes such as NFPA, ADAAG, building code, etc.
    - a. Where system requirements described in the Contract Documents exceed those of the AHJ and/or NFPA, meet the requirements of both.

## **SECTION 28 46 00 - FIRE DETECTION AND ALARM**

- b. Perform a thorough examination of Contract Documents and shall coordinate with other disciplines and trades, e.g. verification of hazardous area locations requiring equipment rated for that type of environment.
      - c. Contractor shall be responsible for providing a fully functional and code compliant fire alarm system at no additional cost to the Owner.
    2. Submit documents after design has been approved by Authority Having Jurisdiction (AHJ).
    3. The fire alarm system shall be designed by a NICET Fire Alarm Systems Level III or IV engineering technician.
      - a. The designer is responsible for understanding the construction of the building to take in consideration ceiling heights, ceiling construction (flat or not flat), and other features of the building that will affect the layout of devices as required to provide a fire alarm system that is fully compliant with NFPA 72.
    4. If required by state regulations, a Professional Fire Protection Engineer shall seal drawings submitted to the AHJ.
  - C. Service Organization Qualifications:
    1. Offer an annual maintenance contract including complete service and equipment costs for maintenance of complete system.
    2. 10 years experience minimum serving fire alarm systems.
    3. Provide for 24 hour emergency service. Response time to site shall be 24 hours or less and service office shall be within 250 miles of site.
    4. System shall be installed under the direct supervision of a technician who is factory trained by manufacturer and is certified as a minimum of NICET Level II in Fire Alarm Systems.
  - D. Field quality control:
    1. Manufacturer's field services: Provide service by a factory-authorized and certified service representative to supervise field assembly and connection of components and pre-testing, testing, and adjustment of system.
    2. Pre-testing: Determine, through pre-testing, conformance of system to requirements of drawings and specifications. Correct deficiencies observed in pre-testing. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.
    3. Inspection:
      - a. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.
      - b. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.
  - E. Authority Having Jurisdiction (AHJ) review:
    1. Concurrent or prior to submission to Engineer, submit shop drawing and product data to Authority Having Jurisdiction (AHJ).
    2. Upon receipt of comments from AHJ, make resubmissions, if required, to make clarifications or revisions to obtain approval.
    3. The AHJ shall witness final testing and inspection in order to obtain final approval for system.

### **1.3 DEFINITIONS**

- A. For the purposes of providing materials and installing electrical work the following definitions shall be used.
  1. Outdoor Area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.

## **SECTION 28 46 00 - FIRE DETECTION AND ALARM**

2. Architecturally Finished Area: Offices, conference rooms, restrooms, corridors and other similar occupied spaces.
3. Non-architecturally Finished Area: maintenance bays, mechanical, electrical rooms and other similar process type rooms.
4. Hazardous areas: Class I, II or III areas as defined in NFPA 70.
5. Shop Fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.
6. Service Organization: Commercial entity comprised of professionals capable of providing the technical knowledge and a supply of replacement equipment required for the comprehensive maintenance of a fire alarm system.

### **1.4 SYSTEM DESCRIPTION**

- A. Automatic and manual, addressable, general alarm and non-coded evacuation alarm, supervised, closed-circuit, 24 VDC microprocessor based fire detection and alarm system.
- B. Provide components and features as required by the applicable codes, AHJ and/or Fire Department, including but not limited to following.
  1. Main FACU as indicated on the Drawings.
  2. Printer terminals.
  3. Smoke sensors.
  4. Ductwork smoke sensors.
  5. Remote alarm indicator for concealed smoke sensors.
  6. Smoke sensors with auxiliary relays.
  7. Sprinkler flow switch and main waterflow detector circuits.
  8. Main, and indicating sprinkler valve tamper switch circuits.
  9. A non-silenceable 24 VDC notification appliance circuit serving a dedicated, exterior alarm device activated upon a waterflow alarm.
    - a. Exterior water flow alarm device shall be a weatherproof audible/visible notification device provided on the exterior of the building located above the Fire Department Connection (FDC).
  10. Visual and audible notification appliances.
  11. Fire alarm system wire, with all wiring in conduit.
  12. Tone generator.
- C. Basic Performance:
  1. Signal Line Circuits (SLC) shall be wired Class A (NFPA Style 6).
  2. Notification Appliance Circuits (NAC) shall be wired Class B.
  3. Each SLC and NAC shall be limited to only 80% of its total capacity at the time of initial installation.
  4. Fire alarm system and all associated equipment and devices shall be suited to the environment in which it is installed, e.g. in a hazardous areas all equipment shall be appropriately rated as explosion-proof, intrinsically safe, etc.

### **1.5 SUBMITTALS**

- A. Shop Drawings:
  1. Shop drawings submittal shall include minimum required documentation as prescribed in NFPA 72. This includes, but is not limited to, the following:
    - a. Written narrative providing design intent and system description.
    - b. Floor plan layout showing location of all devices and control equipment:
      - 1) Indicate salient features of each device (e.g., weatherproof, strobe candela rating).

## SECTION 28 46 00 - FIRE DETECTION AND ALARM

- 2) Designate where protective equipment is provided (e.g. pull station covers, device guards, etc).
  - 3) Explosion-proof or intrinsically safe ratings for devices.
  - c. Wiring diagrams (including riser diagram).
  - d. Include system details including location of FACU and all devices and circuiting.
  - e. System power and battery backup calculations and voltage drop calculations to assure that system will operate in accordance with prescribed backup time periods and under all voltage conditions per UL and NFPA standards.
  - f. Provide equipment technical data sheet Submittal for all products specified in product section (PART 2), below.
  - g. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs.
  - h. Provide list of all input and output points in system with label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.
  - i. Equipment design considerations for future expansion as indicated.
  - j. Operating instructions for FACU.
  - k. Completed NFPA 72 record of inspection and testing (see Contract Closeout Information: below for additional requirements).
  - l. Copy of site specific software.
  - m. Name of local service organization.
  - n. Documentation of AHJ approval for system submittal.
- B. Contract Closeout Information:
1. Operation and Maintenance Data:
    - a. See Specification Section 01 78 23 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
  2. Field test reports.
  3. Owner instruction report.
  4. Prorata warranty for batteries.
  5. Spare parts: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:
    - a. Notification Appliances: Furnish quantity equal to 5% of each type and number of units installed, but not less than one of each type.
    - b. Automatic initiation devices including but not limited to smoke sensors and heat sensors: Furnish quantity equal to 5% of each type and number of units installed but not less than one of each type.
    - c. Detector or Sensor Bases: Furnish quantity equal to 2% of each type and number of units installed but not less than one of each type.
- C. Refer to Section 01 81 33 – Cyber Security Requirements for required cyber security related submittals.

### 1.6 AREA DESIGNATIONS

- A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.
1. Outdoor areas:
    - a. Wet.
  2. Indoor areas:
    - a. Dry.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable.
  - 1. Fire alarm system:
    - a. Edwards Systems Technology (EST).
    - b. Gamewell FCI.
    - c. Notifier.
    - d. Monaco.
    - e. Siemens Industry.
    - f. Silent Knight.
    - g. Simplex Grinnell.
    - h. Cooper Wheelock.
  - 2. Manufacturer must have a service organization local to the project site(s).
- B. All Equipment:
  - 1. UL listed as a product of a single manufacturer under appropriate category.
  - 2. Equipment shall not be modified or installed to alter or void UL label or listing.
  - 3. FM approved.
  - 4. Approved by Fire Marshal.

**2.2 FIRE ALARM CONTROL UNIT (FACU)**

- A. Refer to Section 01 81 33 - Cyber Security Requirements for cyber security related product requirements.
- B. FACU shall perform operations as described in Fire Alarm System Operation:
- C. The Fire Alarm system shall have 100 point minimum initiating device capacity with the capability to add additional 100 point minimum initiating device control modules.
- D. Construction shall be modular with solid-state, microprocessor-based electronics.
  - 1. An 80-character LCD display shall indicate alarms, supervisory service conditions and any troubles.
- E. Keyboards or keypads shall not be required to operate system during fire alarm conditions.
- F. Provide necessary switches, relays, indicator lamps, wiring terminals, etc., to provide complete operation supervising, control, and testing facilities for entire system.
- G. FACU shall allow for loading or editing special instructions and operating sequences as required.
  - 1. System shall be capable of on-site programming to accommodate and facilitate expansion, building parameter changes or changes as required by local codes.
  - 2. All software operations shall be stored in a non-volatile programmable memory within FACU.
- H. System shall have provisions for disabling and enabling all circuits individually for maintenance and testing purposes.

## **SECTION 28 46 00 - FIRE DETECTION AND ALARM**

- I. System shall be capable of logging and storing 300 events in a history log.
  - 1. These events shall be stored in a battery protected random access memory.
  - 2. Each recorded event shall include time and date of that event's occurrence.
  - 3. System shall have capability of recalling alarms, supervisory conditions, trouble conditions, acknowledgments, silencing and reset activities in chronological order for purpose of recreating an event history.
  
- J. FACU shall be listed under UL 864.
  
- K. FACU shall be in an enclosed metal cabinet with glass door specifically designed for public areas.
  - 1. Mounting: Surface.
  - 2. Finish: Red baked enamel.
  
- L. Each addressable device shall be represented individually in FACU.
  - 1. Indicate TROUBLE by a discreet LCD readout for each supervised circuit.
  - 2. Indicate ALARM by a discreet LCD readout for each alarm initiating addressable device.
  - 3. Include individual supervisory and alarm relays in each circuit arranged so that ground or open condition in any circuit or group of circuits, will not affect proper operation of any other device.
  
- M. FACU shall include the capability to report alarm and trouble conditions via a telephone line to a third party alarm reporting services.
  
- N. FACU shall include a system testing capability to help ensure that zoning and supervision have been maintained throughout system.
  - 1. Actuation of the enable walk test program at FACU shall activate "Walk-Test" mode of system which shall cause the following to occur:
    - a. Third party reporting connection circuit shall be disconnected or put in test mode with central station.
    - b. Control relay functions shall be bypassed.
    - c. FACU shall indicate a trouble condition.
    - d. FACU shall, at a minimum, be capable of causing audible signals to activate for 2 seconds upon alarm activation of any initiation device.
    - e. FACU shall automatically reset itself after code is complete.
    - f. Any momentary opening of alarm initiating or alarm indicating circuit wiring shall cause audible signals to sound continuously for 4 seconds to indicate trouble condition.
    - g. System shall have distinctive walk test groups such that only a portion of system need be disabled during testing and an alarm in any other area will be processed normally.
    - h. FACU shall provide addressable output module for shut down of HVLS Fan in the event of sprinkler system water flow and general fire alarm.
  
- O. General Alarm Circuits: Positive non-interfering type so that a second device can be annunciated simultaneously, or closely following first zone.
  
- P. Power Supply:
  - 1. Power limited operation per NFPA 70, Article 760.
  - 2. 120 VAC dedicated circuit from panel board to integral 24 VDC regulated power supply in FACU and battery charger.
    - a. The power supply shall provide all panel and peripheral device power needs.
  - 3. If the FACU cannot provide power for the required number of notification appliances a power extender shall be used.
    - a. An additional 120 VAC dedicated circuit from a panel board shall be used to power the power extenders power supply and battery charger.

4. Provide transient voltage surge suppression (TVSS) for Main FACU for power supply and communication channel(s).

Q. Battery:

1. Low maintenance sealed type, for fire alarm use with automatic battery charger.
2. Fire alarm systems without voice evacuation capability shall be provided with batteries capable of operating maximum normal load of system for 24 hours and then capable of operating system for 5 minutes in alarm condition.
3. Fire alarm systems shall be provided with batteries capable of operating maximum normal load of system for 24 hours and then capable of operating system for 15 minutes in alarm condition.
4. Size batteries for the total maximum number of devices that can be connected to the FACU not the install number of devices.
5. The notification appliance power extender shall have the same battery requirements as the FACU.

**2.3 INITIATING DEVICES**

A. Addressable Smoke Detectors:

1. Photoelectric type that utilizes a sensor chamber with a light source and a photosensitive element that detects products of combustion.
2. Self-restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
3. Quantity and spacing based upon manufacturer's UL listed spacing and the following:
  - a. Provide detectors in accordance with NFPA 72 and the requirements of the AHJ.
  - b. Devices shall be suitable for environment in which they are installed.
  - c. Spacing shall be reduced for increased air changes as required by NFPA 72.
4. Detectors in non-accessible or controlled access locations shall be provided with a remotely located test switch to provide for ease of testing.
5. The detector's electronics shall be immune from false alarms caused by EMI and RFI.
6. Standards: UL 268.

B. Air Duct Smoke Detector (for AHU capacity of greater than 2,000 CFM):

1. Duct smoke detectors shall utilize addressable photoelectric type detector as specified herein.
2. Duct housing mounted directly to outside of duct with a sampling tube extended across duct to sample air movement.
3. Duct housing couplings slotted to insure proper alignment of sampling and exhaust tubes.
  - a. Tube lengths as required per duct width.
4. Detector housing shall have an alarm LED visible through front cover.
5. Remote red LED alarm indicators shall be provided on the wall or ceiling adjacent to detectors above the ceiling or that are not visible from the ground.
  - a. Duct detectors in non-accessible locations shall be provided with a remotely located test switch to provide for ease of testing.
6. Standards: UL 268A.

C. Addressable Monitor Modules:

1. Provides addressability and supervision to a conventional initiating device (e.g., tamper switches, pressure switches, flow switches, etc).
  - a. The conventional initiating device shall be wired Class B, Style B.
2. Integral or remote LED shall be provided that will flash each time it is scanned by the FACU.



## **SECTION 28 46 00 - FIRE DETECTION AND ALARM**

- a. When the FACU determines that a monitor module is in an alarm or a trouble condition, the FACU shall command the LED on that module to turn on steady, change color, or otherwise indicate that an abnormal condition exists.

### **D. Sprinkler System Devices:**

1. Provide monitor module as specified herein for waterflow switches(s).
  - a. Waterflow switches provided in Specification Section 21 05 00.
2. Provide monitor module as specified herein, for tamper switches associated with main water valve, or OS&Y valves.
  - a. Tamper switches provided in Specification Section 21 05 00.

## **2.4 AUTOMATIC CONTROL DEVICES**

### **A. Addressable Relay/Control Modules:**

1. Allows FACU to control a remotely located Form "C" contact (e.g., HVAC fans, dampers, fire shutters, elevator capture).

## **2.5 NOTIFICATION APPLIANCES**

### **A. Alarm Horns:**

1. Electric-vibrating polarized type, operating on 24 VDC, with provision for housing the operating mechanism behind a grille.
2. Horns produce a sound pressure level of 85 dB, measured at 10 feet.
3. Housing: Red with white "FIRE" lettering.
  - a. Semi-flush or flush mounted in architecturally finished areas.
  - b. Surface-mounted in non-architecturally finished areas.
4. Horns shall be weatherproof in areas designated as wet.

### **B. Alarm Strobes:**

1. White tamper resistant lexan lens with 24 VDC xenon strobe.
2. Provide Candela rating as required per ADA and synchronize of multiple strobes when required.
3. Housing: Red with white "FIRE" lettering.
  - a. Semi-flush or flush mounted in architecturally finished areas.
  - b. Surface-mounted in non-architecturally finished areas.
4. Strobes shall be weatherproof in areas designated as wet or in areas indicated in the schedules herein.

### **C. Combination Audio/Visual Devices:**

1. Shall be mounted in an integral unit and shall have the same features as the individual units specified in the previous sub sections.

### **D. Standards: UL 464, UL 1971.**

## **2.6 MISCELLANEOUS DEVICES**

### **A. Isolated Loop Circuit Protector (Transient Suppression):**

1. Hybrid solid state high performance suppression system.
  - a. Do not use gas tubes, spark gaps or other suppression system components which might short or crowbar the line resulting in interruption of normal power flow to connected loads.

## SECTION 28 46 00 - FIRE DETECTION AND ALARM

2. Line-to-line response time of less than 1 nanosecond capable of accepting a 2000 A (8 x 20 usec pulse) at 28 V.
3. Line-to-ground response time of less than 1 nanosecond capable of accepting a 2000 A (8 x 20 usec pulse) to earth.
4. Shield-to-ground shall be capable of accepting a 5,000 A (10 x 50 usec pulse) to earth.
5. Standard: UL 497B.

### 2.7 WIRING

- A. Conduit:
  1. 1/2 inches minimum.
  2. See Specification Section 26 05 33.
- B. Conductors:
  1. Insulation type per NFPA 70, Article 760.
  2. 120 VAC and power supply connections: 12 GA, minimum.
  3. Low-voltage general alarm circuits: 14 GA, minimum.
  4. Low-voltage initiating circuits: 18 GA, minimum.
  5. Annunciator and data communication circuits: As required by manufacturer, UL listed.
  6. Use larger wire sizes when recommended by equipment manufacturer and per voltage drop calculations.
- C. Outlet Boxes: See Specification Section 26 05 33.

### 2.8 SYSTEM OPERATION

- A. Activation of any alarm-causing Initiating device shall cause the following:
  1. General evacuation notification via activation of audible and visual notification appliances.
  2. Automatic control devices to operate as defined by the operating sequences.
  3. Alarm information shall be displayed at the FACU.
- B. All fire alarm signals are automatically locked on the display of the FACU until originating device is returned to normal and FACU is manually reset.
  1. Audible alarm signals shall be silence-able from FACU allowing for re-initiation following a subsequent alarm.
    - a. Silencing of alarm signals shall not impair ability of system to continue to perform as specified.
- C. Air Handling Equipment Fan Control:
  1. De-energize indicated air-handling equipment and interlocked exhaust fans upon alarm and close all associated smoke dampers.
  2. See Specification Section 23 09 00 for mechanical equipment sequence of operation and coordinate all fan controls.
  3. Fans shall not restart until FACU is manually reset.
- D. Activation of any system trouble shall initiate the following:
  1. Common audible trouble signal shall sound and common trouble light shall illuminate at the FACU, any FAA's, and any remote FACU's.
  2. Specific device in trouble shall be indicated.
- E. Audible trouble signal shall be silenceable by FACU.
  1. Visual trouble indication remains until trouble condition is corrected.

## **SECTION 28 46 00 - FIRE DETECTION AND ALARM**

- a. A subsequent trouble condition received after manually silencing shall cause audible trouble signal to resound.
- b. Restoration of system to normal causes audible trouble signal until silencing switch is returned to normal position.
2. Trouble signal(s) will be initiated under following conditions:
  - a. Open on an initiation or alarm indicating circuit.
  - b. Open in wiring to any FAA or any remote FACU's.
  - c. Ground fault condition.
  - d. Auxiliary manual control switch out of normal position.
  - e. Loss of 120 VAC operating power to the Main FACU or any Remote FACU's.
  - f. Low or no battery voltage condition.
  - g. Main sprinkler valve is closed.
  - h. Any sprinkler indicating valve is closed.
- F. Install isolated loop circuit protectors on all fire alarm data communication circuits, SLC and NAC wiring, including shields, which extends beyond the building.
  1. The isolated loop circuit protector shall be located as close as practicable to the point at which the circuits leave or enter a building.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install all fire alarm equipment and wiring in accordance with local and national codes and NFPA 72.
- B. Install all wiring in raceways and all devices in boxes:
  1. Install raceways and boxes in accordance with Specification Section 26 05 33.
  2. In unfinished areas, exposed fire alarm conduit shall be red in color.
  3. All boxes are to be red in color (either painted or a manufacturer's red box).
- C. Install all components as indicated and in accordance with manufacturer's wiring diagrams, instructions and recommendations.
- D. Make all fire alarm wiring continuous from terminal to terminal or from terminal to device pigtail lead.
  1. Circuit splices not permitted.
  2. Wiring joints, only when required at device pigtail leads shall utilize insulated conical spring connector.
- E. Color coding or other identification is required for all fire alarm wiring.
  1. Coordinate requirements with Owner.
- F. Installation of equipment and devices that pertain to other work in contract shall be closely coordinated with appropriate subcontractors.
  1. Coordinate 8 inches minimum square access door with rubber gasket in duct approximately 2 FT upstream from smoke detector for testing and servicing.
- G. Detection devices shall be protected during construction as required by NFPA 72.
- H. Device Mounting Schedule:
  1. Dimensions are to center of item unless otherwise indicated.

## **SECTION 28 46 00 - FIRE DETECTION AND ALARM**

2. Mounting heights as indicated below unless otherwise indicated on the Contract Drawings.
  - a. Notification appliances: Lens is not less than 80 inches and not greater than 96 inches.
  - b. Control panels and remote annunciators: 72 inches to top (display at eye level).

### **3.2 TESTING**

- A. Obtain services of factory trained representative of system manufacturer to supervise installation and its progress, supervise final connections to equipment and provide testing to assure that system is in proper operating condition, and is in compliance with all applicable regulations.
- B. Entire system shall test free from opens, grounds, and short circuits.
- C. Test system to satisfaction of Engineer and state and local fire authorities in accordance with NFPA 72, state and local codes and manufacturer's requirements.
- D. Acceptance Operational Tests:
  1. Perform operational system tests to verify conformance with specifications:
    - a. Each alarm initiating device installed shall be operationally tested.
    - b. Each device shall be tested for alarm and trouble conditions.
    - c. Fire Alarm Submit written certification that Fire Alarm System installation is complete including all punch-list items.
    - d. Test battery operated emergency power supply. Test emergency power supply to minimum durations specified.
    - e. Test supervising station signal transmitter. Coordinate testing with supervising station monitoring firm/entity.
    - f. Test each notification appliance installed for proper operation. Submit written report indicating sound pressure levels at specified distances.
    - g. Test FACU.
  2. Provide minimum 5 business days notice of acceptance test performance schedule to Owner, and local Authority Having Jurisdiction (AHJ).
- E. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by system test that total system meets Specifications and complies with applicable standards.
- F. Report of Tests and Inspections: Provide written record of inspections, tests, and detailed test results in form of test log. Use NFPA 72 Forms for documentation.
- G. Final Test, Record of Completion, and Certificate of Occupancy:
- H. Test system as required by Authority Having Jurisdiction in order to obtain certificate of occupancy. Provide completed NFPA 72 Record of Completion form to Owner and AHJ.

### **3.3 CLEANING AND ADJUSTING**

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris from all devices and equipment panels. Clean panel internally using methods and materials recommended by manufacturer.

## **SECTION 28 46 00 - FIRE DETECTION AND ALARM**

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- B. Occupancy Adjustments: When requested within one year of date of substantial completion, provide on-site assistance in adjusting sound pressure levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to site for this purpose.

### **3.4 TRAINING**

- A. Provide services of factory-authorized service representative to demonstrate system and train Owner's personnel in operation of system as specified below.
  1. Train Owner's maintenance personnel in procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of system.
  2. Provide minimum of 8 hours training.
  3. Schedule training with Owner at least two weeks in advance.
  4. Fill out Owner instruction reports.

### **3.5 CLOSEOUT ACTIVITIES**

- A. Refer to Section 01 81 33 – Cyber-Security Requirements for cyber security related closeout requirements.

**END OF SECTION 28 46 00**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Soil treatment.

**1.2 PREINSTALLATION MEETINGS**

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

**1.3 ACTION SUBMITTALS**

- A. Product Data: For each type of product. Include the EPA-Registered Label for termiticide products.

**1.4 INFORMATIONAL SUBMITTALS**

- A. Product certificates.
- B. Soil Treatment Application Report: Include the following:
  - 1. Date and time of application.
  - 2. Moisture content of soil before application.
  - 3. Termiticide brand name and manufacturer.
  - 4. Quantity of undiluted termiticide used.
  - 5. Dilutions, methods, volumes used, and rates of application.
  - 6. Areas of application.
  - 7. Water source for application.
- C. Sample Warranties: For special warranties.

**1.5 QUALITY ASSURANCE**

- A. Installer Qualifications: A specialist who is licensed according to regulations of authorities having jurisdiction to apply termite control treatment and products in jurisdiction where Project is located and who employs workers trained and approved by manufacturer to install manufacturer's products.

**1.6 WARRANTY**

- A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work consisting of applied soil termiticide treatment will prevent infestation of subterranean termites, including Formosan termites (*Coptotermes formosanus*). If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
  - 1. Warranty Period: Five years from date of Substantial Completion.

**PART 2 - PRODUCTS**

**2.1 SOIL TREATMENT**

- A. Termiticide: EPA-Registered termiticide acceptable to authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation.
  - 1. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

**PART 3 - EXECUTION**

**3.1 PREPARATION**

- A. Remove extraneous sources of wood cellulose and other edible materials, such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
- B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated.

**3.2 APPLYING SOIL TREATMENT**

- A. Application: Mix soil treatment termiticide solution to a uniform consistency. Distribute treatment uniformly. Apply treatment at the product's EPA-Registered Label volume and rate for maximum specified concentration of termiticide to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction.
  - 1. Slabs-on-Grade and Basement Slabs: Underground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
  - 2. Foundations: Soil adjacent to and along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing.
  - 3. Crawlspace: Soil under and adjacent to foundations. Treat adjacent areas, including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.
  - 4. Masonry: Treat voids.
  - 5. Penetrations: At expansion joints, control joints, and areas where slabs and below-grade walls will be penetrated.
- B. Post warning signs in areas of application.
- C. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

**END OF SECTION 31 31 16**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Interior chain-link fences.
  - 2. Interior swing gates.

**1.3 PREINSTALLATION MEETINGS**

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Inspect and discuss preparatory work specified elsewhere.
  - 2. Review coordination of interlocked equipment specified in this Section and elsewhere.
  - 3. Review required testing, inspecting, and certifying procedures.

**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 the following:
    - a. Fence and gate posts, rails, and fittings.
    - b. Chain-link fabric, reinforcements, and attachments.
    - c. Gates and hardware.
- B. Shop Drawings: For each type of fence and gate assembly.
  - 1. Include plans, elevations, sections, details, and attachments to other work.
  - 2. Include accessories, hardware, gate operation, and operational clearances.
- C. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:
- D. Delegated-Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

**1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For professional engineer.
- B. Product Certificates: For each type of chain-link fence, and gate.
- C. Product Test Reports: For framework strength according to ASTM F1043, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.



## SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gate operators to include in emergency, operation, and maintenance manuals.

### 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

### 1.8 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

### 1.9 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure to comply with performance requirements.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - c. Faulty operation of gate operators and controls.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design chain-link fence and gate frameworks.

### 2.2 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
  - 1. Fabric Height: As indicated on Drawings.
  - 2. Steel Wire for Fabric: Wire diameter of 0.192 inch.
    - a. Mesh Size: 1-3/4 inches.
    - b. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
  - 3. Selvage: Knuckled at both selvages.

**2.3 FENCE FRAMEWORK**

- A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 or ASTM F1083 based on the following:
  - 1. Fence Height: As indicated on Drawings.
  - 2. Heavy-Industrial-Strength Material: Group IA, round steel pipe, Schedule 40.
    - a. Line Post: 6.625 inches in diameter.
    - b. End, Corner, and Pull Posts: 6.625 inches in diameter.
  - 3. Horizontal Framework Members: Top and bottom rails according to ASTM F1043.
    - a. Top Rail: 1.66 inches in diameter.

**2.4 SWING GATES**

- A. General: ASTM F900 for gate posts for single gate types.
  - 1. Gate Leaf Width: As indicated.
  - 2. Framework Member Sizes and Strength: Based on gate fabric height as indicated.
- B. Pipe and Tubing:
  - 1. Zinc-Coated Steel: ASTM F1043 and ASTM F1083; protective coating and finish to match fence framework.
  - 2. Gate Posts: Round tubular steel.
  - 3. Gate Frames and Bracing: Round tubular steel.
- C. Frame Corner Construction: Welded or assembled with corner fittings.
- D. Hardware:
  - 1. Hinges: 180-degree swing as indicated.
  - 2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.

**2.5 FITTINGS**

- A. Provide fittings according to ASTM F626.
- B. Post Caps: Provide for each post.
  - 1. Provide line post caps with loop to receive top rail.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
  - 1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
  - 2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate bottom rails to posts.
- E. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.
- F. Tie Wires, Clips, and Fasteners: According to ASTM F626.
  - 1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
    - a. Hot-Dip Galvanized Steel: 0.148-inch- diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.

## SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

- G. Finish:
  - 1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.

### 2.6 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

### 2.7 GROUNDING MATERIALS

- A. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- B. Connectors and Grounding Rods: Listed and labeled for complying with UL 467.
  - 1. Connectors for Below-Grade Use: Exothermic welded type.
  - 2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
  - 1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

### 3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.
- B. Post Excavation: Drill holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.

## SECTION 32 31 13 - CHAIN LINK FENCES AND GATES

1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
  2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    - a. Exposed Concrete: Extend 2 inches above grade; shape and smooth to shed water.
    - b. Posts Set into Holes in Concrete: Form or core drill holes not less than 5 inches deep and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
- D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment of as indicated on Drawings. For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.
- E. Line Posts: Space line posts uniformly at 96 inches o.c.
- F. Post Bracing and Intermediate Rails: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
  1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
- G. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
- H. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.
- I. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.
- J. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. Peen ends of bolts or score threads to prevent removal of nuts.

