



**BUILDING AMERICA<sup>®</sup>**

# **GENERAL CONDITIONS AND SPECIFICATIONS**

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Union Pacific Engineering Department**

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<b>32 13 00</b>	<b>Rigid Paving</b>	
32 13 00	Rigid Paving	2017
32 13 13	Cement Concrete Pavement	2017
<b>32 17 00</b>	<b>Paving Specialties</b>	
32 17 23	Paint Striping and Markings	2017
<b>32 30 00</b>	<b>Site Improvements</b>	
<b>32 31 00</b>	<b>Fences and Gates</b>	
32 31 10	Right of Way Fences and Gates	2017
32 31 13	Chain Link Fencing and Gates	2017
32 31 56	Wire Fences (Deer Proof)	2017
<b>32 32 00</b>	<b>Retaining Walls</b>	
32 32 23	Segmental Retaining Walls	2017
<b>32 90 00</b>	<b>Planting</b>	
32 90 10	Landscaping for Buildings	2017
<b>32 92 00</b>	<b>Turf and Grasses</b>	
32 92 19	Seeding	2019
<b>33 00 00</b>	<b>Utilities</b>	
<b>33 01 00</b>	<b>Operation and Maintenance of Utilities</b>	
33 01 50	Aboveground Petroleum Storage Tank Cleaning	2017
33 01 51	Aboveground Petroleum Storage Tank Inspection	2017
<b>33 05 00</b>	<b>Common Work Results for Utilities</b>	
33 05 23	Pipe Under Crossing	2017
33 05 24	Pipe Bursting	2017
33 05 25	Horizontal Directional Drilling	2017
33 05 26	Mechanical Identification	2017
<b>33 30 00</b>	<b>Sanitary Sewerage Utilities</b>	
<b>33 31 00</b>	<b>Sanitary Utility Sewerage Piping</b>	
33 31 20	Sanitary Lift Stations	2017
<b>33 37 00</b>	<b>Overflow Control</b>	
33 37 17	Above Ground Weir Boxes	2017
<b>33 39 00</b>	<b>Sanitary Utility Sewerage Structures</b>	
33 39 13	Manholes and Covers for Buildings	2017
<b>33 40 00</b>	<b>Storm Drainage Utilities</b>	
33 40 10	Storm Drainage for Buildings	2017
<b>33 41 00</b>	<b>Storm Utility Drainage Piping</b>	
33 41 20	Cured In Place Pipe Liner	2017
<b>33 42 00</b>	<b>Culverts</b>	
33 42 00	Culverts	2017
33 42 16	Reinforced Concrete Box Culverts	2017
33 42 20	Smooth Steel Pipe Culverts	
<b>33 44 00</b>	<b>Storm Utility Water Drains</b>	
33 44 16	Trench Drains for Buildings	2017

<b>33 50 00</b>	<b>Fuel Distribution Utilities</b>	
<b>33 52 00</b>	<b>Liquid Fuel Distribution</b>	
33 52 19	Fleet Fuel Storage and Dispensing System	2017
<b>33 56 00</b>	<b>Hydrocarbon Storage</b>	
33 56 05	Temporary Closure and Return to Service of Aboveground Petroleum Storage Tanks	2017
33 56 13	Aboveground Petroleum Storage Tanks – Field Erected	2017
33 56 15	Aboveground Storage Tanks – Shop Fabricated	2017
<b>33 70 00</b>	<b>Electrical Utilities</b>	
<b>33 71 00</b>	<b>Electrical Utility Transmission and Distribution</b>	
33 71 14	Overhead Electric Service	2017
33 71 19	Precast Concrete Manholes for Buildings	2017
<b>34 00 00</b>	<b>Transportation</b>	
<b>34 10 00</b>	<b>Railways</b>	
<b>34 11 00</b>	<b>Rail Tracks</b>	
34 11 10	Railroad Track Construction	2019
34 11 27	Subballast	2019
<b>34 70 00</b>	<b>Transportation Construction and Equipment</b>	
<b>34 76 00</b>	<b>Railway Equipment</b>	
34 76 10	Locomotive Traction Motor Drop Table	2017
<b>40 00 00</b>	<b>Process Interconnections</b>	
<b>40 05 00</b>	<b>Common Work Results for Process Interconnections</b>	
40 05 03	Piping Materials And Methods	2017
40 05 07	Hangers And Support	2017
40 05 32	Polyvinyl Chloride (PVC) Pressure Pipe	2017
40 05 39	Reinforced Concrete Pipe	2017
40 05 51	Valves And Accessories	2017
40 05 57	Fuel System Motor Operated Valves	2017
<b>40 40 00</b>	<b>Process Piping and Equipment Protection</b>	
<b>40 42 00</b>	<b>Process Piping and Equipment Insulation</b>	
40 42 00	Mechanical Insulation	2017
<b>40 46 00</b>	<b>Process Corrosion Protection</b>	
40 46 20	Hydro-Pox Corrosion Control Lining System	2017
40 46 50	Cathodic Protection – Impressed Current	2017
40 46 51	Cathodic Protection – Galvanic	2017
<b>40 50 00</b>	<b>Mechanical Materials</b>	
40 50 02	Basic Mechanical Materials and Methods	2017
<b>41 00 00</b>	<b>Material Processing and Handling Equipment</b>	
<b>41 20 00</b>	<b>Piece Material Handling Equipment</b>	
<b>41 22 00</b>	<b>Cranes and Hoists</b>	
41 22 13	Jib Cranes	2017
41 22 20	Travelling Gantry Bridge Cranes	2017
41 22 23	Hoists, Trolleys, and Monorails	2017

<b>41 24 00</b>	<b>Specialty Material Handling Equipment</b>	
41 24 40	Locomotive Sand System (Four Arm Gantry System)	2017
<b>41 50 00</b>	<b>Material Storage</b>	
41 50 10	Pre-Engineered Timber Column Structure	2017
<b>41 52 00</b>	<b>Bulk Material Storage</b>	
41 52 20	Prefabricated Salt Storage Dome	2017
 <b>43 00 00</b>	 <b>Process Gas and Liquid Handling, Purification, and Storage Equipment</b>	
<b>43 20 00</b>	<b>Liquid Handling Equipment</b>	
<b>43 21 00</b>	<b>Pumping Equipment</b>	
43 21 00	Pumping Equipment	2017
<b>43 23 00</b>	<b>Dry Location Liquid Pumps</b>	
43 23 32	End Section Centrifugal Pump	2017
43 23 33	Centrifugal Pumps for Petroleum Service	2017
43 23 52	Positive Displacement Pump (Rotary)	2017
43 23 71	Air Operated Diaphragm Pump	2017
<b>43 25 00</b>	<b>Submersible/Immersible Liquid Pumps</b>	
43 25 13	Submersible Non-Clog Pump	2017
43 25 14	Submersible Slurry Pump	2017

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## **SECTION 00 07 00 - GENERAL CONDITIONS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. This Section describes Standard Specifications which are broad in scope and apply on most construction projects.

##### **B. Definition of Terms:**

1. Whenever in these Specifications the following terms or pronouns in place of them are used, the intent and meaning shall be interpreted as follows:
  - a. Railroad: Shall mean Union Pacific Railroad Company and respective affiliates and subsidiary Companies and/or Corporations.
  - b. Agreement: The written Agreement and any written supplements or amendments thereto covering the performance of the Work and the furnishing of all superintendence, labor, tools, equipment, material, supplies and all other things required to properly complete the Work.
  - c. Contractor: The person or persons, firm, partnership, corporation, or combination thereof, who have entered into the Agreement with the Railroad.
  - d. Drawings: The official project plans, profiles, typical cross sections, general cross sections, working drawings and supplemental drawings, or reproductions thereof, approved by the Engineer, which show the location character, dimensions and details of the Work to be performed.
  - e. Engineer: The Vice President Engineering of the Railroad or his authorized representative.
  - f. Right of Way: Land which the Railroad owns or owns an interest in sufficient to permit performance of the Work.
  - g. Specifications: The directions, provisions and requirements contained herein. Any Special Conditions shall override these Specifications.
  - h. Project: The total construction of which the Work performed under the Contract Document may be the whole or a part and which may include construction by the Railroad or by separate contractors.
  - i. Work: The carrying out of responsibilities and duties imposed by the Agreement, whether completed or partially completed, and includes all labor, materials, equipment and services provided or to be provided by the Contractor to fulfill the Contractor's obligations.

- ##### **C. Work is to be completed in accordance with any and all local, state, and federal codes which have jurisdiction.**

D. Site Conditions:

1. The Contractor shall keep himself fully apprised throughout the performance of the Agreement of existing conditions at the site, including the status and progress of other work, which may affect the performance of this Agreement. The Contractor shall verify all necessary measurements and elevations in the field.
2. The Contractor shall promptly notify the Railroad of:
  - a. Any condition at the site which differs from that indicated in the Contract Documents or information furnished by the Railroad, or would be apparent under the mandatory visit to the site to become familiar with existing conditions.
  - b. Any previously unknown physical conditions at the site of an unusual nature not revealed by previous investigations and differing from those ordinarily encountered at the site of the Work.
  - c. The presence of any hazardous substance not shown on the plans and specifications or archaeological remains.

E. Site Supervision:

1. The Contractor shall maintain on the site at all times during Work at the site a competent resident general superintendent and any necessary assistants, all satisfactory to the Railroad. The resident general superintendent shall represent the Contractor and all directions given to him shall be binding as if given to the Contractor.

F. Material and Equipment by the Contractor:

1. Unless otherwise specified, all materials furnished by the Contractor, for installation as part of the Railroad's facility, shall be new.
2. No material or equipment which is deemed by the Railroad to be experimental will be accepted as complying with the requirements of the Contract Documents. Equipment or material which is provided, but fails to comply with the requirements of said documents, shall be corrected or removed and replaced with complying equipment or material at the Contractor's sole expense provided, however, if the progress of the Work is such as to make such removal impractical, the Railroad shall have the right to accept it and reduce the Agreement price by an amount equivalent to the difference in its value and the value of complying equipment or material. The Railroad may perform such factory or field tests as are deemed necessary to verify that equipment or material meets the performance standards recited in the Contractor's proposal. The Contractor shall be permitted to witness such tests.
3. Should equipment or material fail to meet such standards, the Contractor shall, at his own expense, modify, adjust, repair or replace same, as necessary, to assure compliance therewith and with the other applicable requirements of the Contract Documents.



4. Material Safety Data sheets for all hazardous substances must be submitted to the Railroad prior to bringing hazardous substances onto the property. This is in compliance with 29 CFR 1910.1200, the Federal Hazard Communication Standard. The Contractor shall dispose of hazardous substances in accordance with all Federal, State and local regulations.

G. Patents, Other Intellectual Property Rights and Royalties:

1. If any of the Work or equipment proposed to be furnished by the Contractor is covered by claims or patents of any nature, the Contractor will be required to pay all royalties thereon.
2. The Contractor agrees to indemnify and hold harmless the Railroad from any claim of any third party that any equipment furnished under this Agreement infringes any patent of the United States. If the Railroad notifies the Contractor promptly upon receipt of any claim that the equipment infringes a United States patent and gives the Contractor information, assistance and exclusive authority to settle and defend the claim, the Contractor shall at its own expense and option, either:
  - a. Settle or defend the claim or any suit or proceeding and pay all damages and costs awarded in it against the Railroad.
  - b. Procure for the Railroad the right to continue using the equipment.
  - c. Modify the equipment so it becomes non-infringing.
  - d. Replace the equipment or portions thereof so it becomes non-infringing.
3. If, in any suit arising from such claim the continued use of the equipment for the purpose intended is forbidden by any court of competent jurisdiction, the Contractor shall, at its option, take one or more of the actions under 2, 3 and 4 above without affecting the quality, performance or guarantees per the Contract Documents. The foregoing states the entire liability of the Contractor for patent infringement of any equipment.

H. Inspections:

1. The Railroad reserves the right to conduct inspections as it sees fit and hereby requires inspectors shall have the right to inspect all Work as it progresses at the site and shall have access to Contractor's and subcontractor's data relevant to the performance of this Agreement.
2. The Railroad inspectors shall have the right to reject Work which is faulty, or defective, or does not conform to the requirements of the Contract Documents. Inspection shall not relieve the Contractor from any obligations to perform the Work strictly in accordance with the requirements of the Agreement.

I. Occupational Safety and Health:

1. At all times during the performance of the Work, the Contractor shall exercise precaution for the protection of persons and property. The safety provisions of applicable laws, building and construction codes shall be observed. Machinery and equipment and other hazards shall be guarded in accordance with the safety provisions of the Manual of Accident Prevention in Construction, published by the Associated General Contractors of America, to the extent such provisions are not inconsistent with applicable law or regulations.

J. Climatic Conditions:

1. The Contractor shall take all reasonably necessary precautions to protect the Work against adverse climatic conditions.

K. Removal of Debris:

1. All trash, debris, and waste materials shall be removed from the site and disposed of by the Contractor, on a regular basis.
2. If the Contractor does not maintain the cleanliness standards previously mentioned, the Railroad holds the right to perform these duties upon notice to the Contractor and failure by the Contractor with five (5) calendar days to commence corrective action and take other appropriate action. In such case, the costs will be accumulated and subtracted from the Agreement price.

L. Successful Operation:

1. Successful operation is defined as demonstration of meeting performance guarantees by performance testing and completion of all Work including punchlist items, all in accordance with the Contract Documents.

M. Fire Protection:

1. Only work procedures which minimize fire hazards to the extent practicable shall be used. Combustible debris and waste materials shall be collected and removed from the site each day. Fuels, solvents and other volatile or flammable materials shall be stored in separate areas in well-marked, safe containers. Good housekeeping is essential to fire prevention and shall be practiced by the Contractor throughout the construction period. The Contractor shall follow the requirements from the latest version of the UPRR fire prevention plan.
2. Open burning on Railroad property or related to the project although off Railroad property is strictly forbidden.

N. Contractor Security:

1. The Contractor shall be responsible for all materials and equipment in its custody or placed in construction by it. Security methods shall be employed as required to ensure the protection of all materials, equipment and construction work from theft, vandalism, fire, and all other damage and loss. The Contractor must abide by all of the provisions of the Minimum Contractor Safety Requirements. This includes demobilizing equipment left unattended on the right of way, placing crane booms on the ground when left unattended, and no cell phone use while operating equipment on the right of way.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**

## **SECTION 01 11 00 - SUMMARY OF WORK**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Contractor shall furnish engineering, design, labor, material, tools, equipment, and construction services necessary to provide total PROJECT SCOPE OF WORK AS HEREIN DESCRIBED.

#### **1.02 OCCUPANCY**

- A. The Contractor shall allow the Railroad to take possession of and use any completed or partially completed portion of the facility during the progress of the Work as is possible without interfering with the progress of the Contractor. Possession and use of the facility shall not in any way evidence the completion of the Work or signify the Railroad's acceptance of the Work or any part of it.

#### **1.03 NUMBER OF SPECIFIED ITEMS REQUIRED**

- A. Wherever in these Specifications an article, device or piece of equipment is referred to in the singular number, such reference shall apply to as many such articles as are shown on the Drawings or required to complete the Work.

#### **1.04 FURNISHED BY THE RAILROAD**

- A. The following Drawings (see Drawings listed in the 'Project Bid Document Index'), furnished by the Railroad, shall be considered as part of and illustrating these Specifications. The Specifications are intended to supplement the Drawings, the two being considered cooperative. They are the property of the Railroad and shall be returned when the Work is completed.
  - 1. The Drawings show the general character of the Work, but the Railroad may furnish large-scale detail Drawings of such portions, as in its judgment may be required, in the preparation of which slight modifications may be made in minor details of design, if necessary. The Contractor shall not execute any work requiring such large-size details until same has been approved and all work must be made in strict accordance with such detail Drawings.
  - 2. Dimensions on Drawings take precedence over measurements by scale, detail Drawings over small-scale Drawings, and full-size details over all other Drawings. The decision of the Railroad shall be final as to the interpretations of Drawings and Specifications.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

## **END OF SECTION**

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## **SECTION 01 12 10 - CONTRACTS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Responsibilities and Duties - Documents, Specifications and Drawings:**

###### **1. Contract Documents:**

- a. The Agreement, applicable Addenda, Exhibits, Schedule of Billable Service Items, Statement of Equipment, Contractor's Statement of Business and Legal Relationships, Drawings and the Specifications (hereinafter the Contract Documents) all set forth numerous responsibilities and duties of the Contractor. The Contractor shall be thoroughly familiar with all of the above Contract Documents in order to fully understand all of his responsibilities and duties.

###### **2. Access to the Specifications and Drawings:**

- a. The Contractor shall keep a copy of the Specifications and Drawings at the job site, and shall at all times give the Engineer access thereto.

###### **3. Drawings:**

- a. The Engineer during the progress of the Work, by means of drawings or written instructions, may clarify the drawings and Specifications or make necessary changes in the Work. Any Work that may reasonably be inferred from the Specifications or Drawings as being required to produce the intended result shall be supplied whether or not it is specifically called for.

###### **4. Drawings Furnished by the Railroad:**

- a. The drawings furnished by the Railroad shall be considered as part of and illustrating these Specifications. The Specifications are intended to supplement the drawings, the two being considered cooperative.

#### **1.02 INCONSISTENCIES IN SPECIFICATIONS AND CORRECTIONS**

##### **A. In the event of conflicting requirements, the most restrictive provision shall apply.**

- B. The Contractor shall immediately report, and fully describe in writing, to the Engineer any and/or all inconsistencies, discrepancies, and/or ambiguities which the Contractor finds between the Contract Documents. The Engineer will promptly, in writing, correct such inconsistencies, discrepancies, and/or ambiguities in writing. Any such work done by the Contractor after his discovery of these inconsistencies, discrepancies, and/or ambiguities shall be done at the Contractor's risk.**

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

## **END OF SECTION**

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## **SECTION 01 14 10 - IRRIGATION FACILITIES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Contractor shall in no way alter or obstruct any irrigation ditches, canals or other facilities without first securing the Engineer's approval.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**END OF SECTION**

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## **SECTION 01 14 12 - WORKING AND FLAGGING NEAR THE TRACKS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Except as authorized by the Agreement and the Engineer, the Contractor will not work within 25 FT of the centerline of any track in service, and will locate all equipment, devices and materials at a sufficient distance from any track to ensure that no apparatus or part of any piece of equipment, device or material, such as the boom of a crane or a dragline, could under any circumstances reach closer than 25 FT to the centerline of any track. When the Contractor is required to work within 25 FT of the centerline of any track in service, a flagman will be required. The Contractor will shut down or clear equipment within 25 FT of track when trains are approaching, as advised by railroad flagman. The Railroad will bear the cost of such Railroad flagmen required for On Track Safety as defined by the Federal Railroad Administration (FRA).
- B. Railroad flagmen are for the protection of train movements only. The Contractor is responsible for all equipment movements across public and private road crossings. The Contractor's equipment shall be equipped with two-way radios for better communications with railroad flagmen and the railroad engineer. Contractor shall provide Flagger(s) with a working radio(s). All other flagging charges not involving the safety of Railroad operations will be at the Contractor's expense.
- C. The Contractor must notify the Engineer at least fourteen (14) days in advance of the date the Contractor wishes to have a railroad flagman.

#### **1.02 CONTRACTOR SAFETY**

- A. The Contractor shall abide by the rules set forth in the "Minimum Safety Requirements" for UPRR Contractors (separate document).
- B. General Contractor and all Subcontractors shall attend all safety meetings. Contractor shall adequately maintain their company "Safety Management Plan" throughout the duration of the project. Contractor will conduct FRA required "On Track Safety Training" for all contractor and subcontractor workers.
- C. Emergency phone numbers shall be posted in a conspicuous place in all field offices or on the project property.
- D. Cell phone use is not allowed while operating equipment or walking on UPRR property.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

## **END OF SECTION**

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## **SECTION 01 18 13 - UTILITY LINES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Public or private utilities requiring relocation on the Railroad's Right-of-Way, in the area of the Work, shall be arranged by the Railroad at no expense to the Contractor, unless required in the Scope of Work and/or the Schedule of Billable Service Items.
- B. It is the Contractor's responsibility to locate and protect all utilities within the limits of construction. If damaged during grading operations, the Contractor shall repair or replace at no additional cost to Railroad.
- C. If active utility lines are encountered that are not shown on the drawings or otherwise made known to the contractor, the contractor shall promptly take necessary steps to assure that service is not interrupted. If service is interrupted, the Contractor shall immediately restore service by repairing the damaged utility.
- D. If existing utilities are found to interfere with the permanent facilities being constructed under this section, the Contractor shall immediately notify the Engineer and secure his written instructions.

#### **1.02 FIBER OPTICS**

- A. Fiber optic cable systems may be buried on Union Pacific Railroad property within the limits of this project. The Contractor shall notify the UPRR CBUD (call before you dig) at 1-800-336-9193 to arrange for a cable locator prior to commencing work.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

## **END OF SECTION**

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## **SECTION 01 31 10 - PROJECT COORDINATION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Work involves construction and operations on the Railroad's Right-of-Way, and the Contractor will be required to coordinate his activities with the activities of the Railroad as well as others not party to the Agreement. Any questions arising about coordination of work between the Contractor and the Railroad or between the Contractor and others shall be taken up with the Engineer and a method of coordination agreed upon before Work is commenced.
- B. The safe operation of the Railroad shall take precedence over all Work, and nothing shall be done or caused by the Contractor which will endanger Railroad employees or operation. The Contractor shall become familiar with and comply with the Railroad's rules and regulations concerning protection of persons and property and shall consult with the Engineer concerning the Railroad's rules and regulations.
- C. The Contractor is required to furnish and implement a Safety Management Plan. The Safety Management Plan will include General Contractor employees as well as all Sub-Contractors and their employees. The plan will include the following, at a minimum:
  - 1. Requirements contained in established Contractor Safety Plan
  - 2. Governmental Requirements
  - 3. UPRR Minimum Contractor Safety Requirements
  - 4. UPRR Safety Certification
  - 5. UPRR C.I.C. (Contractor in Charge) Policy
  - 6. UPRR Fire Prevention Plan and Risk Assessment
  - 7. UPRR Back-up Policy
  - 8. eRailsafe training
  - 9. eRailsafe Compliance
  - 10. FRA Roadway Worker training
  - 11. FRA Bridge Worker training
  - 12. Safety Audit Process
  - 13. Adjustment Plan to make modifications to The Safety Management Plan
  - 14. Traffic Control Plan and/or Traffic Management
  - 15. UPRR Lead In Construction

- D. All bidders shall submit a critical path schedule, work plan, and spending plan along with their bid proposal. The schedule shall indicate the number of calendar days required for each Bid Item. In determining the calendar days the Contractor shall consider weather and local conditions which are normal for this area. The successful bidder will be required to make monthly updates of the schedule to be submitted with the invoice for payment requests. Contractor's bid may not be considered if a schedule is not included in the bid.
- E. All bidders shall provide a tentative list of sub-contractors and the work to be done by them with their bid. The successful bidder shall submit a final list of sub-contractors and the work to be done by them prior to commencing work.
- F. The Contractor shall provide evidence of a current State Contractor's license with the bid. Contractor shall be responsible to assure compliance with the laws of the State with regards to any sub-contractors used.
- G. UPRR will furnish electronic copies of plans to the Successful Contractor. Hard copies will be the responsibility of the Contractor.

## PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

## PART 3 - EXECUTION

### 3.01 SUBMITTALS

- A. Furnish Safety Management Plan to the Engineer no later than 10 days after NTP, but prior to mobilization on site. Ideally this plan will be submitted prior to the Pre-Construction meeting and will be discussed at this meeting.
- B. Furnish corrections to Safety Management Plan as required by the Engineer no later than 10 days after receipt of request.
- C. Provide as discussion item in weekly meeting, or as otherwise approved by the Engineer.
- D. The Contractor is responsible for monitoring eRailsafe compliance of all General Contractor and Sub-Contractor employees. The Contractor shall maintain a master list of all employees who are working on the job site, with their eRailsafe badge number and expiration date. Each Contractor employee shall sign-in each day they are on the job site. The attendance roster, with each Contractor employee's eRailsafe status, shall be readily available for the Engineer to view. Union Pacific may perform additional audits of eRailsafe compliance at any time.
- E. Safety Audit Process
  - 1. Provide Safety Audit Form.
  - 2. Provide management for Safety Audit Program, with weekly program audits by contractor management.
  - 3. Provide safety audit results, the daily eRailsafe attendance rosters, and corrective actions in a Weekly Safety Audit Report and provide a comprehensive Monthly Safety Audit Report to the Engineer for approval.

- F. If requested adjustments to the Safety Management Plan, including behavior modification process and/or corrective action, are not made, the Contractor may be subject to the deductions as presented in Part 4.

#### PART 4 - MEASUREMENT AND PAYMENT

##### 4.01 MEASUREMENT

- A. No separate measurement will be made for project coordination.
- B. The Safety Management Plan will be measured as follows:
  - 1. The contractor shall submit a completed Weekly Safety Audit Report and a comprehensive Monthly Safety Audit Report to the Engineer.
  - 2. In contracts that do not contain a mobilization bid item, failure to submit a weekly Safety audit report and summarized monthly report over any three weeks may result in removal of contractor from bid lists.
  - 3. Minimum Contractor performed audits should include at least one audit per day for each General Contractor work group and for each Sub-Contractor on-site.

##### 4.02 PAYMENT

- A. Project Coordination shall be incidental to applicable service items. No separate payment shall be made.
- B. The Safety Management Plan will be incidental to mobilization bid item.
  - 1. 70% of Mobilization paid on first invoice will be contingent upon submittal and approval of Safety Management Plan.
  - 2. Failure to submit Weekly Safety Audit Report and comprehensive Monthly Safety Audit Report with any necessary corrective action plans will result in **5% deduction applied to the remaining 30% of the mobilization pay item for that month's invoice.**

**END OF SECTION**

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## **SECTION 01 33 00 - SUBMITTALS AND SUBSTITUTIONS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Special brands of material or devices mentioned in Specifications, or on Drawings are for the purpose of establishing a standard or criterion of quality and character desired.
  - 1. For products specified by naming several products or manufacturers, select any product and manufacturer named.
  - 2. For products specified by naming one of more products, but indicating the option of selecting equivalent products by stating "or equal" after specified product, Contractor must submit request to the Railroad for substitution for any product not specifically named.
  - 3. For products specified by naming one or more products, but indicating the option of selecting equivalent products by stating "or approved equal" after specified product, Contractor must submit information to Railroad for approval of any product not specifically named.
  - 4. For products specified by naming only one product and manufacturer, there is no option, and no substitution will be allowed. However, a submittal is still required for the record.
  - 5. Where specific make or kind of apparatus is called for and furnished by the Contractor, the furnishing of the apparatus does not relieve the Contractor of liability until he shall make such apparatus or appliance operate so it will successfully perform the function for which it is intended.
  - 6. Include in submittals complete data substantiating compliance of proposed substitution, including product identification, manufacturer's literature, performance and necessary test data.
  - 7. In making request for substitutions, Contractor represents he will coordinate installation of accepted substitution into work, making such changes as may be required for work to be complete in all respects.
- B. Design drawings, design information, and other data for all construction work furnished by the Contractor shall be submitted to the Railroad. The Contractor shall submit all design drawings and data sufficiently in advance of construction requirements to allow ample time for checking, resubmitting and rechecking and to avoid any delay in progress of Work.
- C. All equipment supplied by Contractor shall be furnished complete with installation instructions, operating and maintenance instruction bulletins, complete parts lists, and wiring diagrams for all panels. It shall be Contractor's responsibility to furnish two (2) complete, bound sets of these instructions, lists, diagrams, etc., to the Railroad.
- D. Drawings, instructions and manuals supplied with equipment furnished by others, but installed under the Agreement, shall be carefully preserved and turned over to the Railroad.

- E. The Contractor shall provide three (3) days training to Railroad personnel on the operation and maintenance requirements of equipment installed. The Contractor shall provide a one week notice to the Railroad before training commences. The training dates shall be determined through consultation with the Railroad.
- F. All materials to be placed under this Contract will first be approved by the UPRR Engineer. Contractor shall submit to the UPRR Engineer, for review and exception, if any, such work, drawings, shop drawings, laying schedules, test reports, data on material and equipment and material samples, as are required for the proper control of the work. Contractor shall not begin any work covered by a submittal until the submittal is returned to him by the UPRR Engineer. Where exceptions are taken by the UPRR Engineer, the Contractor shall make the necessary revisions and re-submit the information to the UPRR Engineer. Submittals will be required for, but not limited to, the following items: Erosion control plan, subballast, and seeding.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**

## **SECTION 01 33 04 - OPERATION AND MAINTENANCE MANUALS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Administration of the submittal process for Operation and Maintenance Manuals.
2. Content requirements for Operation and Maintenance Manuals.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. General submittal requirements are specified in Specification Section 01 33 00 - Submittals And Substitutions.
- B. Technical Specification Sections identifying required Operation and Maintenance Manual submittals.

#### **1.03 DEFINITIONS**

##### **A. Equipment Operation and Maintenance Manuals:**

1. Contain the technical information required for proper installation, operation and maintenance of process, electrical and mechanical equipment and systems.

##### **B. Building Materials and Finishes Operation and Maintenance Manuals:**

1. Contain the information required for proper installation and maintenance of building materials and finishes.

#### **1.04 SUBMITTALS**

- A. List of all the Operation and Maintenance Manuals required by the Contract as identified in the Technical Specification Sections.
- B. Operation and Maintenance Manuals:
  - 1. Draft and final electronic copies.
  - 2. Final paper copies: One (1).