### 3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

**SECTION 32 31 13 - CHAIN LINK FENCES AND GATES**

**3.5 ADJUSTING**

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range.
  - 1. Confirm that latches and locks engage accurately and securely without forcing or binding.

**END OF SECTION 32 31 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes:
  - 1. Fuel service (diesel, gasoline, ethanol, fuel oil, motor oil, DEF) pipe and piping components.
  - 2. Fuel service containment sumps.
  
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 26 - Electrical.
  - 2. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
  - 3. Section 33 56 13 - Aboveground Fuel Storage Tanks.
  - 4. Section 33 57 10 - Fuel Dispensing Equipment.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Association of State Highway and Transportation Officials (AASHTO):
    - a. M294, Standard Specification for Corrugated Polyethylene Pipe, 12- to 60-in. Diameter.
  - 2. American Petroleum Institute (API):
    - a. RP 1110, Recommended Practice for the Pressure Testing of Steel Pipelines for the Transportation of Gas, Petroleum Gas, Hazardous Liquids, Highly Volatile Liquids, or Carbon Dioxide.
    - b. Spec 5L, Specification for Line Pipe.
    - c. Spec 6FB, Specification for Fire Test for End Connections.
    - d. Std 607, Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats.
  - 3. American Society of Mechanical Engineers (ASME):
    - a. B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
    - b. B16.5, Pipe Flanges and Flanged Fittings.
    - c. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
    - d. B16.10, Face-to-Face and End-to-End Dimensions of Valves.
    - e. B16.11, Forged Steel Fittings, Socket Welding and Threaded.
    - f. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
    - g. B16.34, Valves – Flanged, Threaded, and Welding End.
    - h. B16.39, Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300.
    - i. B18.2.1, Square and Hex Bolts and Screws (Inch Series).
    - j. B18.2.2, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).
    - k. B31.3, Process Piping.
    - l. B36.10, Welded and Seamless Wrought Steel Pipe.
    - m. B36.19, Stainless Steel Pipe.
    - n. Boiler and Pressure Vessel Code (BPVC), Section V – Nondestructive Examination.
  - 4. American Society of Nondestructive Testing (ASNT):
    - a. SNT-TC-1A – Personnel Qualification and Certification in Nondestructive Testing.
  - 5. ASTM International (ASTM):
    - a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    - b. A105, Standard Specification for Carbon Steel Forgings for Piping Applications.
    - c. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.

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- d. A193, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications.
- e. A194, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
- f. A216, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
- g. A234, Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- h. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- i. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
- j. A351, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
- k. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
- l. A403, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
- m. A733, Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples.
- n. A743, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
- o. D229, Rigid Sheet and Plate Materials Used for Electrical Insulation.
- p. D2310, Standard Classification for Machine-Made Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
- q. D2996, Standard Specification for Filament-Wound Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
- r. F436, Hardened Steel Washers.
6. Code of Federal Regulations (CFR):
  - a. 40 CFR 112, Oil Pollution Prevention.
7. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
  - a. SP-6, Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings.
  - b. SP-25, Standard Marking Systems for Valves, Fittings, Flanges, and Unions.
  - c. SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation.
  - d. SP-72, Ball Valves with Flanged or Buttwelding Ends for General Service.
8. National Fire Protection Association (NFPA):
  - a. 20, Standard for the Installation of Stationary Pumps for Fire Protection.
  - b. 30, Flammable and Combustible Liquids Code.
  - c. 30A, Motor Fuel Dispensing Facilities and Repair Garages.
  - d. 31, Standard for the Installation of Oil-Burning Equipment.
  - e. 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
  - f. 110, Standard for Emergency and Standby Power Systems.
9. Occupational Safety and Health Administration (OSHA):
  - a. 29 CFR 1910.106, Flammable Liquids.
10. Society for Protective Coatings (SSPC):
  - a. PA 1, Shop, Field, and Maintenance Painting of Steel.
11. Society of Automotive Engineers International (SAE):
  - a. AMS3275, Sheet, Acrylonitrile Butadiene (NBR) Rubber and Non-Asbestos Fiber Fuel and Oil Resistant.
  - b. J514, Hydraulic Tube Fittings.
12. Underwriters Laboratories, Inc. (UL):
  - a. 842, Standard for Valves for Flammable Fluids.
  - b. 971, Nonmetallic Underground Piping for Flammable Liquids.

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- B. Regulatory Requirements:
  - 1. Pipe installers must be licensed / certified by the state when the state requires licensed installers.
  
- C. Inspections:
  - 1. Visually inspect pipe and fittings at time of delivery and just prior to installation.
    - a. Do not use defective materials.
    - b. Immediately remove rejected material from the project site.

### **1.3 SYSTEM DESCRIPTION**

- A. Design Requirements:
  - 1. Provide the entire fuel distribution system as a complete and fully operational system.
  - 2. Size, select, construct, and install equipment and system components to operate together as a complete system.
  - 3. Pipe and piping components specified herein shall be compatible with the fuel to be handled.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Fabrication and/or layout drawings:
    - a. Below ground piping drawings with information including:
      - 1) Dimensions of piping lengths.
      - 2) Invert or centerline elevations of piping crossings.
      - 3) Acknowledgement of bury depth requirements.
      - 4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, and related appurtenances.
      - 5) Line slopes, vents, and drains.
    - b. Above ground piping drawings with information including:
      - 1) Dimensions of piping from wall surfaces or column lines.
      - 2) Centerline dimensions of piping.
      - 3) Centerline elevation and size of intersecting conduit/conduit racks, or other potential interferences requiring coordination.
      - 4) Location and type of pipe supports and anchors.
      - 5) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
      - 6) Line slopes, air release vents and low point drains.
  
- B. Product Data:
  - 1. Pipe and piping components:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Copies of manufacturer's written directions regarding material handling, delivery, storage, and installation.
    - c. Copies of manufacturer's installation, operation, and maintenance (IOM) manuals.
    - d. Separate schedule sheet for each piping system scheduled in this Section showing compliance of all system components.
      - 1) Attach technical product data on gaskets, pipe, fittings, and other components.
  
- C. Test Reports:
  - 1. Welding NDE test results.
  - 2. Pressure test reports:



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- a. Copies of pressure test results on all piping systems.
  - b. Notification of time and date of piping pressure tests.
- D. Certificates:
- 1. Contractor qualifications:
    - a. State licenses or certificates, if applicable.
    - b. For fiberglass reinforced plastic (FRP) pipe installation, certification by the FRP manufacturer as a qualified installer of their products is required.
  - 2. Welding qualifications:
    - a. Welding Procedure Specification (WPS) for each pipe material and process.
    - b. Procedure Qualification Record (PQR) for each WPS.
    - c. Welder Performance Qualification (WPQ) for each welder and each specification.
- E. Refer to Section 01 81 33 – Cyber Security Requirements for required cyber security related submittals.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle, store, and protect pipe and piping components to prevent damage before and during installation in accordance with the manufacturer's recommendations. Replace damaged or defective items.
- 1. Provide factory-applied plastic end-caps on each length of pipe and tube.
    - a. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.
  - 2. Protect stored pipes and tubes.
    - a. Elevate above grade and enclose with durable, waterproof wrapping.
  - 3. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.
  - 4. Use of bare cables, chains, hooks, metal bars, or narrow skids in contact with coated, plastic, FRP, or flexible pipe is not permitted.
  - 5. Avoid contact of any ferrous metal with stainless steel.
    - a. Use tools dedicated for stainless steel.
    - b. Handle using nylon slings and alloy chains, cable, or straps.
    - c. Store on racks constructed of non-ferrous metal or line with rubber.

### 1.6 PROJECT/SITE CONDITIONS

- A. Fuel required for the testing, flushing, and cleaning efforts, as specified in this section, will be provided and delivered by the Owner. Do not flush, clean, or test any system with fuel or liquid not intended for final system operation. Fuel used in the system will remain the property of the Owner.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, piping that may be incorporated in the work include, but are not limited to, the following:
- 1. Below ground double-wall containment pipe:
    - a. OPW FlexWorks.

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- b. Franking Fueling Systems APT Pipework.
  - c. National Oilwell Varco (NOV) Dualoy 3000/LCX.
  - d. Or equal.
  - 2. Containment sumps:
    - a. OPW FlexWorks.
    - b. Or equal.
- B. Submit requests for substitution in accordance with Division 01 requirements.

### **2.2 CONDITIONS OF SERVICE**

- A. Properties of Fuel Stored:
- 1. Fuel / Fluid: Diesel, Gasoline.
  - 2. Design Pressure: 60 PSIG.
  - 3. Internal temperature: Ambient.

### **2.3 BELOW GROUND FUEL SERVICE PIPING**

- A. System Description:
- 1. Fuel Piping (diesel, gasoline):
    - a. Double-wall containment type piping (ducted or coaxial).
    - b. Flexible or rigid pipe system.
  - 2. Vapor and Vent Piping:
    - a. Single-wall piping.
    - b. Rigid pipe system.
- B. General Requirements:
- 1. Standards compliance:
    - a. NFPA 30.
    - b. NFPA 30A.
    - c. NFPA 37.
    - d. NFPA 110.
    - e. ASME B31.3.
    - f. UL 971 seal of approval.
  - 2. Fittings and Couplings:
    - a. Fittings, tee fittings, elbow fittings, and adaptors as supplied or recommended by piping system manufacturer.
    - b. Provide product-tight sump penetration couplings as recommended by the piping manufacturer at containment sumps and dispenser sumps.
      - 1) Sump penetration coupling shall allow for slope of piping entering or exiting sump.
  - 3. Chemical compatibility:
    - a. All pipe and piping components shall be chemically compatible with products to be transported including EPA approved additives and with chemicals found naturally in the ground.
    - b. Internals of pipe and piping components that could be exposed to fuel during system operation shall not be constructed of zinc-coated (galvanized) metal, brass, bronze, or other copper-bearing alloys unless noted otherwise.
  - 4. Interstitial connections:
    - a. All primary and secondary piping shall be connected to permit integrity testing during installation and at periodic intervals in the future.
    - b. Primary and secondary piping shall remain continuous during testing.

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- c. Pipe shall slope to containment sump for monitoring. Components to allow for continuous monitoring for fluid leakage.
  5. Load tolerance:
    - a. Tolerance of H-20 burial loads in accordance with AASHTO M294.
  6. Corrosion resistance:
    - a. All piping and associated couplings, fittings, and adapters which come in contact with the ground environment shall be made of non-metallic material or encapsulated by non-metallic components to prevent corrosion.
- C. Flexible Piping System:
  1. Flexible inner primary pipe contained within flexible outer containment pipe.
    - a. Piping runs shall be continuous between containment chambers (i.e., tank and dispenser sumps) in which all joints are contained within the containment chambers.
  2. Primary (carrier) pipe:
    - a. Material: PVDF.
    - b. Temperature rating: -20 to 120 degrees F.
    - c. Minimum operating pressure rating: +75 psiG / full vacuum.
    - d. Minimum burst pressure: 250 psiG.
    - e. Minimum bend radius based on 1 inch ID pipe: 18 inches with no kinking, breaking, or cracking.
  3. Secondary pipe:
    - a. Material: PVDF.
    - b. Temperature rating: -20 to 120 degrees F.
    - c. Maximum operating pressure: 10 psiG.
    - d. Extruded over primary piping using standoff ribs allowing communication between primary and secondary layers for leak detection.
    - e. Minimum bend radius based on 1 inch ID primary pipe: 18 inches with no kinking, breaking, or cracking.
  4. Fittings and joints:
    - a. Stainless steel mechanical couplers with Viton gasket seals.
  5. Flexible corrugated ducting:
    - a. Purpose: To allow removal of double-wall pipe without pipe excavation.
    - b. Material: High Density Polyethylene (HDPE).
    - c. Fittings: Manufacturer's standard boot fittings.

### 2.4 ABOVE GRADE FUEL SERVICE PIPING

- A. System Description:
  1. Fuel Piping (diesel, gasoline):
    - a. Single-wall carbon or stainless steel piping.
  2. Vapor Piping:
    - a. Single-wall carbon or stainless steel piping.
- B. General Requirements:
  1. Standards compliance:
    - a. NFPA 30.
    - b. NFPA 30A.
    - c. NFPA 37.
    - d. NFPA 110.
    - e. ASME B31.3.
  2. Pipe and piping components specified herein shall be designed to handle a working pressure of 275 psiG at 100 degrees F.
  3. Pipe:

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- a. Pipe shall meet the material, fabrication, and operating requirements of ASME B31.3, except as modified herein.
4. Fittings:
  - a. Fittings smaller than 2-1/2 inches shall be Class 3000, socket weld type, unless indicated otherwise, conforming to ASME B16.11.
  - b. Fittings 2-1/2 inches and larger shall be butt weld type conforming to ASME B16.9 and be of the same wall thickness as the adjoining pipe.
  - c. Elbows shall be long radius unless otherwise indicated.
5. Flanges:
  - a. Flanges shall conform to ASME B16.5, Class 150.
  - b. Gaskets (non-isolating):
    - 1) Provide flange gaskets that are 1/16 inches thick and that conform to ASME B16.21, raised-face type, unless otherwise indicated.
    - 2) Gaskets shall be constructed of nitrile butadiene (Buna-N) or acrylonitrile butadiene rubber (NBR) material conforming to SAE AMS3275.
    - 3) Provide gaskets that are factory cut from one piece of material.
    - 4) Gaskets shall have a fire safe designation such as testing per API 6FB.
    - 5) Maximum operating temperature: 700 degrees F.
    - 6) Spiral-wound gaskets consisting of stainless-steel spiral wound metal, flexible graphite filler, and inner and centering rings of material similar to piping are also acceptable.
  - c. Gaskets (electrically isolating):
    - 1) Flange gaskets shall conform to ASTM D229 and shall provide an electrical insulating material of 1,000 ohms minimum resistance.
    - 2) Provide full face type gaskets that are chemically compatible with the fuel to be handled.
    - 3) Provide flanges that have a full surface 0.03 inches thick, spiral-wound mylar insulating sleeves between the bolts and the holes in the flanges. Bolts may have reduced shanks of a diameter not less than the diameter at the root of the threads.
    - 4) Provide high strength 1/8 inches thick phenolic insulating washers next to the flanges with flat circular stainless steel washers over the insulating washers and under bolt heads and nuts.
    - 5) Provide bolts long enough to compensate for the insulating gaskets and stainless steel washers.
  - d. Bolts, nuts, and washers:
    - 1) Bolts and nuts for pipe flanges shall conform to ASME B18.2.1 and ASME B18.2.2, except as otherwise specified.
    - 2) Bolts shall be hexagonal, heavy series type. Bolts shall be threaded in accordance with ASME B1.1, Class 2A fit, Coarse Thread Series, for sizes 1 inch and smaller, and Eight-Pitch Thread Series for sizes larger than 1 inch.
    - 3) Nuts shall be the hexagonal, heavy series type. Nuts shall be threaded in accordance with ASME B1.1, Class 2B fit, Coarse Thread Series, for sizes 1 inch and smaller, and Eight-Pitch Thread Series for sizes larger than 1 inch.
    - 4) Bolts shall be of sufficient length to project at least two full threads beyond the nuts with the bolts tightened to the required torque.
6. Piping Components:
  - a. Piping components shall meet the material, fabrication, and operating requirements of ASME B31.3, except as modified herein.
  - b. Pressure design class for piping components shall be Class 150 as defined in ASME B16.5.
7. Chemical compatibility:
  - a. All pipe and piping components shall be chemically compatible with products to be transported including EPA approved additives.

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- b. Internals of pipe and piping components that could be exposed to fuel during system operation shall not be constructed of zinc-coated (galvanized) metal, brass, bronze, or other copper-bearing alloys unless noted otherwise.
- C. Carbon Steel Piping:
- 1. Pipe:
    - a. Carbon steel pipe shall conform to ASTM A53, Grade B, electric resistance welded or seamless (Type E or S).
    - b. Pipe smaller than 2-1/2 inches shall be Schedule 80.
    - c. Pipe 2-1/2 inches and larger shall be Schedule 40.
  - 2. Fittings:
    - a. Fittings smaller than 2-1/2 inches shall conform to ASTM A105.
    - b. Fittings 2-1/2 inches and larger shall conform to ASTM A234, Grade WPB.
  - 3. Flanges:
    - a. Flanges shall conform to ASTM A105.
    - b. Bolts shall conform to ASTM A193, Class 2, Grade B7.
    - c. Nuts shall conform to ASTM A194, Grade 2H.
    - d. Washers shall conform to ASTM F436, Type 1 (carbon steel), flat circular for carbon steel bolts.
- D. Stainless Steel Piping:
- 1. Pipe:
    - a. Stainless steel pipe shall conform to ASTM A312, Grade TP304L, seamless only, pickled and passivated as per ASTM A380.
    - b. Pipe smaller than 3 inches shall be Schedule 40S.
    - c. Pipe 3 inches and larger shall be Schedule 10S.
  - 2. Fittings:
    - a. Fittings smaller than 2-1/2 inches shall conform to ASTM A182, Grade F304L.
    - b. Fittings 2-1/2 inches and larger shall conform to ASTM A403, Grade WP304L, seamless only.
  - 3. Flanges:
    - a. Flanges shall conform to ASTM A182, Grade F304 or F304L, forged type.
    - b. Bolts shall conform to ASTM A193, Class 2, Grade B8.
    - c. Nuts shall conform to ASTM A194, Grade 8.
    - d. Washers shall be flat circular and Type 304 stainless steel.
- E. Tubing:
- 1. Tube:
    - a. Tubing shall be seamless, fully annealed stainless steel tubing conforming to ASTM A269, Grade TP316, with a hardness number not exceeding 80 hourB. For 1/2 inches tubing, provide a minimum 0.049 inches tubing wall thickness.
  - 2. Fittings:
    - a. Fittings shall be the flareless, Type 316 stainless steel type conforming to SAE J514.
- F. Piping Components:
- 1. Welded Nipples:
    - a. Nipples shall conform to ASTM A733 and be constructed of the same material as the connecting pipe.
  - 2. Steel Couplings:
    - a. Couplings shall conform to API Spec 5L, seamless, extra heavy, wrought steel with recessed ends.
  - 3. Threaded Unions:
    - a. Unions shall conform to ASME B16.39, Class 150.

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4. Flexible Pipe Connector:
  - a. Connector shall be the flexible, close pitch, metal hose type that is constructed with exterior annular corrugations and provided with a single layer of braided wire sheath covering.
  - b. Connectors shall be constructed entirely of stainless steel and be rated for the system working pressure and temperature.
  - c. Connectors shall have flanged end connections.
- G. Pipe Hangers and Supports.
  1. General requirements:
    - a. Hangers and supports shall be the adjustable type conforming to MSS SP-58, except as modified herein.
    - b. Provide hot-dipped galvanized finish on rods, nuts, bolts, washers, hangers, and supports.
    - c. Provide miscellaneous metal that conforms to ASTM A36, standard mill finished structural steel shapes, hot-dipped galvanized.
    - d. Provide PTFE pads between the piping and pipe supports to eliminate contact of dissimilar metals and prevent abrasion of the piping.
  2. Pipe protection shields:
    - a. Shields shall conform to MSS SP-58, Type 40, except material shall be Type 316 stainless steel. Provide shields at each slide type pipe hanger and support.
  3. Low Friction Supports:
    - a. Supports must have self-lubricating anti-friction bearing elements composed of 100% virgin tetrafluoroethylene polymer and reinforcing aggregates, prebonded to appropriate backing steel members. The coefficient of static friction between bearing elements shall be 0.06 from initial installation for both vertical and horizontal loads and deformation shall not exceed 0.002 inches under allowable static loads.
    - b. Bonds between material and steel shall be heat cured, high temperature epoxy.
    - c. Design pipe hangers and support elements for the loads applied.
    - d. Provide anti-friction material with a minimum of 0.09 inches thickness.
    - e. Provide hot-dipped galvanized steel supports.
    - f. Provide supports that are factory designed and manufactured.

### 2.5 GENERAL VALVES

- A. General Requirements:
  1. Valves shall have flanged or threaded end connections and conform to ASME B16.34, Class 150.
  2. Body, bonnet, and cover materials shall correspond to the piping system materials:
    - a. Carbon steel: ASTM A216 or brass.
    - b. Stainless steel: ASTM A351, Grade CF8M; ASTM A743, Type 304 or 316; or ASTM A216, Grade WCB internally plated with nickel.
  3. Provide stainless steel or chrome plated stem and trim.
  4. Seats, body seals, and stem seals shall be Viton, Buna-N, or PTFE (except where graphite required by valve manufacturer for fire resistance rating).
- B. Ball Valve:
  1. Ball valve shall be:
    - a. Apollo 88A-100 Series.
    - b. Flow-Tek RF15.
    - c. Morrison Brothers Figure 691B.
    - d. Or equal.
  2. Ball valve shall be non-lubricated, double-seated, with lockable handles.

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3. Ball valve shall be fire safe in accordance with API Spec. 607 or UL 842 listed for flammable liquids.
- C. Check Valve:
1. Check valves shall be:
    - a. Crane Fig. 147.
    - b. Morrison Brothers Figure 246A.
    - c. Or equal.
  2. Check valve shall be full opening, tilting disc, non-slam, swing type. Disc shall be guided and controlled to contact the entire seating surface.
- D. Foot Valve:
1. Foot valves shall be:
    - a. Morrison Brothers Figure 335A.
    - b. Or equal.
  2. Foot valve shall be double-poppet type with metal-to-metal seating.
  3. Foot valve shall include inlet filter screen with stainless steel materials.
- E. Relief Valve:
1. Expansion relief valves shall be:
    - a. Taylor 8200 Series (atmospheric pressure at discharge).
    - b. Taylor 7700 Series (backpressure at discharge).
    - c. Morrison Brothers Figure 076S, 78DI.
    - d. Swagelok RL4 Series.
    - e. Or equal.
  2. Provide relief valves at each location where segments of pipe can be isolated by valving or blinding. Utilize balanced-type relief valves as required to prevent excessive cascading pressures. Product shall return back to storage tank.
- F. Anti-Siphon Valve:
1. Anti-siphon valves shall be:
    - a. Morrison Brothers Figure 910.
    - b. Approved equals.
  2. Anti-siphon valve shall be normally closed, spring loaded, angle pattern type valve.
  3. Provide anti-siphon valve at the high point of the fuel lines from a storage tank.
  4. Valve opening pressure shall be selected to correspond to vertical drop from tank.
  5. Valve shall include integral thermal expansion relief.
  6. Use anti-siphon solenoid valves (below) on remote pump suction lines.
- G. Fire Safety Valve:
1. Fire safety valves shall be:
    - a. Morrison Brothers Figure 446.
    - b. Or equal.
  2. Provide a fire safety valve close to where the fuel supply line enters the building.
  3. Valve shall have a fusible link. Valve shall activate and stop flow in the event of a fire.
- H. Anti-Siphon Solenoid Valve:
1. Anti-siphon solenoid valves shall be:
    - a. Morrison Brothers Figure 710.
    - b. Or equal.
  2. Provide anti-siphon solenoid valve at the high point of the fuel supply lines from a storage tank.
  3. Valve shall be normally closed and shall open upon receipt of an electronic signal from corresponding pumps (tank-mounted pump, dispenser pump, fuel polisher pump, day tank supply pump, generator fuel pump, etc.) when switched on.

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4. Valve shall operate on 120 VAC.
5. Enclosure shall be watertight and rated for hazardous locations – NEMA 3, 4X, 7 and 9; groups C and D.
6. Valve shall include integral thermal expansion relief.
7. Valve shall include manual override option where available.

### 2.6 ACCESSORIES

#### A. Pressure Gauge:

1. Pressure gauges shall be:
  - a. Ashcroft 1009.
  - b. Or equal.
2. Pressure gauge shall be the single style type that conforms to ASME B40.100.
3. Pressure gauge shall have a minimum 4 inches dial size.
4. Pressure gauge materials shall be stainless steel case and tube.
5. Pressure gauge shall be liquid-filled with glycerin.
6. Provide pressure gauge assembly with isolation ball valve, pressure snubber, and scale range as indicated.

#### B. Line Strainer

1. Strainer shall be:
  - a. Morrison Brothers Figure 284, 285.
  - b. Or equal.
2. Provide a Y-type line strainer in each product discharge line.
3. Basket shall have bottom access and be removable for cleaning and/or replacement.
4. Strainer materials shall be cast iron or brass body and 100 mesh, stainless steel screen.

#### C. Cam and Groove Couplers:

1. Coupler shall be:
  - a. Morrison Brothers Figure 800A.
  - b. OPW 633AST.
  - c. Or equal.
2. Coupler shall be aluminum or bronze.
3. Provide coupler with a lockable cap.
  - a. Cap shall be:
    - 1) Morrison Brothers Figure 800DC.
    - 2) OPW 634BK.
    - 3) Or equal.
  - b. Cap shall mate with the adapter and have a latching mechanism which provides a water tight seal.
  - c. Cap shall provide some type of locking provision and be easily attachable and removable.
  - d. Cap shall be attached to the fill adapter by a 12 inch section of brass cable or fuel resistant rope.
  - e. Cap gasket shall be Buna-N or Viton material.

### 2.7 CONTAINMENT SUMPS

- A. Provide containment sumps as a leak collection point in below ground secondarily contained piping systems. Sumps shall also be used at low point drains, high point vents, and at above ground to below ground transitions. Sumps shall also be used to house below ground valves or equipment.



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- B. Requirements:
  - 1. General:
    - a. Do not connect sump in any way to the manway cover or concrete above.
    - b. Rainfall drainage shall not drain into a sump.
    - c. Sump shall be capable of withstanding underground burial loads to be encountered.
    - d. Depth shall be sufficient to maintain minimum bury depth of fuel piping.
    - e. Sump shall have a minimum 5 GAL fuel storage capacity.
    - f. Sump shall not contain any type of drain.
  - 2. Material:
    - a. Sump shall be constructed of FRP that is chemically compatible with the fuels to be handled.
  - 3. Cover:
    - a. Cap the top of each containment sump with a watertight access cover.
    - b. Construct cover of the same material as the sump.
    - c. Cover shall have a minimum diameter of 22 inches.
    - d. Cover shall be easily removable through the manway above.
  - 4. Pipe Connections:
    - a. The sides of a containment sump shall allow the penetration of carrier pipes, exterior containment pipes, conduits, and vapor pipes as required.
    - b. Boot or seal penetrations in the containment sump sides to ensure that liquid will not escape from the sump in the event that the liquid level within the sump rises above the pipe penetration.
    - c. Provide boots and seals that are chemically compatible with the fuel to be handled and that are water resistant to the influx of ground water.
    - d. Boots and seals shall be designed and installed to accommodate the anticipated amount of thermal expansion and contraction in the piping system.
  - 5. Leak Detection Monitoring:
    - a. Provide leak detection monitoring in accordance with Section 33 57 10.

### **2.8 FINISHES**

- A. General Requirements:
  - 1. Ship, store, and handle coating materials as well as apply and cure coatings in accordance with SSPC PA 1.
- B. Above Grade Fuel Service Piping:
  - 1. Coat the exterior of above ground carbon steel piping, flanges, fittings, nuts, bolts, washers, and piping components using a three-part coating system. Coating system shall include a zinc-rich epoxy primer, epoxy polyamide intermediate coat, and polyurethane top coat. Coating system shall be compatible with fuel to be handled and appropriate for outdoor exposures including UV resistance.
  - 2. Perform surface preparation and coating application in accordance with product manufacturer's instructions.
  - 3. Do not coat stainless steel piping, flanges, fittings, or other components.
  - 4. Do not coat piping components provided with a complete factory coating.
  - 5. Prior to any coating, clean surfaces to remove dust, dirt, rust, oil, and grease.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

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- A. Procure necessary permits, provide required notifications, and coordinate inspections with North Carolina Department of Environmental Quality (NCDEQ), North Carolina State Fire Marshal's Office, and other agencies as required, and other agencies as required.
- B. Installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.3, NFPA 30 and NFPA 20 and NFPA 30A, NFPA 37, NFPA 110, and local codes except as modified herein.
- C. General Locations and Arrangements:
  - 1. Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems.
  - 2. Final location and arrangement of piping layout shall take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations.
  - 3. So far as practical, install piping as indicated.
- D. Safety rules as specified in NFPA 30 and OSHA shall be strictly observed.
- E. Never direct bury threaded connections, unions, flanges, valves, air vents, or drains. Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible.
- F. Piping:
  - 1. General:
    - a. Thoroughly clean pipe of all scale and foreign matter before the piping is assembled.
    - b. Cut pipe accurately to measurements established at the jobsite, and work into place without springing or forcing. Cut pipe square and have burrs removed by reaming.
    - c. Install pipe to permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.
    - d. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval.
    - e. Use reducing fittings for changes in pipe sizes.
    - f. Install equipment and piping into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.
    - g. Provide electric isolation fittings between dissimilar metals.
    - h. Install piping straight and true to bear evenly on supports.
    - i. Piping shall be free of sags and traps, shall not be embedded in concrete pavement, and shall drain as indicated.
    - j. Make changes in direction with fittings. Mitering or notching pipe or other similar construction to form elbows or tees will not be permitted.
    - k. When work is not in progress, securely close open ends of pipe and fittings with an expandable pipe plug so that water, earth, or other substances cannot enter the pipe or fittings.
  - 2. Below Ground Piping:
    - a. Perform trenching and backfilling in accordance with the flexible fuel piping manufacturer's installation instructions. Ensure piping is installed in H-20 traffic load rated access/chase pipe.
    - b. The full length of each pipe shall rest solidly on the underlying pipe bed.
    - c. Slope piping towards containment sumps at a minimum of 1 inch per 50 feet.
    - d. Tracer wire is to be taped to any underground piping with marker tape above the pipe.
  - 3. Exterior Containment Piping System:
    - a. Install exterior containment piping in accordance with manufacturer's instructions. Do not assemble joints in an exterior containment piping system until the successful completion of the tests defined in paragraph "Field Quality Control" below.
  - 4. Above grade flexible piping systems:
    - a. Install flexible piping system in accordance with manufacturer's requirements.

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- b. Follow manufacturer's recommendations for configuration of piping at points where flexibility is particularly required such as shore to dock transition.
- 5. Welded Connections:
  - a. Unless otherwise indicated on the drawings, pipe joints shall be welded.
  - b. Welding shall be performed in accordance with the requirements of ASME B31.3.
  - c. Construct branch connections with welding tees or forged welding branch outlets.
  - d. Do not weld stainless steel pipe to carbon steel pipe.
  - e. Make all edges true. Do not leave a shoulder on the inside of the pipe.
  - f. Maintain a 1/16 inches clearance between the end of the pipe and the shoulder in the socket during the installation of socket-welded fittings and valves.
  - g. Welds shall present a smooth, regular workmanship appearance free from defects including undercutting, porosity, and cracking.
  - h. Perform non-destructive examination (NDE) per the requirements of ASME B31.3 for Normal Fluid Service.
    - 1) Use inspectors qualified to at least Level II in accordance with ASNT SNT-TC-1A.
    - 2) Conform to ASME BPVC, Section V.
    - 3) Examine 100% of all welds using visual examination.
    - 4) Examine at least 10% of all welds using liquid penetrant examination.
      - a) If defects are detected, examine all welds using this procedure.
      - b) Remove all penetrant test materials by flushing, washing, or wiping clean with appropriate solvents.
    - 5) Examine at least 5% of all butt welds using radiographic examination.
- 6. Threaded Connections:
  - a. Provide threaded end connections only on piping 2 inches in nominal size or smaller and only where necessary for attachment to valves or equipment.
  - b. Provide adequate and accessible unions for disassembly and maintenance or replacement of valves and equipment.
  - c. Provide threaded connections with PTFE tape or equivalent thread-joint compound applied to the male threads only.
  - d. Not more than three threads shall show after the joint is tightened.
- 7. Bolted Connections:
  - a. For each bolted connection of stainless steel components (e.g., pipes, piping components, valves, and equipment) use stainless steel bolts or studs, nuts, and washers.
  - b. For each bolted connection of carbon steel components, use carbon steel bolts or studs, nuts, and washers.
  - c. Extend bolts, or studs, no less than two full threads beyond their corresponding nut when tightened to the required torque.
  - d. Prior to installing nuts, apply a compatible anti-seize compound to the male threads.
- 8. Flanges:
  - a. Except where threaded end connections and/or unions are indicated, provide flanged joints in each line immediately preceding the connection to a piece of equipment or material requiring maintenance such as pumps, general valves, control valves, strainers, and other similar items and as indicated.
  - b. Assemble flanged joints square and tight with matched flanges, gaskets, and bolts.
  - c. Flange bolt holes shall evenly straddle centerlines.
  - d. Use flanged connections between FRP pipe and metal pipe with the metal pipe anchored within 5 feet of the connection.
  - e. For flanges, provide washers under each bolt head and nut.
  - f. Torque wrenches shall be used to tighten all flange bolts to the torque recommended by the gasket manufacturer. Tightening pattern shall be as recommended by the gasket manufacturer.
  - g. Use anti-seize compound on threads for stainless steel bolts.
- 9. Manual Air Vents:

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- a. Provide 1 inch (or match main line size if smaller) air vents at all high points and where indicated to ensure adequate venting of the piping system.
- 10. Drains:
  - a. Provide 1 inch (or match main line size if smaller) drains at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples, ball valves, and caps or plugged tees unless otherwise indicated.
- 11. Flexible Pipe Connectors:
  - a. Attach connectors to components in strict accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint.
  - b. Hangers, when required to suspend the connectors, shall be of the type recommended by the flexible pipe connector manufacturer and shall be provided at the intervals recommended.
- 12. Grounding:
  - a. Provide adequate grounding of all above grade piping and equipment per requirements of Division 26.
  - b. Provide approved jumpers where fittings cause a break in the electrical continuity of the system.
- G. Pipe Hangers and Supports:
  - 1. Install hangers with a maximum spacing as defined in Table 1 below, except where indicated otherwise. In addition to meeting the requirements of Table 1, provide additional hangers and supports where concentrated piping loads exist (e.g., valves).

Table 1. Maximum Hanger Spacing									
Nominal Pipe Size (IN)	0-1	1.5	2	3	4	6	8	10	12
Maximum Hanger Spacing (FT)	7	9	10	12	14	17	19	22	23

### 3.2 COORDINATION

- A. Coordinate the work of the system manufacturer's service personnel during construction, testing, calibration, and acceptance of the system.
- B. Coordinate installation of dispenser sumps, containment sumps, and piping with all other trades to ensure piping is installed and dispenser sumps are bolted to the fuel island frames prior to placing of concrete.

### 3.3 FUEL SUPPLY

- A. No fuel will be delivered to the system until the Contractor has satisfactorily completed the initial system cleaning and adjusting.
- B. Upon completion and acceptance of construction, examination, and initial testing, the Owner will deliver fuel to the storage tanks to enable the Contractor to make final adjustments to equipment and controls and complete performance testing.
- C. Any fuel found to be contaminated and unsuitable for reuse during subsequent testing and commissioning activities will be the responsibility of the Contractor to remove and dispose, including pumping out the entire fuel supply from the storage tanks and piping system.

**3.4 PRESSURE TESTS**

**A. General Testing Requirements:**

1. All tests shall be made in the presence of the Engineer or Owner. Any preliminary tests that the Contractor may make without such tests being observed by the Engineer or Owner will not be accepted unless prior approval is obtained. The Contractor shall provide notification at least 48 hours before any work is to be inspected or tested.
2. Furnish labor, materials, equipment, electricity, repairs, and retesting necessary for any of the tests required herein.
3. Perform piping test in accordance with the applicable requirements of ASME B31.3 except as modified herein.
4. To facilitate the tests, various sections of the piping system may be isolated and tested separately.
5. Where piping sections terminate at flanged valve points, close the line by means of blind flanges in lieu of relying on the valve.
6. Provide tapped flanges to allow a direct connection between the piping and the air compressor and/or pressurizing pump. Use tapped flanges for gauge connections. Taps in the permanent line will not be permitted. Gauges will be subject to testing and approval.
7. Provide provisions to prevent displacement of the piping during testing.
8. Keep personnel clear of the piping during pneumatic testing. Only authorized personnel shall be permitted in the area during pneumatic and hydrostatic testing.
9. Isolate equipment such as pumps, tanks, and meters from the piping system during the testing.
10. Do not exceed the pressure rating of any component in the piping system during the testing.
11. Following satisfactory completion of each test, relieve the test pressure and seal the pipe immediately.
12. Piping to be installed underground shall not be covered by backfill until the piping has passed the final pneumatic tests described herein.

**B. Preliminary Pneumatic Test:**

1. Apply a 25 psiG pneumatic test to product piping. Maintain the pressure while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, visually inspect the entire run of piping, including the bottom surfaces, for leaks (bubble formations).
2. If leaks are discovered, repair the leaks accordingly and retest.

**C. Hydrostatic Test:**

1. Hydrostatically test piping with the fuel to be handled to the lesser of 1-1/2 times operating pressure or 275 psiG in accordance with API RP 1110. Maintain the pressure within the piping for 4 hours with no leakage or reduction in gauge pressure.
2. If leaks are discovered, repair the leaks accordingly and retest.

**D. Exterior Containment Piping Tests:**

1. Apply a minimum pneumatic pressure of 5 psiG to the exterior containment piping (i.e., double wall secondary piping). Maintain the pressure for at least 1 hour while soapsuds or equivalent materials are applied to the exterior of the piping. While applying the soapsuds, visually inspect the entire run of piping, including the bottom surfaces, for leaks (bubble formations).
2. Repair leaks discovered in accordance with manufacturer's instructions and retest.
3. Perform testing in compliance with the manufacturer's published installation instructions.

**E. Containment Sump Tests:**

1. Test the integrity of the containment sumps using water.
2. Fill sumps to a level near the top of the sump and at least 4 inches about the highest penetration.

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3. Liquid level shall not lower by more than 1/8 inches over a 1 hour period.
4. Repair leaks and retest if required.
5. After the testing, remove all water and clean and dry the sump.

### **3.5 FLUSHING AND ADJUSTING**

- A. Flushing:
1. All new and modified fuel piping shall be flushed with fuel.
  2. Fuel shall be pumped at the system's maximum design flow rate from a storage tank, through the fuel supply piping, through dispensers or other equipment, and then into an empty fuel truck or tank as supplied by the Owner.
  3. During flushing procedure, periodically bleed air through high point vents and flush low point drains.
  4. Flushing shall continue until the fuel being delivered is free of construction debris. Samples of fuel shall be free of visible contamination or free water.
    - a. A minimum of 100 GAL shall be flushed through the system.
    - b. The flushing procedure shall be continued until the fuel being delivered is acceptable to the Owner.
  5. Replace filters and clean strainers after the flushing operation as needed.
- B. Initial System Adjustments:
1. Following the flushing and cleaning operations, each system component shall be initially adjusted, if necessary, to meet the system's final operational requirements.
  2. Flow rates and pressures shall be adjusted as required to meet the indicated requirements.
  3. The sequence of control for each component shall be adjusted to meet the indicated system requirements.
  4. Following the initial system adjustments, the equipment performance tests shall be performed in order to determine any necessary final system adjustments.

### **3.6 Performance Tests**

- A. System Performance Tests:
1. After all components of the system have been properly adjusted, test the system to demonstrate that the system meets the performance requirements for which it was designed.
  2. If any portion of the system or any piece of equipment fails to pass the tests, the Contractor shall make the necessary repairs or adjustments and the test shall be repeated until satisfactory performance is achieved.
  3. Tests shall be performed under all operating scenarios.
  4. The system shall be filled with fuel and shall be operable and leak-free prior to acceptance. The Contractor shall be responsible for any leaks in the new or modified portions of the system. Anything wet with fuel is considered to be leaking.

### **3.7 INITIAL START-UP**

- A. Contractor shall verify system is ready for service including reinstallation of any manway covers or blind flanges, removal of any blanks, and restoration of any other items modified for the cleaning and testing process.

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- B. Provide Owner with a written statement that manufacturer's equipment has been installed properly (including conformance with applicable codes and standards), has been started up, and is ready for operation by Owner's personnel.

### **3.8 TRAINING**

- A. Contractor shall conduct a training course for the operating staff as designated by the Owner.
  - 1. The training period shall consist of a total of 8 (maximum) hours of normal working time and shall start after the system is functionally completed but prior to final system acceptance.
  - 2. The field instructions shall cover all of the items contained in the operation and maintenance manuals, as well as demonstrations of routine maintenance operations.

### **3.9 CLOSEOUT ACTIVITIES**

- A. Refer to Section 01 81 33 – Cyber-Security Requirements for cyber security related closeout requirements.

**END OF SECTION**

# SECTION 33 56 13 - ABOVEGROUND FUEL STORAGE TANKS

## PART 1 - GENERAL

### 1.1 SUMMARY

- A. Section includes:
  - 1. Aboveground fuel storage tank(s) including all components and structures required for a complete operating and approved installation.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Procurement and Contracting Requirements.
  - 2. Division 01 - General Requirements.
  - 3. Division 26 - Electrical.
  - 4. Section 33 52 10 - Service Piping: Fuel Systems.
  - 5. Section 33 57 10 - Fuel Dispensing Equipment.

### 1.2 QUALITY ASSURANCE

- A. Referenced Standards:
  - 1. American Petroleum Institute (API):
    - a. 2000, Venting Atmospheric and Low-Pressure Storage Tanks.
    - b. MPMS 2.2A, Measurement and Calibration of Upright Cylindrical Tanks by the Manual Strapping Method.
    - c. MPMS 2.2E, Petroleum and Liquid Petroleum Products – Calibration of Horizontal Cylindrical Tanks – Part 1: Manual Methods.
  - 2. American Society of Civil Engineers (ASCE):
    - a. 7, Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
  - 3. American Society of Mechanical Engineers (ASME):
    - a. B16.5, Pipe Flanges and Flanged Fittings.
  - 4. American Society for Testing and Materials (ASTM):
    - a. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 5. Code of Federal Regulations (CFR):
    - a. 40 CFR 112, Oil Pollution Prevention.
  - 6. International Building Code (IBC).
  - 7. International Fire Code (IFC).
  - 8. National Fire Protection Association (NFPA):
    - a. 20, Standard for the Installation of Stationary Pumps for Fire Protection.
    - b. 30, Flammable and Combustible Liquids Code.
    - c. 30A, Code for Motor Fuel Dispensing Facilities and Repair Garages.
    - d. 31, Standard for the Installation of Oil-Burning Equipment.
    - e. 37, Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines.
    - f. 70, National Electrical Code.
    - g. 110, Standard for Emergency and Standby Power Systems.
    - h. 704, Standard System for the Identification of the Hazards of Materials for Emergency Response.
  - 9. Occupational Safety and Health Administration (OSHA):
    - a. 29 CFR 1910.106, Flammable Liquids.
  - 10. Petroleum Equipment Institute (PEI):



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- a. RP200, Recommended Practices for Installation of Aboveground Storage Systems for Motor-Vehicle Fueling.
- 11. Steel Tank Institute (STI):
  - a. R912, Shop Fabricated Stationary Aboveground Storage Tanks for Flammable, Combustible Liquids. – Installation Instructions.
- 12. Underwriters Laboratories, Inc. (UL):
  - a. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
  - b. 80, Steel Tanks for Oil-Burner Fuels and Other Combustible Liquids.
  - c. 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.
  - d. 443, Steel Auxiliary Tanks for Oil-Burner Fuel.
  - e. 508A, Standard for Industrial Control Panels.
  - f. 2085, Protected Aboveground Tanks for Flammable and Combustible Liquids.
- B. Regulatory Requirements:
  - 1. Tank installers must be licensed / certified by the state when the state requires licensed installers.
- C. Inspections:
  - 1. Visually inspect tanks and associated components at time of delivery and just prior to installation.
    - a. Do not use defective materials.
    - b. Immediately remove rejected material from the project site.
- D. Tank Manufacturer's Qualifications:
  - 1. Welders to be ASME qualified.
  - 2. Manufacturer to have its own fabricating plant and must show evidence of a minimum of five installations and five years of experience in the design and manufacturer of aboveground chemical storage tanks of capacity and type specified herein.

### **1.3 SYSTEM DESCRIPTION**

- A. Design Requirements:
  - 1. Provide the entire fuel storage and distribution system as a complete and fully operational system.
  - 2. Size, select, construct, and install equipment and system components to operate together as a complete system.
  - 3. Tanks and associated components specified herein shall be compatible with the fuel to be handled.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
  - 1. Complete detailed drawings of equipment provided including dimensions and connection locations.
  - 2. Details on nozzles, penetrations, and other openings.
  - 3. Details on platforms, stairs, ladders, handrails, etc., as required.
  - 4. Support loads (including seismic as needed) and anchor bolt design information.
  - 5. Tank manufacturer's calibration charts.
  - 6. Tank structural and anchorage design calculations stamped and signed by a Professional Engineer demonstrating compliance with the IBC.
- B. Product Data:

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1. Acknowledgement that products submitted meet requirements of standards referenced.
  2. Copies of manufacturer's standard catalog data (prior to the purchase or installation of the particular component) highlighted to show brand name, model number, size, options, performance charts and curves, etc., in sufficient detail to demonstrate compliance with contract requirements on all parts and equipment.
  3. Copies of manufacturer's written directions regarding material handling, delivery, storage, and installation.
  4. Copies of manufacturer's installation, operation, and maintenance (IOM) manuals.
- C. Factory Test Reports:
1. Radiographic inspection.
  2. Pressure and vacuum tests (both primary tank and secondary containment tank).
- D. Field Test Reports:
1. Tank tightness tests.
- E. Certificates:
1. Contractor qualifications:
    - a. State licenses or certificates, if applicable.
  2. Mill test reports.
  3. Certificates of Compliance to required codes and UL listings.
  4. Warranty validation card.
  5. Tank strapping table.

### **1.5 WARRANTY**

- A. Tank will not fail for a period of 30 years from the date of original purchase due to external corrosion.
- B. Tank will not fail for a period of 30 years from the date of original purchase due to internal corrosion provided the tank is used solely with specified fuel.
- C. Will not fail for a period of 30 years from the date of original purchase due to structural failure (defined as breaking or collapse) provided the installation is performed and validated by a qualified installation contractor and the tank is used as stated above.

### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Handle, store, and protect tanks and associated components to prevent damage before and during installation in accordance with the manufacturer's recommendations. Replace damaged or defective items.
  1. Do not handle or move tank unless it is empty. Do not drop or drag the tank.
  2. Repair abrasions, scars, and blemishes. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.
  3. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.
  4. Use of bare cables, chains, hooks, metal bars, or narrow skids in contact with coated tanks or components is not permitted.
  5. Avoid contact of any ferrous metal with stainless steel.
    - a. Use tools dedicated for stainless steel.
    - b. Handle using nylon slings and alloy chains, cable, or straps.
    - c. Store on racks constructed of non-ferrous metal or line with rubber.

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### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
  - 1. Aboveground storage tanks:
    - a. Highland Tank & Manufacturing Company, Inc.
    - b. Containment Solutions, Inc.
    - c. Modern Welding Company.
    - d. Stanwade Metal Products, Inc.
    - e. Or equal.
  - 2. Tank components:
    - a. Morrison Brothers.
    - b. OPW.
    - c. Franklin Fueling Systems.
    - d. Or equal.
  - 3. Leak detection, alarm, and electronic level sensing:
    - a. Veeder-Root Company TLS Series.
    - b. Pneumercator, Inc TMS Series.
    - c. OMNTEC Proteus.
    - d. Frankling Fueling Systems EVO.
    - e. Or equal.
  
- B. Submit requests for substitution in accordance with Division 01 Requirements.

#### **2.2 CONDITIONS OF SERVICE**

- A. Properties of Fuel Stored:
  - 1. Fuel/Fluid: Diesel, Gasoline, DEF.
  - 2. Specific gravity, at 60 DEGF (Design tank for 1.0 minimum):
    - a. Diesel: 0.84
    - b. Gasoline: 0.77
    - c. DEF: 1.
  - 3. Reid Vapor Pressure at 100 DEGF:
    - a. Diesel: <0.1 PSI
    - b. Gasoline: 7.0 to 15.0 (seasonal)
    - c. DEF: N/A
  - 4. Flash Point:
    - a. Diesel: 126 DEGF
    - b. Gasoline: -45 DEGF
    - c. DEF: N/A
  - 5. pH: N/A.
  - 6. Internal pressure:
    - a. Diesel: Atmospheric
    - b. Gasoline: Tank vented through pressure/vacuum relief valve with a pressure setting of 8 OZ/SQIN and a vacuum setting of 2 OZ/SQIN.
  - 7. Internal temperature: Ambient.
  
- B. Structural Design Criteria:
  - 1. Platform live loads:
    - a. Minimum vertical live load: 100 PSF.

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- b. Uniform live load includes allowance for minor pipe and conduit loading.
  2. Equipment loads:
    - a. Tank shall be designed to support accessory equipment such as ladders, pumps, etc., when installed according to manufacturer's instructions and limitations.
  3. Structural design loads for snow, ice, seismic, and wind shall be in accordance with the current edition of the IBC and ASCE 7. Geographic location of the installation is Houston, Texas.
  4. Wind loads: See Section 01 81 10 and Structural General Notes.
  5. Seismic loads: See Section 01 81 10 and Structural General Notes.
  6. Snow loads: See Section 01 81 10 and Structural General Notes.
  7. Flood load:
    - a. Flood elevation: 18 FT.
- C. Environment of Installation:
  1. Storage tank will be installed in an aboveground industrial, coastal environment.
  2. Tank shall be anchored to the existing concrete pad, which has an estimated thickness in excess of 15 inches.

### **2.3 ABOVEGROUND STORAGE TANKS**

- A. Tank Configuration:
  1. Type: Fireguard® thermally protected, double-wall, steel, aboveground tank.
  2. Nominal capacity: 15,000 (diesel) GAL and 12,000 (gasoline) GAL.
  3. Compartments: Single.
  4. Configuration: Horizontal, Cylindrical.
  5. Tank shall be manufacturer's standard size:
    - a. Nominal primary tank diameter: 10 FT.
    - b. Nominal primary tank length: Varies upon tank capacity: approximately 26 FT for diesel tank and 21 FT for gasoline tank.
  6. Materials:
    - a. Primary tank: Carbon steel.
    - b. Secondary containment: Carbon steel.
    - c. Tank saddles: Carbon steel.
    - d. Nozzles: Match primary tank material (using typical pipe fitting alloys).
    - e. Interior ladders, drop tubes, and other components: All interior items exposed to the contents of the primary tank shall match material (and coating as applicable) of primary tank unless noted otherwise. This includes vents and manway covers.
    - f. Exterior ladders, platforms, and other components: Non-process exterior items shall be galvanized steel, aluminum, or fiberglass (such as for grating).
    - g. Coatings: External coating shall be manufacturer's standard system provided it is compatible with the fuel to be handled. Provide internal epoxy lining compatible with the fuel.
    - h. Galvanized materials (zinc coated) shall not be allowed in direct contact with any fuel.
- B. Tank Design Criteria:
  1. The entire tank assembly shall conform to UL 2085. Tank assembly shall bear the UL 2085 label as a protected tank.
    - a. Tank design shall be tested for ballistics, impact, hose stream, and pool fire UL 2085 performance standards.
    - b. Tank shall provide at least 2 HRS fire protection.
  2. The storage tank system must be provided with all safety and overfill prevention devices required by NFPA 30, NFPA 30A, and local codes.
  3. The tank assembly and supports shall meet IBC and state building code requirements.
  4. Primary tank shall conform to UL 142.

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5. Primary tank shall be supported within the containment reservoir with steel tank saddles, or other similar supports, fabricated and installed by the tank manufacturer.
  6. The secondary containment reservoir shall be the factory-fabricated, steel type that fully encloses the primary storage tank. The containment reservoir shall conform to UL 142.
  7. The interstitial space between the primary tank and the containment reservoir shall be both pressure testable and verifiable. Primary tank and containment reservoir shall be designed to withstand required test pressures per applicable codes.
  8. Insulating material in the interstitial space shall be a factory-installed, lightweight, monolithic material and allow fluid migration to the leak detection monitoring point.
  9. Tank shall be designed in a manner to provide for monitoring leak detection in the interstitial space.
  10. Tank shall be designed to support accessory equipment, as shown on Drawings.
- C. Tank Appurtenances:
1. General:
    - a. Provide size, location, and orientation of appurtenances as shown on Drawings.
    - b. All openings shall be located in the top of the tank.
      - 1) Drains located at the bottom of a primary storage tank will not be allowed.
    - c. All fill and return lines shall include drop tubes to within 6 IN of tank bottom.
  2. Nameplates:
    - a. Nameplate shall list at a minimum manufacturer's name and address, model number, serial number, capacity, code stamps, and UL rating.
    - b. Construct plates and fasteners of corrosion resistant materials (such as stainless steel or aluminum) with stamped lettering.
  3. Flanged Nozzles:
    - a. Flanges shall conform to ASME B16.5, Class 150.
    - b. Flanges shall be raised face and weld neck, slip-on, or socket weld style. Threaded flanges are not to be used.
    - c. Gaskets, bolts, nuts, and washers shall conform to requirements of Section 33 52 10.
  4. Threaded Coupling Nozzles:
    - a. Threaded MNPT or FNPT as indicated.
  5. Manways:
    - a. Tank manways shall have an internal diameter of not less than 24 IN.
    - b. Provide tank manways with a matching flanged watertight manway cover including a UL listed gasket.
    - c. Piping will not penetrate through access manways (exceptions: primary tank emergency vent assembly, other items specifically shown on Drawings).
  6. Internal Ladder:
    - a. Provide internal ladder at access manway to bottom of tank.
    - b. Design ladder in accordance with OSHA standards.
  7. Support Saddles:
    - a. Shall be sized such that the bottom of the tank is no more than 12 IN above grade.
  8. Lifting Lugs:
    - a. Provide lifting lugs for installation.
    - b. Lugs shall be capable of supporting the empty tank weight with a 2:1 safety factor.
  9. Striker Plates:
    - a. Provide striker plates under each tank opening.
  10. Exterior Access:
    - a. Provide platform, stair, ladder, catwalk, and handrail system allowing access to all tank top nozzles and manways as shown on Drawings.
    - b. Design all access components in accordance with OSHA standards.
    - c. Where steel is used, components shall be galvanized after fabrication to a G90 finish per ASTM A123, and subsequently bolted into final position.
    - d. Provide any necessary concrete to support above items.

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- D. Tank shall have appropriate warning signs as required by NFPA 704 and local regulations.

### 2.4 TANK COMPONENTS

A. Aboveground Tank Emergency Vent:

1. Provide emergency venting for both primary and secondary containment tanks of a double wall tank.
2. Emergency vent shall be:
  - a. Morrison Brothers Figure 244.
  - b. Protectoseal Series 7800.
  - c. Or equal.
3. Vent shall be the normally-closed, UL listed type that vents outward and upward.
4. Vent capacity and design shall comply with API 2000, NFPA 30 , NFPA 30A, UL 2085, and UL 142 for the size of tank and fuel specified.
5. Vent shall be designed to relieve only at a pressure setting above that of the normal vent.
6. Provide vent with the flow rating (e.g., cubic feet per minute) permanently labeled on the vent's exterior.

B. Pressure Vacuum Vent:

1. Provide pressure vacuum vent designed to provide normal venting for storage tank .
2. Pressure vacuum vent shall be:
  - a. Morrison Brothers Figure 748A.
  - b. Protectoseal Series 8540H.
  - c. Or equal.
3. Vent must be used in conjunction with emergency vent.
  - a. Pressure/vacuum vent opening pressure shall be set below that of the emergency vent so that the normal vent relieves first.
4. Setpoints:
  - a. Operating pressure: 8.0 OZ/SQIN.
  - b. Operating vacuum: 2.0 OZ/SQIN.
  - c. Relief settings shall be set at the factory.
5. Vent and vent pipe shall comply with API 2000, NFPA 30 , NFPA 30A, UL 142, and UL 2085 for the fuel specified and associated fill / discharge rates.
6. Vent body shall be constructed of either cast steel or aluminum. Vent trim shall be stainless steel.
7. Body shall be self-draining to protect from condensate and freezing.
8. Inner vent pallet assemblies shall have a knife-edged drip ring around the periphery of the pallet to preclude condensation collection at the seats.
9. Pallet seat inserts shall be of a material compatible with the fuel specified to be stored.
10. Vent intake shall be covered with a 40-mesh stainless steel wire screen.
11. Vent pipe sizing shall be not less than 2 IN nominal diameter.
12. Discharge point shall be at least 12 FT above adjacent ground level for NFPA 30 Class I fuels (e.g., gasoline, ethanol).

C. Updraft Vent:

1. Provide updraft vent designed to provide normal venting for storage tank.
2. Updraft vent shall be:
  - a. Morrison Brothers Figure 354.
  - b. Or equal.
3. Vent must be used in conjunction with emergency vent.
4. Vent and vent pipe shall comply with API 2000, NFPA 30, NFPA 30A, UL 142, and UL 2085 for the fuel specified and associated fill / discharge rates.
5. Vent body shall be constructed of either cast steel or aluminum.
6. Body shall be self-draining to protect from condensate and freezing.

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7. Vent intake shall be covered with a 40 mesh stainless steel wire screen.
  8. Vent pipe sizing shall be not less than 2 IN nominal diameter.
- D. Tank Overfill Prevention Valve:
1. Provide tank with an overfill prevention valve installed at the fill port. Valve shall stop flow of product when the tank reaches a preset warning level.
  2. Tank overfill prevention valve shall be:
    - a. Morrison Brothers Figure 9095AA or 9095DS.
    - b. OPW 61fSTOP.
    - c. Or equal.
  3. Overfill prevention valve shall comply with NFPA 30 and NFPA 30A.
  4. Valve shall be the float-activated, shutoff type that is an integral part of the drop tube used for filling.
  5. Valve shall completely stop the flow of fuel into the tank when the liquid level rises above 95 PCT of tank capacity. Fuel shut off shall be cushioned to prevent fluid hammer.
  6. Valve shall be constructed of the same material as the fill tube.
  7. Use adapters per manufacturer.
  8. Provide valve fill port with cap. Cap shall mate with adapter and have a latching mechanism which provides a water tight seal.