#### **1.05 SUBMITTAL SCHEDULE**

- A. List of Required Operation and Maintenance Manuals:
  - 1. Submit list with Specification Section number and title within 90 days after Notice to Proceed.
- B. Draft Operation and Maintenance Manuals:
  - 1. Submit approvable draft manuals in electronic format (PDF) within 30 days following approval of the respective Shop Drawing.
    - a. Include placeholders or fly sheet pages where information is not final or is missing from the draft manual.

2. All Draft Operation and Maintenance Manuals shall be received by no later than 50 percent project completion.

C. Final Operation and Maintenance Manuals:

1. Final approval of Operation and Maintenance Manuals in electronic format (PDF) must be obtained 45 days prior to equipment start-up.
2. Provide paper copies and electronic copies on CD-ROMs of approved final Operation and Maintenance Manuals, a minimum of 30 days prior to equipment start-up.
3. Issue addenda to Final Approved Operation and Maintenance Manual to include:
  - a. Equipment data that requires collection after start-up, for example but not limited to HVAC balancing reports, electrical switchgear, automatic transfer switch and circuit breaker settings.
  - b. Equipment field testing data.
  - c. Equipment start-up reports.

## 1.06 PREPARATION OF SUBMITTALS

A. General:

1. All pages of the Operation and Maintenance Manual submittal shall be legible. Submittals which, in the Engineer's sole opinion, are illegible will be rejected without review.
2. Identify each equipment item in a manner consistent with names and identification numbers used in the Contract Documents, not the manufacturer's catalog numbers.
3. Neatly type any data not furnished in printed form.
4. Operation and Maintenance Manuals are provided for Owner's use, to be reproduced and distributed as training and reference materials within Owner's organization.
  - a. This requirement is:
    - 1) Applicable to both paper copy and electronic files.
    - 2) Applicable to materials containing copyright notice as well as those with no copyright notice.
5. Notify supplier and/or manufacturer of the intended use of Operations and Maintenance Manuals provided under the Contract.

B. Operation and Maintenance Manual Format and Delivery:

1. Draft electronic submittals:
  - a. Provide manual in Adobe Acrobat Portable Document Format (PDF), latest version.
  - b. Create one (1) PDF file for each equipment Operation and Maintenance Manual.

- c. Do not password protect or lock the PDF document.
  - d. Drawings or other graphics must be converted to PDF file format from the original drawing file format and made part of the PDF document.
  - e. Scanning of drawings is to be used only where actual file conversion is not possible and drawings must be scanned at a resolution of 300 dpi or greater.
  - f. Rotate sheets that are normally viewed in landscape mode so that when the PDF file is opened the sheet is in the appropriate position for viewing.
  - g. Create bookmarks in the bookmarks panel for the Operation and Maintenance Manual cover, the Table of Contents and each major section of the Table of Contents.
  - h. Using Adobe Acrobat Standard or Adobe Acrobat Professional, set the PDF document properties, initial view as follows:
    - 1) Select File → Properties → Initial View.
    - 2) Select the Navigation tab: Bookmarks Panel and Page.
    - 3) Select the Page layout: Single Page.
    - 4) Select the Magnification: Fit Page.
    - 5) Select Open to page: 1.
    - 6) Set the file to open to the cover page of the manual with bookmarks to the left, and the first bookmark linked to the cover page.
  - i. Set the PDF file "Fast Web View" option to open the first several pages of the document while the rest of the document continues to load.
    - 1) To do this:
      - a) Select Edit → Preferences → Documents → Save Settings.
      - b) Check the Save As optimizes for Fast Web View box.
  - j. PDF file naming convention:
    - 1) Use the Specification Section number, the manufacturer's name and the equipment description, separated by underscores.
    - 2) Example: 41 22 20\_Travelling\_Gantry\_Bridge\_Cranes.pdf.
    - 3) Do not put spaces in the file name.
2. Final electronic submittals:
- a. Submit two (2) copies in PDF file format on two (2) CD-ROM discs (one (1) copy per CD-ROM), each secured in a jewel case.
  - b. CD-ROM Labeling:
    - 1) Provide the following printed labeling on all CD-ROM discs:
      - a) Project name.
      - b) Specification Section.
      - c) Equipment names and summary of tag(s) covered.

- d) Manufacturer name.
    - e) Date (month, year).
  - c. CD-ROM Jewel Case Holder:
    - 1) Insert jewel cases containing labeled CD-ROM discs in three-ring binder holder (C-Line Products, [www.c-lineproducts.com](http://www.c-lineproducts.com) stock number CLI-61968 or equivalent) at the front of each final paper copy.
- 3. Final paper copy submittals:
  - a. Quantity: Provide two (2) copies.
  - b. Paper: 8.5 x 11 IN or 11 x 17 IN bright white, 20 pound paper with standard three-hole punching.
  - c. 3-Ring Binder:
    - 1) Provide D-ring binder with clear vinyl sleeves (i.e. view binder) on front and spine.
    - 2) Insert binder title sheet with the following information under the front and spine sleeves:
      - a) Project name.
      - b) Specification Section.
      - c) Equipment names and summary of tag(s) covered.
      - d) Manufacturer name.
      - e) Date (month, year).
    - 3) Provide plastic sheet lifters prior to first page and following last page.
  - d. Drawings:
    - 1) Provide all drawings at 11 x 17 IN size, triple folded and three-hole punched for insertion into manual.
    - 2) Where reduction is not practical to ensure readability, fold larger drawings separately and place in three-hole punched vinyl envelopes inserted into the binder.
    - 3) Identify vinyl envelopes with drawing numbers.
  - e. Use plastic coated dividers to tab each section of each manual in accordance with the Table of Contents.
- C. Equipment Operation and Maintenance Manual Content:
  - 1. Provide a cover page as the first page of each manual with the following information:
    - a. Manufacturer(s) Name and Contact Information.
    - b. Vendor's Name and Contact Information.
    - c. Date (month, year).
    - d. Project Owner and Project Name.

- e. Specification Section.
  - f. Project Equipment Tag Numbers.
  - g. Model Numbers.
  - h. Engineer's Name.
  - i. Contractor's Name.
- 2. Provide a Table of Contents for each manual.
  - 3. Provide Equipment Record sheets as follows:
    - a. Printed copies of the Equipment Record (Exhibits B1, B2 and B3), as the first tab following the Table of Contents.
    - b. Each section of the Equipment Record must be completed in detail; simply referencing the related equipment Operation and Maintenance Manual sections for nameplate, maintenance, spare parts or lubricant information is not acceptable.
    - c. For equipment involving separate components (for example, a motor and gearbox), a fully completed Equipment Record is required for each component.
    - d. Submittals that do not include the Equipment Record(s) will be rejected without further content review.
  - 4. Provide the following detailed information, as applicable:
    - a. Use equipment tag numbers from the Contract Documents to identify equipment and system components.
    - b. Equipment function, normal and limiting operating characteristics.
    - c. Instructions for assembly, disassembly, installation, alignment, adjustment, and inspection.
    - d. Operating instructions for start-up, normal operation, control, shutdown, and emergency conditions.
    - e. Lubrication and maintenance instructions.
    - f. Troubleshooting guide.
    - g. Mark each sheet to clearly identify specific products and component parts and data applicable to the installation for the Project; delete or cross out information that does not specifically apply to the Project.
    - h. Parts lists:
      - 1) A parts list and identification number of each component part of the equipment.
      - 2) Exploded view or plan and section views of the equipment with a detailed parts callout matching the parts list.
      - 3) A list of recommended spare parts.
      - 4) List of spare parts provided as specified in the associated Specification Section.

- 5) A list of any special storage precautions which may be required for all spare parts.
    - i. General arrangement, cross-section, and assembly drawings.
    - j. Electrical diagrams, including elementary diagrams, wiring diagrams, connection diagrams, and interconnection diagrams.
    - k. Test data and performance curves.
    - l. As-constructed fabrication or layout drawings and wiring diagrams.
    - m. Copy of the equipment manufacturer's warranty meeting the requirements of the Contract.
    - n. Copy of any service contracts provided for the specific piece of equipment as part of the Contract.
  - 5. Additional information as required in the associated equipment or system Specification Section.
- D. Building Materials and Finishes Operation and Maintenance Manual Content:
- 1. Building products, applied materials and finishes:
    - a. Include product data, with catalog number, size, composition and color and texture designations.
    - b. Provide information for ordering custom manufactured products.
  - 2. Necessary precautions:
    - a. Include product MSDS for each approved product.
    - b. Include any precautionary application and storage guidelines.
  - 3. Instructions for care and maintenance:
    - a. Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods and recommended schedule for cleaning and maintenance.
  - 4. Moisture protection and weather exposed products:
    - a. Include product data listing, applicable reference standards, chemical composition, and details of installation.
    - b. Provide recommendations for inspections, maintenance and repair.
  - 5. Additional requirements as specified in individual product specifications.

## 1.07 TRANSMITTAL OF SUBMITTALS

### A. Operation and Maintenance Manuals.

- 1. Transmit all submittals to the Engineer as specified in the Special Conditions.
- 2. Transmittal form: Use Operation and Maintenance Manual Transmittal, Exhibit A.
- 3. Transmittal numbering:



- a. Number each submittal with the Specification Section number followed by a series number beginning with "-01" and increasing sequentially with each additional transmittal, followed by "-OM" (for example: 43 23 14-01-OM).
  4. Submit draft and final Operation and Maintenance Manual in electronic format (PDF) to Engineer, until manual is approved.
- B. Expedited Return Delivery:
1. Include prepaid express envelope or air bill in submittal transmittal package for any submittals Contractor expects or requires express return mail.
  2. Inclusion of prepaid express envelope or air bill does not obligate Engineer to conduct expedited review of submittal.

#### 1.08 ENGINEER'S REVIEW ACTION

A. Draft Electronic (PDF) Submittals:

1. Engineer will review and indicate one of the following review actions:
  - a. A - ACCEPTABLE
  - b. B - FURNISH AS NOTED
  - c. C - REVISE AND RESUBMIT
  - d. D - REJECTED
2. Submittals marked as Acceptable or Furnish As Noted will be retained; however, the transmittal form will be returned with a request for the final paper and electronic documents to be submitted.
3. Copies of submittals marked as Revise and Resubmit or Rejected will be returned with the transmittal form marked to indicate deficient areas.
4. Resubmit until approved.

B. Final Paper Copy Submittals:

1. Engineer will review and indicate one (1) of the following review actions:
  - a. A - ACCEPTABLE
  - b. D - REJECTED
2. Submittals marked as Acceptable will be retained with the transmittal form returned as noted.
3. Submittals marked as Rejected will be returned with the transmittal form marked to indicate deficient areas.
4. Resubmit until approved.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**



# EXHIBIT A Operation and Maintenance Manual Transmittal \_\_\_\_\_ - \_\_\_\_\_ - OM (Spec Section) (Series)

Project Name:		Date Received:
Project Owner:		Checked By:
Contractor:	Owner:	Log Page:
Address:	Address:	HDR No.:
Attn:	Attn:	1st. Sub.                      ReSub.

Date Transmitted:	Previous Transmittal Date:
-------------------	----------------------------

No. Copies	Description of Item	Manufacturer	Dwg. or Data No.	Action Taken*

Remarks:

To:	From:
Date:	

\* The Action designated above is in accordance with the following legend:

- A - Acceptable
- B - Furnish as Noted
- C - Revise and Resubmit
- D - Rejected

Comments:

	By	Date
Distribution: Contractor     File     Field     Owner     Other		

## Equipment Record

Project Name	Specification Section:
Equipment Name	Year Installed:

Local Vendor/Service Center			
Address			Phone
Fax	Web Site	E-mail	

Equip.			Serial No.		
Make			Model No.		
ID No.	Frame No.	HP	RPM	Cap.	
Size	TDH	Imp. Sz.	CFM	PSI	
Other:					

Equip.					Serial No.				
Make					Model No.				
ID No.	Frame No.	HP	V.	Amp.	HZ	PH	RPM	SF	
Duty	Code	Ins. Cl.	Type	NEMA	C Amb.	Temp. Rise	Rating		
Other:									

[illegible][illegible]

## Equipment Record

[illegible]

## EXHIBIT B3

## Equipment Record

## Lubrication Summary

Equipment Description			Project Equip. Tag No(s).			
Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					
Lubricant Point						
Lubricant Type		Manufacturer	Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

## SECTION 01 33 23 - SHOP DRAWINGS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Drawings shall clearly indicate proposed items, capacities, characteristics and details in conformance with the Drawings or schedules. Capacities, dimensions and special features required shall be certified by the manufacturer.
- B. Shop Drawings shall indicate manufacturer's delivery time for the item after receipt of approval by the Railroad.
- C. Shop Drawings for all items requiring same or called for shall be prepared immediately upon award of Agreement and four copies submitted to the Railroad for review. No materials shown thereon shall be ordered until shop Drawings and setting diagrams are reviewed and approved as detailed below. After the review process, Contractor shall then furnish three (3) complete hard copy sets of approved Drawings for the Railroad's use on the job, and one (1) electronic set of approved Drawings in PDF format for the Railroad's Project Closeout CD referenced in Section 07 78 39.
- D. Except for submittals for record, information or similar purposes, where action and return is required or requested, the Railroad will review each submittal, mark to indicate action taken, and return promptly.
- E. Compliance with specified characteristics is the Contractor's responsibility.
- F. Action Stamp: The Railroad will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:
  - 1. Final Unrestricted Release: Where submittals are marked "Approved," that part of the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents; final acceptance will depend upon that compliance.
  - 2. Final-But-Restricted Release: When submittals are marked "Approved as Noted," that part of the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents; final acceptance will depend on that compliance.
  - 3. Returned for Resubmittal: When submittal is marked "Not Approved, Revise and Resubmit," do not proceed with that part of the Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal in accordance with the notations; resubmit without delay. Repeat if necessary to obtain a different action mark. Do not permit submittals marked "Not Approved, Revise and Resubmit" to be used at the Project site, or elsewhere where Work is in progress.
  - 4. Other Action: Where a submittal is primarily for information or record purposes, special processing or other activity, the submittal will be returned, marked "Action Not Required".

- G. The checking and review of shop Drawings by the Railroad will not release the Contractor from any errors thereon. The Contractor is to be responsible for verifying all material and workmanship in shop work or other trades assuming all responsibility for any conflict between the various trades during construction.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**



## **SECTION 01 40 00 - PROJECT SCHEDULING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Contractor's planning, scheduling and execution of the work shall be disclosed to Union Pacific by submission of the Preliminary, Baseline and Contract Schedule information and data specified in this section. The Work under this Contract shall be planned, scheduled, executed, reported and accomplished using Critical Path Method (CPM) scheduling.
- B. No contract work shall begin without a Baseline CPM schedule approved by the Engineer.
- C. CPM schedule must be updated, submitted and approved by Railroad monthly.

#### **1.02 COST LOADING**

- A. Baseline Schedule shall be cost loaded. Activity level cost loading shall be based on Union Pacific bid items and/or items outlined in the contract documents. One or more resources shall be assigned to each activity representing the value of the work identified by the activity.

#### **1.03 PRECONSTRUCTION SCHEDULE**

- A. The Contractor shall have for review, prior to the pre-construction meeting, a cost loaded CPM schedule. At this meeting the Engineer will review the requirements of this section with the Contractor for any revisions to that provided.

#### **1.04 SUBMITTAL OF A CPM SCHEDULE**

- A. Baseline Schedule Submittals:
  - 1. A baseline schedule must be approved by the Engineer prior to the commencement of work.
- B. Contract Schedule Update Submittals.
  - 1. Schedule updates shall be submitted for approval each calendar month with a narrative describing any changes.
- C. Three Week Detail Schedule:
  - 1. A three week look ahead schedule is required on a weekly basis to be provided to the Engineer.

#### 1.05 SCHEDULE REVIEWS

- A. The Engineer's review will be for conformance with the Contract Time and those sequences of Work indicated in or required by the Contract Documents, to record Early and Late Dates for Milestones, to identify the Contractor's use of Float, to compare as-built data, and for conformance with the requirements of this Section and other information given in the Contract Documents which may have a bearing on the Contract Schedule. The Engineer's review may extend to the accuracy of other matters dealt with by the Contract Schedule, including, but not limited to, whether work is omitted, activity durations are reasonable, the level of labor, materials and equipment, sequences of construction, or whether the sequences and timing for work remaining are practicable, the correctness of all which shall remain the sole responsibility of the Contractor.

#### 1.06 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

- A. All costs for complying with this section shall be considered incidental to the project. No separate payment will be made.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

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## **SECTION 01 43 26 – LABORATORY AND FIELD TESTING SERVICES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. All quality control and quality assurance testing and inspecting to ensure the completed Work meets the Project Plans and Specifications shall be provided by the Contractor.
- B. Related Work:
  - 1. Documents affecting work of this Section include, but are not necessarily limited to:
    - a. Section 00 00 00 General Conditions
    - b. Section 01 00 00 General Requirements
  - 2. Requirements for testing may be described in various Sections of these Specifications.
  - 3. Where no testing requirements are described, but the Railroad decides testing is needed, the Railroad may require testing to be performed under pertinent standards for testing.
- C. Work Included:
  - 1. The Contractor will select a qualified independent testing laboratory.
  - 2. Testing engineer or scientist: The Contractor will select a licensed independent engineer or scientist by the state in which the Work is performed to observe performance of the Work in connection with excavating, trenching, filling, backfilling and grading, placing of asphalt and placing of concrete and to perform soils, compaction, asphalt and concrete tests.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 03 12 00 – Non-reinforced Concrete
- B. Section 03 13 00 – Reinforced Concrete
- C. Section 03 20 00 - Concrete Reinforcement
- D. Section 03 30 00 – Cast-in-Place Concrete
- E. Section 31 23 26 – Compaction Control and Testing
- F. Section 32 12 16 – Hot Mix Asphalt Paving
- G. Section 32 13 00 – Rigid Paving
- H. Section 34 11 27 - Subballast

#### **1.03 REFERENCED STANDARDS**

- A. American Society for Testing and Materials (ASTM) E329

#### 1.04 QUALITY ASSURANCE

- A. The testing laboratory will be qualified to the Railroad's approval in accordance with ASTM E329.
- B. Testing will be in accordance with all pertinent codes and regulations, and with pertinent standards of the American Society for Testing and Materials.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with pertinent provisions of Specifications Sections.
- B. Promptly process and distribute required copies of test reports and related instructions to assure necessary retesting and replacement of failed materials with the least possible delay in progress of the Work.
- C. The Contractor will furnish to the Railroad's Engineer the original copies of test reports. In cases of test failure, the Engineer will be notified in the most expedient manner possible and written reports will follow. If the Engineer cannot be located immediately the Contractor will be notified of the failure and the failure shall be rectified.

#### 1.06 SERVICES INCLUDED.

- A. The Contractor will provide all inspection and testing services including, but not necessarily limited to:
  - 1. Observing performance of work in connection with excavating and embankment, trenching, backfilling, grading and installation of asphalt and concrete.
- B. Code Compliance Testing:
  - 1. Inspections and tests required by codes or ordinances or by a plan approval authority, and which are made by a legally constituted authority, shall be the responsibility of, and be paid for by the Contractor, unless otherwise provided in the Contract Documents.
- C. Contractor's Testing:
  - 1. Inspecting and testing performed exclusively for the convenience of the Contractor shall be the Contractor's sole responsibility.
- D. Cooperation with Testing Laboratory:
  - 1. Representatives of the testing laboratory shall have access to the Work at all times and at all locations where the Work is in progress. The Contractor shall provide facilities for such access to enable the laboratory to perform its functions properly.
- E. Taking Specimens:
  - 1. All specimens and samples for testing, unless otherwise provided in the Contract Documents, shall be taken by the testing personnel. All sampling equipment and personnel will be provided by the testing laboratory. All deliveries of specimens and samples to the testing laboratory will be performed by the testing laboratory.

#### 1.07 SCHEDULES FOR TESTING

- A. Establishing Schedule:

UP General Specifications

LABORATORY AND FIELD Testing Services

Issued: 03-26-2019

01 43 26-2

1. Testing shall be performed in accordance of the schedule as noted in Sections 03 12 00, 03 13 00, 03 20 00, 03 30 00, 31 23 26, 32 12 16, and 34 11 27.
  2. Provide all required time within the construction schedule.
- B. Revising Schedule:
1. When changes of construction schedule are necessary during construction, coordination of all such changes with the testing laboratory is required.
- C. Adherence to Schedule:
1. When the testing laboratory is ready to test according to the established schedule, but is prevented from testing or taking specimens due to incompleteness of the Work, all extra charges for testing attributable to the delay shall be back charged to the Contractor and shall not be borne by the Railroad.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION -

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

- A. No separate measurement will be made for laboratory and field testing services.

4.02 PAYMENT

- A. : Laboratory and field testing services shall be incidental applicable service items. No separate payment shall be made.

**END OF SECTION**

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## **SECTION 01 45 00 - QUALITY ASSURANCE AND CONTROL**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Quality assurance and control.
2. Regulatory requirements.
3. Tolerances.
4. Mock-ups.
5. Manufacturer's field services.

#### **1.02 QUALITY ASSURANCE AND CONTROL**

- A. Monitor quality assurance and control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- D. Comply with specified standards as a minimum quality for Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified and experienced to produce required or specified quality.
- F. Verify that field measurements are as indicated on approved shop drawings or as instructed by manufacturer of product.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.
- H. Materials shall be compatible with one another and with other materials with which they may come in contact.

#### **1.03 SUPERVISION AND CONSTRUCTION PROCEDURES**

- A. Contractor shall supervise and direct Work, using Contractor's best skill and attention.
- B. Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of Work under the Contract, unless Contract Documents give other specific instructions concerning these matters.

- C. Whether or not Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall review, substantiate, and comply with current industry execution standards and manufacturer's current execution instructions and evaluate jobsite safety thereof and shall be fully and solely responsible for jobsite safety of such means, methods, techniques, sequences or procedures.
  - 1. If Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to Railroad Engineer and shall not proceed with that portion of Work without further written instructions from Engineer.
  - 2. If Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by Contractor, the Railroad shall be solely responsible for any loss or damage arising solely from those Railroad-required means, methods, techniques, sequences or procedures.
- D. Contractor shall be responsible to Railroad for acts and omissions of Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of Work for, or on behalf of Contractor or any of its Subcontractors.
- E. Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.
- F. Contractor is solely responsible for coordination of scope of Work for its own forces, and of Subcontractors and suppliers, and to complete all Work, whether performed by the Contractor or a Subcontractor.
- G. Contractor shall employ Licensed Surveyor to locate and stake out Work and establish necessary reference and benchmarks.
  - 1. Work from established benchmarks and reference points, layout and correctly establish all lines, levels, grades, and locations of all parts of their own Work and be responsible for their accuracy and proper correlation with Work and established data.

#### 1.04 REGULATORY REQUIREMENTS

- A. Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of Work.
- B. If Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction, including, but not limited to, any penalties, fines or other damages realized.
- C. When Contract Documents require Contractor, Subcontractor, Vendor or other supplier to provide selection or design of parts of Work, such selection or design shall meet requirements of Municipal, State or other governmental authorities having jurisdiction.

#### 1.05 TOLERANCES

- A. Monitor fabrication and installation tolerance control of Products to produce approved Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

#### 1.06 MANUFACTURER'S FIELD SERVICES AND REPORTS

- A. When field services are specified, have material or product suppliers, or manufacturers, provide technically competent staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and supervise installation where specified, as applicable and to initiate instructions when necessary.
- B. Report observations, and site decisions or instructions given to applicators or installers which are supplemental or contrary to manufacturer's written instructions.
- C. Submit report in duplicate within 30 days of observation.

### PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.
- B. Verify existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual Specification Sections.
- D. Verify that utility services are available, of correct characteristics, and in correct locations.

#### 3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

### END OF SECTION

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

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This Section describes construction facilities and temporary controls required for the Work.
  - 1. Provide construction facilities and temporary controls and utilities for as long as needed for the Work. The Contractor shall ensure the timely removal of temporary controls and utilities as required. This includes, but is not necessarily limited to the facilities, controls and utilities covered in this Section.
- B. Related Work:
  - 1. Documents affecting work of this Section include, but are not limited to:
    - a. Section 00 00 00 – General Conditions
    - b. Section 01 00 00 – General Requirements
  - 2. Except equipment furnished by the subcontractors shall comply with requirements of pertinent safety regulations, such equipment normally furnished by the individual trades in execution of their own portions of the Work are not part of this Section.
- C. Requirements:
  - 1. Provide construction facilities and temporary controls needed for the Work including, but not necessarily limited to:
    - a. Temporary utilities such as heat, water, electricity, and telephone.
    - b. Field office for the Contractor's personnel.
    - c. Sanitary facilities.
    - d. Enclosure such as tarpaulins, barricades, and canopies.
    - e. Temporary fencing of the construction site.
    - f. Project sign.

#### **1.02 DELIVERY, STORAGE, AND HANDLING**

- A. Maintain temporary facilities and controls in proper and safe condition throughout progress of the Work.

#### **1.03 MAINTENANCE AND REMOVAL**

- A. Maintain temporary facilities and controls as long as needed for safe and proper completion of the Work.
- B. Remove such temporary facilities and controls as rapidly as progress of the Work will permit, or as directed by the Engineer.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

- A. No separate measurement will be made for construction facilities and temporary controls.

4.02 PAYMENT

- A. Construction facilities and temporary controls shall be incidental applicable service items. No separate payment shall be made.

**END OF SECTION**

## **SECTION 01 51 13 - ELECTRICITY**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Contractor shall provide and/or obtain all electric power necessary to accomplish the Work. Temporary electric lines will be furnished, installed, connected and maintained by the Contractor in a manner satisfactory to the Engineer and shall be removed by the Contractor prior to completion of the Work.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 4 - MEASUREMENT AND PAYMENT**

#### **4.01 MEASUREMENT**

- A. No separate measurement will be made for providing electricity.

#### **4.02 PAYMENT**

- A. Electricity shall be incidental applicable service items. No separate payment shall be made.

**END OF SECTION**

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## **SECTION 01 51 36 - WATER**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Contractor shall provide an adequate supply of water as required to properly carry out the Work and an adequate supply of uncontaminated water as required for domestic consumption and shall install and maintain necessary supply connections and piping for such water supply, but only at such locations and in such manner as may be approved by the Engineer.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 4 - MEASUREMENT AND PAYMENT**

#### **4.01 MEASUREMENT**

- A. No separate measurement will be made for providing water.

#### **4.02 PAYMENT**

- A. Water shall be incidental applicable service items. No separate payment shall be made.

#### **4.03**

**END OF SECTION**

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## **SECTION 01 52 13 - OFFICE SPACE FOR CONTRACTOR AND ENGINEER**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

A. The Contractor shall provide and pay for the Following:

1. Field Offices and Sheds:

a. Contractor's Facilities:

- 1) Provide a field office building and sheds adequate in size and accommodation for Contractor's offices, supply and storage.
- 2) Within the Contractor's facilities, provide enclosed space adequate for holding project meetings. Furnish with table, chairs, etc.

b. Engineer's Facilities:

- 1) Provide a field office building adequate in size and accommodation for the Engineer and staff.
- 2) Provide desks and chairs for the Engineer and staff.
- 3) Provide a printer capable of printing 11 x 17 papers.
- 4) Provide access to the internet.
- 5) Provide access to office supplies.

2. Heating and Air Conditioning:

- a. Provide and maintain heating and air conditioning as necessary for the proper execution of the operations needed on the job.

3. Sanitary Facilities:

- a. Provide temporary sanitary facilities in the quantity required for use by all personnel.
- b. The facility shall be maintained in a sanitary condition at all times.

**PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

**END OF SECTION**

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## **SECTION 01 52 19 - SANITARY FACILITIES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Contractor shall provide and maintain in a neat, sanitary condition such accommodations for the use of his employees and the Engineer's employees, as may be necessary to comply with the requirements of Federal, State and Local Boards of Health regulations, or of other authorities having jurisdiction.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 4 - MEASUREMENT AND PAYMENT**

#### **4.01 MEASUREMENT**

- A. No separate measurement will be made for sanitary facilities.

#### **4.02 PAYMENT**

- A. Sanitary facilities shall be incidental applicable service items. No separate payment shall be made.

#### **4.03**

**END OF SECTION**

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## **SECTION 01 55 13 - ACCESS ROADS AND CROSSINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Contractor shall ensure all roads, whether pavement or gravel, used during construction are maintained and left in pre-construction condition when project is complete. The contractor is responsible for all bonds required by local or state agencies to ensure public roads are maintained or repaired. Any temporary barricades or traffic control, if not included as a bid item, are the responsibility of the contractor and shall be incidental.
- B. Temporary Access Roads and Parking Areas: The location of access roads and parking areas which the Contractor needs to construct on the Railroad's Right-of-Way or property, which the Railroad has easement or interest in, shall be approved by the Engineer before such roads or parking areas are built. All access roads and parking areas constructed by the Contractor which the Engineer deems unsuitable for future Railroad use shall be removed upon completion of the Work and at the Contractor's expense, and shall be stabilized with gravel or put back to pre-existing conditions where required.
- C. Agreements: Any agreements made between the Contractor and private landowners shall be furnished to the Engineer.

#### **1.02 CONSTRUCTION TRAFFIC CONTROL**

- A. General:
  - 1. When work is being performed on or near a public or private roadway, the Contractor shall use temporary traffic control measures to warn and guide the traveling public. The temporary traffic control measures and devices shall be provided and placed in accordance with the Manual on Uniform Traffic Control Devices and the respective State, County or City traffic control requirements, whichever is more stringent.
  - 2. Traffic control devices, and installations shall be checked by the Contractor daily. Broken, damaged, or displaced devices shall be replaced immediately.
  - 3. The Contractor shall, at the preconstruction conference, provide the Engineer with the names and telephone numbers of personnel who will be available on a 24-hour-per-day, 7-days-per-week basis. These people shall be responsible for repair, correction, replacement, and maintenance of the traffic control devices. The Contractor shall also conspicuously post at the site a contact number for the Contractor's staff person responsible for maintaining traffic control measures and devices, and for public safety agencies.