### **2.5 TANK GAUGES**

- A. Stick Gauge:
1. Provide each tank with two wooden stick gauges.
  2. Gauge length shall allow measurement of entire level of fuel in tank.
  3. Gauges shall be compatible with the fuel to be measured (no swelling or damage from fuel contact).
  4. Provide gauge with non-sparking caps on each end.
  5. Mark gauges in feet and inches. The smallest unit of measure on the gauge shall be 1/16 IN.
- B. Tank Strapping Table:
1. Furnish two tank manufacturer's certified strapping tables (calibration charts) for each tank.
  2. Tables shall indicate the liquid contents in gallons for each 1/16 IN of tank depth.
  3. For each tank, provide an electronic media file of each strapping table.
- C. Clock Gauge:
1. Provide tank with clock gauge. Gauge shall be float-activated.
  2. Gauge shall be:
    - a. Morrison Brothers Figure 818.
    - b. Or equal.
  3. Gauge shall be accessible and viewable when the tank is filled.
    - a. Gauge shall be viewable from 20 FT minimum.
    - b. Orientate gauge facing towards tank fill point location.
  4. Gauge float and cable shall be stainless steel.
  5. Gauge shall have vapor tight seals to prevent condensation from fogging the viewing glass.

### **2.6 ADAPTERS, COUPLERS, AND ACCESSORIES**

- A. Remote Spill Container:
1. Provide a remote spill container for use during remote filling operations.
  2. Remote spill container shall be:

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- a. Morrison Brothers 515 series.
  - b. OPW 211-RMOT.
  - c. Or equal.
  3. 12-gauge steel construction.
  4. Minimum capacity of 15 GAL.
  5. Container used for diesel or oil loadout shall have a single 4 IN port.
  6. Container used for gasoline or ethanol loadout shall have double 4 IN ports.
  7. Container shall have a pedestal mount, lockable lid, and a 1 IN drain with lockable ball valve.
- B. Tank Fill Line:
1. Fill Adapter:
    - a. Provide cam and groove fill adapter in API standard 3 IN (diesel and gasoline) size.
    - b. Adapter shall be in accordance with cam and groove couplers in Section 33 52 10.
    - c. Adapter shall be a top seal cam and groove adapter with a tight-fit connection to prevent vapor emissions during filling.
  2. Locking Ball Valve:
    - a. Provide a locking ball valve for each product fill line.
    - b. Ball valve shall be in accordance with Section 33 52 10.
  3. Check Valve:
    - a. Provide a swing check valve for each product fill line.
    - b. Check valves shall be in accordance with Section 33 52 10.
- C. Tank Vapor Recovery Line:
1. Vapor Recovery Adapter:
    - a. Provide bronze adapter fitted with a Buna-N or Viton gasket in the API standard 4 IN size.
    - b. Adapter shall be:
      - 1) Morrison Brothers Figure 323.
      - 2) OPW 1611AV.
      - 3) Or equal.
    - c. Adapter shall provide a tight-fit connection to prevent vapor emissions during filling.
      - 1) Adapter shall have an internal spring-loaded poppet which prevents vapor emissions from the storage tank when the locking cap is removed.
        - a) The poppet shall open immediately during tank fill.
        - b) The poppet shall operate at a lower pressure/vacuum than the tank's pressure/vacuum relief vent in order for vapors to return to the delivery truck instead of exiting through the vent piping.
        - c) The poppet, the poppet stem, and the poppet spring shall be stainless steel.
    - d. Provide adapter with a locking cap.
      - 1) Cap shall be:
        - a) Morrison Brothers Figure 323C.
        - b) OPW 1711T.
        - c) Or equal.
      - 2) The cap shall mate with the adapter and have a latching mechanism which provides a water-tight seal.
      - 3) The cap shall provide some type of locking provision and be easily attachable and removable.
      - 4) The cap shall be attached to the vapor recovery adapter by a 12 IN section of brass cable or fuel resistant rope.
- D. Water Draw-Off Pump:
1. Provide hand-operated water draw-off pump capable of self-priming with sufficient lift to draw contents from the bottom of the fuel storage tank.
  2. Water draw-off pump shall be:



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- a. Fill-Rite FR110.
- b. Or equal.
3. Provide anti-siphon valve near the fuel storage tank connection nozzle.

### **2.7 MONITORING SYSTEMS**

- A. Monitoring panel, level sensors, and leak detection sensors shall be from one manufacturer and compatible with each other.
- B. Coordinate connection requirements of level and leak detection sensors with tank nozzle configuration.
- C. Sensors shall be compatible with the fuel to be handled.
- D. Tank Interstitial Space Leak Detection Sensors:
  1. The interstitial space of each tank shall be continuously and automatically monitored to detect breaches in the integrity of the primary tank.
  2. Sensors shall be float or optical, non-discriminating type.
  3. Sensors shall be UL listed and intrinsically safe for use in a Class 1, Division 1, Group D environment as defined by NFPA 70.
  4. Sensors shall be easily removed from the tank.
- E. Tank Level Sensors:
  1. Each tank shall be provided with a level gauging sensor.
  2. Sensors shall be temperature sensing, magnetostrictive type with stainless steel guide shaft and length to suit tank height.
  3. Sensors shall be accurate to within +/-1/16 IN and be capable of measuring a liquid level over the tank's full usable capacity.
  4. Sensors shall be capable of measuring water accumulation in inches from 3/4 to 5 IN off the bottom of the storage tank.
  5. Sensors shall be UL listed and intrinsically safe for use in a Class 1, Division 1, Group D environment as defined by NFPA 70.
- F. Electronic Monitoring System Panel:
  1. Electronic monitoring system panel for sensors shall conform to requirements of Section 33 57 10.
  2. The following tank level sensor setpoints shall be programmed at the monitoring panel:
    - a. High-high: 95 PCT.
    - b. High: 90 PCT.
    - c. Low: 15 PCT.
    - d. Low-Low: At minimum pump submergence level.

## **PART 3 - EXECUTION**

### **3.1 FACTORY TESTING**

- A. Comply with performance testing requirements of UL 142 and UL 2085.
- B. Any test failure shall require corrective action and retest.

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### **3.2 SHIPPING & DELIVERY**

- A. Provide coverings for all tank openings suitable for protecting against exposure to harmful weather conditions for a period of several months.
- B. Coordinate transportation with supplier for shipping aboveground storage tank, and associated components to the job site.

### **3.3 INSTALLATION**

- A. Procure necessary permits, provide required notifications, and coordinate inspections with North Carolina Department of Environmental Quality (NCDEQ), North Carolina State Fire Marshal's Office, and other agencies as required. ASTs are only required to be registered with NCDEQ.
- B. Handle storage tank with care to prevent damage during placement and install in accordance with the manufacturer's written instructions, STI R912, PEI RP200, NFPA 30, and NFPA 30A, and local codes.
- C. Inspect the exterior surface of the tank for obvious visual damage prior to the placement of the tank.
  - 1. Correct surface damage to the tank according to manufacturer's requirements before proceeding with the equipment installation.
- D. Erect all stairs, platforms, ladders, and handrails as applicable.
- E. Secure tank to concrete footing as specified by manufacturer.
- F. Field Painting:
  - 1. Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory, shall be painted and have identification markings applied as specified in Contract Documents.
- G. Install tank with a 1% slope with tank-mounted pumps or issue lines on the high side and drain / water draw-off nozzle on the low side.
- H. Install interstitial tank sensors and detectors at the tank's low end.
  - 1. Sensor installation shall be in accordance with the tank manufacturer's recommendations and shall not compromise the tank's secondary containment in any manner.
  - 2. Sensors shall be easily removed from a tank.
  - 3. Connection of metal conduit to steel tanks shall be with dielectric fittings.
- I. Attach grounding cabling to the tank in accordance with Division 26 requirements.

### **3.4 FUEL SUPPLY**

- A. Refer to Section 33 52 10.

### **3.5 PRESSURE TESTS**

- A. General Testing Requirements:

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1. All tests shall be made in the presence of the Engineer or Owner. Any preliminary tests that the Contractor may make without such tests being observed by the Engineer or Owner will not be accepted unless prior approval is obtained. The Contractor shall provide notification at least 48 HRS before any work is to be inspected or tested.
  2. Furnish labor, materials, equipment, electricity, repairs, and retesting necessary for any of the tests required herein.
- B. Tank Tightness Tests:
1. Perform tightness tests on the tank in presence of Engineer/Owner Fire Marshal representative and tank manufacturer's representative prior to making piping connections or installing tank accessories.
  2. Perform testing in accordance with STI R912 except as modified herein or by manufacturer's written instructions.
  3. Provide test equipment, tools, blind flanges, and instruments necessary to accomplish testing.
  4. Repair leaks discovered during the tightness tests in accordance with tank manufacturer's instructions.
  5. Following any repair, re-test the tank until the tank successfully passes the testing requirements of this paragraph.
  6. Tank tightness testing may be waived at Engineer/Owner discretion for tanks that continue to maintain a factory-applied vacuum at least until the tank is set in its final location.

### **3.6 CLEANING AND ADJUSTING**

- A. Prior to system performance testing, the following cleaning and adjustments shall be performed.
1. Initial System Cleaning:
    - a. Visually inspect and clean free of debris the interior of the tank before filling.
    - b. In the event of entry into a storage tank, the Contractor shall ensure a safe atmosphere exists.
    - c. Contractor shall remove all preservatives and foreign matter from valves, line strainers, pumps, and other equipment coming in contact with fuel.
    - d. No fuel will be delivered to the system until the Contractor has satisfactorily completed this initial system cleaning.
  2. Initial System Adjustments:
    - a. Each system component shall be initially adjusted, if necessary, to meet the system's final operational requirements.
    - b. The sequence of control for each component shall be adjusted to meet the indicated system requirements.
    - c. Following the initial system adjustments, the equipment tests shall be performed in order to determine any necessary final system adjustments.

### **3.7 PERFORMANCE TESTS**

- A. System Performance Tests:
1. After all components of the system have been properly adjusted, test the system to demonstrate that the system meets the performance requirements for which it was designed.
  2. Test specific pieces of equipment in accordance with manufacturer's written instructions and test procedures for ensuring proper operation.

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3. If any portion of the system or any piece of equipment fails to pass the tests, the Contractor shall make the necessary repairs or adjustments and the test shall be repeated until satisfactory performance is achieved.
4. Tests shall be performed under all operating scenarios.
5. The tests shall demonstrate the following:
  - a. The sensors and alarms are operational and perform as designed.
  - b. Overfill valve shuts off at high liquid level.
  - c. Vent piping is clear of debris, and the pressure/vacuum relief vent is operating properly.
  - d. Vapor recovery systems perform as designed.
  - e. Each safety device works properly and is tested per NFPA requirements as necessary.
  - f. Fuel polishing system performs per manufacturer's testing instructions.

### **3.8 INITIAL START-UP**

- A. Refer to Section 33 52 10.

### **3.9 TRAINING**

- A. Refer to Section 33 52 10.

**END OF SECTION 33 56 13**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Section includes:
  - 1. Fuel dispensing systems:
    - a. Dispensers.
    - b. Submersible turbine pumps.
  - 2. Diesel Exhaust Fluid (DEF) storage and dispensing systems.
  - 3. Monitoring panels for leak detection and tank levels.
  - 4. Fleet fuel management systems.
  
- B. Related Sections include but are not necessarily limited to:
  - 1. Division 26 - Electrical.
  - 2. Section 33 52 10 - Service Piping - Fuel Systems.
  - 3. Section 33 56 13 - Aboveground Fuel Storage Tanks.

**1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. Code of Federal Regulations (CFR):
    - a. 40 CFR 112, Oil Pollution Prevention.
  - 2. International Building Code (IBC).
  - 3. International Fire Code (IFC).
  - 4. National Electrical Manufacturers Association (NEMA):
    - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 5. National Fire Protection Association (NFPA):
    - a. 30, Flammable and Combustible Liquids Code.
    - b. 30A, Motor Fuel Dispensing Facilities and Repair Garages.
    - c. 70, National Electrical Code.
  - 6. Occupational Safety and Health Administration (OSHA):
    - a. 29 CFR 1910.106, Flammable Liquids.
  - 7. Underwriters Laboratories Inc. (UL):
    - a. 87, Standard for Power-Operated Dispensing Devices for Petroleum Products.
    - b. 87A, Standard for Power-Operated Dispensing Devices for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 – E85).
    - c. 87B, Power-Operated Dispensing Devices for Diesel Fuel, Biodiesel Fuel, Diesel/Biodiesel Blends with Nominal Biodiesel Concentrations up to 20 Percent (B20), Kerosene, and Fuel Oil.
    - d. 87C, Outline of Investigation for Power-Operated Dispensing Devices for Diesel Exhaust Fluid.
    - e. 330, Standard for Hose and Hose Assemblies for Dispensing Flammable Liquids.
    - f. 330A, Outline of Investigation for Hose and Hose Assemblies for Use with Dispensing Devices Dispensing Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations Up To 85 Percent (E0 - E85).
    - g. 330B, Standard for Hose and Hose Assemblies for Use with Dispensing Devices Dispensing Diesel Fuel, Biodiesel Fuel, Diesel/Biodiesel Blends with Nominal Biodiesel Concentrations Up To 20 Percent (B20), Kerosene, and Fuel Oil.
    - h. 842, Standard for Valves for Flammable Fluids.

## **SECTION 33 57 10 - FUEL DISPENSING EQUIPMENT**

- i. 842A, Standard for Valves for Gasoline and Gasoline/Ethanol Blends with Nominal Ethanol Concentrations up to 85 Percent (E0 - E85).
  - j. 842B, Standard for Valves for Diesel Fuel, Biodiesel Fuel, Diesel/Biodiesel Blends with Nominal Biodiesel Concentrations up to 20 Percent (B20), Kerosene, and Fuel Oil.
- B. Regulatory Requirements:
- 1. Equipment installers must be licensed / certified by the state when the state requires licensed installers.
- C. Inspections:
- 1. Visually inspect dispensing equipment, panels, and associated components at time of delivery and just prior to installation.
    - a. Do not use defective materials.
    - b. Immediately remove rejected material from the project site.

### **1.3 SYSTEM DESCRIPTION**

- A. Design Requirements:
- 1. Provide the entire fuel distribution system as a complete and fully operational system.
  - 2. Size, select, construct, and install equipment and system components to operate together as a complete system.
  - 3. Dispensing equipment and associated components specified herein shall be compatible with the fuel to be handled.

### **1.4 SUBMITTALS**

- A. Shop Drawings:
- 1. Complete detailed drawings of equipment provided including dimensions and connection locations.
  - 2. Wiring diagrams, piping, and control system layouts.
- B. Product Data:
- 1. Acknowledgement that products submitted meet requirements of standards referenced.
  - 2. Copies of manufacturer's standard catalog data (prior to the purchase or installation of the particular component) highlighted to show brand name, model number, size, options, performance charts and curves, etc., in sufficient detail to demonstrate compliance with contract requirements on all parts and equipment.
  - 3. Copies of manufacturer's written directions regarding material handling, delivery, storage, and installation.
  - 4. Copies of manufacturer's installation, operation, and maintenance (IOM) manuals.
- C. Factory Test Reports:
- 1. Factory test reports for provided equipment as applicable.
- D. Field Test Reports:
- 1. Leak tests.
- E. Certificates:
- 1. Contractor qualifications:
    - a. State licenses or certificates, if applicable.
  - 2. Certificates of Compliance to required codes and UL listings.
  - 3. Warranty validation card.

**1.5 WARRANTY**

- A. Dispensing equipment, panels, and associated equipment shall be warranted against defects in material or workmanship for a minimum period of 1 year.

**1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Handle, store, and protect dispensing equipment, panels, and associated components to prevent damage before and during installation in accordance with the manufacturer's recommendations. Replace damaged or defective items.
  - 1. Repair abrasions, scars, and blemishes. If repair of satisfactory quality cannot be achieved, replace damaged material immediately
  - 2. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.
  - 3. Use of bare cables, chains, hooks, metal bars, or narrow skids in contact with coated equipment or components is not permitted.
  - 4. Avoid contact of any ferrous metal with stainless steel.
    - a. Use tools dedicated for stainless steel.
    - b. Handle using nylon slings and alloy chains, cable, or straps.
    - c. Store on racks constructed of non-ferrous metal or line with rubber.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
  - 1. Remote dispensers:
    - a. Gilbarco, Inc. (Gasboy).
    - b. Tokheim (Dover Fueling Solutions).
    - c. Wayne Fueling Systems LLC.
    - d. Or equal.
  - 2. Dispenser Accessories:
    - a. Morrison Brothers.
    - b. OPW.
    - c. Or equal.
  - 3. Submersible pumps:
    - a. Veeder-Root Co. (Red Jacket).
    - b. Franklin Fueling Systems (FE Petro).
    - c. Or equal.
  - 4. DEF storage and dispensing systems:
    - a. Blue1 Energy Equipment.
    - b. Benecor.
    - c. Spatco Energy Solutions.
    - d. Or equal.
  - 5. Leak detection, alarm, and electronic level sensing monitor panels:
    - a. Veeder-Root Company TLS Series.
    - b. Pneumercator, Inc TMS Series.
    - c. OMNTEC Proteus.
    - d. Frankling Fueling Systems EVO.
    - e. Or equal.

## SECTION 33 57 10 - FUEL DISPENSING EQUIPMENT

6. Fleet fuel management systems:
  - a. Syn-Tech Systems, Inc. (FuelMaster).
  - b. Gilbarco, Inc. (Gasboy).
  - c. Wayne Fueling Systems LLC.
  - d. Or equal.
- B. Submit requests for substitutions in accordance with Division 01 requirements.

### 2.2 DISPENSERS

- A. Dispenser Configuration:
  1. Type: Remote control.
  2. Configuration: Dual product, Dual hose.
  3. Fuel: Diesel, Gasoline.
  4. Flow rate: 20 GPM (diesel) and 12 GPM (gasoline) minimum each nozzle.
  5. Working pressure: 50 psiG minimum.
  6. Nozzle position: Side load.
  7. Power requirement: 115V or 230V, 60 Hz, 1 phase.
- B. Dispenser Design Criteria:
  1. Dispenser unit and unit hardware shall be the factory fabricated type that conforms to UL 87A (gasoline) and UL87B (diesel).
  2. Dispenser shall be approved for use with aboveground storage tanks including anti-siphon kit as necessary.
  3. Dispenser shall be compatible with fleet fuel management system as applicable.
- C. Dispenser Components:
  1. Display:
    - a. Provide display on front and back of cabinet.
    - b. Display shall be solid state liquid crystal display (LCD), minimum 1 inch numerals, back lit, with the following functionality:
      - 1) Four digit volume display to 999.9 GAL.
      - 2) Five digit cash display to \$999.99.
      - 3) Eight digit totalizer to 999,999.99 GAL with identification for each product. Totalizer shall be electronically backed-up.
      - 4) Price-jog keyswitch on each computer housing to enable remote price setting from management control system.
  2. Battery Backup:
    - a. Provide battery backup with automatic charging circuits to hold data for a minimum of three months without recharging. Sales display shall remain visible for fifteen minutes after power failure.
  3. Pulser:
    - a. Pulser shall be compatible with fuel management system.
    - b. Pulser shall be selectable and capable of up to 1,000 pulses per gallon.
  4. Flow Meter:
    - a. Flow meter shall be multi-piston, positive displacement type.
    - b. Flow meter shall be accurate to within 0.33%.
  5. Interlocks:
    - a. Dispenser shall accept signal from master emergency stop system controlling the fuel system as a whole. When activated, all dispenser pumps shall be shut down.
      - 1) Provide easily accessible control switch within 100 feet, but not closer than 20 feet of dispenser for emergency power shut-off.
    - b. Provide nozzle supports interlocked to the pump motor control switch to start and stop the pump by nozzle removal and replacement.



## SECTION 33 57 10 - FUEL DISPENSING EQUIPMENT

- c. Provide each unit with interlock switch and valve arrangement that prevents flow of product until meter is reset after dispensing nozzle is returned to holder.
- 6. Filter:
  - a. Filter shall be spin-on canister type with flow rating equal to that of the dispensing unit.
  - b. Filter rating: 10-micron (gasoline), 30-micron (diesel).
  - c. Provide internal strainer as well with minimum 40 mesh removable strainer basket.
- 7. Cabinet:
  - a. Base, frame, and panels shall be designed for outdoor use and provide vibration free support as well as weather protection for all dispenser components.
  - b. Provide hot-dipped galvanized internal frame.
  - c. Provide corrosion, UV, and fuel resistant exterior finishes of stainless steel, aluminum, or hot-dipped galvanized, electrostatically primed and finished with a durable, non-fading, baked enamel.
  - d. Exterior color scheme to be approved by Owner.
  - e. Provide lockable entry to cabinet.
  - f. Provide locking mechanism for each nozzle to allow securing each nozzle to the housing during non-operational periods.
  - g. Provide lights to illuminate product panels and display areas.
- D. Dispenser Accessories:
  - 1. Emergency Shutoff (Shear) Valve:
    - a. Provide emergency shutoff valve conforming to UL 842A (gasoline) and UL842B (diesel) on fuel line(s) at base of dispenser.
    - b. Valve shall include a fusible link which trips the valve closed at 165 degrees F to provide complete shutoff of a fuel line in the event of a fire at the dispenser.
    - c. Valve shall provide complete shutoff of a fuel line in the event a dispenser is dislocated or overturned due to a sudden impact.
    - d. Valve shall include a secondary poppet to limit spillage from the dispenser after a knockdown or during installation.
    - e. Provide mounting bracket for installation within dispenser sump. Valve shall be rigidly anchored and installed within 1/2 IN of the concrete dispenser island level.
  - 2. Hose:
    - a. Provide dispensing hose conforming to UL 330A (gasoline) and UL330B (diesel), fuel and oil resistant, statically grounded, and flexible in sub-zero temperatures.
    - b. Provide a minimum of 10 feet of hose for each product line on the dispenser.
    - c. Hose shall be smooth bore, black rubber.
  - 3. Hose Retriever:
    - a. Provide spring driven cable retriever integral to the dispenser cabinet.
    - b. Provide high, post-mounted retractor with enclosed spring return reel.
    - c. Attach hose retriever near mid-length of hose.
  - 4. Breakaway:
    - a. Provide each product hose with UL listed emergency breakaway device designed to retain liquid on both sides of the breakaway point.
    - b. Breakaway device shall have pressure balancing chamber to override line pressure to prevent nuisance breaks caused by a restriction in delivery hose diameter.
  - 5. Swivel:
    - a. Provide swivel assembly between hose and nozzle.
    - b. Seals shall be Buna-N or Viton.
  - 6. Nozzle:
    - a. Provide manually activated, automatic shutoff type nozzles without a latch-open device.
    - b. Provide full hand insulator to prevent splash-back.
    - c. Nozzle shall automatically shut off flow when vehicle tank is full.
    - d. Nozzle color:
      - 1) Gasoline: Black or Owner requested.
      - 2) Diesel: Green or Owner requested.

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7. Dispenser Sump:
    - a. Provide sump for each dispenser. Sumps shall be selected based on dispensers to be used.
    - b. Sump shall prevent fuel from escaping to the soil and ground water from entering the sump.
    - c. Sump shall be of fiberglass construction. Corrosion resistant metal construction for above grade installation.
    - d. Sump shall withstand maximum burial loads.
    - e. Provide with rain lip, mounting frame, concrete anchors and mounting and stabilizing bars.
    - f. Sump shall provide a liquid-tight termination point for secondary containment piping that allows for the anticipated expansion and contraction of the piping system.
    - g. Provide leak tight flexible entry boots for double wall piping.
      - 1) Boots shall be compatible with piping slope requirements.
    - h. Provide liquid leak detector in bottom of sump as per this Section.
  8. Dispenser Island Form:
    - a. Provide and install concrete island form for each dispenser. Form shall be compatible with under-dispenser containment sump. Ensure sump is anchored to the form.
    - b. Manufacturer:
      - 1) OPW Standard (Straight) Island Form
      - 2) Approved equal.
    - c. Form shall be of corrosion resistant metal construction (e.g., 12-gauge steel with powder coated gray exterior coating or 304 stainless steel).
- E. Automatic Line Leak Detectors:
1. System shall continuously and automatically monitor for piping leaks using an automatic line leak detector (mechanical or electrical).
  2. Detector shall detect a minimum leak rate of 3 GAL/hour at 10 psiG line pressure within 1 hour. Detector shall detect leaks against a minimum 6 feet of head pressure.
  3. Detector shall detect leaks from any portion of the underground fuel product piping.

### **2.3 SUBMERSIBLE TURBINE PUMPS**

- A. Pump configuration:
1. Fuel: Diesel, Gasoline.
  2. Flow rate: 50 GPM minimum.
  3. Design Total Dynamic Head: 75 feet fluid.
  4. Power requirement: 115V or 230V, 60 Hz, 1-phase.
  5. Materials:
    - a. Baseplate, casing, and bearing housing: Cast iron.
    - b. Pump shaft: Stainless steel.
    - c. Wetted parts: Compatible with fuel product.
  6. Tank mounting: 4 inches threaded.
  7. Discharge piping connection: Threaded.
- B. Pump Design Criteria:
1. Pump shall be single- or multi-stage, vertical, turbine type. Pump and motor combination must operate totally submerged in the product of the storage tank.
  2. Pumps shall be UL listed for specified fuel product and rated for Class 1, Group D atmospheres.
  3. Pump shall be suitable for exposed outdoor installation.
  4. Pump manifold shall be completely sealed against product leakage to the ground and water leakage to the tank.

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5. Pump shall be self-lubricating and have a base mounting flange or riser pipe, horizontal pump discharge, low net positive suction head first stage impellers, and dynamic and thrust balanced impellers. Pump intake inlet shall be horizontal to prevent drawing sediment from the tank bottom into the pump inlet.
6. Pump shall include a vertical solid-shaft motor with hermetically sealed motor windings and thermal overload protection.
7. Pump shall be easily removable without disconnecting discharge piping, leak detection equipment, or siphon systems.
  - a. Pump shall include automatic electrical disconnects and fuel drainage when removing for servicing.
  - b. The pump and motor assembly shall be readily separable from the pump column pipe to allow for simple field replacement of pump and / or motor.
  - c. Pump shall include a lifting lug capable of supporting the weight of the entire pump and motor assembly.
8. Pump shall be provided with check valve, air eliminator, expansion relief valve, and pressure test screw.
9. Pump mounting shall completely support both the weight and vibration of the pump.
10. Pump shall extend to within 6 inches of the storage tank bottom.
11. Pump shall only operate when dispensing nozzle is removed from its bracket and the switch on the dispenser is manually activated.
12. Controls shall accept signal from master emergency stop system controlling the fuel system as a whole. When activated, all pumps shall be shut down.
  - a. Provide easily accessible control switch within 100 feet, but not closer than 20 feet of dispenser for emergency power shut-off.

### **2.4 DEF STORAGE & DISPENSING SYSTEM**

- A. Provide a self-contained, factory-fabricated DEF storage and dispensing system which includes an integral storage tank; dispensing system with pump, meter, hose, and nozzle; and a weather tight enclosure with internal heating for freeze protection.
- B. All wetted materials shall be compatible with DEF.
- C. Storage Tank:
  1. Minimum 300 GAL capacity.
  2. Provide level indication exterior to enclosure.
- D. Dispenser:
  1. DEF dispenser pump with minimum 5 GPM flow rate.
  2. Positive displacement meter with ability to calibrate in place.
  3. Electronic register with pulser compatible with fuel management system.
  4. 1 micron filtration.
  5. Stainless steel nozzle with breakaway swivel.
  6. Minimum 20 feet hose and retractable reel.
- E. Enclosure:
  1. Weather tight and lockable enclosure which houses complete tank and dispenser system.
  2. Insulated and heated for cold weather protection.
  3. Thermostatically controlled heater.
  4. Exterior warning indication (e.g., strobe light or other alarm) of low temperature in the enclosure.

**2.5 EMERGENCY FUEL SHUTOFF (EFSO / E-STOP) STOP PUSHBUTTON**

- A. Provide emergency stop pushbutton which shuts down power to the fuel dispensers, fuel pumps, and all fueling related equipment upon activation via shunt trip device.
- B. Enclosure shall be corrosion resistant, red in color, and include a hinged polycarbonate front and open bottom. Pushbutton shall be accessible through the hinged front.
- C. Pushbutton shall be a momentary contact single unit with a jumbo mushroom operator, 1-NC and 1-NO contact.
- D. Pushbutton station shall be mounted not less than 20 feet and no more than 100 feet from the dispenser, and between 42 inches and 48 inches above finished floor.
- E. Mount a caution sign immediately adjacent to the pushbutton station stating "EMERGENCY FUEL SHUTOFF" in minimum 2 inches high letters in either red letters on a white background or white letters on a red background.

**2.6 FIRE EXTINGUISHER**

- A. Provide a minimum of one fire extinguisher per IFC.
  - 1. Minimum rating shall be 2-A : 20-B : C.
  - 2. Locate extinguisher as shown on Drawings or as directed by Owner.

**2.7 MONITORING SYSTEM**

- A. Electronic Monitoring System Panel:
  - 1. Use a single panel to monitor the entire system's leak detectors and tank level gauging whenever possible.
  - 2. Panel shall be compatible with and connected to the following:
    - a. Tank interstitial sensors and detectors.
    - b. Sump sensors and detectors.
    - c. Automatic line leak detectors.
    - d. Monitoring well sensors and detectors.
    - e. Digital tank level gauge system.
  - 3. Panel shall perform continuous integrity checks on the status of each sensor's connections and wiring.
  - 4. Panel shall include a battery backup (rechargeable) that can operate the complete leak detection system during a power failure for a minimum period of 48 hours.
    - a. Panel using computer memory shall be capable of maintaining current programmable information in the event of a power failure.
  - 5. Panel housing shall be a standard industrial enclosure (exterior installation) or wall-mounted as-is (interior installation). Panel shall be mounted in an electrical non-class area.
  - 6. Panel alarms:
    - a. Panel shall produce an audible and visual alarm in the event any of the following occur:
      - 1) Sensing of a hydrocarbon liquid from a sensor or detector.
      - 2) Sensing of a hydrocarbon vapor from a sensor or detector.
      - 3) Sensing of water from a sensor or detector.
      - 4) Failure of an automatic line leak test.
      - 5) Sensing minimum groundwater setpoint.
      - 6) Failure of an integrity check.
      - 7) Sensing tank high, high-high, low, or low-low level alarm conditions.

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- b. Panel shall account for the effects of thermal expansion or contraction of the fuel product, vapor pockets, tank or piping deformation, evaporation or condensation, as well as groundwater levels (if applicable) prior to initiating an alarm condition.
  - c. Panel shall have speakers that produce a buzzer sound of 70 decibels or greater in the event of a detected alarm condition.
  - d. Panel shall have a visual alarm that illuminates in the event of a detected alarm condition. Visual alarm shall include either individual lights for each alarm type and location or shall include a single light and a liquid crystal display (LCD) panel that displays information regarding each alarm condition.
  - e. Provide panel contacts for interlock with pump and dispenser circuits which shuts down this equipment upon a low-low alarm.
  - f. Provide panel with a manual acknowledge switch which shall deactivate the audible alarm.
    - 1) Acknowledge switch shall not deactivate subsequent audible alarms unless depressed manually again for each occurrence.
    - 2) Under no circumstance shall this acknowledgement switch extinguish the visual alarms until the alarm condition has been corrected.
    - 3) Switches shall be an integral component located on the front panel and be either a key switch or push button.
7. Panel level monitoring:
- a. The panel shall be capable of providing a liquid level readout for each tank in terms of inches and gallons.
  - b. Level alarm setpoints shall be as specified in Section 33 56 13.
8. Panel shall be capable of producing hardcopy printouts of all tests and/or leak notification reports.
9. The monitoring system panel shall be connected to Ethernet for remote monitoring.
10. Provide 120 V dry contacts for remote annunciation of alarm at alarm panels.
11. The panel shall have a means of delineating between the individual set points and the individual tanks.
- B. Tank Interstitial Space Leak Detection Sensors:
- 1. Tank interstitial space leak detection sensors shall be in accordance with Section 33 56 13.
- C. Tank Level Sensors:
- 1. Tank level sensors shall be in accordance with Section 33 56 13.
- D. Dispenser and Containment Sump Leak Detection Sensors:
- 1. Leak detection sensors for dispenser sumps and containment sumps shall continuously and automatically monitor for the presence of water and/or fuel in the sumps.
  - 2. Sensors shall be reed switch / float type or electrical conductivity type for liquid detection. Liquid shall be detected at levels no higher than 1.5 inches from bottom of sump.
  - 3. Sensors shall be product permeable type or optical type for sensing hydrocarbon presence.
  - 4. Sensors shall alarm at fuel at any height on the sensor, even when fuel is floating on other liquids.
  - 5. Sensors shall be reusable after being exposed to hydrocarbons.
  - 6. Sensors shall not put the system into an alarm condition due to high concentrations of hydrocarbon vapors.
  - 7. System shall have the ability to continuously monitor the integrity of the sensor for an open condition, alarm condition, or normal operating condition.
  - 8. Sensors shall be UL listed and intrinsically safe for use in a Class 1, Division 1, Group D environment as defined by NFPA 70.
- E. Remote Alarm Indicator:
- 1. Provide remote alarm indicator for tank overfill alarm at fuel delivery area and elsewhere if indicated on Drawings.

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2. Remote alarm indicator shall include audible horn (70 dB or greater at 10 feet away) and high-visibility LED red light.
3. Remote alarm indicator shall be compatible with monitoring system panel.
4. Enclosure shall be of weatherproof construction.
5. Provide unit with alarm acknowledgement switch mounted in immediate vicinity of alarm indicator.

### **2.8 FLEET FUEL MANAGEMENT SYSTEM**

- A. Provide a fleet fuel management system designed to automate control and accountability of fuel products. The system shall include the following components:
  1. FuelMaster Fuel Management Unit (FMU), Qty. 5.
  2. Central Controller, located in Telecom Room of Maintenance Building.
  3. Prokee access devices.
- B. Fuel Management Unit (FMU):
  1. FMU shall control access to fuel dispensers and collect information on each transaction.
  2. FMU shall be permanently mounted at the fuel island near the associated dispensers.
  3. Where multiple FMUs are required at a facility, the master FMU shall contain the required communications equipment to connect with the Central Controller as well as connections for the local satellite FMUs.
  4. FMUs shall communicate directly with the Central Controller via direct cabling, wireless network, or fiber optic and without relying on telephone lines.
  5. Dispenser units and FMUs shall be programmed for compatible pulse transmissions (including pulse rate, pulse filtering, and voltage).
  6. FMUs shall be powered from a separate circuit from dispensers. Communications cabling shall be routed in separate conduit from power wiring.
- C. Central Controller:
  1. The Central Controller shall be capable of downloading transactions from FMUs, upload information to FMUs, provide transaction and other usage reports, export data to fleet maintenance programs, and provide control of access device authorizations.
  2. The Central Controller shall be a Windows-based personal computer loaded with the associated fuel management system software as provided by the system manufacturer.
    - a. Computer specifications for processor speed, memory, hard drive storage, communication ports, etc., shall be as specified by the manufacturer for their system.
    - b. Computer shall be a complete and functional system including accessories such as monitor, keyboard, pointing device, etc.
- D. Access Devices:
  1. Vendor proprietary keys (FuelMaster Prokee) and FMU keypad shall be used as the access device to activate the dispenser.
  2. Coordinate with owner to provide a specific quantity of keys and turn over to Owner.

## **PART 3 - EXECUTION**

### **3.1 SHIPPING & DELIVERY**

- A. Provide coverings for all equipment piping and electrical connections suitable for protecting against exposure to harmful weather conditions for a period of several months.

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- B. Coordinate transportation with supplier for shipping the dispensing equipment, panels, and associated components to the job site.

### **3.2 INSTALLATION**

- A. Procure necessary permits, provide required notifications, and coordinate inspections with North Carolina Department of Environmental Quality (NCDEQ), North Carolina State Fire Marshal's Office, and other agencies as required, and other agencies as required.
- B. Handle equipment and panels with care to prevent damage during placement and install in accordance with the manufacturer's written instructions, NFPA 30, NFPA 30A, IBC, and local codes.
- C. Coordinate installation of the equipment and panels with other parts of the installation including main storage tanks, day tanks, etc., as applicable.
- D. Inspect the exterior surface of the equipment and panels for obvious visual damage prior to placement.
  - 1. Correct surface damage according to manufacturer's requirements before proceeding with the equipment installation.
- E. Complete installation of equipment in accordance with manufacturer instructions.
- F. Field Painting:
  - 1. Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory, shall be painted and have identification markings applied as specified in Contract Documents.
- G. Install leak detection sensors in the low point of a sump in accordance with sump and sensor manufacturer's recommendations.
- H. Install automatic line leak detector on discharge side of each submersible pump in accordance with pump and detector manufacturer's recommendations.
- I. Complete interconnecting wiring and attach grounding cabling to the fuel system equipment in accordance with Division 26 requirements and manufacturer instructions.
- J. Complete initial setup of monitoring system panel and fleet fuel management system.

### **3.3 FUEL SUPPLY**

- A. Refer to Section 33 52 10.

### **3.4 PRESSURE TESTS**

- A. General Testing Requirements:
  - 1. All tests shall be made in the presence of the Engineer or Owner. Any preliminary tests that the Contractor may make without such tests being observed by the Engineer or Owner will not be accepted unless prior approval is obtained. The Contractor shall provide notification at least 48 hours before any work is to be inspected or tested.

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2. Furnish labor, materials, equipment, electricity, repairs, and retesting necessary for any of the tests required herein.

**B. Dispenser Sump Tests:**

1. Test the integrity of the dispenser sumps using water.
2. Fill sumps to a level near the top of the sump and at least 4 inches about the highest penetration.
3. Liquid level shall not lower by more than 1/8 inches over a 1 hour period.
4. Repair leaks and retest if required.
5. After the testing, remove all water and clean and dry the sump.

### **3.5 CLEANING, FLUSHING, AND ADJUSTING**

**A. Initial System Cleaning:**

1. Visually inspect the fuel system and clean free of debris before introducing fuel to the system.
2. Contractor shall remove all preservatives and foreign matter from valves, line strainers, pumps, and other equipment coming in contact with fuel.
3. No fuel will be delivered to the system until the Contractor has satisfactorily completed this initial system cleaning.

**B. Dispenser Unit Flushing:**

1. Fuel shall be pumped at the system's maximum design flow rate from a storage tank through the fuel supply piping, to the corresponding dispenser unit, and then returned to the storage tank via temporary attachments to the tank's fill port.
2. During flushing procedure, periodically bleed air through high point vents and flush low point drains.
3. Monitor equipment for leaks during flushing procedure.
4. Periodic samples for inspection by the Owner shall be taken during the flushing procedure.
  - a. A minimum of 100 GAL shall be flushed through each dispenser unit's nozzle.
  - b. The flushing procedure shall be continued until the fuel being delivered is acceptable to the Owner.
  - c. Each dispenser unit shall be flushed in the same manner.
5. At the conclusion of flushing, inspect filters and strainers and replace or clean if any signs of visible contamination.

**C. Initial System Adjustments:**

1. Following the flushing and cleaning operations, each system component shall be initially adjusted, if necessary, to meet the system's final operational requirements.
2. Flow rates and pressures shall be adjusted as required to meet the indicated requirements.
3. The sequence of control for each component shall be adjusted to meet the indicated system requirements.
4. Following the initial system adjustments, the equipment tests shall be performed in order to determine any necessary final system adjustments.
5. Emergency shutoff (shear) valves under the dispensers shall be installed and tested in accordance with the manufacturer's instructions. Train owner on adequately testing valve for annual testing by manually tripping the hold-open linkage.

### **3.6 PERFORMANCE TESTS**

**A. System Performance Tests:**



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1. After all components of the system have been properly adjusted, test the system to demonstrate that the system meets the performance requirements for which it was designed.
2. If any portion of the system or any piece of equipment fails to pass the tests, the Contractor shall make the necessary repairs or adjustments and the test shall be repeated until satisfactory performance is obtained from the Owner.
3. Perform start-up and commissioning tests per the manufacturer's recommendations in the corresponding installation manual for the equipment.
4. The tests shall demonstrate the following:
  - a. The capability of each fuel pump to deliver the indicated flow of fuel.
  - b. The alarm and control panels are operational and perform as designed.
  - c. Dispenser units are operational and perform as designed.
  - d. Each safety device works properly and is tested per NFPA requirements as necessary.
  - e. Vapor recovery systems perform as designed.

### **3.7 INITIAL START-UP**

- A. Refer to Section 33 52 10.

### **3.8 TRAINING**

- A. Refer to Section 33 52 10.

**END OF SECTION 33 57 10**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

**1.2 WORK INCLUDED**

- A. Equipment items as listed below by Equipment Identifier:
  - 1. 5010 CRANE, BRIDGE, TOP RUNNING, 5 TON (Ref. Part 2.1)
- B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.
- C. Wiring, and switching between equipment and utilities.

**1.3 QUALITY ASSURANCE**

- A. Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.
- B. Manufacturer's Representative:
  - 1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out, and start up.
  - 2. Training: Provide technical representative to provide training to Owner's maintenance personnel in operation and maintenance of specified equipment.
  - 3. Quality standards shall meet or exceed ISO-9001.

**1.4 SUBMITTALS**

- A. Product Data: Submit Product Data in accordance with Division 1 of these specifications.
- B. Operations and Maintenance Manual:
  - 1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
  - 2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
  - 3. Description of system and components.
  - 4. Schematic diagrams of electrical, plumbing, and compressed air system.
  - 5. Manufacturer's printed operating instructions.
  - 6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.
- C. Shop Drawings: Submit Shop Drawings in accordance with Division 1.

**1.5 PRODUCT SUBSTITUTIONS**

- A. Follow requirements specified in Division 1 - General Requirements.
- B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.
- C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

**1.6 WARRANTY**

- A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.
- B. Warranty shall include materials and labor necessary to correct defects.
- C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situations resulting from non-performance of a manufacturer's recommended preventive maintenance schedule.
- D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.
- E. All parts shall be readily available locally in the United States.

**1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.
- B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.
- C. Provide equipment and material specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

**PART 2 - PRODUCTS**

**2.1 CRANE, BRIDGE, TOP RUNNING, 5 TON**

**Equipment Identifier: 5010**

- A. Manufacturer's Reference:
  - 1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

**SECTION 41 22 00 - CRANES AND HOISTS**

Manufacturer	City	State	Phone
KONECRANES Model No.: CXTS	SPRINGFIELD	OH	(866) 258-8083

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

Manufacturer	City	State	Phone
ALT #1 DEMAG CRANES AND COMPONENTS	OMAHA	NE	(402) 896-9090
ALT #2 R&M MATERIALS HANDLING, INC.	SPRINGFIELD	OH	(937) 328-5100

**B. General Requirements:**

1. Crane shall be built to meet all CMAA standards.
2. Top running single girder electric overhead traveling cranes shall be designed, manufactured, and tested as per Crane Manufacturers Association of America (CMAA) will always be up to date with CMAA.
3. Top running and under running single girder electric overhead traveling cranes shall be designed and manufactured as per CMAA.
4. In addition, the crane design and installation shall meet all the applicable local, state, and federal laws and OSHA regulations having jurisdiction.
5. Cranes shall operate in the given spaces and shall match the runway dimensions and rails indicated. Crane design shall maximize hook coverage, hook vertical travel, and clear hook height.
6. The crane shall be designed and manufactured to meet the appropriate service conditions based on the particular application. The crane service class shall be clearly indicated by the manufacturer at the time the crane proposal is submitted.

**C. Capacities/Dimensions:**

1. Overall capacities/dimensions/weights:
  - a. Span: 44 feet 6 inches (verify exact span in field prior to fabrication)
  - b. Runway length: 145 feet, 3 inches
  - c. Clear hook height: 20 feet
2. Lift: Hoist design shall maximize hook coverage, hook vertical travel (i.e. end approach), and clear hook height (i.e. headroom). The use of a low headroom hoist is mandatory.
3. Lifting capacity: 10,000 pounds
4. Lower load block or assembly of hook, swivel bearing sheaves, pins and frames suspended by the hoisting ropes shall not be considered part of the rated capacity.
5. CMAA service Class C
6. Rated speeds (FPM) ±10%:
  - a. Hoist: Maximum high 10; Minimum low 3.2 FPM
  - b. Trolley: Maximum high 65; Minimum low 65 FPM
  - c. Bridge: Maximum high 100; Minimum low 100 FPM

**D. Features/Performance/Construction:**

1. Hoists and trolleys:
  - a. Hoist design shall maximize hook coverage, hook vertical travel (i.e. end approach), and clear hook height (i.e. headroom).
  - b. All top running and under-running single girder cranes shall utilize low headroom electric wire rope hoists.
  - c. All hoists/trolleys shall be supplied with either two-speed hoisting contractor controls or with an added VFD inverter to provide infinite speeds to minimize load swing and ensure accurate load positioning.

## SECTION 41 22 00 - CRANES AND HOISTS

- d. Any proposed equivalent must meet or exceed the dimensional and performance specification of the above-mentioned products.
- e. The drum to rope diameter ratio shall be a minimum of 40:1 to minimize rope flex and significantly extend rope life. Drum shall be made from steel and supported on heavy-duty anti-friction bearings. The rope drum shall be equipped with a rope guide and spring-loaded roller to help keep the rope aligned in the grooves of the drum at all times.
- f. Gear reducers shall be integral components of standard hoists or hoist/ trolley units of manufacturers regularly engaged in the design and manufacturing of hoists or hoist/trolley units for Class C cranes. The hoist gearbox must be mounted on angle to the drum to achieve zero gear lash and ensure long gear bearing life. The gear reduction units shall be fully enclosed in oil-tight housing. Operation shall be smooth and quiet.
- g. Hoisting gears shall be hardened and ground. Gears and pinions shall be spur, helical, or herringbone type only, and shall be forged, steel; open-type gearing is not acceptable. Gears and pinions shall be manufactured to AGMA or better precision. Gear reducer shall not incorporate a mechanical load brake; the gear reducer shall not require regular internal maintenance (such as mechanical load brake adjustment) and frequent lubricant changes due to friction material contamination and high running temperatures.
- h. The secondary brake shall be a self-adjusting DC disc type rated at a minimum of 150 percent of rated motor torque not including regeneration type braking.
- i. Each hoist shall be equipped with an electro-mechanical load-limiting device that shall prevent lifting more than 110 percent of the rated load.
- j. Hooks shall be made of forged alloy steel. Hooks shall be fitted with spring loaded safety latches designed to preclude inadvertent displacement of slings from the hook saddle and have 360-degree rotation on anti-friction bearings. No additional painting or welding shall be performed on the hook. Hook nut shall be secured with a removable type set screw or another similar fastener; nut shall not be welded. Hooks shall be designed and commercially rated with safety factors in accordance with CMAA.
- k. Bottom block shall be totally enclosed in a steel housing. Rope sheaves shall be supported on heavy-duty anti-friction bearings. Load blocks shall be of steel construction. Load blocks shall be provided with hot-rolled or forged steel fixed crosshead separate from the sheave pin with swivel mounting for forged steel hook. Each lubrication fittings for sheave pins shall be independent type recessed within the sheave pin or adequately guarded to prevent damage.
- l. Sheaves shall be of steel or ductile iron (240 to 302 BHN hardness). Sheaves grooves shall be accurately machined, smoothly finished, and free of surface defects. The sheave to rope diameter ratio shall be a minimum of 20:1 to minimize rope flex and extended rope life.
- m. Wire rope shall be constructed from galvanized steel having a steel core and a minimum safety factor of 5. (Hoisting ropes shall be the rated capacity load plus the load block weight divided by the number of rope parts and shall not exceed 20 percent of the certified breaking strength of rope.) Ropes shall be suited to meet the service requirements. Rope socketing or U-bolt clip connections shall be equal to or greater than the rope lengths. Hoisting ropes shall be secured to hoist drum so that no less than two wraps of rope remain at each anchorage of hoist drum at the extreme low position (limit switch stop).
- n. Trolley shall be complete with a drive arrangement with a minimum of two-wheel driven by an integral electric motor. Drive mechanism shall run in totally enclosed oil bath. Drive gears shall conform to AGMA or better. Stop limit switches must be provided for drive mechanism. Acceleration and deceleration controls shall meet requirements specified in this section. Trolley motor shall be inverter duty motor with minimum class "F" insulation. Motors shall have quick disconnect plugs for easy maintenance. Speed shall be infinitely variable from 65 FPM.

## SECTION 41 22 00 - CRANES AND HOISTS

- o. Trolley braking system shall be automatically set when controls are released, or power is interrupted. Brakes shall be sealed, dust proof and shall require no adjustment over a million cycles and last the life of the hoist under normal use.
- 2. Bridge components:
  - a. High strength bolted connections shall utilize SAE Grade 5 bolts with corresponding lockwashers, nuts, etc., conforming to requirements of AISC S329 bolts. Bolts, nuts, and washers shall conform to ASTM 325 bolts. Galvanized bolts are not acceptable.
  - b. Bridge girders shall be constructed from A36 welded box girders, or A36 Structural beams. Girder shall be notched at the ends only when the crane needs to be lowered relative to the rail to provide for required overhead clearances. The girder shall be bolted to the top of the end trucks with horizontal connections plates utilizing shear rings (only when used on a larger, heavier crane) to absorb horizontal shear forces and to maintain squareness. No "in shear" connections between girders and trucks will be allowed.
  - c. Bridge end trucks to be constructed of a rectangular HSS Shapes, formed into a rigid tubular housing. Trucks to be equipped with removable rail sweep on each end as well as energy-absorbing bumper. Wheel assemblies shall consist of flat tread, double-flanged, high-quality nodular iron or forged steel wheels, having anti-friction bearing assemblies with whole wheel assembly readily removed for easy repair. Drive wheels shall have rotating axles; idler wheels may be of fixed axle type. End connections shall be made with high-strength bolts.
  - d. Bridge drives shall be A-4 drive arrangement as specified in MHI CMAA 70. Bridge drive shall consist of a single electric motor mechanically connected through gear reduction and drive shafts to each drive wheel. Gears shall conform to applicable AGMA standards. Gear reducers shall be oil tight and fully enclosed with pressure or splash type lubrication to reduce maintenance and improve reliability.
  - e. Bridge braking system shall be provided with a spring-applied and electrically released disc brake for each bridge drive motor. Brakes shall have a torque rating of at least 50 percent of bridge drive motor rated torque. Brakes shall be self-adjusting for wear.
  - f. Wheels shall be manufactured of steel or nodular iron. Wheel treads and flanges shall be rim toughened to between 220 and 300 Brinell hardness number. Bridge and trolley wheels shall be double-flanged. Trolley wheels shall have straight treads. Bridge wheels shall have straight treads. Wheel shall be equipped with heavy-duty anti-friction bearings - no bushings shall be allowed.
  - g. Where applicable, cranes shall be designed to preclude leakage of lubricants onto the lifted loads or the floor. Equipment and components, which cannot be made leak-proof, shall be fitted with suitable drip pans. Drip pans shall be manufactured of stainless steel and designed to permit removal of collected lubricant. Gear boxes shall be leak proof. The hoist gear lubricant shall also be drip proof unless temperatures exceed 150 degrees which can possibly cause some liquification.
  - h. Electrically controlled brakes shall be fail-safe spring set when power is interrupted. Brakes shall be released with a mainline contractor POWER-OFF push button or a master switch for the associated drive. Brakes shall automatically stop when there is a power failure.
  - i. Runway (track-type) limit switches shall be provided for crane bridge motion to stop the bridge motion. Trip mechanisms for bridge motion shall be located on crane runway to trip switch before bumper contacts stop. When the switch is tripped, the switch shall permit opposite travel in the direction of stop and then automatically reset.
- 3. Welding: Welders, welding operations and welding procedures shall be qualified or pre-qualified in accordance with AWS D14.1. The surface of parts to be welded shall be free from rust, scale, paint, grease or other foreign matter. Minimum preheat and interpass temperatures shall conform to the requirements of AWS D14.1. Welding shall be performed in accordance with written procedures, which specify the Contractor's standard dimensional tolerances for deviation from camber and sweep. Such tolerances shall not exceed those

## SECTION 41 22 00 - CRANES AND HOISTS

specified in accordance with AWS D14.1. Allowable stress ranges shall be in accordance with MHI CMAA 70. Welding of girders and beams shall conform to AWS D14.1.

4. Markings, labels, and warnings:
  - a. Two capacity plates including the crane capacity in tons are required, one secured to each side of bridge crane. Each capacity plate shall be fabricated of steel or a quality/fade-resistant stick-on label with letters large enough to be easily read from the floor. Capacity plates shall be placed in a location visible to pendant operator's position after the crane has been installed.
  - b. Readable warning labels shall be affixed to each lift block or control pendant in a readable position in accordance with ASME B30.16, ASME B30.2 and ASME B30.17. The word "warning" or other legend shall be designed to bring the label to the attention of the following information concerning safe-operating procedures: operating the hoist when the hook is not centered under the hoist; operating hoist with twisted, kinked or damaged rope; with a rope that is not properly seated in its hoist drum groove; lifting people; lifting loads over people; and removing or obscuring the warning label.
5. Crane runway rail: Manufacturer to provide the crane stops as part of the runway, not the crane or the crane rail. The crane stops need to handle a 2.5 inches diameter energy absorbing crane bumper located 6-3/8 inches above the top of the runway beam.

### E. Electrical and Control Requirements:

1. Cranes shall be designed to be operated from a 460 VAC, 3 phase, 60 Hz, alternating current system power source.
2. The hoist/trolley shall be CAS (US/Canada) approved and/ or UL approved.
3. Sway control features shall be provided with a single winding VFD speed-controlled hoisting motor. Hoisting motors effective duty shall be 50 percent ED (30 minute rated) or higher with minimum class "F" insulation. One thermal sensitive device embedded in hoist motor windings shall be provided. Thermal-sensitive device and associated circuits shall be self-restoring (automatic reset). Motors shall be designed specifically for crane and hoist duty.
4. Hoist controls shall be full magnetic type, specifically selected for hoisting service. The trolley shall be supplied with variable frequency drive (VFD) controls for two-step or infinitely variable speed control for smooth acceleration and deceleration, minimal load swing and accurate load placement.
5. Hoist shall be equipped with a geared adjustable upper and lower limit switch to limit extreme upper and lower travel of the bottom block assembly. Geared limit switch shall have four positions with the following functions- lower limit, upper slowdown, upper limit, and phase reversal supervision. The upper-most limit shall be wired to the down circuit in such manner to prevent hoisting in the event of a phase reversal. Hoist shall include a secondary upper limit.
6. Bridge motors shall be inverter duty motors with minimum class "F" insulation. Motors shall have quick-disconnect plugs for easy maintenance. Travel motors shall have a duty of 40 percent or higher. Motor enclosure shall be TENV (totally enclosed non-ventilated). Provide slow down and stop limit switches at each end of the bridge to insure safe operation. Speed shall be infinitely variable from 0 to 100 FPM.
7. A main line disconnect consisting of a combination circuit breaker (50,000 AIC) and non-reversing starter, starter without overloads (mainline contractor) enclosure shall be UL rated enclosure. Mainline disconnect shall be controlled by a control circuit so that all crane motions will be stopped upon mainline under voltage, overload, control circuit fuse failure, or operation of POWER-OFF push button. Mainline disconnect shall be equipped with energy isolating devices designed to accept lockout devices.
8. Pendant control station enclosure shall be UL rated. Physical size of pendant shall be held to a minimum. Cable shall be integral with pendant control wire.
9. Push button control enclosure shall be UL rated. Thermal overloads to be provided for all motors. Hoist to be equipped with overload cut-off device. Hoist and trolley control functions to be combined with pushbutton control functions for crane motions.
10. Reduced voltage at pendant push button.

**SECTION 41 22 00 - CRANES AND HOISTS**

11. Operation push buttons shall be heavy-duty; type with distinctively felt operation positions, which meet requirements of UL. Pendant control buttons shall be momentary push buttons. Push buttons (except the POWER- OFF button) shall be recessed type to avoid accidental operation. Diameter of buttons shall be a size, which will make operation possible with a thumb while holding the pendant with the same hand. Nameplates shall be provided adjacent to each push button. In a multi-speed application, dual-position push buttons shall have a definite click-indent position for each speed. Pendant shall include a separate set of pushbuttons for each motion and for POWER-OFF. Push buttons shall be as follows:
  - a. POWER-OFF
  - b. POWER-ON
  - c. Hoist-Up
  - d. Hoist-Down
  - e. Bridge-East
  - f. Bridge-West
  - g. Trolley-North
  - h. Trolley-South
12. Bridge span conductor system shall be the rigid conductor/collector type. Cable loops shall not drop below the hook high position. Outdoor crane bridge festoon system hardware shall be corrosion resistant.
13. Pendant festoon system shall consist of a support rail, cables, junction boxes, cable cars, and accessories. Pendant control car shall be provided with UL junction box. Outdoor crane pendant festoon system hardware shall be corrosion resistant.
14. Main power electrification system shall provide power to crane starter/ disconnect circuit breakers.
15. Training: Operator orientation and handoff shall be provided and included. Includes use of cranes and daily inspection. Maintenance and servicing is only by qualified personnel based on annual inspections. No normal oiling, greasing or other maintenance. Brakes are lifetime brakes and can only be serviced by qualified and properly trained technicians. An 8 hour on site crane operator training class is available and is not related to this particular crane. This training class does not include maintenance.