4. It shall be the responsibility of the Contractor to furnish flagger(s) to direct traffic when construction activity occurs on or adjacent to a surface being used by the traveling public. The flagger(s) shall be properly attired with vest and head gear. They shall be provided properly installed advance warning signs, and they shall be otherwise equipped in accordance with the requirements of the plans and specifications. Flaggers shall position themselves appropriately and according to accepted flagging procedures.
5. All traffic control materials and devices shall meet the respective State Department of Transportation's Approved Products List.
6. Off-road travel by project-related vehicles and construction equipment will be prohibited outside of the UPRR Right-of-Way and dedicated roadways, unless prior written approval/permits from private or public property owners are obtained by the contractor.
7. The Contractor shall furnish and place lockable gates at all temporary access crossings. The gates must be locked when left unattended. The Contractor shall be responsible for the security of the gate at all times. A railroad approved flagger, provided by the Contractor, will be positioned at the temporary access crossing to flag construction vehicles and/or equipment across the track.
8. Contractor shall make every effort to minimize the environmental impacts caused by the hauling and spreading of construction materials along the right-of-way.

#### 1.03 PERMANENT TRAFFIC CONTROL

- A. Permanent traffic control measures and devices shall be provided and placed in accordance with the Plans, the Manual on Uniform Traffic Control Devices and the respective State, County or City traffic control requirements, whichever is more stringent.
- B. All traffic control materials and devices shall meet the respective State Department of Transportation's Approved Products List.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**



## **SECTION 01 55 16 - HAUL ROADS**

### **PART 1 - GENERAL**

#### **1.01 GENERAL**

##### **A. Construction of Roads and Parking Areas on Railroad Right of Way:**

1. The location of haul roads and parking areas which the Contractor needs to construct, on the Railroad's Right-of-Way or property, and which the Railroad has an easement or an interest in shall be approved by the Engineer before such roads or parking areas are built. All haul roads and parking areas constructed by the Contractor which the Engineer deems unsuitable for future Railroad use shall be removed upon completion of the Work, at the Contractor's expense, and shall be stabilized with gravel or put back to pre-existing conditions where required.

##### **B. Use of Railroad Roads - Existing and Protection:**

1. Heavy Equipment:
  - a. The Contractor shall not operate heavy equipment on paved roads located on the Railroad's property without the Engineer's prior approval.
2. Temporary Protection and Removal:
  - a. The Contractor, if he needs to have heavy equipment on the right of way, shall provide a temporary protective surface, approved by the Engineer, over such paved roads. Upon completion of the Work, the Contractor shall remove any such temporary protective surfacing from the Railroad's paved roads and property.
3. Flagmen:
  - a. When necessary for the Contractor's equipment to operate on or across roads, not railroad tracks or crossings, located on the Railroad's property, the Contractor shall furnish flagmen, lights and other necessary safeguards as directed by the Engineer or road authority to safely control the flow of traffic. The Contractor shall also provide flagmen to control and direct traffic where hauling equipment enters or crosses roads located on the Railroad's property. The Contractor shall conduct the Work in such a manner which will obstruct and inconvenience traffic as little as possible.

##### **C. Paved Roads:**

1. If the Contractor must cross any paved road, on Railroad property, with cleated or crawler type equipment, then the pavement shall be protected with a temporary surfacing approved by the Engineer.

D. Railroad Crossings:

1. Crossings:

- a. Except as authorized by the Engineer, the Contractor will not construct crossings over any track at any location. Where crossings are needed or desired, the Contractor shall make arrangements directly with the Engineer. If a crossing or crossings are required to complete the Work as set forth in the Request for Bids, the Proposal and Bid, the Specifications, the Drawings and the Agreement, such crossings may be constructed by the Railroad unless the Railroad specifically authorizes the Contractor to construct such crossings. If the Contractor must cross tracks with cleated or crawler type equipment, the track shall be protected with a temporary surfacing approved by the Engineer.

2. Flagging - Railroad Track:

- a. The Railroad will provide flagmen at crossings which have been established pursuant to the provisions of this Section. The Railroad will bear the cost of such flagmen, provided however, the Contractor shall bear the cost of flagmen required at crossings established for the Contractor's convenience. Crossings established for the Contractor's convenience, all temporary and/or construction crossings, will be the responsibility of the Contractor to provide flagmen. All other flagging charges not involving the safety of Railroad operations will be at the Contractor's expense.

3. Notification:

- a. The Contractor shall notify the Engineer at least seven (14) days in advance of the date the Contractor wishes to commence using a crossing to allow the Engineer time to provide the flagmen called for herein. The Contractor must also notify the Engineer at least seven (14) days in advance of the date the Contractor will cease using crossings.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**

## **SECTION 01 56 16 - DUST CONTROL**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This includes the limitation and control of dust and spillage of earth, dusty materials, boulders and mud during construction.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION**

#### **3.01**

- A. Spillage of earth, dusty materials, boulders and mud on roads located on or off the Railroad's property will not be permitted. If spillage cannot be prevented, the Contractor shall provide an hourly patrol, or more frequently if needed, to police and sweep such areas throughout the Work day, and at the conclusion of each work day, any paved roads which have been used by the Contractor shall be broom cleaned and left to the satisfaction of the Engineer. Any expense incurred in the use of Railroad access roads shall be borne by the Contractor.
- B. The Contractor shall provide dust control for construction equipment on and off project site. Twenty-four hour dust control may be required. Non-paved haul roads shall be periodically watered to keep dust down.

### **PART 4 - MEASUREMENT AND PAYMENT**

#### **4.01 MEASUREMENT**

- A. No separate measurement will be made for dust control.

#### **4.02 PAYMENT**

- A. Dust control shall be incidental applicable service items. No separate payment shall be made.

**END OF SECTION**

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## **SECTION 01 56 24 - FENCING AND BARRICADES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Contractor shall provide, erect and maintain adequate temporary fences and barricades to prevent damage and/or trespassing upon the Right-of Way, damage of adjoining property, and for reasons of safety.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 4 - MEASUREMENT AND PAYMENT**

#### **4.01 MEASUREMENT**

- A. No separate measurement will be made for fencing and barricades.

#### **4.02 PAYMENT**

- A. Fencing and barricades shall be incidental applicable service items. No separate payment shall be made.

**END OF SECTION**

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## **SECTION 01 60 00 - MATERIALS, PRODUCTS, AND EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.01 SPECIFIED MANUFACTURERS**

- A. Specified manufacturers are those named in the Contract Documents in conjunction with a specific material, piece of equipment, or product. The specified item establishes the minimum technical and physical requirements and quality standards.

#### **1.02 LISTED MANUFACTURERS**

- A. Manufacturers listed in the Specifications and/or Addenda prior to the bid opening are manufacturers capable of meeting the quality standards established.
- B. Acceptance of a manufacturer prior to the bid opening does not imply acceptance of a specific material, piece of equipment, or product.

#### **1.03 NON-LISTED MANUFACTURERS**

- A. Manufacturers not listed in the Specifications and/or Addenda prior to the bid opening may bid only material, equipment, or products by listing them on the bid form, as an “add to” or “deduct from” voluntary substitution for the specified item.
- B. Utilization of the “Voluntary Substitutions” paragraph by the successful Bidder does not imply acceptance of that substitution.

#### **1.04 NON-SPECIFIED MANUFACTURERS OF MATERIALS, EQUIPMENT OR PRODUCTS**

- A. At the bid opening, an item of material, equipment, or product may be used in lieu of an item which is specified provided that the following provisions are met:
  - 1. The item is manufactured by one of the manufacturers listed in the Specifications and/or Addenda. The item, if not listed in the Specifications and or Addenda, is listed on the Bid Form as a “Voluntary Substitution.”
  - 2. The material, equipment, or product meets or exceeds the minimum technical and physical requirements established by the specified item.
  - 3. The item is throughout the project so that all items of material, equipment, or product used in place of specified items are of the same manufacture and type.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

## **END OF SECTION**

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## **SECTION 01 61 02 - BASIC MECHANICAL REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.01 RELATED REQUIREMENTS (SECTIONS)**

- A. This section shall apply to all phases of the work specified, shown on the Drawings, and required to provide for the complete installation of the mechanical systems for this project.
- B. This Section applies to all items located within the mechanical and plumbing Specifications.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 04 – Operation and Maintenance Manuals

#### **1.03 REFERENCED STANDARDS**

- A. Applicable standards of the following organizations shall establish the quality of materials and equipment, the type and quality of workmanship, mode of operations, safety rules and, if so noted, performance certifications:
  - 1. Acoustical Society of America (ASA).
  - 2. Air Diffusion Council (ADC).
  - 3. Air Movement and Control Association (AMCA).
  - 4. American Gas Association (AGA).
  - 5. American National Standards Institute (ANSI).
  - 6. American Petroleum Institute (API)
  - 7. American Refrigeration Institute (ARI).
  - 8. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE).
  - 9. American Society of Mechanical Engineers (ASME).
  - 10. American Society of Safety Engineers.
  - 11. American Society of Testing and Materials (ASTM).
  - 12. American Waterworks Association (AWWA).
  - 13. American Welding Society (AWS).
  - 14. Associated Air Balance Council (AABC).
  - 15. Canadian Standards Association (CSA).
  - 16. Cast Iron Soil Pipe Institute (CISPI).
  - 17. Federal Specifications (FS).
  - 18. Hydronics Institute (HYDI).
  - 19. Institute of Boiler and Radiator Manufacturers (I-B-R).

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20. International Association of Plumbing and Mechanical Officials (IAPMO).
21. Military Specifications (MIL SPEC).
22. National Electrical Manufacturers Association (NEMA).
23. National Environmental Balancing Bureau (NEBB).
24. National Fire Protection Association (NFPA).
25. National Sanitation Foundation (NSF).
26. Occupational Safety and Health Act (OSHA).
27. Plastic Pipe Institute (PPI).
28. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).
29. Underwriters Laboratories Inc. (UL).

#### 1.04 QUALITY ASSURANCE

- A. Unless specifically named in the Specifications, a manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past 5 years.
- B. Unless otherwise noted or required by the Authority Having Jurisdiction, the latest published edition of applicable codes and regulations shall be followed:
  1. National Electrical Code (NEC).
  2. Uniform Mechanical Code (UMC).
  3. Uniform Plumbing Code (UPC).
  4. International Building Code (IBC).
  5. International Fire Code (IFC).
  6. National Fire Protection Association (NFPA).
  7. Local amendments to above established codes.
  8. UPRR Fuel Standards, as applicable.

#### 1.05 WARRANTY

- A. Provide one-year warranty, unless otherwise noted, to the Owner for all fixtures, equipment, materials, and workmanship.
- B. The warranty period for all mechanical, plumbing, and temperature control work in these Specifications shall commence on the date of final acceptance, unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system or separate piece of equipment or component is placed in operation and accepted in writing by the Owner.
- C. Warranty requirements shall extend to correction, without cost to the Owner, of all Work found to be defective or nonconforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from defects or nonconformance with contract documents.

- D. Mechanical, plumbing, and temperature contractor shall provide manufacturer recommended maintenance at recommended intervals for all equipment during the one-year warranty period.

#### 1.06 CONTRACT DOCUMENTS

- A. All work shall be executed in accord with the requirements of national, state, and local codes, regulations, and standards and regulations shall be done as shown or specified.
- B. Work required by the Contract Documents, which exceed the minimum requirements of the governing codes, standards, and regulations, shall be done as shown or specified.
- C. Include payments for fees, permits, inspections, and licensing required for the Mechanical Work under this division.

#### 1.07 DRAWING AND MEASUREMENTS

- A. Drawing Use:
  - 1. Mechanical Drawings shall be diagrammatic and indicate the general arrangement of systems and equipment, except when specifically dimensioned or detailed. Plumbing and piping and ductwork plans shall show size, capacity, approximate location, direction, and the general relationship of one work phase to another.
  - 2. As the mechanical drawings are of small scale, it is not possible to show all the necessary offsets, fittings and accessories. Examine the General Contractor, Mechanical, and Electrical Drawings and Specifications. The Contractor shall obtain exact locations, measurements and levels at the site, and arrange all systems accordingly, furnishing such fittings, offsets, and accessories as may be required at no additional expense to the Owner.
- B. Drawing Measurement:
  - 1. Drawings shall not be scaled for roughing-in measurements nor used as shop drawings.
  - 2. For exact locations of building elements, refer to the dimensioned Architectural and Structural Drawings. Other Drawings are diagrammatic or schematic.
  - 3. Field measurements shall take precedence over dimensioned Drawings.

#### 1.08 RECORD DRAWINGS

- A. Keep a complete set of Mechanical Drawings in the jobsite office for showing actual installation of mechanical systems and equipment.
- B. This set of Drawings shall be used for no other purpose.
- C. Where any material, equipment, or systems components are installed differently from that shown, indicate such differences clearly and neatly.
- D. Upon project completion, submit the record set of Drawings, As-Built, to the Owner in MicroStation format in same version issued.

#### 1.09 FIELD VERIFICATION

- A. The Contractor shall examine the premise and all conditions thereon and/or therein. He shall compare these conditions with all Drawings and Specifications. He shall ascertain and check all conditions that may affect his work. The Contractor's Bid shall take into consideration all such conditions as may affect the work under this Contract. No allowance shall be made in his behalf for an extra expense incurred as a result of his failure to verify reasonably ascertainable field information.

#### 1.10 COORDINATION WITH OTHER TRADES

- A. The Contractor shall coordinate all details of the equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. The Contractor shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.
- B. Refer to other Drawings and parts of this Specification that cover the work of other trades carried on in conjunction with the Mechanical Work such that all work can proceed without interference resulting from lack of coordination.
- C. Properly size and locate inserts for hangers, chases, sleeves, equipment bases, and accesses including future items as indicated by the Drawings. Whenever applicable, provide accurate wiring diagrams to the Electrical Contractor for equipment furnished by the Mechanical Contractor.
- D. Ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of the conflict, the installation of mechanical equipment and piping shall conform to the following priority lists:
  - 1. Plumbing, Waste and Soil Lines or other lines requiring a definite slope.
  - 2. Refrigerant piping.
  - 3. Supply, Return and Exhaust Ductwork.
  - 4. Water and Natural Gas Piping.
  - 5. Control Conduit and Wiring.

#### 1.11 SUBMITTALS

- A. Submit as specified in Division 01, Section 01 33 00.
- B. Shop Drawings, Product Data and Samples:
  - 1. Submit shop drawings, product data, and samples for materials, products, equipment, and systems noted in each Section of the Specifications.
  - 2. Submittals shall clearly indicate the proposed item, its quality, capacities, characteristics, and details. Items shall be identified with the same "MARK" as used in the Contract Documents.
- C. Reports, Equipment, Startup and Commissioning plans, Warranties and Certificates:
  - 1. Submit reports, equipment startup, warranties, and certificates as noted in each Section of the Specifications.

2. Where equipment startup is specified, provide a factory authorized and trained representative to supervise installation, startup and/or proper operation of equipment. Submit start-up report to the Owner certifying that equipment is installed properly and test at operating conditions as indicated in the Contract Documents.

D. Operation and Maintenance Manuals:

1. Submit operation and maintenance manuals for major pieces of mechanical equipment and mechanical systems in accordance with Section 01 33 04.

1.12 LUBRICATION

- A. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during equipment startup or shutdown and shall not waste lubricants.
- B. Lubricants of the types recommended by the equipment manufacturer shall be provided in sufficient quantities to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by the Owner. Unless otherwise specified or permitted, the use of synthetic lubricants will not be acceptable.
- C. Lubrication systems shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

1.13 OWNER TRAINING

- A. The Contractor shall prepare a detailed, written training agenda and submit it to the Engineer a minimum of four weeks prior to the formal training for approval. The written agenda shall include specific training points within the items described above. For example: How to adjust setpoints, troubleshooting, proper start-up, proper shutdown, seasonal changes, draining, venting, changing filters, changing belts, etc. Failure to provide and follow an approved training agenda may result in additional training required at the expense of the Contractor.
- B. Provide qualified, factory-trained manufacturers' representatives to give detailed instructions to the Owner's personnel in the operation and maintenance for each piece of equipment. All such training shall be done at the jobsite.
- C. Contractor shall maintain a detailed log of training activities and who was trained under each training session.
- D. Contractor shall make a DVD video recording of instructions to the Owner while explaining the system so additional personnel may view the instructions at a later date. The video recording shall be the property of the Owner.

- E. Instructions for different items of equipment, that are parts of a complete system, shall be given in an integrated, progressive manner. Instructors for each piece of component equipment in a system shall be available until instructions for all items included in a system are complete.
- F. Instruction period shall be at times scheduled by the Owner's Representative, and shall be considered concluded only when the Owner's Representative is satisfied in regard to complete and thorough coverage. These services shall be available for a period of not less than forty (40) hours.
- G. Refer to individual specification sections for additional Owner training requirements.
- H. Instruction shall include at a minimum the following:
  - 1. Explanation of all systems.
  - 2. Temperature control system operation including calibration, adjustment and proper operating conditions of all sensors.
  - 3. Maintenance of all equipment.
  - 4. Start-up procedures for all equipment.
  - 5. Explanation of seasonal system changes for all systems.
  - 6. Description of emergency system operation for all systems.

#### 1.14 SYSTEM COMMISSIONING

- A. The mechanical, fueling and plumbing systems shall be complete and operating. System start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This includes calibration and adjustments of all controls, noise level adjustments and final comfort adjustments as required.
- B. Operate all HVAC systems continuously for at least one week prior to occupancy to bring construction materials to suitable moisture levels. Areas with mechanical cooling shall be maintained below 60 percent RH.
- C. Contractor shall adjust the mechanical/plumbing systems and controls at season changes during the one year warranty period, as required, to provide satisfactory operation and to prove performance of all systems in all seasons.
- D. All operating conditions and control sequences shall be tested during the start-up period. Test all interlocks, safety shutdowns, controls, and alarms.
- E. The Contractor, subcontractors, and equipment suppliers shall have skilled technicians to ensure that all systems perform properly. If the Architect/Engineer is requested to visit the job site for trouble shooting, assisting in start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period, through no fault of the design; the Contractor shall reimburse the Owner on a time and materials basis for services rendered at the Architect/Engineer's standard hourly rates in effect when the services are requested. The Contractor shall pay the Owner for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**

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## **SECTION 01 61 03 - EQUIPMENT BASIC REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Requirements of this Section apply to all equipment provided on the Project even if not specifically referenced in individual “Equipment” articles of those Specifications.
- B. Related Sections include but are not limited to:
  - 1. UPRR Contract Section.
  - 2. Division 1 - UPRR General Conditions.
  - 3. Section 03 09 00 - Concrete Work.
  - 4. Section 05 12 00 - Structural Steel.
  - 5. Section 07 92 00 - Joint Sealants.
  - 6. Section 09 90 00 - Painting and Protective Coatings.
  - 7. Section 10 14 00 – Identifying Devices
  - 8. Section 33 05 26 – Mechanical Identification

#### **1.02 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Bearing Manufacturers Association (ABMA).
  - 2. American Gear Manufacturers Association (AGMA).
  - 3. ASTM International (ASTM):
    - a. F593 – Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
  - 4. Institute for Electrical and Electronic Engineers (IEEE).
  - 5. National Electrical Manufacturers Association (NEMA):
    - a. 250 – Enclosures for Electrical Equipment (1000 Volts Maximum).
    - b. ICS 6 – Industrial Controls and Systems Enclosures.
    - c. MG 1 – Motors and Generators.
  - 6. National Fire Protection Association (NFPA):
    - a. 70 – National Electrical Code (NEC).
  - 7. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA):
    - a. 29 CFR 1910 – OSHA Safety and Health Standards for General Industry (referred to herein as OSHA Standards).
  - 8. Building Code:

- a. International Building Code (Latest Edition).
- B. Miscellaneous:
  - 1. A single manufacturer of a “product” is to be selected and utilized uniformly throughout the Project even though:
    - a. More than one manufacturer is listed for a given “product” in the Specifications.
    - b. No manufacturer is listed.
  - 2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls and system components shall FULLY comply with specific NEC requirements related to area classification and to NEMA 250 and NEMA ICS-6 designations shown on Electrical Power Drawings and defined in Section 26 05 00.

### 1.03 DEFINITIONS

- A. Product: Manufactured materials and equipment.
- B. Major Equipment Supports – Supports for Equipment:
  - 1. Located on or suspended from elevated slabs with supported equipment weighing two-thousand pounds (2000 LBS) or greater or;
  - 2. Located on or suspended from roofs with supported equipment weighing five hundred pounds (500 LBS) or greater, or;
  - 3. Located on slab-on-grade or earth with supported equipment weighing five-thousand pounds (5000 LBS) or more.
- C. Equipment: One or more assemblies capable of performing a complete function. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic, or hydraulic connection. Not limited to items listed under “Equipment” article within the Specifications.
- D. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project Site.
  - 1. Installer and Applicator are synonymous.

### 1.04 SUBMITTALS

- A. Shop Drawings:
  - 1. General for all equipment:
    - a. See Section 01 33 00 and 01 33 23.
    - b. Acknowledgement that products submitted comply with the requirements of the standards referenced.
    - c. Manufacturer’s delivery, storage, handling, and installation instructions.
    - d. Equipment identification utilizing numbering system and name utilized in the Drawings.
    - e. 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.
- f. Equipment area classification rating.
- g. Shipping and operating weight.
- h. Equipment physical characteristics:
  - 1) Dimensions (both horizontal and vertical).
  - 2) Materials of construction and construction details.
- i. Equipment factory primer and paint data.
- j. Manufacturer's recommended spare parts list.
- k. Equipment lining and coatings.
- l. Equipment utility requirements include air, natural gas, electricity, and water.
- m. Ladders and platforms provided with equipment:
  - 1) Certification that all components comply fully with OSHA requirements.
  - 2) Full details of construction/fabrication.
  - 3) Scaled plan and sections showing relationship to equipment.
2. Mechanical and process equipment:
  - a. Operating characteristics:
    - 1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
    - 2) Brake horsepower requirements.
    - 3) Copies of equipment data plates.
  - b. Piping and duct connection size, type and location.
  - c. Equipment bearing life certification.
  - d. Equipment foundation data:
    - 1) Equipment center of gravity.
    - 2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.
3. Electrical and control equipment:
  - a. Electric motor information:
    - 1) Documentation that motors provided are manufacturer's energy efficient type and not standard efficiency motors.
    - 2) When efficiency motors are submitted, provide documentation why energy efficient motors are not available.

- 3) Nameplate data as required by the NEC.
  - a) Manufacturer's name.
  - b) Rated Voltage.
  - c) Full load current.
  - d) Rated frequency.
  - e) Number of Phases.
  - f) Rated full load speed.
  - g) Insulation system class and rated ambient temperature or rated temperature rise.
  - h) Time Rating: 5,10, 30 or 60 minutes or continuous.
  - i) Rated horsepower (HP).
  - j) Code letter or locked rotor circuit.
  - k) NEMA design letter.
  - l) Marked "Thermally Protected" where applicable.
- 4) Motor service factor.
- 5) Motor enclosure type.
- 6) NEMA frame size.
- 7) NEMA design code.
- 8) Insulation type and temperature rise.
- 9) Motor locked rotor current.
- 10) Current efficiency and power factor at one half (1/2) three quarters (3/4) and full load.
- b. Control Panels:
  - 1) Panel Construction.
  - 2) Point-to-point ladder diagrams.
  - 3) Scaled panel face and subpanel layout.
  - 4) Technical product data or panel components.
  - 5) Panel and subpanel dimensions and weights.
  - 6) Panel access openings.
  - 7) Nameplate test.
  - 8) Panel anchorage.
- c. Systems Schematics and Data:
  - 1) Provide system schematics where required in system specifications.
    - a) Acknowledge all system components being supplied as part of the system.

- b) Utilize equipment, instrument and valving tag numbers defined in the contract documents for all components.
- c) Provide technical data for each system component showing compliance with the Contract Document requirements.
- d) For piping components, identify all utility connections, vents and drains which will be included as part of the system.

B. Operation and Maintenance Manuals:

- 1. See Section 01 33 04.

C. Miscellaneous Submittals:

- 1. Sample form letter for equipment field certification.
- 2. Certification that equipment has been installed properly, has been initially started up, has been calibrated and /or adjusted as required, and is ready for operation.
- 3. Certification for major equipment supports that equipment foundation design loads shown on the Drawings or specified have been compared to actual loads exhibited by equipment provided for this Project and that said design loadings are equal to or greater than the loads produced by the equipment provided.
- 4. Field noise testing reports if such testing is specified in narrow scope sections.
- 5. Field vibration testing reports if vibration testing is specified in narrow scope sections.
- 6. Notification, at least one (1) week in advance, that motor testing will be conducted at the factory.
- 7. Certification from equipment manufacturer that all manufacturer-supplied control panels that interface in any way with other controls or panels have been submitted to and coordinated with the suppliers/installer of those interfacing systems.
- 8. Motor test reports.
- 9. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-made modifications.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 1. Motors:
  - a. Siemens.
  - b. Westinghouse.
  - c. General Electric.
  - d. U.S. Motors.

- e. Reliance Electric.
- f. Baldor.
- 2. Mechanical Variable Speed Drives:
  - a. U.S. Motors (VariDrive).
  - b. Reeves.
- B. Submit requests for substitution in accordance with Specification Section 01 33 00.

## 2.02 MANUFACTURED UNITS

### A. Electrical Motors:

1. Provide motors designed and applied in compliance with NEMA, IEEE and the NEC for specific duty imposed by driven equipment and location.
2. Where used in conjunction with adjustable speed AC or DC drives, provide motors that are fully compatible with the speed controllers.
3. Design for frequent starting duty equivalent to duty service required by driven equipment.
4. Design for full voltage starting.
5. Design bearing life based upon actual operating load conditions imposed by driven equipment.
6. Size for altitude of project.
7. Furnish with stainless steel nameplates which include all data required by Article 430 of the National Electrical Code.
8. 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.
9. Electric Motors less than one third horsepower (1/3 HP):
  - a. Single phase, sixty Hertz (60Hz), designed for the supply voltage shown on the Drawings.
  - b. Totally enclosed non-ventilated (TENV) or totally enclosed fan-cooled (TEFC).
  - c. Permanently lubricated sealed bearings conforming to ABMA standards.
  - d. Built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element with stainless steel enclosure.
10. Electric motors 1/3 to 1 HP:
  - a. Single or three phase, sixty Hertz (60Hz), designed for supply voltage shown on the Drawings.
  - b. Totally enclosed non-ventilated (TENV) or totally enclosed fan cooled (TEFC).

- c. Permanently lubricated sealed bearings conforming to ABMA standards. For single phase motors, provide built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element.
- 11. Electric motors 1 1/2 to 10HP:
  - a. Three phase, 60 Hz, designed for the supply voltage shown on the Drawings.
  - b. Totally enclosed fan cooled (TEFC).
  - c. Permanently lubricated sealed bearings conforming to ABMA standards.
  - d. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
- 12. Electric motors greater than 10HP:
  - a. Three phase, 60 Hz, designed for the supply voltage on the Drawings.
  - b. Totally enclosed fan cooled (TEFC).
  - c. Oil or grease lubricated anti-friction bearings conforming to ABMA standards. Design bearing life for 90 percent survival rating at 50,000 HRS of operation for motors up to and including 100 HP. For motors greater than 100 HP, design bearing life for 90 percent survival rating at 100,000 HRS of operation.
  - d. For vertical motors provide 15-year, average-life thrust bearings conforming to ABMA standards.
- B. Submersible Motors: Refer to individual narrow scope specifications for submersible motor requirements.
- C. V-Belt Drive:
  - 1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
  - 2. Provide V-belts with a service factor of at least 1.6 at maximum speed.
  - 3. Provide staticproof belts.
- D. Mechanical Variable Speed Drives:
  - 1. Oil-lubricated shaft-mounted reduction gear drive capable of 300 percent shock load and providing a 1.5 service in accordance with AGMA.
  - 2. Assure infinite speed adjustment over a 4:1 range.
  - 3. Secure drive to equipment base.
  - 4. Flexible coupling between drive shaft and equipment shaft.

## 2.03 COMPONENTS

- A. Gear Drives and Drive Components:
  - 1. Size drive equipment capable of supporting full load including losses in speed reducers and power transmission.
  - 2. Provide nominal input horsepower rating of each gear or speed reducer at least equal to nameplate horsepower of drive motor.

3. Design drive units for 24 HR continuous service, constructed so oil leakage around shafts is precluded.
4. Utilize gears, gear lubrication systems, gear drives, speed reducers, speed increasers and flexible coupling meeting applicable standards of American Gear Manufacturers Association.
5. Gear Reducers:
  - a. Provide gear reducer totally enclosed and oil lubricated.
  - b. Utilize anti-friction bearings throughout.
  - c. Provide worm gear reducers having a service factor of at least 1:20.
  - d. Furnish other helical, spiral bevel, and combination bevel-helical gear reducers with a service factor of at least 1:50.

## 2.04 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-flattening type 16 GA galvanized steel with nominal 1/2 IN 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.
  - 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. Anchorage:

1. Cast-in-place anchorage:
  - a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
  - b. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
  - c. Provide two nuts for each bolt.
2. Drilled Anchorage:
  - a. Epoxy grout per Section 03 09 00.
  - b. Threaded rods same as cast-in-place.



C. 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.

D. Gauges:

1. Provide gauges in accordance with Section 23 09 00.
2. Provide at the following locations:
  - a. Inlet and outlet of all reciprocating, centrifugal, and positive displacement mechanical and process equipment.
  - b. At locations identified on Drawings.
3. Utilize tapping sleeves for mounting per Section 40 05 07.

E. Lifting Eye Bolts or Lugs:

1. Provide on all equipment 50 LBS or greater.
2. Provide on other equipment or products as specified in the narrow specifications.

2.05 FABRICATION

- A. Design, fabricate and assemble equipment in accordance with modern engineering and shop practices.
- B. Manufacture individual parts to standard sizes and gauges 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. 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. Provide connection for 3/4 IN PVC tubing.
- G. Machine the mounting feet of rotating equipment.
- H. Fabricate equipment which will be subject to a corrosive environment in such a way as to avoid back to back placement of surfaces that cannot be properly prepared and painted. When such back to back fabrication cannot be avoided, provide continuous welds to seal such surfaces from contact with a corrosive environment. Where continuous welds are not practical, after painting, seal the back to back surfaces from the environment in accordance with Section 07 92 00.

## 2.06 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 90 00 or receive field painting.

### B. Field paint other equipment in accordance with Section 09 90 00.

## 2.07 SOURCE QUALITY CONTROL

### A. Motor Tests:

1. Test motors in accordance with NEMA and IEEE standards.
2. Provide routine test for all motors.
3. The Engineer reserves the right to select and have tested, either routine or complete, any motor included in the project.
  - a. The Contractor shall pay all costs, including shipping and handling, for all motors tests.
  - b. If two consecutive motors of the same manufacturer fail testing, the Engineer has the right to reject all motors from that manufacturer.

## 2.08 SEISMIC DESIGN

- ### A. Equipment (400 LBS or greater) and its anchorage to be designed to resist the total design seismic forces prescribed in the most current relevant Code in the jurisdiction in which the project is to be constructed.

## PART 3 - EXECUTION

## 3.01 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 seal water, provide 3/4 IN PVC or clear plastic tubing from equipment base to nearest floor or equipment drain. Route clear of major traffic areas and as approved by the Engineer.
- ### D. DO NOT construct foundations until major equipment supports are approved.
- ### E. Extend all non-accessible grease fittings using stainless steel tubing to a location which allow easy access of fittings.
- ### F. Construct subbases, either concrete, steel or cast iron, level in both directions. Particular care shall be taken at hold-down bolt locations so these areas are flat and level.
- ### G. Machine Base:
1. Mount machine bases of rotating equipment on subbases in a manner that they are level in both directions according to machined surfaces on base. Use machinist level for this procedure.

2. Level machine bases on subbases and align couplings between driver and driven unit using steel blocks and shims.
  - a. Size blocks and shims to provide solid support at each anchor bolt location. Area size of blocks and shims shall be approximately 1-1/2 times area support surface at each anchor bolts point.
  - b. Provide blocks and shims at each anchor bolt. Blocks and shims that are square shape with “U” cut out to allow blocks and shims to be centered on anchors bolts.
  - c. After all leveling and alignment has been completed and before grouting, tighten anchor bolts to proper torque value.
  - d. Do not use nuts below the machine base in anchor bolts for base leveling.

#### H. Couplings:

1. Align in the annular and parallel positions.
  - a. For equipment rotating at 1,200 RPM or less, align both annular and parallel within 0.001 IN tolerance for couplings 4 IN in size or smaller. Couplings larger than 4 IN in size: Increase tolerance 0.0005 IN per inch of coupling diameter, i.e., allow 6 IN coupling, 0.002 IN tolerance, and allow a 10 IN 0.004 IN tolerance.
  - b. For equipment rotating at speed greater than 1,200 RPM allow both annular and parallel positions within a tolerance rate of 0.00025 IN per inch of 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 run out before attempting to trim or align units.

#### I. Grouting:

1. After the machine base has been shimmed, leveled, couplings aligned, and anchor bolts tightened to correct torque value, a dam or formwork shall be placed around the base to contain grouting. Extend the dam or formwork at least 1/2 IN above the top of the leveling shims and blocks.
2. Saturate the top of the roughened concrete subbase with water before grouting. Add grout until entire space under the machine base is filled to the top of the base underside. 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. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout. When the grout has fully hardened (after a minimum of seven (7) days) tighten all anchor bolts and recheck driver-driven unit for proper alignment.

### 3.02 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. In each case, representative(s) shall be present during placement and startup of equipment and as often as necessary to resolve any operational issues that 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 and anchor bolts.
  - 4. Has been operated under full load conditions and that it operated satisfactorily. Secure and deliver a field report to the Engineer immediately prior to leaving the jobsite.
- C. No separate payment shall be made for installation checks. All or any time expended during the installation check does not qualify as O&M training or instruction time when specified.

### 3.03 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS

- A. Identify equipment and install hazard warnings signs in accordance with Sections 10 14 00 and 33 05 26.

### 3.04 FIELD PAINTING AND PROTECTIVE COATINGS

- A. For required field painting and protective coatings, comply with Section 09 90 00.

### 3.05 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. Wrapping thickness shall be 150 percent of the conductor insulation thickness.
- E. Connections to carry full ampacity of conductors without temperature rise.
- F. Terminate spare conductors with electrical tape.

### 3.06 FIELD QUALITY CONTROL

- A. Furnish equipment manufacturer services as specified in the individual equipment specifications.
- B. Inspect wire and connections for physical damage and proper connection.
- C. Bump motor to check for correct rotation.
  - 1. Ensure motor to check for correct rotation.

2. Check prior to connection to driven equipment, before coupling are bolted or belts installed.
- D. Subbase that supports the equipment base and that is made in the form of a cast iron or steel structure that has supporting beams, legs and cross member that are cast welded or bolted, shall be tested for a natural frequency of vibration after equipment is mounted. Keep the ratio of the natural frequency of the structure to the frequency of the disturbing force out of the range from 0.5 to 1.5.

### 3.07 DEMONSTRATION

- A. Demonstrate equipment in accordance with UPRR requirements.

**END OF SECTION**

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## **SECTION 01 61 04 - ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Basic requirements for electrical components which are an integral part of packaged mechanical equipment. These components include, but are not limited to factory installed motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Drawings and General Provisions of Contract, including Special Conditions, apply to the work of this section.

#### **1.03 REFERENCED STANDARDS**

- A. Electrical components and material shall be UL labeled.
- B. NEMA Standards MG-1: Motors and Generators.
- C. NEMA Standard ICS 2: Industrial Control Devices, Controllers, and Assemblies.
- D. NEMA Standard 250: Enclosures for Electrical Equipment.
- E. NEMA Standard KS 1: Enclosed Switches.
- F. Comply with National Electrical Code (NFPA 70).

### **PART 2 - PRODUCTS**

#### **2.01 MOTORS**

- A. The following are basic requirements for simple or common motors.
  1. Motor Sizes: Motors shall be large enough so that the driven load will not require the motor to operate in the service factor range.
  2. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
  3. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.

#### **2.02 STARTERS, ELECTRICAL DEVICES, AND WIRING**

##### **A. Motor Starter Characteristics:**

1. Enclosures: NEMA 1, general purpose enclosures with padlock ears.
2. Manual switches shall have pilot lights.

3. Overload protection: Melting alloy type thermal overload relays

2.03 MAGNETIC STARTERS

- A. Maintained contact push buttons and pilot lights, properly arranged for single speed operation as indicated.
- B. Trip-free thermal overload relays, each phase.
- C. Interlocks and similar devices as required.
- D. Built-in 120 volts control circuit transformer, fused from line size, where service exceeds 240 volts.
- E. Externally operated manual reset.
- F. Under-Voltage release or protection.

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**



## **SECTION 01 65 50 - DELIVERY, STORAGE AND HANDLING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This Section includes minimum requirements for the delivery, storage and handling of materials and equipment required to complete the Work.

#### **1.02 RESPONSIBILITY FOR MATERIALS AND EQUIPMENT**

- A. Items Furnished by Owner: Contractor's responsibility for materials and equipment furnished by Owner shall begin at the point of delivery to the contractor or job site.
- B. Delivery:
  - 1. All materials and equipment furnished by Owner will be delivered to the job site. Such items will be available to Contractor, as required to maintain contractor's construction schedule.
  - 2. Contractor shall be responsible for inspection, verification of quantities, unloading and proper storage.
  - 3. All materials and equipment furnished by Owner which disappear or are damaged after their acceptance by Contractor shall be replaced by and at the expense of Contractor. Replacements shall conform to the original procurement specifications.
- C. Delivery and Handling of Items Furnished by Owner:
  - 1. Equipment and materials furnished by Owner for installation by Contractor will be delivered f.o.b. cars or trucks to the Union Pacific Railroad Company, at or near the job site. Contractor shall be responsible for all unloading, reloading, transporting to the site, storage if necessary, rehandling, and installation.
  - 2. All items shall be unloaded promptly after arrival. All charges for demurrage due to negligence or delay by Contractor shall be paid by Contractor. Equipment and materials shall be handled by methods which will prevent damage.
  - 3. Equipment and materials shall be protected from exposure to the elements.
  - 4. Contractor shall accept the risk of any delay in delivery of equipment or materials furnished by Owner, and if the Work is delayed, Contractor shall have no claim for damages or contract adjustment other than an extension of time occasioned by the delay.
  - 5. All equipment shall be arranged and installed as indicated on the Drawings, and in conformity with installation drawings and instructions furnished to Owner by the manufacturer of the equipment.

6. Before being placed in operation, all equipment furnished by Owner and installed by Contractor will be inspected, checked and adjusted by an experienced and competent technical representative of the equipment manufacturer. The technical representative will also place the equipment in initial operation under both trial and full load conditions and determine whether its operation is satisfactory and proper. This service is included as part of the equipment procurement contract and will be provided by Owner at no cost to Contractor, as set forth in the quality control section.

D. Items Furnished by Contractor: Contractor shall be fully responsible for all materials and equipment which it has furnished.

#### 1.03 DEFECTIVE MATERIALS

A. Defective materials and equipment discovered after installation and prior to final acceptance of the Work, where the defect is of a nature not detectable by visual examinations and other appropriate field inspection methods, shall be replaced by Owner, together with such additional materials and supplies as may be necessary for their replacement. Contractor shall furnish all necessary tools, equipment, and appliances, and perform all necessary labor, for the removal and replacement of such defective items in a manner acceptable to Owner; adjustment to the Contract Price for the costs of the removal and replacement shall be made in accordance with the General Conditions.

#### 1.04 OFFSITE STORAGE

A. Offsite storage arrangements shall be approved by Owner for all materials and equipment not incorporated into the Work. Such offsite storage arrangements shall be presented in writing and shall afford adequate and satisfactory security and protection. Offsite storage facilities shall be accessible to Owner and Engineer. The Contractor will be responsible for all items held in the offsite storage.

#### 1.05 PREPARATION FOR SHIPMENT

A. All materials provided by the Contractor shall be suitably packaged to facilitate handling and protect against damage during transit and storage. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. All painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Owner.

B. Each item, package, or bundle of material shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of materials shall be included with each shipment.

#### 1.06 SALVAGE OF MATERIALS AND EQUIPMENT

A. Existing materials and equipment removed, and not reused as a part of the Work or indicated as salvage items, shall become Contractor's property upon approval by the railroad.

B. Contractor shall carefully remove, in a manner to prevent damage, all materials and equipment specified or indicated to be salvaged and reused or to remain the property of Railroad. Contractor shall store and protect salvaged items specified.

- C. Salvaged items not to be reused in the Work, but to remain Railroad's property, shall be delivered by Contractor in good condition to Railroad at the site.
- D. Any salvage items damaged in removal, storage, or handling through carelessness or improper procedures shall be replaced by Contractor in kind or with new items.
- E. Contractor may furnish and install new items instead of those specified or indicated to be salvaged and reused, in which case such removed items will become Contractor's property.
- F. Existing materials and equipment removed by contractor shall not be reused in the Work except where so specified or indicated.

1.07 PROTECTION

- A. Protect finished surfaces, including jambs and soffits of openings used as passageways, through which equipment and materials are handled.
- B. Provide protection for finished floor surfaces in traffic areas prior to allowing equipment or materials to be moved over such surfaces.
- C. Maintain finished surfaces clean, unmarred, and suitably protected until accepted by the Railroad.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**

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## **SECTION 01 71 13 - MOBILIZATION AND EQUIPMENT RENTAL**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Mobilization Description:**

1. This work consists of preparatory work and operations, including those necessary for movement of personnel, equipment, supplies and incidentals to the project site; the establishment of offices, buildings and other facilities necessary for work on the project; the cost of bonds and any required insurance; the cost for as-built production and other preconstruction expenses necessary for start of the Work, excluding the cost of construction materials.

##### **B. Equipment Rental Description:**

1. This work consists of providing equipment for rent to the Railroad during the project as requested by Railroad Engineer.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Section 01 78 39 – Project Record Documents**

### **PART 2 - PRODUCTS**

#### **2.01 EQUIPMENT RENTAL**

- ##### **A.**
- All equipment expected to be used on the project should be listed on the “Statement of Equipment”. These hourly rates will be used for any extra equipment rental that might occur during the project. Mobilization and demobilization costs shall be included in the hourly rate for any equipment not already on the job site. Daily work tickets must be filled out for all equipment rental. Contractor shall ensure that these tickets are accurately maintained on a daily basis. Hours of equipment rental use will not be continuous. Individual pieces of equipment will be used sporadically throughout the project. Equipment Rental on equipment that is not on site shall be used for a 4 HR minimum. All equipment shall be in good condition and include both operator and fuel.

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 4 - MEASUREMENT AND PAYMENT**

#### **4.01 PAYMENT**

- ##### **A.**
- Mobilization payment will be made at the contract lump sum price subject to the following provisions:

1. Payment for mobilization shall be made at a rate of 70 percent when Work is commenced and 30 percent upon demobilization. Request for retention invoice shall include all lien releases, the delivery of project record documents, the amount of retention withheld for every payment is outlined in the contract.
- B. Equipment Rental payment shall be based on the unit prices provided in project bid items.

**END OF SECTION**

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## **SECTION 01 71 23 - FIELD ENGINEERING**

### **PART 1 - GENERAL**

#### **1.01 GENERAL**

- A. Provide such field engineering services as are required for proper completion of the Work including, but not necessarily limited to:
  - 1. All construction surveying and staking, including, but not limited to, establishing and maintaining lines and levels, slope stakes and grade stakes, any intermediate stakes, right-of-way fence and final blue tops (finished grade stakes) for the grading, bedding for culverts, rip rap, bridge construction, and track construction, including work to be performed by the Railroad, will be the responsibility of the Contractor.
  - 2. Structural design of shoring, forms and similar items provided by the Contractor as part of his means and methods of construction.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- 1. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions and Special Conditions.
- 2. Additional requirements for field engineering also may be described in other Sections of these Specifications.
- 3. As described in the General Conditions, and if available, the Railroad will furnish survey describing the physical characteristics, legal limitations, utility locations, and legal description of the site.

#### **1.03 REFERENCED STANDARDS**

- A. UPRR/BNSF Guidelines for Temporary Shoring

#### **1.04 SUBMITTALS**

- A. Upon request of the Engineer, submit:
  - 1. Data demonstrating qualifications of persons proposed to be engaged for field engineering services.
    - a. Documentation verifying accuracy of field engineering work.
    - b. Certification, signed by the Contractor's retained field engineer, certifying that elevations and locations of improvements are in conformance with requirements of the Contract Documents.
  - 2. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

## PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Horizontal and vertical control will be furnished by the Railroad.
- B. The Contractor shall re-establish the project engineering stationing and remark missing or obscured stationing with a paint stick on the field side of the rail.

### 3.02 INSTALLATION

#### A. Grading

- 1. Right of way fence – Set lath with flag on right of way line at 100' intervals and at all intermediate break points. Lath shall be marked with station and offset.
- 2. Subgrade - Set slope stakes and grade stakes, any intermediate stakes, and final blue tops (finished grade stakes) for the grading, at the vertical cut next to existing track, track centerline, shoulder(s) and other break points shown on the cross sections. Stakes shall be set on 100' intervals and intermediate locations shown on the cross sections. For grading areas greater than 50' wide blue tops will be required on a 50 FT by 50 FT grid in addition to those listed prior. Point identity, station, offset, and cut and fill information shall be provided on lath next to hub.
- 3. Subballast – Set blue tops (finished grade stakes) for subballast at the vertical cut next to existing track, track centerline, shoulder(s) and other break points shown on the cross sections. Blue tops shall be set on 100' intervals and intermediate locations shown on the cross sections. For grading areas greater than 50' wide blue tops will be required on a 50 FT by 50 FT grid in addition to those listed prior.

#### B. Culverts

- 1. Set stakes with appropriate offsets to establish horizontal location, grade and invert elevation at each end of culvert. Set additional stakes to locate bedding and rip rap limits.

#### C. Bridges

- 1. Set stakes with appropriate offset to establish elevation and horizontal location of bridge backwalls, wingwalls, piles, pile caps, piers, and other associated features.

#### D. Railroad Tracks

- 1. Set stakes for track construction, including track to be constructed by the Railroad, to the planned horizontal and vertical alignments.

2. All tangent track shall be staked at 100 FT intervals and at vertical curve cardinal points, which include point of vertical curvature (PVC) and point of vertical tangent (PVT). Set nail at actual point with flagging or whisker attached to nail. If a nail cannot be set at actual point, use a paint stick to mark actual point on rail. Offset actual point 15 FT from nail and write description, including point type, station, top of rail elevation shown with horizontal bar and "V", and horizontal offset to centerline of track, on flag or lath at offset point. If a lath cannot be set at 15 FT, use an offset that will work.
  3. All horizontal curves in track shall be staked at 50 FT intervals and at cardinal points, which include point of curvature (PC) and point of tangent (PT) for simple curves, and point of spiral to tangent (PS), point of spiral to curve (PSC), point of curve to spiral (PCS), and point of spiral to tangent (PT) for spiral curves. Set nail at actual point with flagging or whisker attached to nail. If a nail cannot be set at actual point, use a paint stick to mark actual point on rail. Offset actual point 15 FT from nail and write description, including point type, station, top of rail elevation shown with horizontal bar and "V", and horizontal offset to centerline of track, on flag or lath at offset point. If a lath cannot be set at 15 FT, use an offset that will work. If possible, give line reference (LR) in case of actual point gets disturbed. Line Reference can be on adjacent rail or by setting another offset out further.
  4. Turnouts shall be staked at point of switch (POS), 1/2 IN point of frog (PF), and last long tie (LLT). Each point shall be set with a nail on actual point with flagging or whisker attached to nail. If a nail cannot be set at actual point, use a paint stick to mark actual point on rail. Offset actual point 15 FT from nail and write description, including turnout size and type for POS and PF points, and top of rail elevation shown with horizontal bar and "V", on flag or lath at offset point. If possible, give line reference (LR) in case actual point gets disturbed. Line Reference can be on adjacent rail or by setting another offset out further.
  5. Offsets and LR may also be marked on adjacent rail with permission from the Engineer.
- E. In addition to procedures directed by the Contractor for proper performance of the Contractor's Responsibilities:
1. Locate and protect control points before starting Work on the site.
  2. Preserve permanent reference points during progress of the Work.
  3. Do not change or relocate reference points or items of the Work without specific approval from the Engineer.
- F. Promptly advise the Engineer when a reference point is lost or destroyed, or requires relocation because of other changes in the Work.
1. The Contractor shall replace all disturbed stakes or markers disturbed by construction activities.
  2. Locate such replacements according to the original survey control.
- G. Shoring designs shall be according to UPRR/BNSF Guidelines for Temporary Shoring. Submit shoring designs to Engineer for review prior to installing shoring.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.01 MEASUREMENT**

A. No separate measurement will be made for field engineering.

**4.02 PAYMENT**

A. Field engineering shall be incidental applicable service items. No separate payment shall be made.

**END OF SECTION**

## **SECTION 01 74 13 - CLEANING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Intermediate and final cleaning of Work not including special cleaning of closed systems specified elsewhere.

#### **1.02 DELIVERY, STORAGE, AND HANDLING**

- ##### **A. Store cleaning products and cleaning wastes in containers specifically designed for those materials.**

#### **1.03 SCHEDULING**

- ##### **A. Schedule cleaning operations so that dust and other contaminants disturbed by cleaning process will not fall on newly painted surfaces.**

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

##### **A. Cleaning Agents:**

1. Compatible with surface being cleaned.
2. New and uncontaminated.
3. For Manufactured Surfaces: Material recommended by manufacturer.

### **PART 3 - EXECUTION**

#### **3.01 CLEANING - GENERAL**

- ##### **A. Prevent accumulation of wastes that create hazardous conditions.**
- ##### **B. Conduct cleaning and disposal operations to comply with laws and safety orders of governing authorities.**
- ##### **C. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains or sewers.**
- ##### **D. Dispose of degradable debris at an approved solid waste disposal site.**
- ##### **E. Dispose of nondegradable debris at an approved solid waste disposal site or in an alternate manner approved by Engineer and regulatory agencies.**
- ##### **F. Handle materials in a controlled manner with as few handlings as possible.**
- ##### **G. Do not drop or throw materials from heights greater than 4 FT or less than 4 FT if conditions warrant greater care.**
- ##### **H. On completion of work, leave area in a clean, natural looking condition.**

1. Remove all signs of temporary construction and activities incidental to construction of required permanent Work.

I. Do not burn on-site.

### 3.02 INTERIOR CLEANING

A. Cleaning During Construction:

1. Keep work areas clean so as not to hinder health, safety or convenience of personnel in existing facility operations.
2. At maximum weekly intervals, dispose of waste materials, debris, and rubbish.
3. Vacuum clean interior areas when ready to receive finish painting.
  - a. Continue vacuum cleaning on an as-needed basis, until substantial completion.
4. Control dust in work areas of existing facilities.
  - a. Provide protection to existing electrical and mechanical equipment as required to eliminate detrimental effects due to construction.
  - b. Weekly check air handling filters in existing units having construction activities.
    - 1) Replace as necessary.
  - c. At maximum monthly intervals, check interior of existing electric panels and vacuum if dust accumulation has occurred.
  - d. At maximum weekly intervals, sweep all floors, including basins, tunnels, platforms, walkways, and pick up and dispose of all debris.
    - 1) Use dust suppressant sweeping compound in areas open to areas of existing facility operations.

B. Final Cleaning:

1. Complete immediately prior to Demonstration Period.
2. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed surfaces.
3. Wipe all lighting fixture reflectors, lenses, lamps and trims clean.
4. Wash and shine glazing and mirrors.
5. Polish glossy surfaces to a clear shine.
6. Ventilating systems:
  - a. Clean permanent filters and replace disposable filters if units were operated during construction.
  - b. Clean ducts, blowers and coils if units were operated without filters during construction.
7. Replace all burned out lamps.
8. Broom clean process area floors.

9. Mop office and control room floors.

### 3.03 EXTERIOR (SITE) CLEANING

#### A. Cleaning During Construction:

1. Construction debris:
  - a. Confine in strategically located container(s):
    - 1) Cover to prevent blowing by wind.
    - 2) Haul from site minimum once a week.
  - b. Remove from work area to container daily.
2. Vegetation: Keep weeds and other vegetation trimmed to 3 IN maximum height.
3. Soils, sand, and gravel deposited on paved areas and walks:
  - a. Remove as required to prevent muddy or dusty conditions.
  - b. Do not flush into storm sewer system.

#### B. Final Cleaning:

1. Remove trash and debris containers from site.
  - a. Re-seed areas disturbed by location of trash and debris containers.
2. Clean paved roadways.

### 3.04 FIELD QUALITY CONTROL

- A. Immediately prior to Demonstration Period, conduct an inspection with Engineer to verify condition of all work areas.

**END OF SECTION**

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## **SECTION 01 77 00 - TIME OF COMPLETION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Information relevant to the completion of the Work in a timely manner.

#### **1.02 DETERMINATION OF CONTRACT TIME ALLOWABLE FOR COMPLETION OF WORK**

- A. The proposal will show a tentative date on which it is anticipated that the contractor may begin operations, and a specified number of calendar days in which to complete the Work. A written "Notice to Proceed" will be furnished to the contractor as soon as feasible after the award and execution of the contract and determination has been made that all or a major portion of the site is available to permit the start of the Work.
- B. The determination of the days to be charged against the time allowance for completion of the Work shall be made by the Engineer, and shall be calculated based upon the number of calendar days elapsed since the start of the work, regardless of whether the Contractor worked each of those days.

#### **1.03 DETERMINATION OF DAYS CHARGED**

##### **A. Contract days charged to the project will begin to amass on:**

1. The actual date work began on the project, or
2. A given number of days, based on the Contractor's schedule, after the "Notice to Proceed" which matches the days needed to mobilize, whichever is earlier.

- B. The computation of days charged against the allowable contract time, shall be continued, until all work is completed, unless the Engineer authorizes a temporary suspension of the operations in accordance with Subsection 1.04. However, when the work is temporarily suspended by the Engineer for failure on the part of the Contractor to correct conditions unsafe for the workmen, employees of the Railroad or the general public, to carry out provisions of the contract, or to carry out orders given, the computation of calendar days will not be suspended.

- C. Once each month the Engineer will furnish the Contractor a report of days charged against the completion of the work. Any disagreement with the charges shown must be expressed in writing to the Engineer within seven (7) days of receipt of the report giving detailed reasons for the disagreement. The Engineer will make the final resolution of the disagreement.

#### 1.04 DELAY OF WORK

- A. Should the Contractor find they are unable to complete the work within the number of days specified due to conditions beyond their control, The Contractor shall promptly make a written request to the Engineer for an extension in the time of completion. The request shall describe the nature of the delay, conditions responsible, the length of time and/or its anticipated time, and submit sufficient evidence to substantiate those conditions. If the Engineer determines conditions are beyond the control of the Contractor, The Engineer may either authorize a temporary suspension of operations, adjust the number of days previously charged, or grant in writing an extension of the time of completion consistent with the facts presented. The action taken will depend upon the nature and extent of the delay involved. The Engineer's decision shall be final and conclusive.
- B. When the Special Provisions call for the necessity of performing work in cold weather, consideration will not be given to possible loss of efficiency due to prosecution of the work during the winter months in the determination of days to complete the Work.
- C. It is considered that, generally, materials will be available for delivery in sufficient time to permit completion of the work within the specified time of completion. Delays due to slow delivery from material suppliers will not be considered as justification for an extension in the specified time of completion. A letter from the supplier shall substantiate any requests for extension in the time of completion due to delay of delivery. The letter shall relate the date the Contractor ordered the material, the date the supplier confirmed the order, the cause or reason for the delivery delay, and the anticipated delivery date. The request for extensions in the time of completion should also provide information relative to efforts made to obtain the material from sources other than the supplier that incurred the delay in delivery of the material.
- D. If the Engineer determines the delay involved was due to a delay in delivery of material needed for the prosecution of the controlling operation or severe weather, The Engineer may authorize a temporary suspension of that operation, adjust the number of days charged, or grant in writing, an extension of the time of completion consistent with the facts presented.
- E. Shortage of labor in the vicinity of the project will not be considered as justification for an extension in the specified time of completion. It is advised that the Contractor investigate the anticipated availability of labor in the area during the period that the Work is to be performed and give careful thought in preparing their proposal to the necessity of importing labor.
- F. The Engineer may grant an extension in days specified when items of "Extra Work" not contemplated in the original contract or additional quantities of contract items of work are required. Extension in time of completion granted for such reasons shall be in proportion to the value of extra and additional work as compared to the total amount of the original contract for the group or groups of work included in the time of completion to be extended, except that further consideration may be given when it can be shown that the extra or additional work was of such character that it required more time than the proportionate value of the contract.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**

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## **SECTION 01 77 10 - PROJECT CLOSEOUT AND CLEANING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Cleaning Up:**

1. Upon completion of the Work involved, the Contractor shall clean the location of the Work and all ground occupied by him in connection with the Work and shall remove all rubbish, excess materials, falsework, temporary structures, and equipment, leaving the location of the Work cleaned to the satisfaction of the Engineer.

##### **B. Material Delivery:**

1. The Contractor shall pick up and deliver to a site or sites designated by the Engineer all excess and useable materials furnished by the Railroad in connection with the Work.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

## **END OF SECTION**

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## **SECTION 01 78 19 - MAINTENANCE CONTRACT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Contractor shall provide a full service contract that provides 100% coverage for all labor, parts and materials for a period of one year (12 months) beginning at Substantial Completion; a comprehensive preventive maintenance plan for all covered equipment emergency services' and a semi-annual equipment inspection to insure proper operation of the systems. A maximum response time of four (4) hours for all computer room HVAC equipment and next day service will also be required.
- B. Any building having HVAC equipment to have all such equipment covered by this contract.
- C. Contractor shall provide an example contract for the Owner's review at Notice to Proceed.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. See Packaged Engine Generators, if included in the project, for maintenance of emergency generators

### **PART 2 - PRODUCTS**

#### **2.01 NOT USED**

### **PART 3 - EXECUTION**

#### **3.01 SCHEDULING**

- A. Perform regular and systematic Maintenance, during normal working hours and according to the manufacturer's recommendations. Normal working hours are defined as 8:00 a.m. to 5:00 p.m. Monday through Friday inclusive, excluding holidays.

### 3.02 MAINTENANCE ROUTINES

- A. Maintenance shall be performed in accordance with a prepared program of standardized maintenance routines according to the manufacturer's recommendations and approved by the Owner
- B. Maintenance routines at a minimum shall consist of:
  - 1. Check air handler filters. Clean or replace as necessary.
  - 2. Check for adequate refrigerant charge.
  - 3. Check condenser and clean if necessary.
  - 4. Lubricate condenser fan motor.
  - 5. Check condenser fan blades for tightness.
  - 6. Tighten electrical connections at equipment.
  - 7. Check voltage at unit under load.
  - 8. Check condensate drain for blockage. Clean as necessary.
  - 9. Check blower belt for condition, tension, and alignment, replace as necessary.
  - 10. Lubricate all bearings where applicable.
  - 11. Check blower for cleanliness.
  - 12. Check all safety controls.
  - 13. Inspect contractor points
  - 14. Check and clean thermostat.
  - 15. Check lockout control.
  - 16. Inspect evaporator coil cleanliness.
  - 17. Inspect starting capacitor.
  - 18. Inspect running capacitor.
  - 19. Check for vibration and noise.
  - 20. Inspect relays.
  - 21. Check and record running and starting amperages.
  - 22. Check and record suction and discharge pressures.
  - 23. Make recommendations of any needed repairs to system.