F. Accessories:

1. Crane runway rail to match end truck wheel assembly with crane stop.
2. Crane runway conductor system shall be covered conductor bar system type designed and manufactured to meet UL requirements. Protective covers shall be the rigid or flexible self-closing type designed to cover all live conductors and shall be shaped to prevent accidental contact with conductors. Collectors shall be heavy-duty sliding shoe type compatible with the electrification system. Two tandem designed collector heads shall be provided for each conductor rail to provide redundancy.
3. A solid-waste electronic warning horn shall be provided on the crane. Any bridge or trolley motion shall be accompanied by a continuous series of alternating tones.
4. Control panels shall be provided with a 120-volt lamp fixture with an unbreakable lens and switch. Two floodlights shall be provided to illuminate the work area under the crane. Floodlights shall be LED type to manufacturer's standard (155 watts luminescence 116 lumens per watt) IP classification IP 66 (wet environment). Each floodlight shall be totally enclosed, vapor-tight design, gasketed, and shall be provided with a heat-resistant glass lens. Floodlights shall be spaced and attached to underside of crane to provide uniform lighting.

G. Utility Requirements:

Electrical				
Voltage	Phase	HP	Amperage	Connection Type
115	1	0	5.00	J-BOX
460	3	5.3	14.90	DISCONNECT



- H. Finish: Bridge crane including bridge, trolley, hoist, and all attached items shall be painted in accordance with the manufacturer's standard practices. Items such as surfaces in contact with the electrical collector bars in contact with the collector shoes and nameplates shall not be painted.

**PART 3 - EXECUTION**

**3.1 INSPECTION**

- A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.
- B. Inspect delivered equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.

**3.2 INSTALLATION**

- A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect or designated representative.
- B. Install equipment in accordance with plans, shop drawings, and manufacturer's instructions:
  - 1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.
  - 2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
  - 3. Anchorage: Attach equipment as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.
- C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

**3.3 TESTING**

- A. After final installation is complete and prior to authorizing payment, specified equipment shall be checked with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

**3.4 CLEANUP**

- A. Touch-up damage to painted finishes.
- B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.
- C. Clean area around equipment installation and remove packing and installation debris from job site.

## **SECTION 41 22 00 - CRANES AND HOISTS**

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- D. Notify Architect or designated representative when installation and cleanup is 100% complete and ready for final observation (punchlist).

### **3.5 TRAINING**

- A. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.
  - 1. 5010 CRANE, BRIDGE, TOP RUNNING, 5 TON; 3 hours (minimum)
- B. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

**END OF SECTION 41 22 00**

## **APPENDIX**

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# STEWART

STRONGER BY DESIGN

## GEOTECHNICAL ENGINEERING REPORT

### **Concord Fleet Services Facility**

880 Warren C. Coleman Blvd.  
Concord, North Carolina

May 25, 2023

# GEOTECHNICAL ENGINEERING REPORT

## Concord Fleet Services Facility

880 Warren C. Coleman Blvd.  
Concord, North Carolina

May 25, 2023

Prepared For:

**City of Concord**  
PO Box 308  
Concord, NC 28026-0308

Prepared By:



**STEWART**  
5400 Old Poole Road  
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Stewart Project No.: F23004.00

5/25/2023

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**Appendix A**

- Site Vicinity Map
- Boring Location Diagram

**Appendix B**

- Boring Snapshots
- Boring Logs
- Boring Summary Table
- Legend to Soil Descriptions

**Appendix C**

- Laboratory Results

**Appendix D**

- Site Photographs

## **1 EXECUTIVE SUMMARY**

Stewart has completed a geotechnical exploration for the proposed Concord Fleet Services Facility at 880 Warren C. Coleman Boulevard in Concord, North Carolina. This Executive Summary is provided as a brief overview of our geotechnical evaluation for the project and is not intended to replace more detailed information contained elsewhere in this report. A summary of our findings, opinions, and recommendations is provided below.

- The project consists of a new single-story, 38,400± SF Fleet Services Facility. Site improvements are expected to include new light-duty and heavy-duty pavement for parking lots and driveways, as well as a covered fuel island.
- A total of 30 soil test borings were performed for this geotechnical exploration. Soil test borings were advanced to approximate depths ranging from 7 feet and 49 feet below the existing grade.
  - The soils encountered at the boring locations consisted of fill and/or residual soils with USCS soil classifications of Silty and Clayey SANDs (SM and SC), Sandy and Clayey SILTs (ML and MH), Fat CLAY (CH), and Lean CLAY (CL).
  - Groundwater was encountered in six borings at the time of drilling at depths ranging from approximately 23 feet to 39 feet below the current grade.
  - Weathered rock was encountered in nine borings at approximate depths ranging from 4 feet to 39 feet below the current grade.
  - Rock was encountered in six borings at approximate depths ranging from 7 feet to 32.5 feet below the current grade.
- For design, we recommend a Seismic Site Class D.
- CH soils were encountered in many boring across the site. These soils are considered poorly suited for pavement, slab, and foundation support and may require undercutting and replacement, depending on final grading plans. CH soils will also be limited in their use as fill during site grading.
- The use of conventional spread footings and concrete slab-on-grade are recommended.

The owner/designer/contractor should not rely solely upon the summary above. This report should be read in its entirety prior to implementing the recommendations in the preparation of design and construction documents. Stewart should be retained to perform sufficient services to determine plan/specification compliance with the recommendations in this report.

## 2 PROJECT INFORMATION

### 2.1 Project Understanding

The proposed Fleet Services Facility will be a one-story, 38,400± SF addition to the current operations center on Alfred Brown Jr. Court. The structure will have a slab-on-grade, with the possibility of service pits in vehicle bays and a finished floor elevation of 624 feet. Site improvements will include new light-duty and heavy-duty pavement for parking lots and a heavy-duty access road at the north end of the site. A covered fuel island is also planned for the south side of the site.

### 2.2 Site Information

#### 2.2.1 Location

The site is located at 880 Warren C. Coleman Boulevard, in Concord, North Carolina. Please refer to Figure A1 in Appendix A of this report for the site vicinity map.

#### 2.2.2 Current Conditions

The northern portion of the site is a grass field that slopes downward approximately 20 feet to a gravel lot at the south end of the site that is used for solid waste handling and processing. There is a large debris pile separating the field from the gravel lot, as well as a large mulch pile on the south end of the lot, which are also associated with the onsite solid waste operations. There are also miscellaneous spoils piles located on the south end of the grass field.

The southernmost portion of the site is wooded with a powerline easement trending east to west. Site photographs taken during our time on site are included in Appendix D of this report.

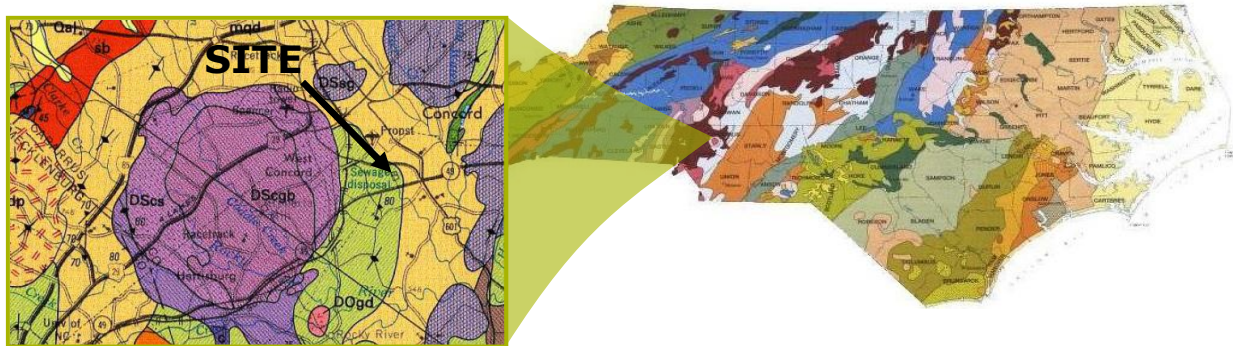
#### 2.2.3 Past Conditions/Uses

Looking through past aerial photographs available on the Cabarrus County GIS webmap (link below), which date back to 1938, the majority site appears to have been a farm field up until the late 1990s. After the 1990s the site slowly reforested until 2014 when the gravel lot was installed, and later in 2018-2019 mass grading shaped the site to its current day conditions.

<https://location.cabarruscounty.us/mapcabarrus/?pin=55393666570000>

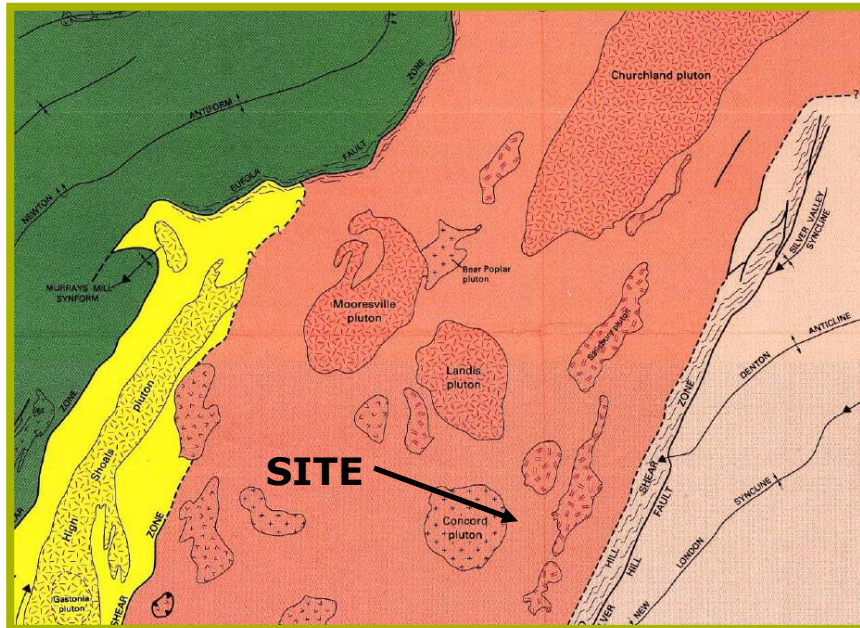
### 2.3 Geologic Area Overview

The project site is located in Cabarrus County, North Carolina, which lies within the Piedmont Geologic Province of North Carolina within the Charlotte Belt. Review of the *Geologic Map of Charlotte, North Carolina and South Carolina (1988)* indicates that the underlying bedrock at the subject site is characterized by metavolcanics (mv) of the Salisbury Plutonic Suite.





The site is located in a region of North Carolina that contains several mapped faults and shear zones. These geologic features have relatively low seismicity and are not associated with seismic events that have caused significant structural damage.



Based on our local experience, differential weathering of bedrock often results in highly variable subsurface conditions over relatively short horizontal and vertical distances. Furthermore, suspended boulders, discontinuous rock layers/lenses, rock pinnacles and/or zones of weathered and/or fractured rock are commonly encountered within the residual soils in this region.

### **3 SUBSURFACE EXPLORATION**

#### **3.1 Field Testing**

The subsurface conditions at the site were explored with 30 soil test borings (B-1 thru B-9 and S-1 thru S-20, including an additional S-11A). The boring layout is illustrated in Figure A2 in Appendix A of this report. The borings were advanced to approximate depths ranging from 7 to 39 feet below the current grade. Drilling was performed by RDL Drilling using a truck-mounted Mobile B-47 and ATV-mounted CME 550 drill rig and 2¼-inch (ID) hollow-stem, continuous flight augers in general accordance with ASTM D6151.

Sampling operations were conducted in general accordance with ASTM D1586. At predetermined intervals, soil samples were obtained with a split-barrel sampler (standard 2-inch O.D.). The sampler was rested on the bottom of the borehole and driven to a penetration of 18 inches (or fraction thereof) with blows of a 140-pound drop hammer falling a distance of 30 inches. Of the 18 inches, the number of hammer blows required to achieve 6 inches of penetration is recorded for three consecutive segments. The sum of the blow counts for the second and third 6-inch segment is termed the Standard Penetration Test (SPT) resistance, or N-value. The N-values presented on the Boring Logs and Boring Snapshot are the actual field-recorded blow counts and do not include correction factors for hammer energy or overburden soil pressures.

All boreholes were backfilled with auger cuttings (soil) following groundwater measurements.

#### **3.2 Laboratory Services**

The soil samples obtained during the drilling operations were placed in labeled containers and delivered to our Raleigh laboratory where they were visually-manually classified in general accordance with ASTM D2488 and logged by a member of Stewart’s geotechnical engineering staff. Typed boring logs are included in Appendix B of this report.

Laboratory testing was performed on select soil samples to aide in our geotechnical evaluation. Atterberg Limits testing, fines content testing, and water content testing was performed on near-surface split-spoon soil samples from four borings. The results of these lab tests are summarized in Table 1. Additional water content tests were performed on 26 other split-spoon soil samples and reported in Appendix C. All untested soil samples will be stored for two months before discarding.

Table 1: Summary of Lab Testing

Boring	Depth, ft	Att. Limits <i>[ASTM D4318]</i>			% Passing #200 <i>[ASTM D1140]</i>	USCS Class. <i>[ASTM D2487]</i>
		LL	PL	PI		
B-5	1.0-2.5	103	39	64	98.0	CH
B-7	3.5-5.0	33	18	15	39.4	SC
S-6	1.0-2.5	79	28	51	77.4	CH
S-17	1.0-2.5	71	28	43	34.3	GC

### 3.3 Subsurface Conditions

The following is a subsurface description of a generalized nature, provided to highlight the major soil strata encountered. The stratification of the subsurface materials illustrated on the Boring Logs and Boring Snapshots represent the conditions at the actual test locations; therefore, variations should be expected between borings. Stratigraphy boundaries only represent the approximate depth/elevation of a noticed material change but the transition between material types is typically gradual. The soil types are based on the Unified Soil Classification System (USCS).

The ground surface elevation and northing-easting at each boring location were surveyed by Stewart using a survey-grade Carlson BRx7 GPS unit. The elevations are reported on the logs, rounded to the nearest 1-foot.

#### 3.3.1 Ground Cover

A thin veneer of organic-laden soil (topsoil) was encountered in 24 borings (B-1 thru B-8, S-1 thru S-4, S-6 thru S-14, and S-18 thru S-20) ranging in thickness from approximately 2 inches to 6 inches.

Borings B-9 and S-17 encountered mulch with little to no soil intermixed to depths of approximately 8 feet and 2 feet below the current ground surface, respectively. Boring B-3 encountered a layer of topsoil-mulch mixture approximately 1 foot thick.

Borings S-15 and S-16 encountered a layer of gravel at the surface with thicknesses of approximately 7 inches and 6 inches, respectively.

#### 3.3.2 Fill

Fill soil is a material that was placed during previous grading activities. Fill soil was encountered in nine borings (B-6 thru B-9, S-3, S-11A, S-15, S-17, and S-19) to depths ranging from approximately 1.5 feet to 12 feet below the current ground level. The fill consisted of loose to medium dense Silty SAND (SM), stiff Clayey Sandy SILT (ML), soft to stiff Clayey SILT (MH), and medium stiff to stiff Sandy Lean CLAY (CL), and soft Sandy Fat CLAY (CH).

#### 3.3.3 Residual

Residual soils are the undisturbed, weathered remains of the parent rock. Residual soil was encountered directly below the ground cover or fill in all borings, except for boring S-5 where it was found at the surface. These soils consisted of medium dense to very dense Silty SAND (SM), loose to medium dense Clayey SAND (SC), soft to very stiff Clayey SILT (MH), and medium stiff to hard Sandy SILT (ML). SPT N-values in the residuum ranged from 5 to 83 blows per foot (bpf).

#### 3.3.4 Weathered Rock

For engineering purposes, weathered rock (WR) is defined by SPT N-values of 100 bpf, or more commonly 50 blows with 6 inches of less penetration. Geologically, weathered rock is geomaterial that is structurally between the parent rock and soil. Weathered rock was encountered in nine borings (B-4, B-8, S-2, S-9, S-10, and S-14 thru S-17) at depths ranging from approximately 4 feet to 39 feet below the existing ground surface (el. 571± feet to 624± feet).

#### 3.3.5 Rock

Rock is defined as material of sufficient hardness to refuse mechanical drilling equipment. Rock was encountered in six borings (B-8, S-9, S-10, S-14, S-16, and S-17) at approximate depths ranging from 7 feet to 32.5 feet below the current ground surface (el. 592± feet to 583.5± feet).

### 3.3.6 Groundwater

Groundwater was encountered in six borings (B-4 thru B-7, B-9, and S-15) immediately after drilling, at approximate depths ranging from 23 feet to 39 feet below the current ground surface (el. 569± feet and 595± feet). All boreholes were backfilled with auger cuttings (soil) after groundwater measurements were complete.

The groundwater conditions represent the conditions at the time of the exploration. Fluctuations in groundwater levels are common and should be expected. Common factors that influence groundwater levels include, but are not limited to, soil stratification, climate/weather, nearby bodies of water (lakes, ponds, etc.), underground springs, streams, rivers and surface water discharge. At the onset, as well as continually throughout the construction process, the contractor should monitor groundwater levels if determined to be detrimental to the project.

## **4 ENGINEERING ASSESSMENT AND RECOMMENDATIONS**

### **4.1 Site Grading**

#### **4.1.1 Subgrade Preparation**

All vegetation, topsoil, root mat, and any other unsatisfactory or deleterious materials should be removed from the limits of new construction. The mulch mixtures encountered in borings B-3, B-9, and S-17, as well as any other areas that it is encountered, should be removed during site grading. Considering the current site usage, we expect that this type of material will be encountered across the surface sporadically throughout the site with variable thicknesses. Such material should be considered unsuitable for reuse as structural fill.

After stripping the site, the exposed ground surface in areas to receive fill or at finished subgrade elevation should be moisture conditioned and thoroughly densified with a large roller for all areas at or below finished subgrade. In areas of cut, the finished subgrade should be rolled/compacted to densify any disturbed material. Scarifying of the exposed ground surface may be required for excessively wet soils prior to densification.

The areas of borings B-6 and B-7 encountered the deepest fill of the building pad area. The SPT N-values in this fill were highly variable, and in the case of B-6 some N-values were low. These conditions suggest that the placement and compaction of the soil may have occurred in an uncontrolled and/or monitored manner. The soil conditions in boring B-6 would typically require undercutting and replacement if within the building pad; however, the latest building footprint is now 30± feet north of this boring. As such, we expect the fill in the pad to be more consistent with boring B-7 and should not require undercutting. Nevertheless, the presence of large fill masses like this increases the risk of encountering poorly compacted or unsuitable material unexpectedly during construction. If soft/weak or otherwise unsuitable soil conditions are encountered within the building pad during site grading, it will require removal and replacement. Depending on its depth and conditions, such conditions could also require undercutting in pavement areas - just typically not as deep.

Areas of the site to receive fill or directly support new construction should be proofrolled with a tandem-axle dump truck weighing between 15 and 20 tons. Proofrolling should occur prior to fill placement or after reaching final grade in cut areas but must be in the presence of the owner's testing agency so that recommendations can be provided for areas that rut, pump, or deflect excessively. Proofrolling should not be performed on frozen or excessively wet subgrades. Once prepared, it is contractor's responsibility to protect the prepared subgrade from degradation caused by wet weather and/or construction traffic.

Given the fine/clayey nature of the onsite soil, the exposed surface soils are likely to become unstable rapidly in the presence of excess moisture (water) and construction traffic loading. Therefore, proper site drainage should be maintained during earthwork operations. If not, the accumulation of water could result in construction delays. Common approaches to reduce wet weather delays include grading the area so that surface water flows away from the excavation, sealing exposed soil surface with a smooth-drum roller prior to precipitation events, and forming temporary ditches, swales, berms or other surface water diversion features. We also recommend limiting construction traffic during and after wet weather.

#### 4.1.2 Fat Clay and High Elasticity Silts

Fat clays (CH) and high elasticity silts (MH) are considered poorly suited for direct support of foundations, pavements, and slabs due to potential volume change (shrink-swell) with moisture fluctuation as well as strength loss when wetted. If the proposed grading scheme provides at least 18 inches of new fill between stable/compacted MH or CH soils and the overlying construction, then their removal is not required. Conversely, if present at/near finished subgrade elevation, the MH and CH soils should be undercut and replaced to provide a minimum 18-inch buffer (separation) between them and the overlying construction. Judging by the borings, we anticipate this condition in the area of boring B-5. We recommend the undercut soils be replaced with a structural soil meeting the criteria provided in Section 4.1.5 of this report. Undercutting should extend a minimum of 2 feet laterally beyond edges of the foundation/slab/pavement. Alternatively, the clay can be chemically stabilized using lime, cement, or kiln dust in lieu of undercutting.

CH and MH soils will also have limitations on use as structural fill, which is discussed in Section 4.1.5.1 of this report.

#### 4.1.3 Difficult Excavation

Based on the shallow WR depths in borings S-2, S-9, and S-14 through S-6, difficult excavations should be expected in these respective areas during mass grading. Deeper excavations for utilities will likely be hampered by shallow as well.

Experience has shown that materials with SPT N-values of 50 blows per 4 inches to 50 blows per 6 inches of penetration are generally rippable using a CAT D9 dozer using ripper tooth or large excavators (e.g., CAT 330) with rock teeth. Denser material such as rock or weathered rock with SPT N-values of 50 blows per 3 inches or less penetration will likely require hammering to facilitate removal.

#### 4.1.4 Slopes

Based on our experience and the known site soil conditions, we recommend that permanent cut and unreinforced fill slopes be no steeper than 2(H):1(V). If steeper slopes are required, we recommend a detailed slope stability evaluation. For maintenance purposes, slopes of 4H:1V or flatter may be desirable to allow access to mowing equipment.

Buildings should have the appropriate setbacks in accordance with Section 1808.7 of the NC Building Code.

#### 4.1.5 Structural Fill

##### 4.1.5.1 Selection

Whether imported or borrowed from an onsite source, structural fill should satisfy the following:

- No excessive deleterious material
- No rocks or other inclusions greater than 3 inches in diameter
- A maximum of 30% of the total material weight retained on the ¾-inch sieve
- Maximum Dry Density (MDD) of 95 pounds per cubic foot (pcf) or greater, as determined by the Standard Proctor Compaction Test (ASTM D698)
- Liquid Limit (LL) of 50 or less and a Plasticity Index (PI) of 25 or less, as determined by Atterberg Limit testing (ASTM D4318), unless otherwise noted/allowed
- Organic content no greater than 3% (by weight)

The SM, ML, and CL soils encountered onsite meet the LL/PI requirements above and are suitable for reuse as structural fill. The CH and MH soils encountered onsite will not meet the LL/PI requirements above; therefore, their use should be restricted to areas outside of the building pad. If used in pavement areas, CH and MH soils should be capped with at least 18 inches of structural fill meeting the requirements herein.

#### 4.1.5.2 Moisture Conditioning

The water content of the structural fill should be maintained within  $\pm 3\%$  of the material's optimum water content as determined by the Standard Proctor Compaction Test (ASTM D698); however, slight deviation from this can sometimes be tolerated depending on the grading plan and type of material being placed. Such deviation should be considered by the engineer representing the material testing firm.

Please note that soils can be deemed unusable due to water content but shall not be classified as unsuitable based solely on water content. When soil water content falls outside of the requirements set herein, the contractor shall be responsible for taking appropriate measures (drying or wetting) to render the soil usable unless otherwise agreed to by the Owner.

#### 4.1.5.3 Compaction

When using large, ride-on compactors, fill should be placed in loose lifts measuring 8 to 10-inch thick. Lift thicknesses should be thinned to 4 to 6 inches when using smaller, Rammax-type compactors and no more than 4 inches thick for sled and jumping-jack tampers. Structural fill should be compacted to the requirements below, which are based on the soil's maximum dry density as determined by ASTM D698:

- Within 12 inches of finished subgrade elevation ..... 98%
- Below 12 inches of finished subgrade elevation ..... 95%

It is recommended that the placement and compaction of structural fill be monitored by an engineering technician from the owner's testing agency. Field compaction testing should be performed in accordance with ASTM D1556 (Sand Cone Method), ASTM D2167 (Rubber Balloon Method), ASTM D2937 (Drive Cylinder Method), or ASTM D6938/ D8167 (Nuclear Methods).



## 4.2 Foundations

### 4.2.1 Design

Based on an assumed maximum column load of 100 kips and the site preparation recommendations provided in this report, we recommend the use of conventional shallow spread footings to support the proposed structure. In designing the foundations, we recommend the parameters provided in Table 2.

Table 2: Spread Footing Design Parameters

Parameter	Value
Net Allowable Soil Bearing Capacity, psf	3,000
Minimum Bearing Depth, in.	18
Minimum Footing Width, in. Column	36
Wall	18
Estimated Post-Construction Settlement, in. Total	Up to 1
Differential	Up to ½
Moist Soil Weight, pcf	120
Passive Earth Pressure Coefficient*	2.77
Ultimate Friction Factor ( $\tan \delta$ )	0.30
*We recommend that a safety factor of at least 1.5 be used to determine the soil's allowable passive resistance and the soil's allowable base friction.	

### 4.2.2 Construction

It is preferable for spread footing excavations to be performed using a bucket with a flat cutting edge (no teeth) to reduce disturbance of the exposed bearing soil. Regardless, footing bottoms should be tamped with a jumping-jack or sled compactor prior to the foundation inspection and placement of reinforcing steel. Footings should be clean of loose material and debris and protected from disturbance. This includes protection from surface water run-off and freezing. If water is allowed to accumulate within a footing excavation and soften the bearing soils, or if the bearing soils are allowed to freeze, the deficient soils should be removed from the excavation and rechecked by the owner's testing agency prior to concrete placement. When concrete cannot be placed immediately, we recommend placing a mud-mat to protect the bearing soil.

Foundation bearing soils should be checked by the owner's testing agency during construction to verify satisfactory bearing conditions (i.e., materials and strength). This typically involves using a ½-inch diameter, T-handled probe rod for an overall qualitative assessment throughout the foundation excavations, followed by strategically placed hand auger borings and Dynamic Cone Penetrometer (ASTM STP-399) testing for quantitative evaluation. DCP testing should be performed prior to stone, steel, or concrete placement. Unsuitable soil detected during this evaluation should be repaired as recommended by the owner's testing agency.

In the event that fat clay is encountered within 12 inches of the design bearing elevation, it should be undercut a minimum of 18 inches and replaced with compacted structural fill soil. No. 57 washed stone shall not be used as footing backfill. Alternatively, footing(s) can be deepened to bear in fat clay at a depth of 48 inches or greater below the lowest surrounding finished grade, provided that satisfactory bearing is verified by DCP testing.



### 4.3 Slab-On-Grade

#### 4.3.1 Design

In designing the slab-on-grade floor, we recommend a minimum 4-inch base layer of washed No. 57 stone to provide uniform support and to provide a capillary break. We also recommend the installation of a vapor barrier as a measure of protection against water vapor intrusion for enclosed spaces. Even when groundwater is relatively deep, water vapor transmission through the slab could damage flooring and/or cause elevated moisture levels within the structure. We recommend considering the use of a vapor barrier meeting ASTM E1745, which should be installed per the ACI guidelines (ACI 302.2R) and ASTM E1643.

The design of the concrete slab-on-grade should be based on Westergaard's modulus of subgrade reaction ( $k$ ). Based on the soil conditions encountered at the site, and the stone base noted above, we recommend an effective  $k$ -value ( $k_{ef}$ ) 120 pci.

It is important to point out that cracking of concrete is normal and should be expected. Proper jointing of slabs is paramount in the control of cracking. The American Concrete Institute (ACI) recommends a maximum panel size (in feet) equal to approximately three times the thickness of the slab (in inches) in both directions. Controlling the water-cement ratio of the concrete, particularly after batching, and including fiber reinforcement in the mix can also help reduce shrinkage cracking.

#### 4.3.2 Construction

After the pad area is prepared as discussed in Section 4.1.1 of this report, it should be evaluated by the owner's testing agency to identify any weak or excessively unstable areas that require repair. This is typically accomplished by proofrolling with heavy, rubber-tired equipment such as a tandem-axle dump truck. In confined areas that cannot be proofrolled with a dump truck, use of smaller rubber tire equipment, probing, and/or DCP testing should be considered.

### 4.4 Below-grade Walls

The project may include vehicle service pits and loading docks, which would consist of cast-in-place concrete retaining walls extending below the finished floor level. When designing such wall, we recommend the design parameters provided in Table 3.

Table 3: Retaining Wall Design Parameters

Moist Unit Weight, $\gamma$ (pcf)	Earth Pressure Coefficients		
	Active Condition, $K_a$	At-Rest Condition, $K_o$	Passive Condition, $K_p$
120	0.36	0.53	2.77

### 4.5 Seismic Design Considerations

Per the 2018 NC State Building Code, the design of a structure must consider dynamic forces resulting from seismic events, regardless of their likelihood of occurrence. As part of a generalized procedure to estimate seismic forces, the code assigns a Seismic Site Classification (letter designation of Class A through F) based on the subgrade soil/rock conditions within the upper 100 feet of the ground surface at the subject site. Based on our review of the SPT N-values recorded at this site, we recommend designing for a Seismic Site Class "D".

The following bulleted items briefly discuss our qualitative assessments of the other seismic-related issues. Detailed quantitative analyses for these items were not included in our Scope of Work and are not

considered necessary at this time given the development plans and the subsurface conditions encountered.

- Liquefaction Hazard – Risk level is low – The soils encountered were of sufficient fines content and/or density to render them not readily liquefiable during the design earthquake.
- Slope Stability – Risk level is low - Based on the grading plan, neither tall nor overly steep cut/fill slopes are planned for construction.
- Surface Rupture – Risk is low – No active faults underlie the site.

#### 4.6 Pavement

The pavement at this facility will support a mix of vehicles type with a wide array of loading. For our assessment, the City of Concord provided the weight categories shown in Table 4. For the purpose of our evaluation, we have assumed most of these vehicles to have single axles in the front and rear, with a 20%(F):80%(R) weight distribution, except as noted. Based on gas pump transaction data and the anticipated growth rate provided by the City, we have based our pavement designs on a total of 110 vehicles per day.

Table 4: Traffic Weights

Provided Weight Category, lb	Weight Used in Design, lb	% of Total Traffic
Less than 15,000	10,000	67
15,000 to 32,000	28,000	9
Over 32,000	50,000*	24
*Assumed to have a rear tandem axle		

The facility will include a mixture of light and heavy-duty pavements, using both asphalt and concrete sections.

##### 4.6.1 Flexible (Asphalt) Design

The provided site plan illustrates standard-duty asphalt pavement for the parking lots on the north and west sides of the proposed Fleet Building, as well as the western portion of the south lot (outside of the fence). Heavy-duty asphalt pavement for the larger, heavier vehicles is planned for the east and south lots. Based on the provided traffic information, the site soil conditions encountered in the borings, and the site preparation recommendations herein, we recommend the minimum asphalt pavement sections in Table 5.

Table 5: Asphalt Pavement Sections

Course	Standard-Duty Thickness*, in.	Heavy-Duty Thickness, in.
Surface (S9.5C)	2	2
Intermediate (I19.0C)	---	2.5
Aggregate Base Course (ABC)	6	8
* Passenger cars/pickup trucks only		

The flexible pavement design is based on the standard 20-year design life and the NCDOT/AASHTO design methodology. All materials and workmanship used during construction should conform to the NC Department of Transportation Standard Specifications for Roads and Structures, current edition.

As a potential cost savings alternative, recycled crushed concrete (RCC) can be considered for use in lieu of ABC stone, if available. To be approved, the RCC must meet the gradation requirements of NCDOT ABC stone and exhibit similar compacted weight when subjected to a modified Proctor test.

Another potential alternative for consideration is cement stabilization of the subbase. With either pavement class (duty), if the subbase is treated with cement to a depth of 10 inches, the ABC stone can be eliminated to place the asphalt directly on the treated subbase. This process involves mixing the cement into the subgrade soils with water using specialized equipment, and then compacting the mixed material to at least 97% of its standard-effort maximum dry density (Proctor). Furthermore, the heavy-duty surface course noted in Table 5 can be reduced to 1.5 inches. The cement stabilization contractor should determine the appropriate cement dosage needed based on past experience; however, we recommend assuming a rate of 40 pounds per square yard for bidding purposes.

#### 4.6.2 Rigid (Concrete) Design

The provided site plan also illustrates concrete pavement for the area surrounding the new gas pumps, the south access driveway, and the westernmost 25±% of the new access road at the north end of the site. Based on the heavy traffic anticipated, the site soil conditions encountered in the borings, and the site preparation recommendations herein, we recommend the minimum concrete pavement sections in Table 6.

Table 6: Concrete Pavement Section

Layer	Thickness, in.
Concrete	6.5
Aggregate Base Course (ABC)	6

The concrete pavement sections above are based on NCDOT/AASHTO design methodology with a design life of 30 years, doweled joints, and modulus of rupture of 650 psi (AASHTO T97/ASTM C78). We recommend using an NCDOT-approved "pavement" mix that is designed with a MoR of 650 psi and a compressive strength of 4,500 psi (AASHTO T22/ASTM C39). The contractor's concrete submittal should include the modulus of rupture test data with the standard compressive strength test data. For the purpose of acceptance testing, the mix's compressive strength may be verified via test cylinders. For exposure durability, the concrete pavement should be air-entrained. Air-entrainment is governed by aggregate size and exposure level, which is outlined in Section 4.3 of ACI 330.

As a potential cost savings alternative, recycled crushed concrete (RCC) can be considered for use in lieu of ABC stone if available. To be approved, the RCC must meet the gradation requirements of an NCDOT-approved ABC stone and exhibit similar compacted weight when subjected to a modified Proctor test.

Cracking of concrete is normal and should be expected. Proper jointing practices are paramount in the control of cracking, particularly their location and the time at which they are installed. Concrete pavements should be jointed according to ACI 330 Section 3.7. Joint reinforcing (dowels) shall be sized and detailed by the project's civil engineer.

#### 4.6.3 Gravel Design

The plans show roughly 75% of the northern access road to be a gravel. Based on the heavy traffic anticipated, the site soil conditions encountered in the borings, and the site preparation recommendations herein, we recommend a 15-inch gravel section over a Type IV geotextile.

#### 4.6.4 Construction

The pavement and gravel road recommendations herein are predicated by the assumption that the subgrade soils are stable and suitable for pavement support. We recommend proofrolling finished subgrades, as well as the subsequently placed stone base, with a tandem-axle dump truck weighing between 25 and 35 tons. Proofrolling should occur in the presence of the owner's testing agency so that recommendations can be provided for areas that rut, pump, or deflect excessively. Proofrolling should not be performed on frozen or excessively wet subgrades. If subgrades are exposed to precipitation or freezing temperatures prior to paving, the area should be re-proofrolled to verify its condition.

Aggregate base course stone should be compacted to at least 98 percent of its maximum dry density as determined by AASHTO T-180 (modified Proctor). The same compaction standard shall apply to RCC if used. Asphalt shall be placed with appropriate lift thicknesses and achieve the proper compaction for the mix(es) used, as specified in the latest edition of the NCDOT QMS for Asphalt Pavements.

The pavement sections provided herein do not account for construction traffic (e.g., dump trucks, concrete trucks, Lulls, etc.), which is typically very heavy. If construction traffic is allowed to operate on asphalt-paved surfaces, damage should be expected. Best paving practices prevent, or at least minimize, operating construction equipment on early (thin) lifts of asphalt, since doing so can shorten the pavement life.

**APPENDIX A**

SITE VICINITY MAP  
BORING LOCATION DIAGRAM





**STEWART**

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RALEIGH, NC 27610  
770.300.9700

FIRM LICENSE # C-1051  
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Note: All test locations are approximate (unless otherwise reported) and intended for illustration purposes only.

CONCORD FLEET SERVICES FACILITY  
880 Warren Coleman Blvd.  
Concord, NC

Title:  
**SITE  
VICINITY  
MAP**

Project number: F23004.00  
Date: 04-13-23  
Prepared by: HH  
Scale: 1 in = XX ft

Figure:  
**A1**





**APPENDIX B**

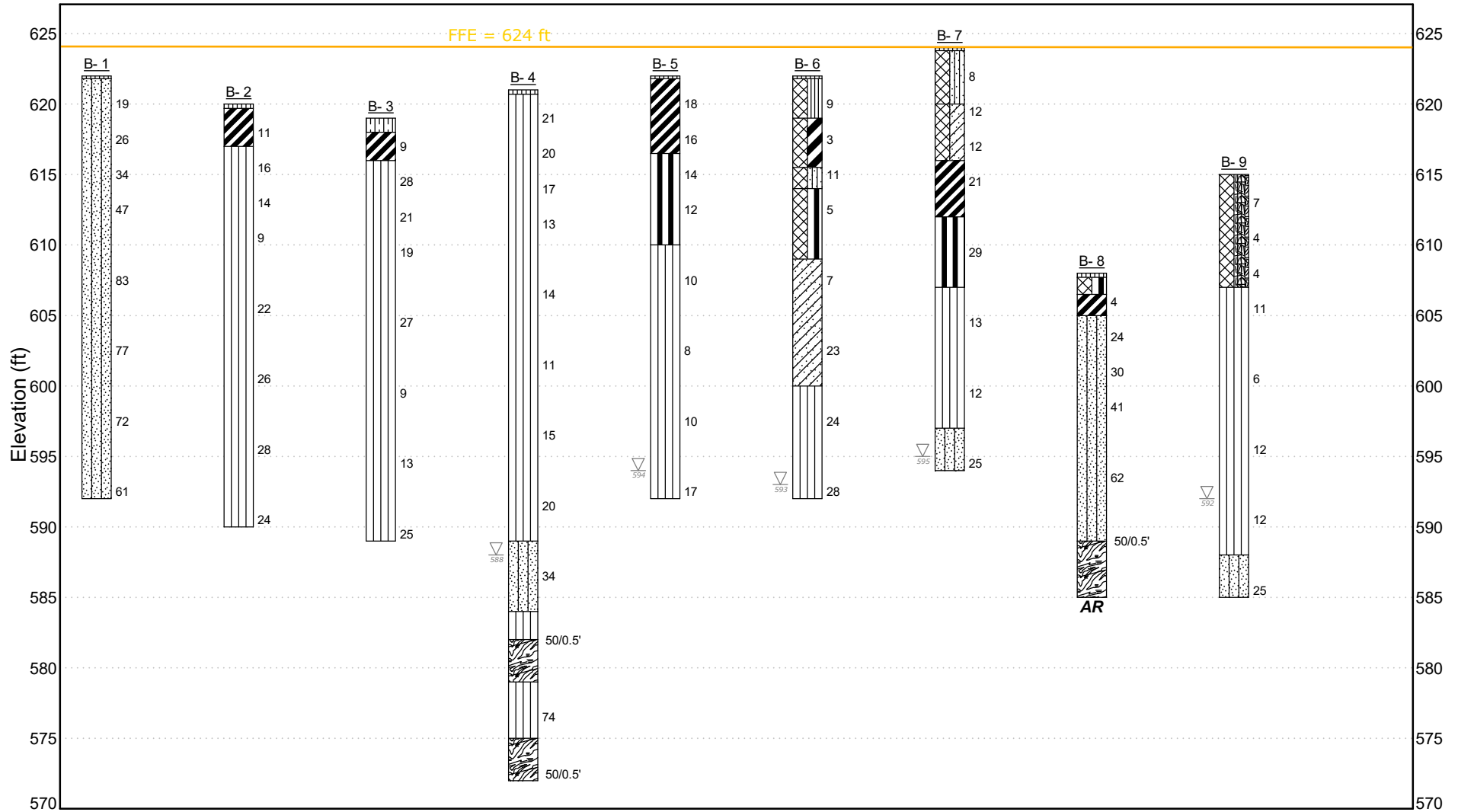
BORING SNAPSHOTS  
BORING SUMMARY TABLE  
BORING LOGS  
LEGEND TO SOIL DESCRIPTIONS





STEWART

# BORING SNAPSHOT BUILDING BORINGS



The borings in this snapshot are arranged in alphabetical order and do not represent a profile or cross section of the subsurface conditions.

### LITHOLOGY GRAPHICS

Topsoil / Organic Layer	Silty Sand (SM)	Fat Clay (CH)	Silt (ML)	Weathered Rock (WR)
Elastic Silt (MH)	Fill - Silt (ML)	Fill - Fat Clay (CH)	Fill - Silty Sand (SM)	Fill - Elastic Silt (MH)
Clayey Sand (SC)	Fill - Clayey Sand (SC)	Fill - Mulch		

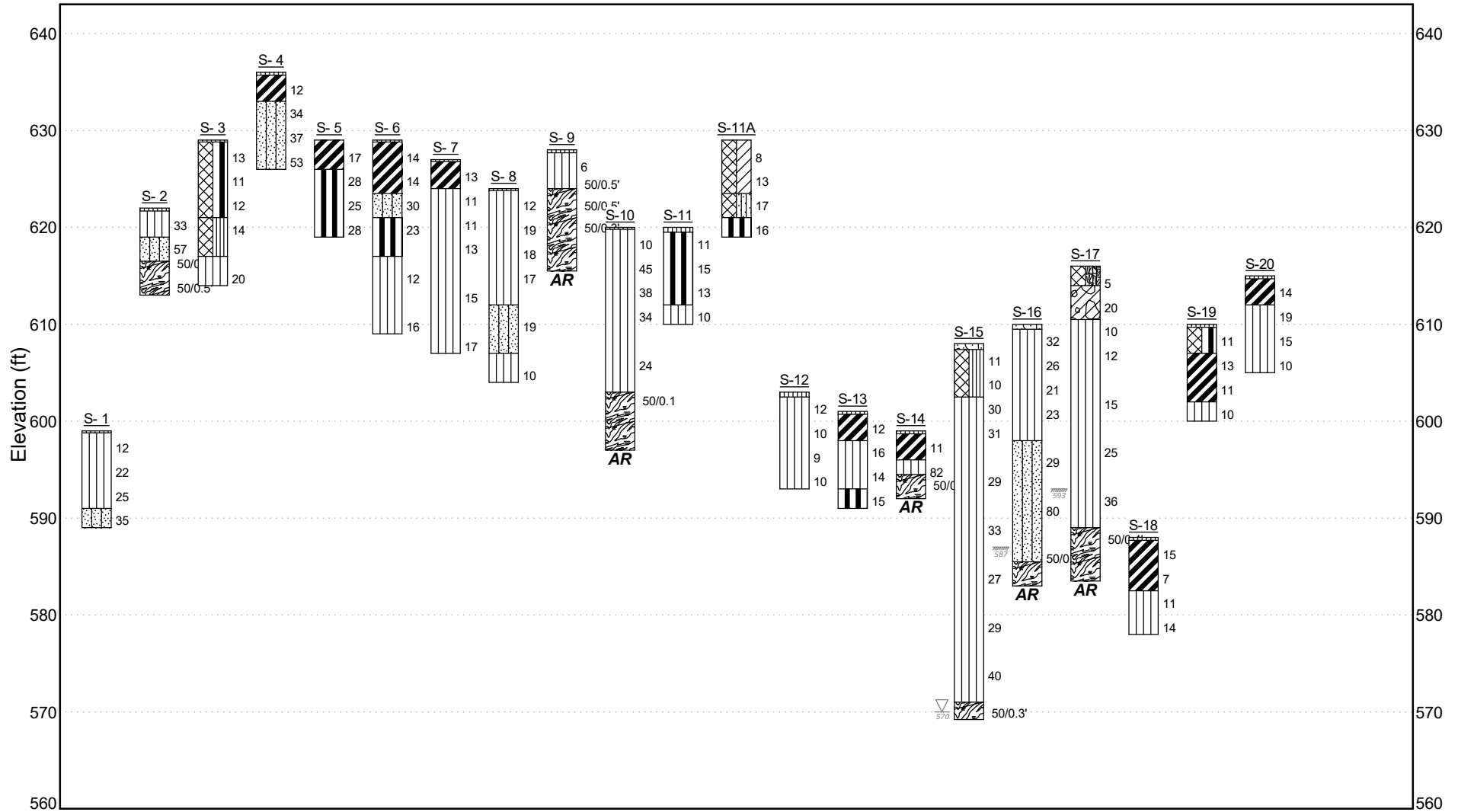
**CONCORD FLEET SERVICES FACILITY**  
CONCORD, NC

PROJECT NO.: F23004.00



STEWART

# BORING SNAPSHOT SITE BORINGS



The borings in this snapshot are arranged in alphabetical order and do not represent a profile or cross section of the subsurface conditions.

## LITHOLOGY GRAPHICS

Topsoil / Organic Layer	Silt (ML)	Silty Sand (SM)	Weathered Rock (WVR)	Fill - Elastic Silt (MH)
Fill - Silt (ML)	Fat Clay (CH)	Elastic Silt (MH)	Fill - Lean Clay (CL)	Fill - Silty Sand (SM)
Gravel	Fill - Mulch	Clayey Gravel (GC)		

**CONCORD FLEET SERVICES FACILITY**  
CONCORD, NC

PROJECT NO.: F23004.00



STEWART

BORING SUMMARY TABLE

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

Borehole ID	Boring Depth (ft)	GSE (ft)	GW at 0 Hr		GW at 24+ Hr		Weathered Rock		Rock/Refusal		State Plane Coordinates		
			Depth (ft)	El. (ft)	Depth (ft)	El. (ft)	Depth (ft)	El. (ft)	Depth (ft)	El. (ft)	Northing	Easting	
B- 1	30	622	DRY		DRY							596581.6053	1533652.949
B- 2	30	620	DRY		FIAD							596491.3217	1533586.202
B- 3	30	619	DRY		FIAD							596374.0821	1533584.323
B- 4	49	621	33	588	FIAD		39	582				596415.6184	1533649.619
B- 5	30	622	28	594	FIAD							596454.9216	1533717.703
B- 6	30	622	29	593								596363.3108	1533756.749
B- 7	30	624	29	595	FIAD							596448.3851	1533823.079
B- 8	23	608	DRY		FIAD		19	589	23	585		596349.7293	1533304.746
B- 9	30	615	23	592	FIAD							596367.5176	1533379.183
S- 1	10	599	DRY		FIAD							596921.1788	1533475.189
S- 2	9	622	DRY		FIAD		5.5	616.5				597003.3449	1533680.949
S- 3	15	629	DRY		FIAD							596872.8156	1533914.065
S- 4	10	636	DRY		FIAD							596770.6105	1534145.406
S- 5	10	629	DRY		FIAD							596424.1278	1533997.081
S- 6	20	629	DRY		FIAD							596689.7531	1533985.885
S- 7	20	627	DRY		FIAD							596627.7023	1533906.718
S- 8	20	624	DRY		FIAD							596639.8946	1533728.461
S- 9	12.5	628	DRY		FIAD		4	624	12.5	615.5		596655.1237	1533552.915
S-10	23	620	DRY		FIAD		17	603	23	597		596522.2693	1533543.567
S-11	10	620	DRY		FIAD							596161.4122	1533900.038
S-11A	10	629	DRY		FIAD							596235.8653	1533882.34
S-12	10	603	DRY		FIAD							596176.9469	1533692.82
S-13	10	601	DRY		FIAD							596191.1843	1533478.707
S-14	7	599	DRY		FIAD		4.5	594.5	7	592		596224.4801	1533225.957
S-15	39	608	39	569	FIAD		37	571				596481.8896	1533354.409
S-16	27	610	DRY		FIAD		24.5	585.5	27	583		596464.3984	1533419.786
S-17	32.5	616	DRY		FIAD		27	589	32.5	583.5		596352.3107	1533426.977
S-18	10	588	DRY		FIAD							596098.2529	1533189.827
S-19	10	610	DRY		FIAD							596066.4737	1533774.192
S-20	10	615	DRY		FIAD							595949.4292	1533871.286

Note: Blank cells indicate not encountered or not measured/recorded. Refer to the individual boring log and report for additional details



# STEWART

## BORING LOG: B-1

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/20/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 622 FT BORING DEPTH 30 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

24± HR GW DRY

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft)	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)					
									10	20	30			
									PL ● WC LL					
									10	20	30			
									□ FINES CONTENT (%)					
									10	20	30			
0.2		TOPSOIL	621.8											
		<b>RESIDUAL</b> MEDIUM DENSE TO VERY DENSE, TAN - GRAY, MOIST, SILTY SAND WITH TRACE MICA AND SMALL ROCK FRAGMENTS												
					1	SS 1	6 8 11	19						
					2.5	SS 1								
					3.5	SS 2	9 11 15	26						
					5	SS 2								
					6	SS 3	9 13 21	34						
					7.5	SS 3								
					8.5	SS 4	14 20 27	47						
					10	SS 4								
					13.5	SS 5	24 34 49	83						
					15	SS 5								
	SM				18.5	SS 6	21 34 43	77						
					20	SS 6								
					23.5	SS 7	22 34 38	72						
					25	SS 7								
					28.5	SS 8	18 27 34	61						
					30	SS 8								
30.0		BORING TERMINATED	592.0											

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: B-2

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/21/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 620 FT BORING DEPTH 30 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)									
										10	20	30	40	50	60	70	80	90	
										PL ● WC LL									
										10	20	30	40	50	60	70	80	90	
										□ FINES CONTENT (%)									
										10	20	30	40	50	60	70	80	90	
0.3		TOPSOIL	619.7																
0.3 - 3.0	CH	<b>RESIDUAL</b> STIFF, RED AND GRAY, MOIST, SILTY FAT CLAY			1	SS	SS 1	3 5 6	11										
3.0 - 30.0	ML	STIFF TO VERY STIFF, ORANGE, TAN AND GRAY, MOIST, SANDY SILT WITH TRACE MICA	617.0		2.5	SS	SS 2	5 7 9	16										
					6	SS	SS 3	4 6 8	14										
					8.5	SS	SS 4	4 4 5	9										
					13.5	SS	SS 5	6 8 14	22										
					18.5	SS	SS 6	9 12 14	26										
					23.5	SS	SS 7	12 13 15	28										
					28.5	SS	SS 8	12 12 12	24										
30.0		BORING TERMINATED	590.0		30														

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: B-3

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/24/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 619 FT BORING DEPTH 30 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG CME 550 HAMMER TYPE AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)									
								10	20	30							
								PL ● WC LL									
								□ FINES CONTENT (%)									
								10	20	30	40	50	60	70	80	90	
1.0		TOPSOIL AND MULCH	618.0														
1.0 - 3.0	CH	<b>RESIDUAL</b> STIFF, RED, MOIST, SANDY SILTY FAT CLAY	616.0		1-2.5 SS 1	3 4 5	9										
3.0 - 30.0	ML	STIFF TO VERY STIFF, ORANGE, TAN AND GRAY, MOIST, SANDY SILT			2.5-3.5 SS 2	12 13 15	28										
					3.5-6 SS 3	10 10 11	21										
					6-8.5 SS 4	12 8 11	19										
					8.5-13.5 SS 5	10 12 15	27										
					13.5-18.5 SS 6	3 4 5	9										
					18.5-23.5 SS 7	5 6 7	13										
					23.5-28.5 SS 8	7 10 15	25										
30.0		BORING TERMINATED	589.0		30												

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: B-4

PAGE 1 OF 2

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/21/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 621 FT BORING DEPTH 49 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW 33 FT

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)											
								10	20	30	40	50	60	70	80	90			
								PL ● WC LL			□ FINES CONTENT (%)								
0.3		TOPSOIL	620.7																
		<b>RESIDUAL</b> STIFF TO VERY STIFF, RED, TAN AND GRAY, MOIST, SANDY SILT			1 SS 1	5 8 13	21												
		POCKET OF CLAYEY SILT IN SS-2			2.5 SS 2	5 7 13	20												
					3.5 SS 3	5 6 11	17												
					5 SS 4	4 6 7	13												
					6 SS 5	7 6 8	14												
	ML				8.5 SS 6	5 5 6	11												
					13.5 SS 7	6 7 8	15												
					15 SS 8	6 8 12	20												
					18.5 SS 9	7 13 21	34												
32.0		DENSE, GRAY AND WHITE, MOIST, SILTY SAND	589.0		23.5 SS 9														
	SM				33.5 SS 9														

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

(Continued Next Page)



# STEWART

## BORING LOG: B-4

PAGE 2 OF 2

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)	
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
								PL ● WC LL	□ FINES CONTENT (%)
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
37.0	SM	DENSE, GRAY AND WHITE, MOIST, SILTY SAND <i>(continued)</i>	584.0		35				
39.0	ML	VERY STIFF, GRAY, MOIST, SANDY SILT	582.0		38.5 39.5	SS 10	28 50/0.5'		
42.0	WR	<b>WEATHERED ROCK</b> GRAY, METAVOLCANICS [SAMPLED AS SANDY SILT]	579.0				50/0.5'		
46.0	ML	HARD, GRAY, MOIST, SANDY SILT	575.0		43.5 45	SS 11	18 24 50	74	
49.0	WR	<b>WEATHERED ROCK</b> GRAY, METAVOLCANICS [SAMPLED AS SANDY SILT]	572.0		48.5 49	SS 12	50/0.5'	50/0.5'	
BORING TERMINATED									

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.





# STEWART

## BORING LOG: B-5

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/21/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 622 FT BORING DEPTH 30 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW 28 FT

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft)	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)									
									10	20	30							
									PL ● WC LL									
									□ FINES CONTENT (%)									
									10	20	30	40	50	60	70	80	90	
0.2		TOPSOIL	621.8															
	CH	RESIDUAL VERY STIFF, RED, MOIST, SILTY FAT CLAY			1	SS 1	4 8 10	18										
5.5		STIFF, RED, MOIST, CLAYEY SILT	616.5		2.5	SS 1												
	MH				3.5	SS 2	5 7 9	16										
					5	SS 2												
					6	SS 3	5 6 8	14										
					7.5	SS 3												
					8.5	SS 4	3 5 7	12										
					10	SS 4												
12.0		MEDIUM STIFF TO VERY STIFF, TAN, BLACK AND WHITE, WET, CLAYEY SANDY SILT WITH TRACE MICA	610.0															
					13.5	SS 5	4 4 6	10										
					15	SS 5												
					18.5	SS 6	3 3 5	8										
					20	SS 6												
					23.5	SS 7	3 4 6	10										
					25	SS 7												
					28.5	SS 8	5 6 11	17										
					30	SS 8												
30.0		BORING TERMINATED	592.0	594														

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: B-6

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/21/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 622 FT BORING DEPTH 30 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW 29 FT

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft)	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)									
									10	20	30	40	50	60	70	80	90	
									PL ● WC LL									
									10	20	30	40	50	60	70	80	90	
									□ FINES CONTENT (%)									
									10	20	30	40	50	60	70	80	90	
0.2		TOPSOIL	621.8															
0.2 - 3.0	ML	<b>FILL</b> STIFF, BROWN, MOIST, SANDY SILT WITH TRACE ROCK FRAGMENTS	619.0		1	SS 1	6 4 5	9										
3.0 - 6.5	CH	SOFT, TAN, WET, SANDY FAT CLAY WITH TRACE ROCK FRAGMENTS	615.5		2.5	SS 2	1 2 1	3										
6.5 - 8.0	SM	MEDIUM DENSE, TAN-GRAY, MOIST, SILTY SAND	614.0		5	SS 3	5 5 6	11										
8.0 - 13.0	MH	MEDIUM STIFF, RED-BROWN, WET, CLAYEY SILT	609.0		6	SS 4	1 2 3	5										
13.0 - 22.0	SC	<b>RESIDUAL</b> LOOSE TO MEDIUM DENSE, RED, BROWN, AND TAN, MOIST TO WET, CLAYEY SAND  GRAY WITH SMALL QUARTZ FRAGMENTS BELOW ~18 FEET	600.0		8.5	SS 5	3 3 4	7										
22.0 - 28.5					15	SS 6	10 13 10	23										
28.5 - 30.0	ML	VERY STIFF, BROWN, CLAYEY SANDY SILT WITH TRACE MICA	592.0	593	18.5	SS 7	8 12 12	24										
30.0		BORING TERMINATED			20	SS 8	8 12 16	28										

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: B-7

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/21/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 624 FT BORING DEPTH 30 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW 29 FT

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft)	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)									
									10	20	30							
									PL ● WC LL									
									10	20	30							
									□ FINES CONTENT (%)									
									10	20	30							
0.2		TOPSOIL	623.8															
	SM	FILL LOOSE, BROWN, MOIST, CLAYEY SILTY SAND WITH ROCK FRAGMENTS AND POCKETS OF FAT CLAY			1	SS 1	3 4 4	8										
4.0		MEDIUM DENSE, DARK BROWN, MOIST, CLAYEY SAND	620.0		2.5													
	SC				3.5	SS 2	3 4 8	12										
					5													
					6	SS 3	4 5 7	12										
8.0		RESIDUAL VERY STIFF, ORANGE AND TAN, MOIST, SILTY FAT CLAY WITH TRACE MICA	616.0		7.5													
	CH				8.5	SS 4	5 9 12	21										
12.0		VERY STIFF, ORANGE AND TAN, MOIST, CLAYEY SILT WITH TRACE MICA	612.0		10													
	MH				13.5	SS 5	8 14 15	29										
17.0		STIFF, TAN, GRAY AND WHITE, WET, SANDY SILT WITH TRACE MICA	607.0		15													
	ML				18.5	SS 6	5 6 7	13										
					20													
					23.5	SS 7	5 5 7	12										
27.0		MEDIUM DENSE, TAN, GRAY AND WHITE, WET, SILTY SAND	597.0		25													
	SM				28.5	SS 8	10 11 14	25										
30.0		BORING TERMINATED	594.0	595	30													