**END OF SECTION**



## **SECTION 01 78 34 - GUARANTEES, WARRANTIES AND BONDS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Contractor shall guarantee all Work under this Agreement for a period of one year from the date of acceptance by the Railroad, unless otherwise indicated. Contractor shall leave the Work in perfect order at completion, and the final certificate of payment shall not relieve him of the responsibility for negligence, faulty materials, or workmanship; upon written notice, he shall remedy any defects or workmanship that may appear during the time hereinbefore mentioned and pay all expenses due therefrom to the entire satisfaction of the Engineer.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 1 - MEASUREMENT AND PAYMENT**

#### **1.01 MEASUREMENT**

- A. No separate measurement will be made for project guarantees, warranties and bonds.

#### **1.02 PAYMENT**

- A. Guarantees, warranties and bonds shall be incidental to applicable service items. No separate payment shall be made.

**END OF SECTION**

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

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Contractor shall provide an Electronic Closeout Library to the Engineer prior to final invoice. The Library shall contain (if project applicable):
  - 1. All as-built drawings for the project including but not limited to grading, top of rail, utilities, buildings, facilities, bridges, culverts and work associated with road crossings. The drawings shall reflect all modifications made during construction. Each sheet shall be stamped "As-Built," signed and dated. Required documentation includes:
    - a. As-built CAD format file (base file to be provided by UP)
    - b. As-built pdf format file: Issued for Construction drawings annotated to show all changes made during construction.
  - 2. All density tests and soil proctor data.
  - 3. All concrete break tests.
  - 4. All welding data.
  - 5. Material certifications.
  - 6. VERSE test reports.
  - 7. Ultrasonic test reports on rail welds.
  - 8. All pile driving and drilled shaft data.
  - 9. All reviewed submittals sent to engineer during project duration.
  - 10. Any DWR forms for equipment rental used on the project.
  - 11. Per Section 01 33 00, the Contractor will supply the instructions, operating and maintenance instruction bulletins, complete parts lists and wiring diagrams for all panels.
  - 12. Per Section 01 55 13, supply any agreements made between the Contractor and private landowners.
- B. Provide two (2) hard copy sets of O&M's sent to the Yard Office, Terminal, or other facility designated by the Engineer, and two (2) electronic set sent to Facility Department at UPRR Headquarters. (No preferred electronic method, via FTP, CD/DVD, or flash drive).

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 4 - MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. No separate measurement will be made for project record documents.

4.02 PAYMENT

A. Payment will be incidental the project mobilization with the following provisions:

1. Failure to submit the electronic closeout library will result in **5% hold to the remaining 30% of the mobilization pay item.**

**END OF SECTION**

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

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

#### **1.02 RELATED DOCUMENTS**

- A. OPR (Owner Project Requirements) and BoD (Basis of Design) documentation.

#### **1.03 DEFINITIONS**

- A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- C. CxA: Commissioning Authority.
- D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

#### **1.04 COMMISSIONING TEAM**

- A. Members Appointed by Contractor(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.
- B. Members Appointed by Owner:
  - 1. Representatives of the facility user and operation and maintenance personnel.
  - 2. Engineering design professionals.

#### **1.05 OWNER'S RESPONSIBILITIES**

- A. Provide the OPR documentation to the CxA and each Contractor for information and use.

- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the BoD documentation, prepared by Engineer and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

#### 1.06 EACH CONTRACTOR'S RESPONSIBILITIES

- A. Each Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
  - 1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
  - 2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
  - 3. Attend commissioning team meetings held on a variable basis.
  - 4. Integrate and coordinate commissioning process activities with construction schedule.
  - 5. Review and accept construction checklists provided by the CxA.
  - 6. Complete paper construction checklists as Work is completed and provide to the Commissioning Authority on a weekly basis.
  - 7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
  - 8. Complete commissioning process test procedures.

#### 1.07 CXA'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.
- B. Provide commissioning plan.
- C. Convene commissioning team meetings.
- D. Provide Project-specific construction checklists and commissioning process test procedures.
- E. Verify the execution of commissioning process activities using random sampling. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
- F. Prepare and maintain the Issues Log.
- G. Prepare and maintain completed construction checklist log.
- H. Witness systems, assemblies, equipment, and component startup.
- I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - GENERAL - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**

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## **SECTION 02 00 00 - SITE WORK FOR BUILDINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This section does not apply to the construction of mainline and/or yard track projects.

#### **1.02 FIBER OPTIC CABLE**

- A. Before beginning any work under these specifications, the Contractor shall, without fail, telephone Union Pacific Railroad at 1-800-336-9193 (a 24 HR number) to determine if fiber optic cable is buried anywhere on the Railroad's premises to be used by the Contractor. If fiber optic cables are buried on the premises, the Contractor shall telephone the telecommunications company(ies) involved, arrange for a cable locator, make arrangements for relocation or other protection of the fiber optic cable, and shall not commence any work on the premises until all such protection or relocation has been accomplished. If the Contractor contacts the Railroad and telecommunications company(ies) as required, the Contractor will not be responsible for the cost to locate, relocate, or protect the fiber optic cable.

#### **1.03 RAILROAD SIGNAL CABLE**

- A. Before beginning any work under these specifications, the Contractor shall, without fail, coordinate location of Railroad Signal Cables with the Engineer to determine if signal cable is buried anywhere on the Railroad's premises to be used by the Contractor. If signal cables are buried on the premises, the Contractor shall pothole all located wires to determine both horizontal and vertical location to the satisfaction of the Engineer.

#### **1.04 CUT AND FILL**

- A. The Contractor shall, under Division 02 and 31, clear the site within the limits shown, make all excavations and fills to the lines and elevations indicated on the drawings, and as required for the proper completion of the work under this contract, and shall dispose of all excess excavation materials not deemed suitable for use as fill by the Engineer. In case it is necessary to place excavation material adjacent to structures, the Contractor shall erect barriers to keep the earth at least 4 FT from such structures.

#### 1.05 SITE WORK

- A. Site work shall include the removal of any and all trees, stumps, brush, trash, stone walls, obstructions, and other materials, re-handling for the limits of the Work and shall include all pumping, bailing, draining, sheeting, and shoring, prevention of damage to existing structures, piping and embankments constructed by others, protection of trees, all embankments, fills, compacted fill, compacting and protection therefore, and all incidental work. Moreover, the Contractor must assume all responsibility for any added expense or other liability which may arise by means of quicksand, obstacles or conditions, foreseen or unforeseen, and encountered or manifest during the prosecution of any work which is specified or required under this contract. If underground utilities and/or obstacles not shown on the drawings are encountered, notify the Engineer and do not proceed until the Engineer's instructions are obtained.

#### 1.06 CLEARING OF SITE

- A. The Railroad shall clear the site of all storage materials, equipment, scrap iron, or other materials which would require special equipment for removal or which would interfere with normal excavating procedures.

#### 1.07 UNDERGROUND UTILITIES

- A. Necessary arrangements shall be made by the Contractor with all persons, firms, or corporations owning or using any poles, pipes, or conduits, etc., affected by the construction of this project, to maintain and protect such facilities during construction. In the event that any existing gas pipes, water pipes, conduits, sewers, tile drains, or poles are blocked, or interfered with by the excavation required on this project, the Contractor shall maintain them in continuous operation, and restore them to the same or better condition than they were prior to the start of construction on this project.

#### 1.08 SITE IMPROVEMENTS

- A. All permanent site improvements such as driveways, roads, sidewalks, walls, drainage ditches, culverts, fencing, etc., shall be protected. If damaged, they shall be restored by the Contractor to a condition equal or better to that existing at the date of award of the contract.

#### 1.09 CONTAMINATED SOIL

- A. If indications of contaminated soils, springs or running water are encountered, the Contractor shall contact the Engineer for instructions.

#### 1.10 TESTING

- A. The laboratory performing sampling and testing required herein shall be subject to approval of the Engineer. Reports of all tests shall be submitted to the Engineer for approval. The costs of the required tests are covered by Contractor. Should any tests not meet these specifications, the Contractor shall be responsible for all costs of any additional re-testing.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**

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## **SECTION 02 30 10 - SOILS INVESTIGATION REPORT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This Section describes soils investigation at the site, and use of data resulting from that investigation.

#### **1.02 SOILS INVESTIGATION REPORT**

##### **A. General:**

1. A soils investigation report may have been prepared for the site of this Work by an independent testing laboratory selected by the Railroad.
2. If available, the soils investigation report is attached to the Specification and copies may be obtained upon request addressed to the Railroad.

##### **B. Use of Data:**

1. This report was obtained for the Railroad's use in design purposes and is not a part of the Contract Documents.
2. The report is available for the Contractor's information, but is not a warranty of subsurface conditions and the Railroad does not guarantee the accuracy of the report.
3. Bidders should visit the site and acquaint themselves with existing conditions.
4. Prior to bidding, bidders may make their own soil investigations to satisfy themselves as to site and subsurface conditions, investigations may be performed only under time schedules and arrangements approved in advance by the Engineer.

#### **1.03 QUALITY ASSURANCE**

- A. An independent testing laboratory may be retained by the Railroad to perform tests in connection with embankment, excavating, trenching, grading, and to report the findings to the Engineer and the Contractor.
- B. The Contractor is to readjust work performed that does not meet technical or design requirements, but make no deviation from the Contract Documents without specific and written approval from the Engineer.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 GENERAL

- A. All cost associated with soil investigation shall be incidental to the total project cost.

**END OF SECTION**

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## **SECTION 02 41 00 - DEMOLITION FOR BUILDINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This section covers all wrecking and demolition, together with the removal, handling, and disposal of items. This section shall be used in coordination with building demolition specifications, with the more stringent specification requirements taking precedence.
- B. Demolition shall be done in an orderly and careful manner with due consideration for neighbors and the public. Execute the work to ensure adjacent properties and the public against damages incurred by falling debris or other causes.
- C. The Contractor and their sub-contractors shall perform their sitework, and any work which will disturb the soil in compliance with United States Occupational Safety and Health Administration (OSHA) regulations 29 CFR 1910.120. The Contractor shall utilize safe work practices that prevent dust emissions.
- D. This section does not apply to the construction of mainline and/or yard track projects.

#### **1.02 RESPONSIBILITY**

- A. The Contractor shall be responsible for any damage to existing buildings or to equipment and furnishings housed therein which are due directly or indirectly to the construction operations.
- B. Except where site grading or location of new buildings necessitates removal, use every possible precaution to prevent injuries to drives, curbs, and walks on or adjacent to the site of the work and replace at no expense to the Railroad any such damaged or destroyed.

#### **1.03 SUBMITTALS**

- A. Submit as specified in Section 01 33 00.
- B. Schedule of Demolition:
  - 1. Submit proposed methods and operations of demolition to the Engineer for review prior to the start of work. Include in the schedule the coordination for shutoff, capping and continuation of utility services as required, together with details for dust and noise control protection.
  - 2. Provide a detailed sequence of demolition and removal work to minimize interruptions of Railroad, Utility or neighbor operations.

#### **1.04 WRECKING AND DEMOLITION**

- A. Completely remove all items and obstructions as shown on the drawings or called out in these specifications. Remove any existing rubbish, trash and junk and leave the site clear of such materials.

#### 1.05 REMOVAL

- A. Unless otherwise noted or specified to be relocated or stored, all materials removed become the property of the Contractor and are to be removed completely away from the site and disposed of in a legal manner by the Contractor. Do not store or permit debris to accumulate on the site. If the Contractor fails to remove excess debris promptly, the Railroad reserves the right to cause same to be removed at the Contractor's expense.
- B. Where it is necessary to remove fences to permit the accomplishment of construction work, they shall be returned to a condition as good or better condition as they were originally found and if necessary, relocated as shown on the drawings.

#### 1.06 PIPE ABANDONMENT

- A. Piping specified to be abandoned-in-place shall be completely drained of all liquid by the Contractor using low point drains and/or pigs. All collected liquid shall be legally disposed of offsite by the Contractor unless alternate arrangements are agreed upon prior to bid. In some cases, the Railroad may accept liquid for on-site disposal subject to prior agreement.
- B. Fill the piping with non-shrink flowable grout. Flushing liquids mixed with product which are displaced by the grout shall be collected by the Contractor and properly disposed of.
- C. Ensure that all abandoned-in-place piping is completely filled with grout.
- D. The open end or ends of the abandoned-in-place piping shall be permanently capped or blind-flanged after the filling is complete. The Contractor is to provide documentation of the location of abandoned-in-place piping to the Railroad.

#### 1.07 BURNING OF MATERIALS

- A. Burning of materials or debris on the premises is not permitted.

#### 1.08 GROUND AND SURFACE WATER

- A. After the removal operation, the Contractor shall protect the resulting excavation or open area from surface or groundwater. The Contractor shall execute prompt removal of any water that accumulates in the excavation or opening, at the Contractor's expense.

#### 1.09 GRADING

- A. After the removal work is completed, grade all areas within the construction area so that proper drainage will be provided at all times.
- B. Bring all low sections, holes or depressions to proper level by filling and compacting as specified in SECTION 31 00 00 - Earthwork as required.

## PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. Prior to commencement of demolition work, the Contractor shall inspect areas in which work will be performed. The Contractor shall photograph existing conditions of structures, surfaces, equipment, and surrounding properties that could be misconstrued as damage resulting from selective demolition work. Deliver copies to the Railroad prior to starting work.
- B. The Contractor is to maintain a project book on-site of photographs taken during demolition and construction phases. Photograph significant features of demolition and construction activities. Upon completion of the work and prior to final payment, the Contractor shall deliver the project book to the Engineer.

### 3.02 WASTE MATERIALS

- A. All materials classified as hazardous or special waste, excluding contaminated soils and groundwater, shall be disposed of by methods approved by the Railroad at the disposal facility identified at the pre-bid meeting. If no disposal facility is identified, the disposal facility shall be at Contractor's option, subject to approval by the Railroad.
- B. Hazardous or Special Wastes Removed from Tanks and Piping:
  - 1. All fuel, debris, loose scale, liquid and sludge shall be removed by the Contractor from the tank and piping and handled in accordance with EPA, State and Local regulations to a properly permitted treatment, storage and disposal facility. The Contractor shall be responsible for waste sampling as necessary to satisfy the disposal facility requirements.
  - 2. Hazardous and special waste removed from tanks and piping shall be packaged and transported in accordance with State and Federal Department of Transportation regulations and disposed of, or stored, in accordance with Federal, State and Local regulations. The Contractor shall prepare shipping papers, including manifests, to be signed by a representative of the Railroad, who is the generator, before any shipments leave the premises.
  - 3. The Contractor shall furnish Department of Transportation (DOT) or U.S. EPA approved containers for collection and transport of demolished materials.
  - 4. Generated copies of the waste shipping manifest shall be returned to a specified representative of the Owner to verify the receipt and proper disposal of the material. The Owner shall provide copies of the documents to the Contractor. Any disposal discrepancies identified by the Owner, or others, shall be the responsibility of the Contractor and shall be resolved by the Contractor, the Waste Transporter and the Disposal Facility.
  - 5. If agreed to by the Railroad and the Contractor in advance, the Contractor may dispose of hydrocarbon liquids at the Railroad's wastewater treatment plant.

- C. The Contractor shall be responsible for any costs such as sampling, analysis, removal and disposal resulting from contamination or spillage caused by the Contractor. The laboratory to be used and tests to be performed will be identified by the Engineer.
- D. All other demolished materials shall be removed from the site and disposed of by the Contractor in accordance with all Federal, State and Local regulations.

**END OF SECTION**

## **SECTION 02 41 17 - BUILDING DEMOLITION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The extent of demolition work is shown on the Drawings.
- B. Demolition requires removal and disposal, off site, in a proper and legal manner, of the following:
  - 1. Buildings and other structures.
  - 2. Foundations.
  - 3. Footings.
  - 4. Slabs on grade.
  - 5. Existing fence.
  - 6. Above and below grade improvements.

#### **1.02 CONDITIONS**

- A. Occupancy: Structures to be demolished will be vacated, discontinued in use, prior to start of work.
- B. Condition of Structure: The Railroad assumes no responsibility for actual condition of structures to be demolished. Conditions existing at time of inspection for bidding purposes will be maintained by Railroad insofar as practicable.
- C. Storage or sale of items on the right of way site will not be permitted.
- D. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with railroad service, roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways, if required, by the governing regulations.
- E. Explosives: Use of explosives will not be permitted.

#### **1.03 PROTECTIONS**

- A. Ensure safety of persons around area of demolition.
- B. Contractor will, disconnect and seal utilities, and shut off power, serving the structures to be demolished, prior to demolition work.

## PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

## PART 3 - EXECUTION

### 3.01 DUST AND WIND EROSION CONTROL

- A. Excavations and embankments section on dust control is in section 31 35 20.
- B. Approved temporary methods of dust control, including sprinkling, chemical treatment, light bituminous treatment or similar methods may be approved. Sprinkling must be repeated at such intervals as to keep all potential sources of dust wet at all times, and the Contractor shall provide sufficient sprinkling equipment to comply with this requirement.

### 3.02 DEMOLITION

- A. Demolish buildings completely and remove from site. Use such methods as required to complete work within limitations of governing regulations.
- B. Break up and remove concrete slabs on grade.
- C. Demolish foundation walls, footings, and basement slabs and remove.
- D. Demolish and remove below grade wood, metal and floor construction.

### 3.03 ABOVE AND BELOW GRADE IMPROVEMENTS

- A. Demolish and remove above and below grade construction, including concrete slab on grade, as shown on site plan.
- B. Remove existing fence, posts, and all related materials from locations at perimeter of site, and other locations on the site.

### 3.04 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Remove from site debris, rubbish, and other materials resulting from demolition operations.
- B. Burning of removed materials from demolished structures will not be permitted on site.
- C. Transport materials removed from demolished structures and dispose of legally off site.

### 3.05 ASBESTOS

- A. Pre-Demolition Walk-Through:
  - 1. Before building demolition, the Contractor and Engineer shall have made a thorough visual walk-through of the building(s) to be demolished.
  - 2. Purpose of this inspection is to locate any suspect asbestos-containing materials (ACM). If suspect material is discovered, the Contractor must verify its composition using formal testing procedures. Example: Polarized Light Microscopy (Asbestos).

3. Arrangements for removal of any ACM discovered during the pre-demolition walk-through will be coordinated by the Railroad. This abatement will be performed either as an extra order on the demolition contract or under separate contract with an asbestos abatement Contractor.

#### 3.06 ASBESTOS OR SUSPECT ASBESTOS DISCOVERED (DURING DEMOLITION)

- A. The Contractor must be able to verify any suspect material as ACM or non-asbestos during the course of the entire demolition process. In the unlikely event the Contractor finds suspect ACM, he is to immediately stop work and notify the Engineer for further instructions and arrangements for testing.
- B. Any testing or if necessary, asbestos removal, will be handled as an extra order with the demolition Contractor under the terms of the contract.

#### 3.07 ASBESTOS - CONTRACTOR PENALTY CLAUSE

- A. As previously stated in this section, the Contractor shall be held responsible, during the entire demolition project, for determining what, if any, materials contain ACM. If the Contractor encounters or overlooks suspect ACM and **does not stop** work immediately upon its initial discovery and notify the Engineer; the Contractor will be held responsible for the cleanup of the ACM (if determined to be ACM) and decontamination of the project site or that portion of the project which he contaminated as a result of his demolition work.

#### 3.08 GENERAL CONDITIONS

- A. The Contractor shall be responsible for any damage to existing and remaining buildings or to equipment and furnishings housed therein which are due directly or indirectly to the demolition operations. Use every precaution to prevent injuries to curbs, drives and sidewalks adjacent to the site of the work and replace at no expense to the Railroad any such destroyed. Unless specified otherwise by the Railroad's Engineering Environmental Department or their representative all necessary wrecking or demolition together with the removal and disposal of items shall be performed to the following requirements.

#### 3.09 INSPECTIONS

- A. Prior to the razing of any structure, an inspection by the Railroad Environmental Representative shall be performed to identify and quantify any existing hazardous materials.
- B. Identify any utilities such as electrical, gas, sewers or water supply that may have to be disconnected or rerouted prior to any structural disassembly. Disconnection of said utilities not to interfere with operations of adjacent or structures not within the scope of demolition.
- C. Identify any special conditions that exist that need to be preserved, protected, or require special handling. Examples of such being EPA monitoring devices, wells, or test locations. Any salvageable equipment or apparatus to be retained by the Railroad.

### 3.10 PERMITS, BONDS AND LICENSES

- A. In the event of hazardous materials that require abatement prior to or during demolition, Contractor and/or subcontractors shall be familiar with all Federal, state and municipal and be licensed to perform this nature of work. The Railroad reserves the right to subcontract any abatement or remediation as separate contract to work in conjunction with the General Contractor.

### 3.11 DISPOSAL OF MATERIALS

- A. Contractor to be responsible for segregation of all scrap, trash, structural materials, concrete, contaminants, etc., that may be required before disposal. Contractor to indemnify the Railroad of any costs or liabilities arising from his transport and disposal of said materials arising from demolition or excavation. Contractor to provide the Railroad the required documentation verifying compliance with Federal, State and Local laws, codes and regulations governing the disposal and transportation of the demolition materials.
- B. All excavated earthen soils that, by examination, indicate contaminants from petrochemical absorption of diesel fuel, lube oils, etc., shall be placed on protective plastic, covered for protection and enclosed by a temporary berm. Railroad to furnish railcars or mode of transport for eventual disposal. Railroad to assume costs and responsibility for disposal of these soils unless specified by other Contract agreement. Structural components identified as having surface contaminants in excess of EPA guidelines shall be disposed of in an approved manner dictated by Federal, State, and Local laws, codes and regulations. Excavated concrete or mortar products indicating contamination to be segregated from soils and held for Railroad disposal. Temporary storage of this concrete to be handled the same as contaminated soils aforementioned.

### 3.12 EXCAVATIONS AND GRADING

- A. Excavations arising from demolition to remove equipment, foundations, piping, etc., shall be restored to general grade with clean earthen fill and compacted to reduce settlement and graded to provide adequate drainage. Excavations within areas identified by a Railroad representative as having petroleum contamination shall be excavated to the extent that Federal, State and Local laws, codes and regulations require, (typically 1,000 ppm). Contaminated soils to be separated from contaminated masonry or concrete and stored for disposal by the Railroad. (See 3.11.B above for temporary storage requirements)

### 3.13 SCOPE OF DEMOLITION

- A. Building, Structures, and Above and Below Grade Improvements:
  - 1. Excavations or pits existing within the building proper shall be drained and cleared if necessary of any residual petroleum contaminants. Drainage holes shall be provided to prevent any future entrapment of water before being back filled with clean earthen fill.
  - 2. Abandoned manholes, whether sanitary, industrial, or storm, shall have top broken to 24 IN below finished grade, all piping plugged and capped, bottom penetrated for drainage, then back filled with clean earth to grade.



B. Utilities:

1. Natural Gas Lines:

- a. Municipal services shall be cut off and capped at street, property easement or meter, whichever is applicable to property, i.e., partial or total facility demolition.
- b. Intra facility or building gas lines to be flushed with water, plugged and abandoned in place. Connections to be cut at 12 IN below grade level.

2. Water Lines:

- a. Abandoned lines shall be drained, cut off and plugged at 24 IN below finished grade.

3. Sanitary and Storm Sewers:

- a. Abandon in place with ends cut and capped 24 IN below finished grade. All drains and any other associated influent openings also removed to 24 IN below grade and plugged.

4. Industrial Sewers, Fuel Lines & Waste Water Systems:

- a. Industrial piping to be drained and water flushed to waste water treatment plant. After flushing, abandon in place with connections severed and plugged 24 IN below finished grade.
- b. Waste Water Treatment Plants involve piping, hardware, storage tanks and in some cases, settling ponds. Each situation requires special instructions and methodologies to remediate or remove. Refer to Engineer for requirements and/or instructions.
- c. All fuel meters and ancillary controls, pump skids, (circa 1985 or newer), and specialized valves to be property of the Railroad unless pre-designated as scrap by the Railroad.
- d. The Railroad shall salvage those items it deems necessary. The responsibility for removal by either the Contractor or another party to be dictated by the Railroad at the time of bidding.
- e. All existing EPA monitoring wells or inspection points are to be preserved and marked in a method to prevent damage from equipment or personnel during the term of the demolition contract.

5. Electrical:

- a. Contact Municipal Power Company for disconnect and relocation needs
- b. All transformers to be salvaged for storage and reuse by Railroad. Panel boxes, disconnects, controllers, conduit, etc., shall be considered property of Contractor unless specified by contractual agreement.
- c. All electrical inventories or components stored as new or reusable within buildings or premises shall be property of the Railroad unless specified by contract agreement.

- d. Transformers deemed by Railroad to be obsolete or defective to be marked by Railroad as scrap together with latest date tested (PCBs). If no test date available, units shall be considered possible hazardous waste.
6. Communications:
- a. Any Railroad antennas, transmitters, computer equipment, or communication devices shall be salvaged as property of the Railroad unless previously designated as scrap. Contact the Railroad Communications Department for disposition if questionable.
  - b. All communication wiring and coaxial cables overhead and internal to buildings to be considered as scrap. If fiber optical cabling systems are encountered, notify Communications Department for instructions.
  - c. All locations of underground fiber optics shall be located, marked and protected from excavation.
- C. Storage Tanks (Above Ground):
1. Tank Contents:
- a. If indicated, contents are to be pumped down and transported for disposal or salvage by the Contractor. Contractor to arrange transfer and transport of contents unless specified differently by contract. At the option of Railroad, excess fuel or oils may be sold to “scavenger” refiners or given to Contractor for his removal, transport or disposal.
2. Tank Removal:
- a. Clean interior and degas, remove sludge and haul away to licensed disposal facility.
  - b. Sever underground pipe lines at 24 IN below general grade. Prior to capping, water flush with influent routed to waste water facility for processing.
  - c. Cut up tank and auxiliary steel components and haul away as scrap, if scheduled for demolition. If tanks are reusable at other Railroad facilities, clean and sever connections for transport per Railroad instructions.
  - d. All work shall be accomplish in accordance with Federal, State, and Local regulations including API Bulletin 1604, 40 CFR 280 & 281 latest revisions and OSHA. Prior to mobilization Contractor is responsible for making necessary notification to appropriate state agency and obtaining proper permits from local fire departments. Prior to commencement of work, provide disposal plan to the Railroad’s Engineer for approval. Upon completion, Contractor shall provide the Railroad Engineer all documentation of disposal and/or product disposition.
3. Containment Dikes:
- a. Earth berms to be bladed to general ground elevation with contaminated soils removed. Any remaining depressions shall be backfilled with clean earth and compacted to reduce settlement and provide adequate drainage.
  - b. Concrete Ring Walls to be treated as building foundations and cleared to a minimum of 24 IN below general grade unless prescribed to additional depths by contract.

- c. Slab pads to be removed to 24 IN below grade and removed from the demolition site. If concrete or base soils indicate contamination, treat as hazardous materials. Restore all excavations to general grade.
- 4. Pump and Meters:
  - a. Any pumps or meters removed during tank dismantling shall be salvaged for the Railroad, unless contract designates as scrap.
  - b. Salvaged meters or pumps shall be covered or preserved from dirt and water pending railroad disposition.

**END OF SECTION**

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## **SECTION 02 41 19 – SELECTIVE DEMOLITION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This section covers limited scope, selective demolition as defined on the Drawings, together with the removal, handling, and disposal of items. Work Included shall include but shall not be limited to:
  - 1. Demolition and removal of selected portions of the building.
  - 2. Disconnecting, capping or sealing and removing or abandoning in place utilities.
  - 3. Salvaging items for re-use by Owner
- B. This is an active facility and is in operation 24 hours per day; seven days per week; 52 weeks per year and the Building must remain fully operational during construction. Work shall be accomplished within phases and sequences so as to minimize impacts to operations. The contractor shall be responsible for maintaining access to building at all times. Provide temporary walkways, barricades and safety provisions to keep employees, visitors, and other contractors on site away from and safe from construction operations

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.

#### **1.03 DEFINITIONS**

- A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner
- C. Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

#### **1.04 MEETING REQUIREMENTS.**

- A. Pre-demolition Conference: Conduct at project site.
  - 1. Attendees: In addition to representatives of Owner, Construction Manager, Architect, and Contractor shall be represented at the meeting.
  - 2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
    - a. Fire-prevention plan.

- b. Governing regulations.
  - c. Areas where existing construction is to remain and the required protection.
  - d. Review procedures for noise control and dust control.
  - e. Hauling routes.
  - f. Sequence of alteration work operations.
  - g. Storage, protection, and accounting for salvaged and specially fabricated items.
  - h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
- 3. Reporting: Record conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.
- B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at weekly intervals. Coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
  - 1. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.
  - 2. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting

#### 1.05 RESPONSIBILITY

- A. The Contractor shall be responsible for any damage to existing buildings or to equipment and furnishings housed therein which are due directly or indirectly to the demolition operations.
- B. Contractor shall repair at no cost to the Owner any damaged materials or building elements not designated for demolition.

#### 1.06 SUBMITTALS

- A. Submit as specified in Section 01 33 00.
- B. Pre-demolition Photographs or Video: Submit before Work begins.
- C. Alteration Work Program: Submit 30 days before work begins.
  - 1. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work sections.

2. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
  3. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- D. Fire-Prevention Plan: Submit 30 days before work begins.
1. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety

#### 1.07 CLOSEOUT SUBMITTALS

- A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

#### 1.08 REMOVAL

- A. Unless otherwise noted or specified to be relocated or stored, all materials removed become the property of the Contractor and are to be removed completely away from the site and disposed of in a legal manner by the Contractor.
  1. Do not store or permit debris to accumulate on the site. If the Contractor fails to remove excess debris promptly, the Railroad reserves the right to cause same to be removed at the Contractor's expense.
- B. Burning of materials or debris on the premises is not permitted.

#### 1.09 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Storage or sale of removed items or materials on-site is not permitted.
- E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  1. Maintain fire-protection facilities in service during selective demolition operations.

### PART 2 - PRODUCTS

#### 2.01 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements:

1. Comply with governing EPA notification regulations before beginning selective demolition.
2. Comply with hauling and disposal regulations of authorities having jurisdiction.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- B. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

#### 3.02 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
  1. Comply with requirements for existing services/systems interruptions specified by Owner's representative.
  2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment

#### 3.03 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
  2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.



4. Dispose of demolished items and materials promptly.
5. Comply with requirements in Section 01741 "Construction Waste Management."

B. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Protect items from damage during storage.
3. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

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

3.04 CLEANING

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

**END OF SECTION**

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## **SECTION 03 09 00 - STRUCTURAL CONCRETE FOR BUILDINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Contractor to furnish all labor, materials, tools, equipment, and services for all concrete work as indicated in accord with provisions of the contract documents.
- B. Contractor to coordinate with work of all other trades.
- C. Contractor to furnish and install all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure and complete installation.

#### **1.02 REFERENCED STANDARDS**

- A. Codes and Standards: To comply with most recent provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified.
- B. American Concrete Institute (ACI):
  - 1. 117, Standard Specifications for Tolerances for Concrete Construction and Materials.
  - 2. 301, Specifications for Structural Concrete for Buildings.
  - 3. 304, Guide for Measuring, Mixing, Transporting, and Placing Concrete.
  - 4. 305, Hot Weather Concreting.
  - 5. 306, Cold Weather Concreting.
  - 6. 318, Building Code Requirements for Reinforced Concrete.
- C. American Society of Testing and Materials (ASTM):
  - 1. A615, Standard Specifications for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
  - 2. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
  - 3. C33, Standard Specification for Concrete Aggregates.
  - 4. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  - 5. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
  - 6. C94, Standard Specification for Ready-Mixed Concrete.
  - 7. C150, Standard Specification for Portland Cement.
  - 8. C171, Standard Specification for Sheet Materials for Curing Concrete.
  - 9. C172, Standard Practice for Sampling Freshly Mixed Concrete.

- 10. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
- 11. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing.
- 12. E1155, Standard Test Method for Determining Floor Flatness and Levelness Using the F-Number System.
- D. Concrete Reinforcing Steel Institute (CRSI) - Manual of Standard Practice.
- E. American Association of State Highway and Transportation Officials (AASHTO).

#### 1.03 QUALITY ASSURANCE

- A. Concrete Testing Service: Concrete Testing specified hereinafter shall be done by an independent testing laboratory approved by the Railroad. Costs of the testing will be paid for by the Contractor.
- B. Materials and installed work may require testing and re-testing, as directed by the Railroad, at any time during the progress of work. The Contractor is to allow free access to material stockpiles and facilities. Re-testing of rejected materials and installed work shall be done at the Contractor's expense.

#### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Reinforcement – Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI 315 “Manual of Standard Practice for Detailing Reinforced Concrete Structures” showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required and openings through concrete structures.
- C. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design for each class of concrete specified.

### PART 2 - PRODUCTS

#### 2.01 FORM MATERIALS

- A. Forms for Exposed Finished Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced or other panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Finish the largest practicable sizes to minimize the number of joints. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.
- B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least two (2) edges and one (1) side for tight fit.
- C. Form Coatings: Provide commercial formulation form-coating compounds that will not bind with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

## 2.02 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A615, Grade 60, deformed.
- B. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing bar and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications, unless otherwise acceptable.
- C. Fabrication of reinforcing steel shall be per the CRSI "Manual of Standard Practice." Dimension of bending details on drawings are measured out to out of bar.

## 2.03 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150, Type II, unless otherwise acceptable to the Engineer. Use one (1) brand of cement throughout the project, unless otherwise accepted by the Engineer. Normal weight aggregates shall conform to ASTM C33.
- B. Water: Potable.
- C. Air-Entraining Admixture: ASTM C260.
- D. Water-Reducing Admixture: ASTM C494, Type A. Calcium chloride or admixtures containing chloride ions are not permitted. Use in concrete as required for placement and workability.

## 2.04 GROUT

- A. Non-shrink, Non-metallic Grout: ASTM C1107, grade B.
  - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic cement grout, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 500 psi compressive strength at twenty-eight (28) days.

## 2.05 ABSORPTIVE COVER

- A. Burlap cloth made from jute or kenaf, weighing approximately 9 OZ/SQ YD complying with AASHTO M182, Class 2.

## 2.06 MOISTURE-RETAINING COVER

- A. One of the following, complying with ASTM C171.
  - 1. Waterproof paper.
  - 2. Polyethylene film.
  - 3. Polyethylene-coated burlap.

## 2.07 LIQUID MEMBRANE FORMING CURING COMPOUND

- A. Liquid type membrane-forming curing compound complying with ASTM C309, Type I-D, Class A unless other types acceptable to the Railroad. Moisture loss not more than 9.955 gm/SQ CM when applied to 2300 SQ FT/GAL.

## 2.08 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to the Architect-Engineer for preparing and reporting proposed mix designs.
- B. Submit written reports to the Railroad of each proposed mix for each class of concrete at least 15 days prior to the start of work. Do not begin concrete production until mixes have been reviewed by the Engineer.
- C. Design mixes to provide normal weight concrete as indicated in the structural general notes on the drawings.
- D. Concrete shall have a minimum compressive strength of 4,000 PSI at twenty-eight (28) days unless otherwise noted.

## 2.09 CONCRETE MIXES

- A. Ready-Mix Concrete: Comply with requirements of ASTM C94.

# PART 3 - EXECUTION

## 3.01 GENERAL

- A. Comply with ACI 304 Guide for Measuring, Mixing, Transporting and Placing Concrete and as herein specified.

## 3.02 PLACING REINFORCEMENT

- A. Comply with Concrete Reinforcing Steel Institute's (CRSI) Manual of Standard Practice for details and methods of reinforcement placement and supports, and as herein specified.
- B. Clean reinforcement of loose rust and mill scale, earth, ice and other materials that reduce or destroy bond with concrete.
- C. Accurately position, support, and securely wire reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers as required. Wet setting is prohibited of reinforcing steel unless approved by Engineer of record.
- D. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.
- E. Unless noted otherwise, all reinforcing steel shall conform to the Minimum Concrete Cover Schedule listed in the general construction notes sheet and ACI 318, whichever is greater.
- F. Reinforcing shall be lap spliced in accordance to ACI 318. Mechanical splices may be substituted when used in accordance with ACI 318 where they develop 125 percent of yield strength of the reinforcing steel. Mechanical splices must be submitted to the Railroad prior to incorporation into the work. Welding of reinforcing steel is not allowed under any circumstances.

### 3.03 PLACING CONCRETE SLABS

- A. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
- B. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
- C. Bring slab surface to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
- D. Maintain reinforcing in proper position during concrete placement operations.

### 3.04 PLACING VERTICAL CONCRETE

- A. (Pending Review).

### 3.05 COLD WEATHER CONCRETING

- A. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures in compliance with ACI 306 and as herein specified.
- B. Do not use calcium chloride, salt or other materials containing antifreeze agents or chemical accelerators.

### 3.06 HOT WEATHER CONCRETING

- A. When hot weather conditions exist, place concrete in compliance with ACI 305.

### 3.07 MONOLITHIC SLAB FINISH

- A. Float Finish:
  - 1. Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified.
  - 2. After screeding, consolidating and leveling concrete slabs, float concrete surface immediately. Do not trowel surface. Before surface water has appeared, check and level surface plane so that depressions between high spots do not exceed 1/4 IN under a 10 FT straightedge. Cut down high spots, and fill in low spots. Uniformly slope surfaces to drains. Immediately after leveling, re-float surface to a uniform, smooth, granular texture.
- B. Broom Finish: Apply non-slip medium broom or dragged burlap finish to exterior slabs.

### 3.08 CONCRETE CURING AND PROTECTION

- A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Start curing as soon as free water has disappeared from surface. Continue curing for seven days.
- B. Curing Methods: Perform curing of concrete by curing and sealing compound or moist curing or by moisture-retaining cover, or by combinations thereof, as specified in ACI 301.

- C. If liquid membrane curing compound is used, the Contractor shall ascertain that it is compatible with subsequent concrete coatings or finishes or shall remove all compound from the surface to prepare floor for seal coat or other finish.

### 3.09 QUALITY CONTROL TESTING DURING CONSTRUCTION

- A. A testing laboratory shall perform test and submit test reports. Cost of the testing laboratory shall be paid by the Contractor.
- B. Sampling and testing for quality control during placement of concrete shall include the following, as directed by the Engineer:
  - 1. Sampling Fresh Concrete: ASTM C172, except modified for slump to comply with ASTM C94.
  - 2. Compression Test Specimen: ASTM C31; one set of standard cylinders as required for the 28 day compressive strength test and one additional cylinder for 7 day compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.

### 3.10 COMPRESSIVE STRENGTH TESTS

- A. ASTM C39: One (1) set for each days' pour plus additional sets for each 50 CU YDS over and above the first 50 CU YDS of each concrete class placed in any one (1) day; one (1) specimen tested at seven (7) days and specimens tested at twenty-eight (28) days.
- B. Strength level of concrete will be considered satisfactory if averages of sets of three (3) consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive by more than 500 PSI.
- C. Test results will be reported in writing to the Architect/Engineer and Contractor within 24 HRS after tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, compressive strength at twenty-eight (28) days, concrete mix proportions and materials; compressive breaking strength and type of break for both seven (7) day tests and twenty-eight (28) day tests.

### 3.11 ADDITIONAL TESTS

- A. The testing service will make additional test of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Architect/Engineer. The testing service may conduct test to determine adequacy of concrete by cored cylinders complying with ASTM C42, or other methods as directed. The Contractor shall pay for such tests conducted and any other additional testing may be required, when unacceptable concrete is verified.

## **END OF SECTION**



## **SECTION 03 10 00 - FORMWORK**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Formwork requirements for concrete construction.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Section 01 12 10 - Contracts.**

##### **B. Section 03 09 00 - Structural Concrete For Buildings.**

#### **1.03 REFERENCED STANDARDS:**

##### **A. American Concrete Institute (ACI):**

1. 116R Cement and Concrete Terminology.
2. 347R Guide to Formwork for Concrete.

#### **1.04 QUALITY ASSURANCE**

##### **A. Qualifications:**

1. Formwork, shoring and reshoring shall be designed by a professional structural engineer currently registered in the state where the Work is located and having a minimum of 3 years' experience in this type of design work.

##### **B. Miscellaneous:**

1. Design and engineering of formwork, shoring, and reshoring as well as its construction is the responsibility of the Contractor.
2. Design Requirements:
  - a. Design formwork for loads, lateral pressures, and allowable stresses outlined in ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local building code. Where conflicts occur between the above two standards, the more stringent requirements shall govern.
  - b. Design formwork exposed to view to 1/240th of span between structural members.
3. Develop a procedure and schedule for removal of shores and for calculating the loads transferred to the structure during this process.
  - a. 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.

- b. When developing procedure, schedule and structural calculations, consider the following at each stage of construction.
  - 1) The structural system that exists.
  - 2) Effects of all loads during construction.
  - 3) Strength of concrete.
  - 4) The influence if deformation of the structure and shoring system on the distribution of dead loads and construction loads.
  - 5) The strength and spacing of shores or shoring systems used, as well as the method of shoring, bracing, shore removal, and reshoring including the minimum time intervals between the various operations.
  - 6) Any other loading or condition that affects the safety if serviceability of the structure during construction.

## 1.05 DEFINITIONS

- A. The words and terms used in these Specifications are defined in ACI 116R.

## 1.06 SUBMITTALS

- A. Shop Drawings:
  - 1. Submit under provisions of Section 01 33 00.
  - 2. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Manufacturer and type of proposed form materials.
    - d. Manufacturer and type of proposed form ties.
    - e. Manufacturer and type of proposed form coating material.
    - f. Manufacturer and type of void forms including compressive strength.
  - 3. Formwork designer qualifications.
  - 4. If requested, submit structural analysis and concrete strength data used in planning and implementing form removal and shoring.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Forms for Surfaces Exposed to View:
  - 1. Wood Forms:
    - a. New 5/8 IN or 3/4 IN, 5-ply structural plywood of concrete form grade.
    - b. Built-in-place or prefabricated type panel.

- c. 4 x 8 FT sheets for built-in-place type except where smaller pieces will cover the entire area.
  - d. When approved, plywood may be reused.
- 2. Metal forms:
  - a. Metal forms excluding aluminum may be used.
  - b. Forms to be tight to prevent leakage, free of dust, and straight without dents to provide members of uniform thickness.
- B. Forms for Surfaces Not Exposed to View:
  - 1. Wood or metal sufficiently tight to prevent leakage. Do not use Aluminum forms.

## 2.02 ACCESSORIES

- A. Form Ties:
  - 1. Commercially fabricated for use in form construction. Do not use wire ties.
  - 2. Constructed so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete.
  - 3. 3/4 IN minimum to 1 IN maximum diameter cones on both ends.
  - 4. Embedded portion of ties to be not less than 1-1/2 IN from face of concrete after ends have been removed.
  - 5. Provide ties with built-in water stops in all exterior pit and containment wall as well as exterior retaining walls.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Form Surface Treatment:
  - 1. Before placing of either reinforcing steel or concrete, cover surfaces of forms with an approved coating material that will effectively prevent absorption of moisture and prevent bond with concrete, will not stain concrete or prevent bonding of future finishes. A field-applied form release agent or sealer of approved type or a factory-applied, non-absorptive liner may be used.
  - 2. Do not allow excess form coating material to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.
- B. Provide temporary openings at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed, and to limit the height of free fall of concrete to prevent aggregate segregation. Temporary openings to limit height of free fall of concrete shall be spaced no more than 8 FT apart.
- C. Clean surfaces of forms, reinforcing steel and other embedded materials of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.

### 3.02 ERECTION

A. Install products in accordance with manufacturer's instructions.

B. Tolerances:

1. Variations from plumb:
  - a. In lines and surfaces of columns, piers, wall and risers:
    - 1) Maximum in any 10 FT of height: 1/4 IN.
    - 2) Maximum for entire height: 1/2 IN.
  - b. For exposed corner columns, control-joint grooves, and other exposed to view lines:
    - 1) Maximum in any 20 FT length: 1/4 IN.
    - 2) Maximum for entire length: 1/2 IN.
2. Variation from level or from grades specified:
  - a. In slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores.
    - 1) Maximum in any 10 FT of length: 1/4 IN.
    - 2) Maximum in any bay or in 20 FT length: 1/4 IN.
    - 3) Maximum for entire length: 3/4 IN.
  - b. In exposed lintels, sills, parapets, horizontal grooves and other exposed to view lines:
    - 1) Maximum in any bay or in 20 FT length: 1/4 IN.
    - 2) Maximum for entire length: 1/2 IN.
3. Variation of linear structure lines from established position in plan and related position of columns, walls, and partitions:
  - a. Maximum in any bay: 1/2 IN.
  - b. Maximum in any bay 20 FT of length: 1/2 IN.
  - c. Maximum for entire length: 1 IN.
4. Variation in sizes and location of sleeves, floor openings, and wall openings:
  - a. Maximum of  $\pm 1/2$  IN.
5. Variation in horizontal plan location of beam, column, and wall centerlines from required location:
  - a. Maximum of  $\pm 1/2$  IN.
6. Variation in cross-sectional dimensions of columns and beams and in thickness of slabs and walls:
  - a. Maximum of -1/4 IN, +1/2 IN.
7. Footings and foundations:
  - a. Variations in concrete dimensions in plan: -1/2 IN, +2 IN.

- b. Misplacement or eccentricity:
  - 1) 2 percent of footing width in direction of misplacement but not more than 2 IN.
- c. Thickness:
  - 1) Decrease in specified thickness: 5 percent.
  - 2) Increase in specified thickness: No limit except that which may interfere with other construction.
- 8. Variation in steps:
  - a. In a flight of stairs:
    - 1) Rise:  $\pm 1/8$  IN.
    - 2) Tread:  $\pm 1/4$  IN.
  - b. In consecutive steps:
    - 1) Rise:  $\pm 1/16$  IN.
    - 2) Tread:  $\pm 1/8$  IN.
- 9. Establish and maintain in an undisturbed condition and until final completion and acceptance of the Project, sufficient control points and bench marks to be used for reference purposes to check tolerances.
- 10. Regardless of tolerances listed allow no portion of structure to extend beyond legal boundary of the Project.
- 11. To maintain specified tolerances, camber formwork to compensate for anticipated deflections in formwork prior to hardening of concrete.
- C. Make forms sufficiently tight to prevent loss of mortar from concrete.
- D. Place  $3/4$  IN chamfer strips in exposed to view corners of forms to  $3/4$  IN wide beveled edges.
- E. At construction joints, overlap contact surface of form sheathing for flush surfaces exposed to view over hardened concrete in previous placement by at least 1 IN. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain a true surface. Where possible, locate juncture of built-in-place wood or metal forms at architectural lines, control joints, or at construction joints.
- F. Construct wood forms for wall openings for wall openings to facilitate loosening, if necessary, to counteract swelling.
- G. Anchor formwork to shores or other supporting surfaces or members so that movement of any part of formwork system is prevented during concrete placement.
- H. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing steel.
- I. Provide positive means of adjustment (wedges or jacks) of shores and struts and take up all settlement during concrete placing operation. Securely brace forms against lateral deflection. Fasten wedges used for final adjustment of forms prior to concrete placement in position after final check.

### 3.03 REMOVAL OF FORMS

- A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.
- B. When required for concrete curing in hot weather, required for repair of surface defects or when finishing is required at an early age- remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations or lack of support.
- C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging. Perform any needed repairs or treatment required on such sloping surfaces at once, followed by curing as specified in UPRR Specification Section 03 09 00.
- D. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete.
- E. Formwork of columns, walls, sides of beams and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.
- F. Where no reshoring is planned, leave forms and shoring used to support weight of concrete in place until concrete has attained its specified 28-day compressive strength. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.
- G. When shores and other vertical supports are so arranged that non-load-carrying form facing material may be removed without loosening or disturbing shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.

**END OF SECTION**

## **SECTION 03 10 10 - CONCRETE FORMWORK**

### **PART 1 - GENERAL**

#### **1.01 DESCRIPTION**

A. This Section includes but is not necessarily limited to:

1. Footings, foundation walls, floor slab, house pads, trash enclosure foundations, other similar concrete items not specifically mentioned herein.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 03 20 00 - Concrete Reinforcement
- B. Section 03 30 00 - Cast-in-Place Concrete.

#### **1.03 QUALITY ASSURANCE**

A. Qualifications of workmen:

1. Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of materials being installed, the referenced standards, and the requirements of this Work, and who shall direct all Work performed under this Section.

B. Codes and standards:

1. Comply with applicable provisions of the latest edition of the Building Code that has jurisdiction and occupational Safety and Health Act.
2. Where provisions of pertinent codes and standards conflict with the requirements of this Section of these Specifications, the more stringent provisions shall govern.
3. Product Standard PS 1-74 for softwood plywood.
4. American Concrete Institute Standard recommended practice for concrete formwork, ACI 347-latest edition.

#### **1.04 TESTING LABORATORY SERVICES**

A. In accordance with Section 01 43 26.

### **PART 2 - PRODUCTS**

#### **2.01 FORM MATERIALS**

A. Form lumber:

1. Forms for Exposed Finished Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced or other panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Finish the largest practicable sizes to minimize the number of joints. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection. All form lumber in contact with exposed concrete shall be new except as allowed for re-use of forms in Part 3 of this Section of these Specifications, and all form lumber shall be one

of the following, a combination thereof, or an equal approved in advance by the Architect:

- a. Plyform", Class I 5/8" PS 1-66, C-D exterior plywood, bearing the label of the Douglas Fir Plywood Association.
  - b. Douglas Fir-Larch, number two grade seasoned, surfaced four (4) sides.
- B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least two (2) edges and one (1) side for tight fit.
- C. Chamfer strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch minimum.

## 2.02 OTHER MATERIALS

- A. Form Coatings: Provide commercial formulation form-coating compounds that will not bind with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.
- B. All other materials, not specifically described but required for proper completion of concrete framework, shall be as selected by the Contractor subject to the advanced approval of the Architect.

## PART 3 - EXECUTION

### 3.01 SURFACE CONDITIONS

- A. Inspection:
  - 1. Prior to all Work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
  - 2. Verify that forms may be constructed in accordance with all pertinent codes and regulations, the referenced standards, and the original design.
- B. Discrepancies:
  - 1. In the event of discrepancy, immediately notify the Architect.
  - 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

### 3.02 CONSTRUCTION OF FORMS

- A. General:
  - 1. Design, erect, shore, brace, and maintain formwork, according to ACI 301 to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
  - 2. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
  - 3. Construct forms tight enough to prevent loss of concrete mortar.



4. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
5. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
6. Chamfer exterior corners and edges of permanently exposed concrete.
7. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required for the Work. Determine sizes and locations from trades providing such items.
8. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
9. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
10. Coat contact surfaces of forms with form release agent, according to manufacturer's written instructions, before placing reinforcement.

B. Embedded items:

1. Set all required steel frames, angles, grilles, bolts, inserts, and other such items required to be anchored in the concrete before the concrete is placed. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

C. Bracing:

1. Properly brace and tie the forms together so as to maintain position and shape and to ensure safety to personnel.
2. Construct all bracing, supporting members, and centering of ample size and strength to safely carry, without excessive deflection, all loads to which they may be subjected.
3. Properly space the forms apart and securely tie them together, using metal spreader ties that give positive tying and accurate spreading

### 3.03 RE-USE OF FORMS

#### A. General:

1. Re-use of forms shall be subject to advance approval of the Architect.

#### B. Requirements:

1. Except as specifically approved in advance by the Architect, re-use of forms shall in no way delay or change the schedule for placement of concrete from the schedule obtainable if all forms were new.
2. Clean and repair surfaces of forms to be reused in the Work.
3. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces.
4. Apply new form-release agent.
5. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets.
6. Do not use patched forms for exposed concrete surfaces unless approved by Architect.
7. Except as specifically approved in advance by the Architect, re-use of forms shall in no way impart less structural stability to the forms nor less acceptable appearance to finished concrete

### 3.04 REMOVAL OF FORMS -USE OF FORMS

#### A. General:

1. Removal of formwork may be extended if deemed necessary by the Architect.
  - a. Slabs and curbs: 24 hours
  - b. Vertical walls (4'-0" Ht. and less): 36 hours
  - c. Vertical walls (over 4'-0" Ht.): 7 days
2. Do not remove forms until the Architect's approval has been obtained.

#### B. Removal:

1. Remove metal spreader ties on exposed concrete by removing or snapping off inside the wall surface and pointing up and rubbing the resulting pockets to match the surrounding areas.
2. Flush all holes resulting from the use of spreader rods and sleeve nuts, using water, and then solidly pack throughout the wall thickness with cement grout applied under pressure by means of a grouting gun; grout shall be (1) part Portland cement to two and one-half (2-1/2) parts sand; apply grout immediately after removing forms

**END OF SECTION**

## **SECTION 03 12 00 - NON-REINFORCED CONCRETE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Installation of non-reinforced concrete, in accordance with these Specifications, and in close conformity with the lines, grades and dimensions as shown on the Drawings or established by the Engineer.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. 01 43 26 Laboratory and Field Testing Services
- B. 03 09 00 Concrete Work
- C. 03 10 00 Formwork
- D. 31 24 13 Excavation, Embankments and Other Fills

### **PART 2 - PRODUCTS**

#### **2.01 HORIZONTAL AND LONGITUDINAL TIE BARS**

- A. The Contractor shall furnish all reinforcing steel bars fabricated to shapes and dimensions shown on drawings. Contractor shall unload and place reinforcing steel where indicated on drawings or where required to carry out the intent of the drawings or specifications. Before being placed, reinforcing steel shall be thoroughly cleaned of loose or flaky rust, mill scale or coating, including ice, or any other substance that would reduce or destroy the bond.
- B. Reinforcing steel reduced in section shall not be used. It shall not be bent or straightened in a manner injurious to the steel. Bars with kinks or bends not shown on plans shall not be placed. The use of heat to bend or straighten reinforcing steel will be permitted only if the entire operation is approved by the Engineer.
- C. Splicing of reinforcing steel, if required, will be made of lap splices of a minimum length of 24 bar diameters, not less than 12 IN.
- D. All reinforcing steel shall meet the requirements of ASTM A615 for Grade 60 deformed billet steel bars for concrete reinforcement.

#### **2.02 CONCRETE**

- A. Contractor shall furnish and place concrete in accordance with these Specifications and in close conformity with the lines, grades and dimensions as shown on the Drawings or established by Engineer.
- B. Concrete material, mixing, transportation, placing and curing shall conform to AREMA Specifications for Concrete and Reinforced Concrete Railroad Bridges and Other Structures.
  1. Compressive Strength: 4,000 LBS/SQ IN @ 28 days.

2. Water Content: 6-1/2 GAL Maximum per Sack of Cement.
  3. Concrete Aggregates: To comply with current ASTM C33 Specifications.
  4. Coarse aggregate shall be graded #4 to 1 IN size.
- C. Mix:
1. Approximate proportions Cement: Sand: Gravel: by volume measure to be 1:2.5:3.2. Minimum cement content to be 6.5 sacks per CU YD.
- D. Slump:
1. 2 IN to 3 IN for heavy mass construction and pavements.
  2. 2 IN to 5 IN for reinforced foundation walls and footings.
  3. 3 IN to 5 IN for reinforced structural members - slabs, columns, beams and walls.
- E. Curing: Membrane curing shall be used following recommendations and procedures of AREMA Specifications Chapter 8, Part 1, Sec. P, Art. 4.

### PART 3 - EXECUTION

#### 3.01 GENERAL

- A. Concrete shall be placed within 1-1/2 HRS after the cement has been added to the mix. A delivery ticket shall be furnished to the Engineer with the following information: name of concrete firm, serial number of ticket, date, truck number, specific class of concrete, amount of concrete, time loaded, water added and time unloaded.
- B. Prior to placing concrete, remove water, all debris and foreign material from forms. Check the reinforcing steel for proper placement and correct any discrepancies. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 2 FT deep.
- C. The vertical drop to final placement shall not exceed 4 FT. Placement shall conform to the requirements of the before mentioned.
- D. After the initial water has been absorbed, float with wood float and trowel with steel trowel to a smooth finish free from trowel marks. Concrete abutments shall not vary from level or true plane more than 1/8 IN in 10 FT when measured with a straightedge.
- E. Construction joints shall be placed as indicated on the plans or as directed by the Engineer and shall be formed so as not to impair the strength and appearance of the structure.
- F. In joining fresh concrete to concrete that has already set, the work already in place shall have its surface sand or water blasted until well bonded aggregate is exposed. This surface shall be washed and scrubbed with wire brooms and thoroughly drenched with water until saturated. It shall remain saturated until the new concrete is placed. Immediately prior to the placing of the new concrete, all forms shall be drawn tight against the concrete already in place and the old surface shall be thoroughly coated with a water cement paste, scrubbed into the existing concrete surface.

- G. Remove form after concrete has set sufficiently to carry the dead load and construction loads and when approved by the Engineer. Remove forms with care to prevent scarring and damaging the surface. As soon as forms are removed, remove fins or projections from surface of exposed areas and rub surface with wood float or burlap sack to provide a uniform surface texture.
- H. Cure formed surfaces with an approved curing compound applied in conformance with the manufacturer's directions as soon as the forms are removed and finishing completed.
- I. The quantity of concrete for which payment will be made shall be computed from the dimensions shown in the plans, or ordered by the Engineer. No deductions shall be made for the volume of concrete displaced by steel reinforcement, floor drains or expansion joint material.

### 3.02 FIELD QUALITY CONTROL

- A. Concrete samples shall be obtained in accordance with the requirements of ASTM C172. Air content, slump, and unit weight shall be checked at least twice during each shift that concrete is placed. Air content shall be determined in accordance with ASTM C231. Slump shall be measured in accordance with ASTM C143. Unit weight shall be checked in accordance with ASTM C138.
- B. Samples for strength testing of each concrete mix shall be taken not less than once each day nor less than once for each 150 CU YDS of concrete. A minimum of three cylinders shall be made from each sample, two shall be tested at 28 days and one shall be tested at 7 days. Compression test specimens shall be made and cured in accordance with ASTM C31 and tested in accordance with ASTM C39.
- C. Any concrete represented by a test which indicates a strength which is less than the specified 28-day strength will be subject to rejection and shall be removed and replaced with acceptable concrete as directed by the Engineer at no additional cost to the Railroad.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 PAYMENT

- A. Payment for "Non-reinforced Concrete" will be made at the contract unit price and shall be full compensation for all costs involved in furnishing, forming and placing all concrete, reinforcing steel, welded wire fabric, required grouts, dowels, expansion joint material, epoxy, and mortars, all as specified herein and shown on the drawings. It includes all tools, labor, supplies, materials, equipment, testing and work incidental thereto.