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: B-8

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/22/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 608 FT BORING DEPTH 23 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)		
								10	20	30
								PL ● WC LL		
								10	20	30
								□ FINES CONTENT (%)		
								10	20	30
0.3	MH	TOPSOIL	607.7							
1.5	CH	<b>FILL</b> SOFT, BROWN, MOIST, SANDY CLAYEY SILT WITH TRACE MICA, ROCK AND WOOD FRAGMENTS	606.5		1 SS 1	1 2				
3.0	CH	<b>RESIDUAL</b> SOFT, RED AND BROWN, MOIST, SANDY FAT CLAY WITH TRACE MICA	605.0		2.5 SS 1	2	4			
		<b>RESIDUAL</b> MEDIUM DENSE TO VERY DENSE, TAN, GRAY AND WHITE, MOIST, SILTY SAND WITH TRACE MICA			3.5 SS 2	8 10 14	24			
					6 SS 3	8 14 16	30			
					8.5 SS 4	12 18 23	41			
	SM	ROCK FRAGMENTS BELOW ~12 FEET			13.5 SS 5	16 27 35	62			
19.0			589.0		18.5 SS 6	30				
	WR	<b>WEATHERED ROCK</b> GRAY AND WHITE, METAVOLCANICS [SAMPLED AS SILTY SAND]			19.5 SS 6	50/0.5	50/0.5			
23.0		AUGER REFUSAL	585.0							

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: B-9

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/23/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 615 FT BORING DEPTH 30 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW 23 FT

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG CME 550 HAMMER TYPE AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)	
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
								PL ● WC LL	
								□ FINES CONTENT (%)	
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
8.0		<b>FILL</b> BLACK, MOIST, MULCH WITH TRACE FAT CLAY			1 SS 1	2 3 4	7		
					2.5 SS 1			▲	
					3.5 SS 2	2 2	4		
					5 SS 2			▲	
					6 SS 3	2 2	4		
					7.5 SS 3			▲	
			607.0						
		<b>RESIDUAL</b> MEDIUM STIFF TO STIFF, RED-ORANGE, TAN AND GRAY, MOIST, SANDY SILT WITH TRACE MICA			8.5 SS 4	2 5 6	11		
					10 SS 4			▲	
					13.5 SS 5	2 3 3	6		
					15 SS 5			▲	
					18.5 SS 6	3 5 7	12		
					20 SS 6			▲	
					23.5 SS 7	3 4 8	12		
					25 SS 7			▲	
			592						
27.0			588.0						
		MEDIUM DENSE, GRAY AND WHITE, MOIST, SILTY SAND			28.5 SS 8	9 12 13	25		
					30 SS 8			▲	
30.0			585.0						
BORING TERMINATED									

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-1

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/21/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 599 FT BORING DEPTH 10 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE		SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)									
					DEPTH (ft)	ID NUMBER			10	20	30	40	50	60	70	80	90	
0.2		TOPSOIL	598.8		1	SS 1	4											
		<b>RESIDUAL</b> STIFF TO VERY STIFF, TAN, MOIST, SANDY SILT			2.5	SS 1	6	12										
	ML				3.5	SS 2	7											
					5	SS 2	10	22										
					6	SS 3	9											
					7.5	SS 3	13	25										
8.0		DENSE, GRAY-BROWN, MOIST, SILTY SAND	591.0															
	SM				8.5	SS 4	8											
							15											
10.0			589.0		10	SS 4	20	35										

BORING TERMINATED

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-2

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/20/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 622 FT BORING DEPTH 9 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (ppf)	▲ SPT N-VALUE (BPF)	
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
								PL ● WC LL	
								□ FINES CONTENT (%)	
								10 20 30 40 50 60 70 80 90	
0.3		TOPSOIL	621.7						
0.3 - 3.0	ML	<b>RESIDUAL</b> HARD, TAN, MOIST, SANDY SILT WITH TRACE ROCK FRAGMENTS	619.0		1 2.5 SS 1	7 13 20	33		
3.0 - 5.5	SM	VERY DENSE, TAN AND GRAY, MOIST, SILTY SAND WITH TRACE MICA AND ROCK FRAGMENTS	616.5		3.5 5 SS 2	16 24 33	57		
5.5 - 9.0	WR	<b>WEATHERED ROCK</b> BROWN, METAVOLCANICS [SAMPLED AS SILTY SAND]	613.0		6 6.5 SS 3	50/0.5	50/0.5		
BORING TERMINATED									50/0.5

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-3

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/20/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 629 FT BORING DEPTH 15 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)	
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
								PL ● WC LL	□ FINES CONTENT (%)
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
0.2		TOPSOIL	628.8						
		<b>FILL</b> STIFF, GRAY-BROWN, MOIST, SANDY CLAYEY SILT WITH TRACE ROCK AND WOOD FRAGMENTS AND MICA			1 SS 1	4 5 8	13	▲	
	MH	POCKETS OF FAT CLAY IN SS-2			2.5 SS 2	3 5 6	11	▲	
					5 SS 3	5 6 6	12	▲	
8.0		STIFF, GRAY-BROWN, MOIST, CLAYEY SANDY SILT TRACE ROCK AND WOOD FRAGMENTS AND MICA	621.0		7.5 SS 4	5 7 7	14	▲	
	ML				8.5 SS 4				
					10 SS 4				
12.0		<b>RESIDUAL</b> VERY STIFF, TAN AND ORANGE, MOIST, SANDY SILT WITH TRACE MICA	617.0						
	ML				13.5 SS 5	7 8 12	20	▲	
15.0		BORING TERMINATED	614.0		15 SS 5			▲	

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.





# STEWART

## BORING LOG: S-4

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PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/20/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 636 FT BORING DEPTH 10 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)	
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
								PL ● WC LL	□ FINES CONTENT (%)
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
0.3		TOPSOIL	635.7						
0.3 - 3.0	CH	<b>RESIDUAL</b> STIFF, ORANGE, MOIST, SANDY FAT CLAY WITH TRACE MICA			1 2.5 SS 1	4 5 7	12		
3.0 - 10.0	SM	DENSE TO VERY DENSE, TAN, MOIST, SILTY SAND WITH TRACE ROCK FRAGMENTS	633.0		3.5 5 6 7.5 8.5 SS 2 SS 3 SS 4	9 14 20 14 16 21 17 24 29	34 37 53		
BORING TERMINATED									

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-5

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/21/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 629 FT BORING DEPTH 10 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)	
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
								PL ● WC LL	
								□ FINES CONTENT (%)	
								10 20 30 40 50 60 70 80 90	
3.0	CH	<b>RESIDUAL</b> VERY STIFF, RED, MOIST, SANDY FAT CLAY	626.0		1 SS 1	6 7 10	17		
		VERY STIFF, RED, MOIST, SANDY CLAYEY SILT			2.5 SS 2	7 12 16	28		
					3.5 SS 2	7 12 16	28		
					5 SS 3	6 10 15	25		
					6 SS 3	6 10 15	25		
					7.5 SS 3	6 10 15	25		
					8.5 SS 4	8 11 17	28		
10.0	MH	BORING TERMINATED	619.0		10 SS 4	8 11 17	28		

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-6

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/20/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 629 FT BORING DEPTH 20 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft)	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)									
									10	20	30							
									PL ● WC LL									
									□ FINES CONTENT (%)									
									10	20	30	40	50	60	70	80	90	
0.2		TOPSOIL	628.8															
	CH	RESIDUAL STIFF, RED, TAN AND GRAY, MOIST TO WET, SILTY FAT CLAY			1	SS 1	5 6 8	14										
5.5		MEDIUM DENSE, GRAY AND TAN, MOIST, SILTY SAND	623.5		2.5	SS 2	4 5 9	14										
8.0	SM	VERY STIFF, GRAY AND BROWN, MOIST, SANDY CLAYEY SILT	621.0		3.5	SS 3	16 12 18	30										
	MH	STIFF TO VERY STIFF, TAN, MOIST, SANDY SILT WITH TRACE MICA AND ROCK FRAGMENTS	617.0		5	SS 4	7 9 14	23										
12.0					8.5	SS 5	5 5 7	12										
	ML				13.5	SS 6	6 7 9	16										
20.0		BORING TERMINATED	609.0		18.5													

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-7

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/20/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 627 FT BORING DEPTH 20 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft)	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)									
									10	20	30	40	50	60	70	80	90	
									PL ● WC LL									
									10	20	30	40	50	60	70	80	90	
									□ FINES CONTENT (%)									
									10	20	30	40	50	60	70	80	90	
0.2		TOPSOIL	626.8															
0.2 - 3.0	CH	<b>RESIDUAL</b> STIFF, TAN, RED AND BLACK, MOIST, SANDY FAT CLAY			1	SS 1	4 6 7	13										
3.0 - 20.0	ML	STIFF TO VERY STIFF, TAN, ORANGE AND GRAY, MOIST, SANDY SILT WITH TRACE MICA	624.0		2.5	SS 2	4 5 6	11										
					3.5	SS 2	4 5 6	11										
					5	SS 3	4 5 6	11										
					6	SS 3	4 5 6	11										
					7.5	SS 3	4 5 6	11										
					8.5	SS 4	4 6 7	13										
					10	SS 4	4 6 7	13										
					13.5	SS 5	5 7 8	15										
					15	SS 5	5 7 8	15										
					18.5	SS 6	7 8 9	17										
20.0		BORING TERMINATED	607.0		20	SS 6	7 8 9	17										

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-8

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/20/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 624 FT BORING DEPTH 20 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)										
								10	20	30								
								PL ● WC LL										
								10	20	30								
								□ FINES CONTENT (%)										
								10	20	30								
0.2		TOPSOIL	623.8															
		<b>RESIDUAL</b> STIFF TO VERY STIFF, TAN, GRAY AND BLACK, MOIST, SANDY SILT WITH TRACE MICA			1 SS 1	3 5 7	12											
					2.5 SS 1													
					3.5 SS 2	6 8 11	19											
	ML				5 SS 2													
					6 SS 3	4 8 10	18											
					7.5 SS 3													
					8.5 SS 4	4 7 10	17											
					10 SS 4													
12.0		MEDIUM DENSE, TAN AND PINK, MOIST, SILTY SAND	612.0															
	SM				13.5 SS 5	7 9 10	19											
					15 SS 5													
17.0		STIFF, GRAY AND WHITE, MOIST, SANDY SILT	607.0															
	ML																	
20.0		BORING TERMINATED	604.0		18.5 SS 6	3 5 5	10											
					20 SS 6													

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-9

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PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/24/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 628 FT BORING DEPTH 12.5 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG CME 550 HAMMER TYPE AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)	
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
								PL ● WC LL	□ FINES CONTENT (%)
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
0.3		TOPSOIL	627.7						
	ML	<b>RESIDUAL</b> MEDIUM STIFF, TAN AND ORANGE, MOIST, CLAYEY SANDY SILT			1 2.5 SS 1	2 3 3	6		
4.0		<b>WEATHERED ROCK</b> GRAY AND BROWN, METAVOLCANICS [SAMPLED AS SILTY SAND]	624.0		3.5 4.3 SS 2	8 50/0.5'	50/0.5'		
	WR				6 6.5 SS 3	50/0.5'	50/0.5'		
					8.5 8.8 SS 4	50/0.3'	50/0.3'		
12.5		AUGER REFUSAL	615.5						

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-10

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/23/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 620 FT BORING DEPTH 23 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG CME 550 HAMMER TYPE AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)											
								10	20	30	40	50	60	70	80	90			
0.2		TOPSOIL	619.8																
	ML	<b>RESIDUAL</b> STIFF TO HARD, TAN, ORANGE AND GRAY, MOIST, SANDY SILT POCKETS OF CLAYEY SILT IN SS-1			1 SS 1	3 4 6	10												
					2.5 SS 1														
					3.5 SS 2	12 19 26	45												
					5 SS 2														
					6 SS 3	12 17 21	38												
					7.5 SS 3														
					8.5 SS 4	14 15 19	34												
					10 SS 4														
					13.5 SS 5	13 12 12	24												
					15 SS 5														
17.0		<b>WEATHERED ROCK</b> GRAY AND TAN, METAVOLCANICS [SAMPLED AS SILTY SAND]	603.0		18.5 SS 6	50/0.1	50/0.1												
	WR				18.6 SS 6														
23.0		AUGER REFUSAL	597.0																

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-11

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PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/22/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 620 FT BORING DEPTH 10 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)											
								10	20	30	40	50	60	70	80	90			
0.5		TOPSOIL	619.5																
		<b>RESIDUAL</b> STIFF, RED, MOIST, SANDY CLAYEY SILT			1 2.5 3.5 5 6 7.5	3 5 6 4 6 9 5 7 6	11 15 13												
8.0		STIFF, RED-ORANGE, MOIST, SANDY SILT WITH TRACE MICA	612.0		8.5	4 5 5	10												
10.0		BORING TERMINATED	610.0		10														

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.





# STEWART

## BORING LOG: S-11A

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PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/21/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 629 FT BORING DEPTH 10 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)	
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
								PL ● WC LL	□ FINES CONTENT (%)
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
5.5	CL	<b>FILL</b> MEDIUM STIFF TO STIFF, DARK BROWN, MOIST, SANDY LEAN CLAY WITH TRACE WOOD AND ROCK FRAGMENTS			1 2.5 3.5 5	2 4 4 3 7 6	8 13		
8.0	SM	MEDIUM DENSE, DARK GRAY, MOIST, SILTY SAND WITH TRACE WOOD	623.5		6 7.5	7 8 9	17		
10.0	MH	<b>RESIDUAL</b> VERY STIFF, RED, MOIST, CLAYEY SILT	621.0		8.5 10	4 7 9	16		
BORING TERMINATED									

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-12

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/22/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 603 FT BORING DEPTH 10 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)	
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
								PL ● WC LL	□ FINES CONTENT (%)
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
0.5		TOPSOIL	602.5						
		<b>RESIDUAL</b> STIFF, ORANGE, TAN AND GRAY, MOIST, CLAYEY SANDY SILT			1 SS 1	4 6 6	12		
					2.5 SS 1				
					3.5 SS 2	3 4 6	10		
					5 SS 2				
					6 SS 3	4 4 5	9		
					7.5 SS 3				
					8.5 SS 4	4 5 5	10		
10.0		BORING TERMINATED	593.0		10 SS 4				

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-13

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/22/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 601 FT BORING DEPTH 10 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)											
								10	20	30	40	50	60	70	80	90			
0.3		TOPSOIL	600.7																
0.3 - 3.0	CH	<b>RESIDUAL</b> STIFF, TAN AND ORANGE, MOIST, SILTY FAT CLAY			1 2.5 SS 1	5 5 7	12	▲											
3.0 - 8.0	ML	STIFF TO VERY STIFF, ORANGE AND GRAY, MOIST, SANDY SILT WITH POCKETS OF FAT CLAY	598.0		3.5 5 SS 2	4 7 9	16	▲											
8.0 - 8.5			593.0		6 7.5 SS 3	5 7 7	14	▲											
8.5 - 10.0	MH	STIFF, GRAY, MOIST, SANDY CLAYEY SILT	591.0		8.5 10 SS 4	6 7 8	15	▲											

BORING TERMINATED

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-14

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/22/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 599 FT BORING DEPTH 7 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)								
								PL	WC LL							
								□ FINES CONTENT (%)								
								10	20	30	40	50	60	70	80	90
0.3		TOPSOIL	598.7													
0.3 - 3.0	CH	<b>RESIDUAL</b> STIFF, GRAY AND BROWN, MOIST, SILTY FAT CLAY WITH TRACE MICA			1 SS 1	3 4 7	11									
3.0 - 4.5	ML	HARD, GRAY, MOIST, SANDY SILT WITH TRACE MICA	596.0		2.5 SS 2	20 32 50										
4.5 - 7.0	WR	<b>WEATHERED ROCK</b> GRAY, METAVOLCANICS [SAMPLED AS SANDY SILT]	594.5		5 SS 3	50/0.3'	82									
7.0		AUGER REFUSAL	592.0		6 6.3 SS 3		50/0.3'									

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-15

PAGE 1 OF 2

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/22/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 608 FT BORING DEPTH 38.8 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW 38 FT

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)		
								10	20	30
								● WC		
								□ FINES CONTENT (%)		
								10	20	30
0.6		GRAVEL (7 INCHES)	607.4							
		<b>FILL</b> STIFF, BROWN AND GRAY, MOIST, CLAYEY SANDY SILT			1 SS 1	3 5 6	11			
	ML				2.5 SS 1					
					3.5 SS 2	3 4 6	10			
5.5		<b>RESIDUAL</b> VERY STIFF TO HARD, TAN, BROWN AND GRAY, MOIST, SANDY SILT	602.5		5 SS 2					
					6 SS 3	8 13 17	30			
					7.5 SS 3					
					8.5 SS 4	10 14 17	31			
					10 SS 4					
					13.5 SS 5	10 13 16	29			
					15 SS 5					
		ROCK FRAGMENTS AND TRACE MICA BELOW ~17 FEET			18.5 SS 6	10 13 20	33			
	ML				20 SS 6					
					23.5 SS 7	9 12 15	27			
					25 SS 7					
					28.5 SS 8	16 13 16	29			
					30 SS 8					
					33.5 SS 9	13 17 23	40			

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

(Continued Next Page)



STEWART

BORING LOG: S-15

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PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)											
								10	20	30	40	50	60	70	80	90			
37.0	ML	<b>RESIDUAL</b> VERY STIFF TO HARD, TAN, BROWN AND GRAY, MOIST, SANDY SILT <i>(continued)</i>	571.0																
38.8	WR	<b>WEATHERED ROCK</b> DARK GRAY, METAVOLCANICS [SAMPLED AS SILTY SAND]	569.2	570	38.5 38.8	SS 10	50/0.3'												
BORING TERMINATED																			

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-16

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/23/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 610 FT BORING DEPTH 27 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY 0 HR CAVE-IN 23 FT

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)									
										10	20	30	40	50	60	70	80	90	
0.5		GRAVEL (6 INCHES)	609.5																
		<b>RESIDUAL</b> VERY STIFF TO HARD, RED AND TAN, MOIST, SANDY SILT WITH TRACE MICA			1	SS	SS 1	10 15 17	32										
					2.5	SS	SS 2	8 11 15	26										
	ML				3.5	SS	SS 3	8 10 11	21										
					6	SS	SS 4	8 10 13	23										
					8.5	SS													
12.0		MEDIUM DENSE TO VERY DENSE, TAN AND GRAY, MOIST, SILTY SAND WITH ROCK FRAGMENTS	598.0																
	SM				13.5	SS	SS 5	8 13 16	29										
					15	SS													
					18.5	SS	SS 6	16 30 50	80										
					20	SS													
					23.5	SS	SS 7	26 38	50/0.4										
24.5		<b>WEATHERED ROCK</b> TAN-GRAY, METAVOLCANICS [SAMPLED AS SILTY SAND]	585.5	587.0															
	WR				24.9	SS		50/0.4	50/0.4										
27.0		AUGER REFUSAL	583.0																

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-17

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/23/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 616 FT BORING DEPTH 32.5 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY 0 HR CAVE-IN 23 FT

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG CME 550 HAMMER TYPE AUTO

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft)	SAMPLE TYPE	SAMPLE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)				
										10	20	30		
2.0	GC	<b>FILL</b> SOFT, BLACK AND BROWN, MOIST, MULCH WITH POCKETS OF SILTY FAT CLAY	614.0		1	SS	1	2		28				
					2.5	SS	1	3	5					
5.5	ML	<b>RESIDUAL</b> VERY STIFF, ORANGE, MOIST, (FAT) CLAYEY GRAVEL WITH SAND	610.5		3.5	SS	2	5	20					
						5	SS	2	10					
	WR	STIFF TO HARD, TAN, ORANGE AND GRAY, MOIST, SANDY SILT	589.0		6	SS	3	4	10					
							7.5	SS	3	4				
							8.5	SS	4	5	12			
							10	SS	4	7				
							13.5	SS	5	6	15			
							15	SS	5	8				
							18.5	SS	6	8	25			
							20	SS	6	15				
27.0	WR	<b>WEATHERED ROCK</b> GRAY, METAVOLCANICS [SAMPLED AS SILTY SAND]	589.0		23.5	SS	7	12	36					
							25	SS	7	15				
32.5		AUGER REFUSAL	583.5		28.5	SS	8	50/0.4'	50/0.4'					
					28.9	SS	8							

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.





# STEWART

## BORING LOG: S-18

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/22/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 588 FT BORING DEPTH 10 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)		
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90	
								PL	● WC	LL
								□ FINES CONTENT (%)		
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
0.3		TOPSOIL	587.7							
	CH	<b>RESIDUAL</b> MEDIUM STIFF TO STIFF, RED-ORANGE, MOIST, SANDY FAT CLAY			1 2.5 3.5 5	5 7 8 3 3 4	15 7			
5.5		STIFF, ORANGE AND TAN, MOIST, SANDY SILT WITH TRACE MICA	582.5		6 7.5 8.5	3 5 6 5 6 8	11 14			
10.0	ML		578.0		10					

BORING TERMINATED

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-19

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/22/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 610 FT BORING DEPTH 10 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)

BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL

DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)	
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
								PL ● WC LL	
								□ FINES CONTENT (%)	
								10 20 30 40 50 60 70 80 90	10 20 30 40 50 60 70 80 90
0.3		TOPSOIL	609.7						
	MH	<b>FILL</b> STIFF, RED, MOIST, CLAYEY SILT WITH TRACE WOOD FRAGMENTS			1 SS 1	5 5 6	11	▲	
3.0		<b>RESIDUAL</b> STIFF, ORANGE AND GRAY, MOIST, SILTY FAT CLAY	607.0		2.5 SS 2	4 5 8	13	▲	
	CH				5 SS 3	4 5 6	11	▲	
8.0		STIFF, TAN AND BLACK, MOIST, SANDY SILT	602.0		6 SS 3	4 5 6	11	▲	
	ML				8.5 SS 4	3 4 6	10	▲	
10.0		BORING TERMINATED	600.0		10			▲	

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.



# STEWART

## BORING LOG: S-20

PAGE 1 OF 1

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

DATE DRILLED 03/22/23 LOGGED BY H. HANCOCK

GROUND SURFACE EL. 615 FT BORING DEPTH 10 FT

DRILLING CONTRACTOR RDL DRILLING

0 HR GW DRY

DRILLING METHOD HSA AUGER SIZE 2-1/4 INCH (ID)
















BOREHOLE BACKFILLED IMMEDIATELY AFTER DRILLING

DRILL RIG MOBILE B-47 HAMMER TYPE MANUAL















DEPTH (ft)	MATERIAL TYPE	MATERIAL DESCRIPTION	ELEVATION (ft)	WL / CAVE EL (ft)	SAMPLE DEPTH (ft) TYPE ID NUMBER	SPT BLOW COUNTS	N-VALUE (bpf)	▲ SPT N-VALUE (BPF)											
								10	20	30	40	50	60	70	80	90			
0.3		TOPSOIL	614.7																
0.3 - 3.0	CH	<b>RESIDUAL</b> STIFF, ORANGE, TAN AND GRAY, MOIST, SILTY FAT CLAY			1 2.5	5 6 8	14												
3.0 - 6.0		STIFF TO VERY STIFF, TAN AND RED, MOIST, SANDY SILT WITH TRACE MICA	612.0		3.5 5	5 7 12	19												
6.0 - 7.5	ML				6 7.5	5 6 9	15												
7.5 - 8.5					8.5	4 5 5	10												
8.5 - 10.0		BORING TERMINATED	605.0		10														

Note: SPT Blow Counts are per 6 inches of penetration unless otherwise noted.

# UNIFIED SOIL CLASSIFICATION (ASTM D-2487)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND	
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS  >50% OF COARSE FRACTION RETAINED ON NO. 4. SIEVE	CLEAN GRAVELS <5% FINES	$Cu > 4$ AND $1 < Cc < 3$	GW	WELL-GRADED GRAVEL	
			$Cu > 4$ AND $1 > Cc > 3$	GP	POORLY-GRADED GRAVEL	
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR CL	GM	SILTY GRAVEL	
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL	
	SANDS  >50% OF COARSE FRACTION PASSES ON NO. 4. SIEVE	CLEAN SANDS <5% FINES	$Cu > 6$ AND $1 < Cc < 3$	SW	WELL-GRADED SAND	
			$Cu > 6$ AND $1 > Cc > 3$	SP	POORLY-GRADED SAND	
		SANDS AND FINES >12% FINES	FINES CLASSIFY AS ML OR CL	SM	SILTY SAND	
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND	
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS  LIQUID LIMIT <50	INORGANIC	$PI > 7$ AND PLOTS > "A" LINE	CL	LOW PLASTICITY (LEAN) CLAY	
			$PI > 4$ AND PLOTS < "A" LINE	ML	LOW PLASTICITY SILT	
		ORGANIC	LL (oven dried)/LL (not dried) < 0.75	OL	ORGANIC CLAY OR SILT	
	SILTS AND CLAYS  LIQUID LIMIT >50	INORGANIC	$PI$ PLOTS > "A" LINE	CH	HIGH PLASTICITY (FAT) CLAY	
			$PI$ PLOTS < "A" LINE	MH	HIGH ELASTICITY SILT	
		ORGANIC	LL (oven dried)/LL (not dried) < 0.75	OH	ORGANIC CLAY OR SILT	
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	PEAT	

### MATERIAL TYPES ENCOUNTERED ONSITE

 Fat Clay (CH)	 Fill - Fat Clay (CH)
 Fill - Lean Clay (CL)	 Fill - Elastic Silt (MH)
 Fill - Silt (ML)	 Fill - Mulch
 Fill - Clayey Sand (SC)	 Fill - Silty Sand (SM)
 Clayey Gravel (GC)	 Gravel
 Elastic Silt (MH)	 Silt (ML)
 Clayey Sand (SC)	 Silty Sand (SM)

### SAMPLE TYPES FOR THIS EXPLORATION

SPLIT SPOON

### PENETRATION RESISTANCE

(RECORDED AS BLOWS PER 6 IN.)

SAND & GRAVEL		SILT & CLAY	
DENSITY	BLOWS/FT*	CONSISTENCY	BLOWS/FT*
VERY LOOSE	0 - 3	VERY SOFT	0 - 1
LOOSE	4 - 9	SOFT	2 - 4
MEDIUM DENSE	10 - 30	MEDIUM STIFF (FIRM)	5 - 8
DENSE	31 - 50	STIFF	9 - 15
VERY DENSE	51+	VERY STIFF	16 - 30
		HARD	31+

\* NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1-3/8 INCH I.D.) SPLIT-BARREL SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE (ASTM-1586 STANDARD PENETRATION TEST).

### ADDITIONAL ABBREVIATIONS, TERMINOLOGY, & SYMBOLS

HSA - HOLLOW-STEM AUGER	EOD - END OF DAY
HA - HAND AUGER	FIAD - FILLED IMMEDIATELY AFTER DRILLING/DIGGING
SPT - STANDARD PENETRATION TEST	DRY - REQUIRES WETTING TO REACH OPTIMUM
BPF - BLOWS PER FOOT	MOIST - AT OR NEAR OPTIMUM
PL - PLASTIC LIMIT	WET - REQUIRES DRYING TO REACH OPTIMUM
LL - LIQUID LIMIT	SAT - SATURATED, EXCESSIVELY WET (FREE WATER)
MC - MOISTURE CONTENT	▽ - WATER LEVEL AT TIME OF DRILLING
SS - SPLIT SPOON	▼ - WATER LEVEL AFTER DRILLING
AP - AUGER PROBE	//// - CAVE-IN LEVEL
WL - WATER LEVEL	
USCS - UNIFIED SOIL CLASSIFICATION SYSTEM	
WOH - WEIGHT OF HAMMER	
WOR - WEIGHT OF RODS	

## **APPENDIX C**

LABORATORY RESULTS





STEWART

# SUMMARY OF LABORATORY TEST RESULTS

PROJECT CONCORD FLEET SERVICES FACILITY

CLIENT CITY OF CONCORD

LOCATION CONCORD, NC

PROJECT NO. F23004.00

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	%<#200 Sieve	Water Content* (%)	Class-ification	Max. Dry Density (pcf)	Opt. Water Content (%)	Comments
B- 1	1.0					13.2				
B- 2	1.0					28.0				
B- 3	1.0					26.0				
B- 4	1.0					23.1				
B- 5	1.0	103	39	64	98.0	35.9	CH			
B- 6	1.0					14.7				
B- 7	1.0					15.4				
B- 7	3.5					15.2				
B- 7	4.3	33	18	15	39.4		SC			
B- 8	1.0					23.9				
S- 1	1.0					20.5				
S- 2	1.0					14.7				
S- 3	1.0					16.4				
S- 4	1.0					29.5				
S- 5	1.0					15.9				
S- 6	1.0	79	28	51	77.4	32.6	CH			
S- 7	1.0					30.2				
S- 8	1.0					25.7				
S- 9	1.0					17.3				
S-10	1.0					14.7				
S-11	1.0					27.0				
S-11A	1.0					20.7				
S-12	1.0					13.5				
S-13	1.0					20.0				
S-14	1.0					22.5				
S-15	1.0					17.0				
S-16	1.0					18.7				
S-17	1.0	71	28	43	34.3	13.9	GC			
S-18	1.0					30.6				
S-19	1.0					26.4				
S-20	1.0					26.4				

\*At time of testing

**APPENDIX D**

SITE PHOTOGRAPHS



Site Photographs



Photograph 1: General site conditions on both sides of the powerline easement.



Photograph 2: Looking southwest across the existing grass field.



Site Photographs



Photograph 3: Looking east across the existing grass field towards boring S-5 and spoils piles.



Photograph 4: The gravel lot with all land/lawn debris operations under way.