**END OF SECTION**

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## **SECTION 03 13 00 - REINFORCED CONCRETE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Installation of reinforced concrete, in accordance with these Specifications, and in close conformity with the lines, grades and dimensions as shown on the Drawings or established by the Engineer.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. 01 43 26 Laboratory and Field Testing Services
- B. 03 09 00 Structural Concrete For Buildings
- C. 03 10 00 Formwork

### **PART 2 - PRODUCTS**

#### **2.01 REINFORCING STEEL**

- A. The Contractor shall furnish all reinforcing steel bars fabricated to shapes and dimensions shown on drawings. Contractor shall unload and place reinforcing steel where indicated on drawings or where required to carry out the intent of the Drawings or Specifications. Before being placed, reinforcing steel shall be thoroughly cleaned of loose or flaky rust, mill scale or coating, including ice, or any other substance that would reduce or destroy the bond.
- B. Reinforcing steel reduced in section shall not be used. It shall not be bent or straightened in a manner injurious to the steel. Bars with kinks or bends not shown on plans shall not be placed. The use of heat to bend or straighten reinforcing steel will be permitted only if the entire operation is approved by the Engineer.
- C. Splicing of reinforcing steel, if required, will be made of lap splices of a minimum length of 24 bar diameters, not less than 12 IN.
- D. All reinforcing steel shall meet the requirements of ASTM A615 for Grade 60 deformed billet steel bars for concrete reinforcement.

#### **2.02 CONCRETE**

- A. Contractor shall furnish and place concrete in accordance with these Specifications and in close conformity with the lines, grades and dimensions as shown on the Drawings or established by Engineer.
- B. Concrete material, mixing, transportation, placing and curing shall conform to AREMA Specifications for Concrete and Reinforced Concrete Railroad Bridges and Other Structures.
  1. Compressive Strength: 4,000 LBS/SQ IN @ 28 days.
  2. Water Content: 6-1/2 GAL Maximum per Sack of Cement.

3. Concrete Aggregates: To comply with current ASTM C33 Specifications.
  4. Coarse aggregate shall be graded #4 to 1 IN size.
- C. Mix - Approximate proportions Cement: Sand: Gravel: by volume measure to be 1:2.5:3.2. Minimum cement content to be 6.5 sacks per CU YD.
- D. Slump:
1. 2 IN to 3 IN for heavy mass construction and pavements.
  2. 2 IN to 5 IN for reinforced foundation walls and footings.
  3. 3 IN to 5 IN for reinforced structural members - slabs, columns, beams and walls.
- E. Curing: Membrane curing shall be used following recommendations and procedures of AREMA Specifications Chapter 8, Part 1, Sec. P, Art. 4.

### PART 3 - EXECUTION

#### 3.01 GENERAL

- A. Concrete shall be placed within 1-1/2 HRS after the cement has been added to the mix. A delivery ticket shall be furnished to the Engineer with the following information: name of concrete firm, serial number of ticket, date, truck number, specific class of concrete, amount of concrete, time loaded, water added and time unloaded.
- B. Prior to placing concrete, remove water, all debris and foreign material from forms. Check the reinforcing steel for proper placement and correct any discrepancies. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 2 FT deep.
- C. The vertical drop to final placement shall not exceed 4 FT. Placement shall conform to the requirements of the before mentioned.
- D. After the initial water has been absorbed, float with wood float and trowel with steel trowel to a smooth finish free from trowel marks. Concrete abutments shall not vary from level or true plane more than 1/8 IN in 10 FT when measured with a straightedge.
- E. Construction joints shall be placed as indicated on the plans or as directed by the Engineer and shall be formed so as not to impair the strength and appearance of the structure.
- F. In joining fresh concrete to concrete that has already set, the work already in place shall have its surface sand or water blasted until well bonded aggregate is exposed. This surface shall be washed and scrubbed with wire brooms and thoroughly drenched with water until saturated. It shall remain saturated until the new concrete is placed. Immediately prior to the placing of the new concrete, all forms shall be drawn tight against the concrete already in place and the old surface shall be thoroughly coated with a water cement paste, scrubbed into the existing concrete surface.



- G. Remove form after concrete has set sufficiently to carry the dead load and construction loads and when approved by the Engineer. Remove forms with care to prevent scarring and damaging the surface. As soon as forms are removed, remove fins or projections from surface of exposed areas and rub surface with wood float or burlap sack to provide a uniform surface texture.
- H. Cure formed surfaces with an approved curing compound applied in conformance with the manufacturer's directions as soon as the forms are removed and finishing completed.
- I. The quantity of concrete for which payment will be made shall be computed from the dimensions shown in the plans, or ordered by the Engineer. No deductions shall be made for the volume of concrete displaced by steel reinforcement, floor drains or expansion joint material.

### 3.02 FIELD QUALITY CONTROL

- A. Concrete samples shall be obtained in accordance with the requirements of ASTM C172. Air content, slump, and unit weight shall be checked at least twice during each shift that concrete is placed. Air content shall be determined in accordance with ASTM C231. Slump shall be measured in accordance with ASTM C143. Unit weight shall be checked in accordance with ASTM C138.
- B. Samples for strength testing of each concrete mix shall be taken not less than once each day, nor less than once for each 150 CU YD of concrete. A minimum of three cylinders shall be made from each sample, two shall be tested at 28 days and one shall be tested at 7 days. Compression test specimens shall be made and cured in accordance with ASTM C31 and tested in accordance with ASTM C39.
- C. For bridges, five cylinders will be cast at the beginning of concrete placement for each shaft and each cap. Compressive strength testing on the cylinders will be as follows:
  - 1. 1 cylinder for a 3-day break.
  - 2. 1 cylinder for a 7-day break.
  - 3. 2 cylinders for a 28-day break.
  - 4. 1 extra cylinder.
- D. Any concrete represented by a test which indicates a strength which is less than the specified 28-day strength will be subject to rejection and shall be removed and replaced with acceptable concrete as directed by the Engineer at no additional cost to the Railroad.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 PAYMENT

- A. Payment for "Reinforced Concrete" will be made at the contract unit price and shall be full compensation for all costs involved in furnishing, forming and placing all concrete, reinforcing steel, welded wire fabric, required grouts, dowels, expansion joint material, epoxy, and mortars, all as specified herein and shown on the drawings. It includes all tools, labor, supplies, materials, equipment, testing and work incidental thereto.

**END OF SECTION**

## **SECTION 03 15 13 - CHEMICALLY RESISTANT WATERSTOPS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Embedded waterstop in concrete including control, expansion and construction joints creating a continuous diaphragm to prevent passage of fluid.
2. Use of non-metallic waterstops for use in concrete joints subjected to chlorinated water, seawater, oils, solvents, acids, salts, fuels and many other aggressive chemicals and fluids.

#### **1.02 REFERENCED STANDARDS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. Codes & Standards: To comply with most recent provisions of following codes, specifications and standards, except where more stringent requirements are shown or specified.
- C. American Society for Testing and Materials (ASTM):
  1. D395, Test Methods for Rubber Property – Compression Set.
  2. D412, Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers – Tension.
  3. D471, Test Method for Rubber Properties – Effects of Chemicals.
  4. D624, Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
  5. D746, Test Method for Brittleness Temperature of Plastics by Impact.
  6. D792, Test Method for Specific Gravity (Gravity Density) and Density of Plastics by Displacement.
  7. D1171, Test Method for Ozone Resistance at 500 pphm.
  8. D2240, Test Method for Shore Hardness.
- D. Federal Specifications:
  1. COE CEGS-03250 July 1995 Guide Specification for Military Construction.
  2. EPA Title 40 CFR Section 265.193
- E. American Concrete Institute (ACI):
  1. 350.2R-04, Concrete Structures for Containment of Hazardous Wastes
- F. NSF International (NSF):
  1. 61, Certification for Drinking Water System Components – Health Effects.
- G. Canadian Council of Ministers of the Environment:

1. Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products

H. BuildingGreen, Inc.:

1. GreenSpec® - Green Spec® Directory 6th Edition.

1.03 SUBMITTALS

A. Chemical Resistant Waterstops:

1. TPV Waterstop submittal shall contain the following:
  - a. Samples of each size and shape used.
  - b. Plate drawings of waterstop profile indicating all dimensions.
  - c. Shop drawings of each shop made fittings to be provided by the manufacturer or prepared by the contractor.
  - d. Copy of test results of ASTM D471 Chemical Resistance showing compliance with Appendix A.
  - e. Copy of independent certification to NSF/ANSI Standard 61 Certification for Drinking Water System Components – Health Effects.
  - f. Copy of independent testing to ASTM D1171 Ozone Resistance to 500 pphm concentration.
  - g. Manufacturer's Literature, including MSDS sheets, installation instructions and splicing instructions.
  - h. Certificate of compliance to physical properties outlined in this specification.
2. Non-Metallic Waterstop and Splices – Specimens identified to indicate manufacturer, type of material, size, quantity of material and shipment or lot presented. Each sample shall be a piece not less than 6 IN long of each type, size, and lot furnished. One splice sample of each size and type for every fifty (50) splices made in the shop and every ten (10) splices made at the job site. The splice samples shall be made using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each splice shall be not less than 1 FT long.

1.04 QUALITY ASSURANCE

- A. Edge welding will not be permitted. Center bulbs shall be compressed or closed when welding to non-center-bulb type.
- B. Waterstop splicing defects which are unacceptable include, but are not limited to the following:
  1. Tensile strength not less than 60 percent of parent sections.
  2. Free lap joints.
  3. Misalignment of center bulbs, ribs and end bulbs greater than 1/16 IN.
  4. Misalignment which reduces waterstop cross section more than 15 percent.
  5. Bond failure at joint deeper than 1/16 IN or 15 percent of material thickness.

6. Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 1/2 IN in 10 FT.
7. Visible porosity in the weld.
8. Charred or burnt material.
9. Bubbles or inadequate bonding.
10. Visible signs of splice separation when cooled splice (24 HRS or greater) is bent by hand at a sharp angle.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt and other contaminants.

### PART 2 - PRODUCTS

#### 2.01 WATERSTOPS

- A. Intersections and changes of direction of waterstops shall be shop fabricated.
- B. Manufacturers:
  1. JP Specialties Inc.  
551 Birch Street, Lake Elsinore, CA 92530  
P. 888-836-5778  
F. 951-674-1315  
Web: [www.earthshield.com](http://www.earthshield.com)
  2. Greenstreak Group, Inc.  
3400 Tree Court Industrial Blvd, St. Louis, MO 63122  
P. 800-325-9504  
F. 800-551-5145  
Web: [www.greenstreak.com](http://www.greenstreak.com)
- C. Non-Metallic Waterstops – Nonmetallic waterstops shall be manufactured from a fully cross-linked thermoplastic vulcanizate, containing no scrap or reclaimed material.
  1. Thermoplastic Vulcanizate (TPV) Waterstop shall conform to EPA title 40 CFR Section 265.193. The suitability of the waterstop for a specific application should be determined by specific testing for that particular requirement by ASTM D471.
  2. Thermoplastic Vulcanizate (TPV) Waterstop shall be certified for use in potable water per NSF / ANSI Standard 61. Third-party certified documentation to be provided by the Manufacturer.

- D. Thermoplastic Vulcanizate (TPV) Waterstop shall conform to the following typical physical properties:

PROPERTY	TEST METHOD	REQUIRED RESULTS
Specific Gravity	ASTM D792	.96
Shore A Hardness (5 sec.)	ASTM D2240	90±3 at 25 Deg. C (77 Deg. F)
Tensile Strength	ASTM D412	2300 psi
Ultimate Elongation	ASTM D412	530 percent
100% Modulus	ASTM D746	1000 psi
Tear Strength	ASTM D624	278 pli @ 35 Deg. C
Compression Set	ASTM D395	29 percent at 25 Deg. C (77 Deg. F)
Brittle Point	ASTM D746	-73 Deg. C (-174 Deg. F)
Drinking Water Safe	NSF / ANSI 61	Certified for use in potable water (see Appendix B)
Ozone Resistance	ASTM D1171	Passed, no cracking at 500 pphm
Chemical Resistance	ASTM D471	Meet or exceed specific testing standards for contained fluids as required by the Owner and <i>certified</i> by the Manufacturer.
Green Certification	GreenSpec	Approved

### PART 3 - EXECUTION

#### 3.01 WATERSTOP INSTALLATIONS AND SPLICES

- A. Waterstops shall be installed at the locations shown to form a continuous fluid-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Exposed waterstops shall be protected during application of form release agents to avoid being coated. Suitable guards shall be provided to protect exposed projecting edges and end of partially embedded waterstops from damage when concrete placement has been discontinued.
1. Non-Metallic Shop Made Fittings – Fittings shall be shop made using a machine specifically designed to mechanically weld the waterstop. A miter gauge, proper fixturing (profile dependent) and portable power saw shall be used to miter cut the ends to be joined to ensure good alignment and contact between jointed surfaces. The splicing of straight lengths shall be done by squaring the ends to be jointed and using a manufacturer approved waterstop splicing tool. Continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions, etc.) shall be maintained across the splice.
  2. Thermoplastic Vulcanizate Waterstop – The splicing of straight lengths shall be done by squaring the ends to be joined and using the manufacturers recommended waterstop splicing tool utilizing a thermoplastic splicing iron with a non-stick surface specifically designed for waterstop welding. The correct temperature (410 to 430 Deg. F) shall be used to sufficiently melt without charring the plastic. The spliced area, when cooled, shall show no signs of separation, holes or other imperfections when bent by hand in as sharp an angle as possible.

### 3.02 PREPARATION

- A. Uncoil waterstop 24 HRS prior to installation for ease of handling and fabrication.
- B. Position waterstop to ensure proper distance from steel reinforcing bars to prevent rock pockets and honeycomb (See installation Section 3.04).
- C. Protect Waterstop from damage during progress of work.
- D. Clean Concrete joint after each pour to remove debris and dirt.

### 3.03 EXAMINATION / INSPECTION

- A. Prior to placement of concrete notify the Engineer for field inspection approval.
- B. Inspect waterstop and field splices for defects and conformance to Quality Assurance Standard Section 3.05.
- C. Upon inspection of waterstop installation, replace any damaged or unacceptable waterstop and dispose of defective material.

### 3.04 INSTALLATION

- A. Position waterstop in joint as indicated on Drawings.
- B. Center waterstop on joint, with approximately one-half of waterstop width to be embedded in concrete on each side of the joint.
- C. Allow clearance between waterstop and reinforcing steel of a minimum of two times the largest aggregate size. Prevent rock pockets and air voids caused by aggregate bridging.
- D. Ensure center bulb is not embedded at expansion joints.
- E. Secure waterstop in correct position using optional factory-installed brass eyelets (or JPS hog rings crimped between the two ribs on 1 FT maximum centers), and wire tie to adjacent reinforcing steel. Center to center spacing may be increased upon request and approval from the Engineer.
- F. Carefully place concrete without displacing waterstop from its proper position.
- G. Thoroughly and systematically vibrate concrete in the vicinity of the joint, and to maximized intimate contact between concrete and waterstop.
- H. After first pour, clean the un-embedded waterstop leg to ensure full contact of second concrete pour. Remove laitance, spillage, form oil and dirt.
- I. Wet setting of waterstop is not an acceptable installation method.

**END OF SECTION**

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## **SECTION 03 20 00 - CONCRETE REINFORCEMENT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This Section includes but is not necessarily limited to:
  - 1. Reinforcing bars, wire & wire fabric.

#### **1.02 1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Division 03 - Concrete Formwork.
- D. Division 03 - Cast-in-Place Concrete.

#### **1.03 QUALITY ASSURANCE**

- A. Qualifications of Workmen:
  - 1. Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of materials being installed and the best methods for their installation and who shall direct all Work performed under this Section.

#### **1.04 REFERENCED STANDARDS**

- A. Comply with applicable provisions of the latest edition of the Building Code that has jurisdiction.
- B. Where provisions of pertinent codes and standards conflict with this Specification, the more stringent provisions shall govern.
- C. ACI – American Concrete Institute

#### **1.05 SUBMITTALS**

- A. Shop Drawings:
  - 1. Before any concrete reinforcement materials are fabricated and/or delivered to the job site, submit Shop Drawings to the Architect.
  - 2. Do not fabricate and/or deliver concrete reinforcement to the job site until receipt of Shop Drawings approval from the Architect.
  - 3. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

## 1.06 TESTING LABORATORY SERVICES

- A. In accordance with Section 01 43 26.

## 1.07 PRODUCT HANDLING

### A. Protection:

1. Use all means necessary to protect concrete reinforcement before, during, and after installation and to protect the installed work and materials of all other trades.
2. Store in a manner to prevent excessive rusting and fouling and dirt, grease, and other bond-breaking coatings.

### B. Replacements:

1. In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

## PART 2 - PRODUCTS

### 2.01 CONCRETE REINFORCEMENT

- A. All concrete reinforcement materials shall be new, free from rust, and complying with the following reference standards:
  1. Bars for reinforcement: "Specifications for Deformed Billet-Steel Bars for Concrete Reinforcement", ASTM, A615 latest editions, Grade 60.
  2. Wire for reinforcement: "Specifications for Cold-Drawn Steel Wire for Concrete Reinforcement", ASTM A82.
  3. Wire fabric "Specifications for Wire Fabric for Concrete Reinforcement", ASTM A185 latest editions.

### 2.02 OTHER MATERIALS

- A. All other materials, not specifically described but required for a complete and proper installations of concrete reinforcement, shall be as selected by contractor subject to approval of the Architect.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacturer bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete. Concrete blocks or bricks shall not be used.
- C. Joint Dowel Bars: Plain-steel bars, ASTM A615/A615M, Grade 60. Cut Bars true to length with ends squared and free of burns.

## PART 3 - EXECUTION

### 3.01 SURFACE CONDITIONS

#### A. Inspection:

1. Prior to installation of the Work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that concrete reinforcement may be installed in strict accordance with all pertinent codes and regulations, the approved Shop Drawings, and the original design.

#### B. Discrepancies:

1. In the event of discrepancy, immediately notify the Architect.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

### 3.02 BENDING

#### A. General:

1. Fabricate all reinforcement in strict accordance with the approved Shop Drawings.
2. Do not use bars with kinks or bends not shown on the Drawings or on the approved Shop Drawings.
3. Do not bend or straighten steel in a manner that will injure the material.

### 3.03 PLACING

#### A. General:

1. Comply with CRSI's "Manual of Standard Practice" for placing reinforcing.
2. Before the start of concrete placement, accurately place all concrete reinforcement, positively securing and supporting by means of chairs, spacers, and metal hangers. Do not tack weld crossing reinforcing bars.

#### B. Clearance:

1. Preserve clear space between bars of not less than 1-1/2 times the nominal diameter of round bars.
2. Provide minimum concrete covering of reinforcement as shown or noted on the Drawings.
3. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
4. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

### 3.04 CLEANING REINFORCEMENT

- A. Steel reinforcement, at the time concrete is placed around it, shall be free from rust scale, loose mill scale, oil paint, and all other coatings which will destroy or reduce bond between steel and concrete.

**END OF SECTION**

## **SECTION 03 30 00 - CAST-IN-PLACE CONCRETE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

A. This Section includes but is not necessarily limited to:

1. Footings.
2. Foundation Walls.
3. Slabs on Grade.
4. Fill for Steel Deck.
5. Equipment Pads and Bases.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 23 - Shop Drawings.
- B. Section 01 43 26 - Testing Laboratory Services.
- C. Section 32 01 13 - Asphalt Concrete Paving.
- D. Section 03 10 00 - Concrete Formwork.
- E. Section 03 20 00 - Concrete Reinforcement.
- F. Section 03 35 00 - Cement Finishes and Surface Treatments.

#### **1.03 QUALITY ASSURANCE**

- A. Perform cast-in-place concrete work in accordance with ACI 318, unless specified otherwise in this Section.
- B. Where provisions of pertinent codes and standards conflict with this Specification, the more stringent provisions shall govern.

#### **1.04 REFERENCED STANDARDS**

- A. American Concrete Institute (ACI):
  1. 301, Specifications for Structural Concrete for Buildings.
  2. 304, Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
  3. 305, Recommended Practice for Hot Weather Concreting.
  4. 306, Recommended Practice for Cold Weather Concreting.
  5. 318, Building Code Requirements for Reinforced Concrete.
- B. ASTM International (ASTM):
  1. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field
  2. C33, Concrete Aggregates.

3. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. C94, Ready-mixed Concrete.
5. C150, Portland Cement.
6. C172, Standard Practice for Sampling Freshly Mixed Concrete
7. C260, Air Entraining Admixtures for Concrete.

#### 1.05 SUBMITTALS

##### A. Materials List:

1. Before any concrete is delivered to the job site, submit to the Architect a complete list of all materials proposed to be furnished and installed under this portion of the Work, showing manufacturer's name and catalog number of all items and the name and address of transit mix concrete supplier and proposed mix design and test data.
2. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

##### B. Laboratory Test Reports:

1. Submit laboratory test reports for concrete materials and mix design for each class of concrete specified.

#### 1.06 TESTING LABORATORY SERVICES

- A. Concrete Testing Service: Concrete Testing specified hereinafter shall be done by an independent testing laboratory approved by the Owner.

### PART 2 - PRODUCTS

#### 2.01 CONCRETE MATERIALS

- A. Portland Cement: Conforming to requirements of ASTM C150, Type I, and shall be the product of one (1) manufacturer.
- B. Normal Weight Aggregates: Well graded to minimize the quantity of cement past required yet provide for the specified slump and workability. Provide aggregates from a single source with documented service record data of at least 10 years satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
1. Normal weight aggregates shall conform to ASTM C33.
  2. Use 3/4 IN aggregate maximum in all concrete.
  3. All aggregates shall be from State DOT approved sources.
- C. Water: Potable, clean and free from deleterious matter and complying with ASTM C94.
- D. Fly-Ash: Not permitted unless approved in writing by the Engineer and Union Pacific.

## 2.02 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.
- B. Air Entraining Admixture: ASTM C260.
  - 1. “Air-mix”, Euclid Chemical Company.
  - 2. “Sika-Aer”, Sika Corp.
  - 3. “MB-VR OR MB-AE”, Master Builders.
  - 4. “Darex AEA” or “Darrair”; W.R. Grace.
- C. Water Reducing Admixtures: ASTM C 494, Type A., and containing no more than 0.1 percent chloride ions.
  - 1. WRDA Hycol”, W.R. Grace.
  - 2. “Eucon WR-75”, Euclid Chemical Co.
  - 3. “Pozzolith Normal”, Master Builders.
  - 4. “Plastocrete 160”, Sika Chemical Co.
- D. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
- E. Water-Reducing and Accelerating Admixture: ASTM C494, Type E.
  - 1. “Accelguard 80”, Euclid Chemical Company.
  - 2. “Pozzolith High Early”, Master Builder.
- F. Water Reducing and Retarding Admixture:
  - 1. “Pozzolith Retarder”, Master Builders.
  - 2. “Eucon Retarder 75”, Euclid Chemical Co.
  - 3. “Daratard”, W.R. Grace.
  - 4. “Plastiment”, Sika Chemical Co.

## 2.03 ABSORPTIVE COVER

- A. Burlap cloth made from jute or kenaf, weighting approximately 9 OZ/SQ YD complying with AASHTO M182, Class 2.

## 2.04 MOISTURE RETAINING COVER

- A. Vapor Retarder: ASTM E1745, Class A, not less than 10 mils thick.

## 2.05 LIQUID MEMBRANE FORMING CURING COMPOUND

- A. Liquid type membrane-forming curing compound complying with ASTM C309, Type I-D, Class A unless other types acceptable to the Railroad. Moisture loss not more than 0.55 kg/SQ M when applied at 300 SQ FT/GAL.
  - 1. Clear, Waterborne, Membrane-Forming Curing Compound:

- a. Rez-Seal by Euclid Chemical Company.
  - b. Safe-Cure & Seal 20; ChemMasters.
  - c. Safe Cure and Seal; Dayton Superior Corporation.
  - d. L&M Cure R, L&M Construction Chemicals.
  - e. Vocomp-20; W. R. Meadows, Inc.
  - f. Masterkure, Master Builders, Inc.
  - g. Kure-N-Seal WB; Sonneborn, Div. of ChemRex, Inc.
  - h. Cure & Seal 14 percent E; Symons Corporation.
2. The Contractor shall verify that the selected curing compound in each area is compatible with the selected floor finish for that area.

## 2.06 RELATED MATERIALS

- A. Non-shrink, Non-metallic Grout: ASTM C1107 Grade B.
  1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic cement grout, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
  2. Design Mix: 5000 psi compressive strength at twenty-eight (28) days.
- B. Waterstops:
  1. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
    - a. Profile: Flat, dumbbell with center bulb.
  2. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.
    - a. Profile: Flat, dumbbell with center bulb.
- C. Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber, or ASTM D1752, cork or self-expanding cork.
- D. Bonding Agent: ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- E. Other Materials: All other materials, not specifically described but required for a complete and proper installation of cast-in-place concrete shall be as selected by the Contractor subject to approval of the Architect / Engineer.

## 2.07 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301. If trial batch method is used, use an independent testing facility acceptable to the Architect-Engineer for preparing and reporting proposed mix designs.



- B. Submit written reports to the Railroad of each proposed mix for each class of concrete at least 15 days prior to the start of work. Do not begin concrete production until mixes have been reviewed by the Engineer.
- C. Design mixes to provide normal weight concrete as indicated in the structural general notes on the drawings.
- D. Compressive Strengths:
  - 1. All concrete shall attain a minimum twenty-eight (28) day compressive strength of 4,000 psi.
  - 2. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
    - a. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
    - b. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
- E. Water - Cement Ratio:
  - 1. Maximum Water-Cementitious Materials Ratio:
    - a. Foundations & all concrete exposed to de-icers or subject to freezing and thawing - 0.40.
    - b. Enclosed Building Slabs - 0.45.
- F. Slump:
  - 1. Maximum slump for 4,000 psi concrete shall be 3 IN,  $\pm 1$  IN.
- G. Air Content:
  - 1. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content as follows within a tolerance of +1 or -1.5 percent, unless otherwise indicated. Air entraining admixture is not required for the enclosed building slabs and shall not be used in concrete to receive a trowel finish.
    - a. Air Content: 6 percent for 3/4 IN nominal maximum aggregate size

### PART 3 - EXECUTION

#### 3.01 GENERAL

- A. Comply with ACI 304 "Recommended Practice For Measuring, Mixing, Transporting and Placing Concrete" and as herein specified.

#### 3.02 SURFACE CONDITIONS

- A. Inspection:
  - 1. Prior to all Work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
  - 2. Verify that all items to be embedded in concrete are in place.

3. Verify that concrete may be placed to the lines and elevations indicated on the Drawings, with all required clearance from reinforcement.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Architect.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

### 3.03 PLACING CONCRETE

A. Handling and Placing:

1. Transporting and placement of concrete shall be as per Reference Standards.
2. Concrete temperatures controlled during hot or cold weather shall be as per Reference Standards.
3. Immediately after depositing, compact concrete thoroughly by mechanical vibration. No vibrating of formwork is allowed.
4. There shall be a minimum of two (2) mechanical vibrators at all times during pours.
5. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
6. Deposit concrete in forms in horizontal layers no deeper than 24 IN (600 mm) and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
  - a. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
  - b. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 IN into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.
7. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
  - a. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  - b. Maintain reinforcement in position on chairs during concrete placement.
  - c. Screed slab surfaces with a straightedge and strike off to correct elevations.
  - d. Slope surfaces uniformly to drains where required.

- e. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
8. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
- a. When air temperature has fallen to or is expected to fall below 40 DegF (4.4 DegC), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 DegF (10 DegC) and not more than 80 DegF (27 DegC) at point of placement.
  - b. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  - c. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
9. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
- a. Cool ingredients before mixing to maintain concrete temperature below 90 DegF (32 DegC) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
  - b. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
  - c. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.
10. Slabs-on-Grade:
- a. All Slabs-on-grade laid over a carefully prepared sub-grade. See also foundation plan for vapor barrier and associated preparation.
  - b. Standard for "Level Slab," maximum variation 1/8 IN under 10 FT straight edge. Pitch all exterior flat work for positive drainage or as indicated on the Drawings.

### 3.04 PLACING REINFORCING STEEL

- A. Refer to Section 03 20 00 for placement of Reinforcing Steel.

### 3.05 EMBEDDED ITEMS

- A. Pipes and conduit in concrete, located, sized and if required, sleeved in accordance with requirements of the Reference Standards. No sleeve greater than 4 IN shall pass through grade beams and it shall be located at mid-height of grade beam running horizontally. Bolts and anchorage devices embedded in concrete to fasten sills, tie-down columns and other structural and framing members to concrete shall be installed and secured in place before concrete is placed.

### 3.06 CONSTRUCTION JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Location: Make and locate construction joints so as to not impair the strength of the structure (See Structural Drawings).
- C. Approval: Obtain the Architect's approval of location of all construction joints and control joints in the Work prior to start of concrete placement.
- D. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one- fourth of concrete thickness, as follows:
  - 1. Sawcutting shall start immediately as the concrete will allow without raveling along the sawcut to minimize drying shrinkage cracks.

### 3.07 CURING

- A. Beginning immediately after placement, protect concrete from premature drying, excessive hot or cold temperatures, and mechanical injury. Maintain concrete with minimal water loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

### 3.08 DRY PACK

- A. Ram in dry pack under column base plates in thin layers using a short length of ram, the free end of which shall be struck with a heavy hammer, or mallet, several blows for each layer, to compact the mixture. When completed, the exposed dry pack shall show slight indication of moisture. The ram for dry packing around bolts shall be a short length of pipe which will pass within the hole and over the bolt. Do not tension bolts sooner than seven (7) days after dry packing. Cure dry pack with a curing agent or with burlap kept wet for not less than seven (7) days.

### 3.09 WATERSTOPS

- A. Flexible Waterstops: Install in construction joints as indicated to form a continuous diaphragm. Install in longest lengths practicable. Support and protect exposed waterstops during progress of Work. Field-fabricate joints in waterstops according to manufacturer's written instructions.

### 3.10 VAPOR RETARDER

- A. Place, protect, and repair vapor-retarder sheets according to ASTM E1643 and manufacturer's written instructions.

### 3.11 MONOLITHING SLAB FINISH

- A. Refer to Section for 03 35 00 for Concrete Finishes.

### 3.12 INSPECTIONS

- A. Notify the Architect and the Testing Agency and Owner Representative at least 48 HRS in advance of the initial placement of concrete and sufficiently in advance of subsequent placement to permit inspection.

### 3.13 TESTING

- A. The representative of the testing laboratory will take at least (1) set for each days pour plus additional sets of four (4) cylinders from each pour and/or 200 CY or fraction thereof. Field specimens of concrete taken and tested in accordance with the Reference Standards. Label each cylinder with job name, date, number, result of slump test, and the point in the pour in the structure from which the sample was taken noted thereon.

1. The Contractor will deliver or pay for shipping all cylinders to the laboratory. See Section 01 43 26 of these Specifications.
2. Test concrete, one at seven (7) days and two at twenty-eight (28) days. Carry out a third test at fifty-six (56) days in the event the first two tests fail.
3. Strength level of concrete will be considered satisfactory if averages of sets of three (3) consecutive strength test results equal or exceed specified compressive strength, and no individual strength test result falls below specified compressive by more than 500 psi.
4. Test results will be reported in writing to the Architect/Engineer and Contractor within 24 HRS after tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of compressive strength at twenty-eight (28) days, concrete mix proportions and materials; compressive breaking strength and type of break for both seven (7) day tests and twenty- eight (28) day tests.
5. Concrete slump shall be within the maximum allowable as noted below.
  - a. If the concrete slump test shows greater slump than the maximum allowable, the concrete batch shall be rejected by the testing engineer.
  - b. Adding water into the transit-mixed concrete at the site will not be permitted without the testing engineer's inspection and approval.
  - c. The testing engineer shall notify the Architect immediately of any and all irregularities.

#### B. Additional Tests:

1. The testing service will make additional test of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Architect/Engineer. The testing service may conduct test to determine adequacy of concrete by cored cylinders complying with ASTM C42, or other methods as directed. The Contractor shall pay for such tests conducted and any other additional testing may be required, when unacceptable concrete is verified.

3.14 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 IN in height.

3.15 EQUIPMENT BASES AND FOUNDATIONS:

- A. Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

**END OF SECTION**

## **SECTION 03 35 00 - CONCRETE FINISHES AND SURFACE TREATMENTS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This Section includes but is not necessarily limited to:
  - 1. Interior slabs
  - 2. Exterior slabs.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Section 03 30 00 - Cast-in-Place Concrete.
- D. Section 09 78 50 – Epoxy Floor Coating

#### **1.03 QUALITY ASSURANCE**

- A. For finishing of exposed surfaces of the concrete, use only thoroughly trained and experienced journeyman concrete finishers.

#### **1.04 TESTING LABORATORY SERVICES**

- A. In accordance with Section 01 43 26.

#### **1.05 PRODUCT HANDLING**

- A. Use all means necessary to protect concrete finishes and the installed work and materials of all other trades.

### **PART 2 - PRODUCTS**

#### **2.01 FLOOR AND SLAB TREATMENT**

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
  - 1. See 3.01 for locations to receive troweled or “broom” finishes.
  - 2. Slabs within buildings shall receive Floor Hardener or Epoxy Coating as indicated on the Drawings.
  - 3. Floor Hardener:
    - a. Ashford Formula as manufactured by Curecrete Chemical Company, Inc., or approved equal.
    - b. Floor areas shall be chemically hardened at the application rate of 100 to 150 SQ FT/GAL as recommended for heavy duty floors.

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- 1) Second application at a rate of 400 to 500 SQ FT/GAL.
- c. Floor hardener shall be applied in successive coats with a minimum of 24 HRS between coats with curing method shall be by means of damp curing only.
4. Epoxy Floor Coating: Where indicated on the Drawings concrete areas are to be sealed with a 2-part epoxy sealant.
  - a. Section 09 78 50 – Epoxy Floor Coating

### PART 3 - EXECUTION

#### 3.01 GENERAL

- A. All concrete slabs not otherwise indicated shall have a steel troweled monolithic finish.
- B. Slab at rooms to receive ceramic tile shall have a “light broom” finish.
- C. Trash Enclosure slab shall have a “medium broom” finish.
- D. Exterior flatwork surfaces such as sidewalks and shall receive a “medium broom” finish.

#### 3.02 MONOLITHIC FINISH

- A. Just after the concrete has been rodded off, the monolithic concrete shall be tamped to bring fines to the surface. After tamping, the surface shall be screeded level, using a roller screed wherever possible. After screeding, the concrete shall be of proper design and shall not be used until the slab will bear the weight of a man without indentation. Precautions shall be taken to avoid overfloating or other practices that will bring an excess of fines to the surface. After floating, the surface shall be steel troweled to a smooth hard finish. A 10 FT straight-edge placed anywhere on the surface shall not allow a deviation of more than 1/8 IN from a true surface.

#### 3.03 EXPOSED CONCRETE FINISH

- A. Rubbed finish shall be applied to all exposed wall surfaces, whether specified to be painted or not. All fins and projections shall be removed, offsets leveled, holes filled, damages repaired. Surfaces shall be rubbed with carborundum or other suitable non-staining abrasives and shall be washed with clean water. No mortar or grout shall be used. The finish shall be smooth and of uniform appearance, acceptable to the Owner.
- B. Medium broom finish shall be applied where shown on the Drawings. The finish shall be applied by a non-staining broom, producing a medium grain of even depth and appearance at right angle to the slope of the area. The edges shall be neatly tooled.
- C. Light broom finish shall be applied where shown on the Drawings. The finish shall be applied by a non-staining broom, producing a light grain of even depth and appearance at right angle to the slope of the area. The edges shall be neatly tooled.



- D. Finish Sample: Contractor shall provide a concrete finish sample to determine the degree of finish to be applied to the slab. This sample shall be cast prior to placing the slab, approved by the Owner and used as a comparison to the actual finish.
1. Contractor shall provide a 4 FT x 4 FT square concrete finish sample of light broom finish.
  2. Contractor shall provide a 4 FT x 4 FT square concrete finish sample of medium broom finish
  3. The approved samples shall be available at the job site to match the actual slab finish work with the approved sample.

### 3.04 FLOOR & SLAB TREATMENT

#### A. General:

1. With Applicator present, examine substrates and conditions under which coatings will be applied, for compliance with coating application requirements.
2. Apply coatings only after unsatisfactory conditions have been corrected and surfaces to receive coatings are thoroughly dry.
3. Start of application is construed as Applicator's acceptance of surfaces within that particular area.
4. Coordination of Work: Review other Sections in which primers or other coatings are provided to ensure compatibility of total systems for various substrates. On request, furnish information on characteristics of specified finish materials to ensure compatible primers.

#### B. Preparation:

1. General: Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
2. Surface Preparation: Clean and prepare surfaces to be coated according to manufacturer's written instructions for each substrate condition and as specified.
  - a. Cementitious Substrates: Prepare concrete surfaces to be coated. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods to prepare surfaces.
  - b. Use abrasive blast-cleaning methods if recommended by coating manufacture.
3. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not coat surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
4. After completing coating operations, reinstall items that were removed; use workers skilled in the trades involved.

#### C. Application:

1. Apply high-performance surface treatments and coating according to manufacturer's written instructions.
2. Floor Hardener:
  - a. Floor areas shall be chemically hardened at the application rate of 100 - 150 SQ FT/GAL as recommended for heavy duty floors.
  - b. Floor hardener shall be applied in successive coats with a minimum of 24 HRS between coats.
  - c. Curing method shall be by means of damp or membrane curing only.

### 3.05 CURING AND PROTECTION

- A. For surfaces not receiving treatments membrane curing shall be commenced immediately following finishing of surface. During hot or windy weather, temporary wet covering or other approved methods shall be used to maintain moisture in concrete in advance of the membrane application.
- B. Surfaces that have been membrane cured shall be protected during the entire curing period from all forms of abrasion.
- C. The floors shall remain covered and be kept free of traffic and loads for at least ten (10) days after their completion. Adequate provision shall be made for maintaining proper concrete curing temperature.

### 3.06 WORKMANSHIP

- A. The finishing of all concrete shall be of highest quality. Surfaces shall have neat patterns, tooled edges and joints.
- B. All cracked and/or chipped slabs shall be repaired at no additional cost to the Owner.

### **END OF SECTION**

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

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Mortar and grout for masonry.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.

#### **1.03 REFERENCED STANDARDS**

##### **A. American Concrete Institute (ACI):**

1. 530, Building Code Requirements for Masonry Structures.
2. 530.1, Specifications for Masonry Structures.

##### **B. ASTM International (ASTM):**

1. C94, Ready-Mixed Concrete.
2. C144, Aggregate for Masonry Mortar.
3. C207, Hydrated Lime for Masonry Purposes.
4. C270, Mortar for Unit Masonry.
5. C387, Packaged, Dry, Combined Materials, for Mortar and Concrete.
6. C404, Aggregates for Masonry Grout.
7. C780, Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
8. C1019, Method of Sampling and Testing Grout.
9. E447, Test Methods for Compressive Strength of Masonry Prisms.

#### **1.04 SUBMITTALS**

- A. Submit under provisions of Section 01 33 23.
- B. Include design mix, indicate whether the Proportion or Property specification of ASTM C270 is to be used, required environmental conditions, and admixture limitations.
- C. Samples: Submit two samples of mortar, illustrating mortar color and color range.
- D. Reports: Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270 and test and evaluation reports to ASTM C780.

- E. Reports: Submit reports on grout indicating conformance of component grout materials to requirements of ASTM C476 and test and evaluation reports to ASTM C1019.
  - F. Manufacturer's Certificates: Certify that products meet or exceed specified requirements.
  - G. Submit premix mortar manufacturer's installation instructions under provisions of Section 01 33 23.
- 1.05 QUALITY ASSURANCE
- A. Perform Work in accordance with ACI 530 and ACI 530.1.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect, and handle products to site under provisions of Section 01 65 50.
  - B. Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.
- 1.07 ENVIRONMENTAL REQUIREMENTS
- A. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
  - B. Maintain materials and surrounding air temperature to maximum 90 DegF (32 DegC) prior to, during, and 48 HRS after completion of masonry work.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Premix Mortar: ASTM C387, Type S, using gray color cement.
  - 1. Use Type S Mortar for all masonry unless otherwise indicated.
- B. Mortar Aggregate: ASTM C144, standard masonry type.
- C. Hydrated Lime: ASTM C207, Type S.
- D. Water: Clean and potable.
- E. Bonding Agent: Latex type.
- F. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMU, containing integral water repellent by same manufacturer.
  - 1. Product: Subject to compliance with requirements, provide "Dry-Block" admixture by W. R. Grace & Co.

### 2.02 MORTAR COLOR

- A. Mortar Color: As selected by architect from manufacturer's full range of colors.

### 2.03 MORTAR MIXES

- A. Mortar for Masonry: ASTM C270, Type S using the Property specification.

#### 2.04 MORTAR MIXING

- A. Thoroughly mix mortar ingredients in accordance with ASTM C270 in quantities needed for immediate use.
- B. Maintain sand uniformly damp immediately before the mixing process.
- C. Add mortar color and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.
- D. Do not use anti-freeze compounds to lower the freezing point of mortar.
- E. If water is lost by evaporation, re-temper only within two hours of mixing.
- F. Use mortar within two hours after mixing at temperatures of 90 DegF (32 DegC), or two-and-one-half hours at temperatures under 40 DegF (5 DegC).

#### 2.05 MIX TESTS

- A. Test mortar in accordance with Section 01 43 26.
- B. Testing of Mortar Mix: In accordance with ASTM C270.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Request inspection of spaces to be grouted.

#### 3.02 PREPARATION

- A. Apply bonding agent to existing concrete or masonry surfaces.
- B. Plug clean-out holes with masonry units. Brace masonry for wet grout pressure.

#### 3.03 INSTALLATION

- A. Install mortar in accordance with ASTM C270.
- B. Do not displace reinforcement while placing grout.
- C. Remove excess mortar from grout spaces.

#### 3.04 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 43 26.
- B. Test and evaluate mortar in accordance with ASTM C780.
- C. Test mortar and masonry units to ASTM E447; test in conjunction with masonry unit sections specified.

**END OF SECTION**

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## **SECTION 04 20 00 - UNIT MASONRY SYSTEM**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Concrete masonry units. (standard gray color).
2. Split-faced and ground-faced concrete masonry units as indicated on the drawings. (Aggregate, color and texture to be as selected by Architect.)
3. Reinforcement, anchorage, and accessories.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Section 04 72 00 - Cast Stone.
- D. Section 05 50 10 - Metal Fabrications.
- E. Section 07 62 00 - Sheet Metal Flashing and Trim.
- F. Section 07 19 00 - Water Repellents.
- G. Division 26 - Pipe and conduit sleeves for placement in walls.

#### **1.03 REFERENCED STANDARDS**

##### **A. American Concrete Institute (ACI):**

1. 530, Building Code Requirements for Masonry Structures.
2. 530.1, Specifications for Masonry Structures.

##### **B. ASTM International (ASTM):**

1. A641, Zinc-Coated (Galvanized) Carbon Steel Wire.
2. C129, Non-Load Bearing Concrete Masonry Units.

##### **C. International Masonry Industry All-Weather Council (IMIAC):**

1. Recommended Practices and Guide Specification for-Cold Weather Masonry Construction

#### **1.04 SUBMITTALS**

- A. Submit under provisions of Section 01 33 23.
- B. Product Data: Provide data for masonry units and fabricated wire reinforcement.
- C. Samples:
  1. Submit one complete set of manufacturers samples of each type of concrete masonry unit to illustrate color, texture and extremes of color range.

2. After final selection is made by Architect and Owner, provide 4 samples of final selection for Architect's use.
  - D. Manufacturer's Certificate: Certify that concrete masonry units meet or exceed specified requirements.
  - E. Test Reports: Submit test results indicating compressive strength, water absorption, saturation and suction.
- 1.05 QUALITY ASSURANCE
- A. Perform Work in accordance with ACI 530 and ACI 530.1.
  - B. Single Source Responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.
- 1.06 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- 1.07 DELIVERY, STORAGE, AND HANDLING
- A. Deliver, store, protect and handle products to site under provisions of Section 01 65 50.
  - B. Accept split-faced units on site. Inspect for damage.
- 1.08 ENVIRONMENTAL REQUIREMENTS
- A. Cold Weather Requirements: IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
  - B. Perform the following construction procedures while masonry work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected within 10 DegF (6 DegC).
    1. 40 DegF (4 DegC) to 32 DegF (0 DegC):
      - a. Mortar: Heat mixing water to produce mortar temperature between 40 DegF (4 DegC) and 120 DegF (49 DegC).
      - b. Grout: Follow normal masonry procedures.
    2. 32 DegF (0 DegC) to 25 DegF (-4 DegC):
      - a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40 DegF (4 DegC) and 120 DegF (49 DegC) maintain temperature of mortar on boards above freezing.
      - b. Grout: Heat grout materials to 90 DegF (32 DegC) to produce in-place grout temperature of 70 DegF (21 DegC) at end of work day.
    3. 25 DegF (-4 DegC) to 20 DegF (-7 DegC):



- a. Mortar: Heat mixing water and sand to produce mortar temperature between 40 DegF (4 DegC) and 120 DegF (49 DegC); maintain temperature of mortar on boards above freezing.
  - b. Grout: Heat grout materials to 90 DegF (32 DegC) to produce in-place grout temperature of 70 DegF (21 DegC) at end of work day.
  - c. Heat both sides of walls under construction using salamanders or other heat sources.
  - d. Use windbreaks or enclosures when wind is in excess of 15 mph.
4. 20 DegF (-7 DegC) and below:
- a. Mortar: Heat mixing water and sand to produce mortar temperatures between 40 DegF (4 DegC) and 120 DegF (49 DegC).
  - b. Grout: Heat grout materials to 90 DegF (32 DegC) to produce in-place grout temperature of 70 DegF (21 DegC) at end of work day.
  - c. Masonry Units: Heat masonry units so that they are above 20 DegF (-7 DegC) at time of laying.
  - d. Provide enclosure and auxiliary heat to maintain an air temperature of at least 40 DegF (4 DegC) for 24 HRS after laying units.
  - e. Do not heat water for mortar and grout to above 160 DegF (71 DegC).
- C. Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry temperature ranges apply to anticipated minimum night temperatures.
- 1. 40 DegF (4 DegC) to 32 DegF (0 DegC):
    - a. Protect masonry from rain or snow for at least 24 HRS by covering with weather- resistive membrane.
  - 2. 32 DegF (0 DegC) to 25 DegF (-4 DegC):
    - a. Completely cover masonry with weather resistive membrane for at least 24 HRS.
  - 3. 25 DegF (-4 DegC) to 20 DegF (-7 DegC):
    - a. Completely cover masonry with weather resistive insulating blankets or - similar protection for at least 24 HRS, 48 HRS for grouted masonry.
  - 4. 20 DegF (-7 DegC) and below:
    - a. Except as otherwise indicated, maintain masonry temperature above 32 DegF (0 DegC) for 24 HRS using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry maintain heated enclosure to 40 DegF (4 DegC) for 48 HRS.

## 1.09 COORDINATION

- A. Coordinate the masonry work with veneer, door and window frames, cast stone window sills, embedment and anchors for other work.

## PART 2 - PRODUCTS

### 2.01 CONCRETE MASONRY UNITS

- A. Hollow and Solid Non-Load Bearing Block Units (CMU): ASTM C129, Normal Weight. Color to be selected by architect from manufacturer's full range.
  - 1. Split Face Units
  - 2. Ground Face Units
- B. Size and Shape: Nominal modular size of 8 IN x 16 IN x 4 IN, 6 IN, 8 IN or 12 IN as indicated on the drawings. Provide special units for 90 degree corners, lintels, jambs, sashes, sills, movement joints, headers, bonding and other special conditions.
- C. Integral Water Repellent: Provide units produced with liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E514, with test period extended to 24 HRS, show no visible water or leaks on the back of the test specimen.
  - 1. Product: Subject to compliance with requirements, provide units made with "Dry-Block" by W. R. Grace & Co. or equal product approved by Architect.

### 2.02 REINFORCEMENT AND ANCHORAGE

- A. Single Wythe Joint Reinforcement: Truss type; steel wire, hot dip galvanized (for exterior and below grade) to ASTM A641 Class 3 after fabrication, 3/16 IN (4.8 mm) side rods with 9 GA (4.8 mm) cross ties.
  - 1. Acceptable Manufacturers:
    - a. Dur-O-Wal, Inc.
    - b. Hohmann & Barhard, Inc.
    - c. A-A Wire Products Co.
    - d. Heckman Building Products, Inc.
    - e. Masonry Reinforcing Corp. of America (Wirebound).
- B. Reinforcing Steel: ASTM A615, 60 ksi (414 MPa) yield grade, deformed billet bars, uncoated finish.
- C. Strap anchors: Bent steel shape as detailed.

### 2.03 MORTAR AND GROUT

- A. Mortar and Grout: As specified in Section 04 05 13.

### 2.04 FLASHINGS

- A. Copper-Fabric Laminated Flashing: Copper sheet weighing 5 OZ/SQ FT bonded with asphalt between 2 layers of glass fiber cloth. Use where flashing is fully concealed in masonry.
- B. Acceptable Manufacturers: Subject to compliance with requirements, provide one of the following:

1. Copper Fabric; Afco Products, Inc.
  2. Type FCC - Fabric Covered Copper; Phoenix Building Products.
  3. Copper Fabric Flashing; Sandell Manufacturing Co., Inc.
  4. York Copper Fabric Flashing; York Manufacturing, Inc.
- C. Adhesive for Flashing: Of type recommended by manufacturer of flashing material for use indicated.

## 2.05 ACCESSORIES

- A. Building Paper: No. 15 asphalt saturated felt.
- B. Weeps: Performed round plastic tubes, 3/8 IN (9 mm) outside diameter.
- C. Cavity Vents: Molded polyvinyl chloride grilles; insect resistant.
  1. Acceptable Manufacturer:
    - a. Williams Products, Inc., Model Williams-Goodco Vinyl Block Vent. Vents shall be 7-5/8 IN in color to match mortar color.
- D. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

## 2.06 LINTELS

- A. Steel Lintels: angle type, nominal 3 1/2 IN x 3 1/2 IN x 5/16 IN, refer to lintel schedule on Drawings.

# PART 3 - EXECUTION

## 3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Verify items provided by other sections of work are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

## 3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied in other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

## 3.03 COURSING

- A. Provide coursing as shown on the Drawings for all Unit Masonry.
- B. Establish lines, levels, and coursing indicated. Protect from displacement.
- C. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- D. Concrete Masonry Units:
  1. Bond: Running bond.

2. Coursing: One unit and one mortar joint to equal 8 IN (200 mm).
3. Mortar Joints: Concave (Tooled).

#### 3.04 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
- D. Remove excess mortar as work progresses.
- E. Interlock intersections and external corners.
- F. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- G. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- H. Cut mortar joints flush where resilient base is scheduled and where CMU is indicated to receive Acrylic Based Fiber Reinforced Wall Coating.
- I. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

#### 3.05 WEEPS

- A. Install weeps in veneer at 16 IN (600 mm) OC horizontally above through-wall flashing, above shelf lintels, at bottom of walls, and above doors, windows and frames.

#### 3.06 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Install horizontal joint reinforcement 16 IN (400 mm) OC.
- B. Place joint reinforcement continuous in first joint below top of walls.
- C. Lap joint reinforcement ends minimum 6 IN (150 mm).
- D. Embed wall ties in dovetail inserts in concrete wall back-up to bond veneer at maximum 16 IN (400 mm) OC vertically and 32 IN (1200 mm) OC horizontally.
- E. Reinforce joint corners with strap anchors 16 IN (400 mm) OC.

#### 3.07 MASONRY FLASHINGS

- A. Extend flashings horizontally at foundation walls, above lintels, at bottom of walls, and above door and window frames.
- B. Turn flashing up minimum 8 IN (200 mm) and bed into mortar joint of masonry or seal to back-up.
- C. Lap end joints minimum 6 IN (150 mm) and seal watertight.

- D. Turn flashing, fold, and seal at corners, bends, and interruptions.
- E. Extend flashing through exterior face of masonry and cut off flashing flush with face of wall after masonry wall construction is completed.

### 3.08 LINTELS

- A. Install lintels over openings.
- B. Maintain minimum 8 IN bearing on each side of opening.

### 3.09 CONTROL AND EXPANSION JOINTS

- A. Install control joints in masonry walls in locations and methods as described in the Concrete Masonry Handbook, latest edition, by the Portland Cement Association. Control joint spacing to not exceed 24 FT horizontally. Caulk each side of joint with caulking as specified in Section 07 92 00.
- B. Do not continue horizontal joint reinforcement through control and expansion joints.
- C. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the block unit. Fill the resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.
- D. Size control joint in accordance with Section 07 92 00 for sealant performance.
- E. Form expansion joint as detailed.

### 3.10 BUILT-IN WORK

- A. As work progresses, install built-in metal door and glazed frames, fabricated metal frames, window frames, wood blocking, anchor bolts, plates, and embeds and other items to be built-in the work and furnished by other sections.
- B. Install built-in items plumb and level.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 12 IN (300 mm) from framed openings.
- D. Do not build in organic materials subject to deterioration.

### 3.11 TOLERANCES

- A. Maximum Variation from Unit to Adjacent Unit: 1/32 IN (1.5 mm).
- B. Maximum variation from Plane of Wall: 1/4 IN in 10 FT (6 mm/3 m) and 1/2 IN in 20 FT (13 mm/6 m) or more.
- C. Maximum Variation from Plumb: 1/4 IN in 10 FT (6 mm/3 m); 3/8 IN in 20 FT (0 mm/6 m); 1/2 IN in 40 FT (12 mm/12 m) or more.
- D. Maximum Variation from Level Coursing: 1/4 IN in 20 FT (6mm/6 m); 1/2 IN in 40 FT (12mm/12 m).
- E. Maximum Variation of Joint Thickness:  $\pm 1/8$  IN (3mm) from joint thickness indicated; maximum bedjoint thickness shall be 1/2 IN (12 mm).
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 IN (6 mm).

3.12 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, sleeves, and grounds. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.13 QUALITY CONTROL

- A. Field testing will be performed under provisions of Section 01 43 26.
- B. Inspect all masonry work.

3.14 CLEANING

- A. Clean work under provisions of Section 01 77 10.
- B. Remove excess mortar and mortar smears as work progresses.
- C. Replace defective mortar. Match adjacent work.
- D. Clean soiled surfaces with cleaning solution.
- E. Use non-metallic tools in cleaning operations.

3.15 PROTECTION OF FINISHED WORK

- A. Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

**END OF SECTION**

## **SECTION 04 21 13 - BRICK MASONRY ASSEMBLIES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Face brick.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.
- C. Section 04 05 13 - Mortar and Masonry Grout
- D. Section 04 72 00 - Cast Stone
- E. Section 07 92 00 - Joint Sealants.

#### **1.03 SUBMITTALS**

##### **A. Action Submittals:**

1. Product Data: For each type of product indicated.
2. Samples:

##### **B. Samples:**

1. Sample Boards for each type and color of brick and colored mortar showing manufacturer's full range of colors
2. After initial color selection, provide minimum three samples of each color and finish selected.

##### **C. Informational Submittals:**

1. Material Certificates: For each type and size of product indicated.

#### **1.04 QUALITY ASSURANCE**

- A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- B. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects.
  1. Build sample panels of exposed unit masonry construction approximately 48 IN long.

## 1.05 PROJECT CONDITIONS

- A. 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 ACI 530.1/ASCE 6/TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 DegF and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## PART 2 - PRODUCTS

### 2.01 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

### 2.02 BRICK

- A. General: Provide shapes indicated and as follows.
  - 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 shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Face Brick: Facing brick complying with ASTM C216.
  - 1. Grade: SW.
  - 2. Type: FBS.
  - 3. Efflorescence: Provide brick that has been tested according to ASTM C67 and is rated "not effloresced."

### 2.03 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Masonry Cement: ASTM C 91.
- E. Aggregate for Mortar: ASTM C 144.



1. White-Mortar Aggregates: Natural white sand or crushed white stone.
2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

## 2.04 REINFORCEMENT

- A. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

## 2.05 TIES AND ANCHORS

- A. 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 ASTM A153/A153M, Class B coating.
- B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8 IN cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 IN parallel to face of veneer.
- C. Adjustable Masonry-Veneer Anchors:
1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
  2. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - b. Dayton Superior Corporation, Dur-O-Wal Division; D/A 213.
    - c. Heckmann Building Products Inc.; 315-D with 316 or Pos-I-Tie.
    - d. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, having slotted holes for inserting wire tie.

## 2.06 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
1. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 IN into wall and 1/2 IN out from wall, with outer edge bent down 30 degrees and hemmed.
  2. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 IN into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 IN and down into joint 1/4 IN to form a stop for retaining sealant backer rod.

- B. 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.

## 2.07 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; formulated from PVC.
- B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D226, Type I (No. 15 asphalt felt).
- C. Weep/Vent Products: Use one of 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 IN less than depth of outer wythe, in color selected from manufacturer's standard.
    - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Blok-Lok Limited; Cell-Vent.
      - 2) Heckmann Building Products Inc.; No. 85 Cell Vent.
      - 3) Hohmann & Barnard, Inc.; Quadro-Vent.
      - 4) Wire-Bond; Cell Vent.
- D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Archovations, Inc.
    - b. Dayton Superior Corporation, Dur-O-Wal Division.
    - c. Mortar Net USA, Ltd.

## 2.08 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.

## 2.09 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.

2. Use portland cement-lime mortar unless otherwise indicated.
  3. 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. Provide Type N unless another type is indicated.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION, GENERAL

- A. 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.
- B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
- C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 SQ IN per minute when tested per ASTM C67. Allow units to absorb water so they are damp but not wet at time of laying.

#### 3.02 TOLERANCES

- A. Dimensions and Locations of Elements:
  1. For dimensions in cross section or elevation do not vary by more than +1/2 IN or -1/4 IN.
  2. For location of elements in plan do not vary from that indicated by more than  $\pm 1/2$  IN.
  3. For location of elements in elevation do not vary from that indicated by more than  $\pm 1/4$  IN in a story height or 1/2 IN 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 IN in 10 FT, or 1/2 IN maximum.
  2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 IN in 10 FT, 1/4 IN in 20 FT, or 1/2 IN maximum.
  3. For vertical lines and surfaces do not vary from plumb by more than 1/4 IN in 10 FT, 3/8 IN in 20 FT, or 1/2 IN 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 IN in 10 FT, 1/4 IN in 20 FT, or 1/2 IN maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 IN in 10 FT, 3/8 IN in 20 FT, or 1/2 IN maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than  $\pm 1/8$  IN, with a maximum thickness limited to 1/2 IN; do not vary from bed-joint thickness of adjacent courses by more than 1/8 IN.
2. For exposed head joints, do not vary from thickness indicated by more than  $\pm 1/8$  IN. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 IN.

### 3.03 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 horizontal face dimensions at corners or jambs.

### 3.04 MORTAR BEDDING AND JOINTING

- A. Lay hollow brick as follows:
  1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  2. With entire units, including areas under cells, fully bedded in mortar at starting course on footings.
- B. 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.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

### 3.05 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 IN 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 IN OC vertically and 36 IN OC horizontally.

#### 3.06 FLASHING, WEEP HOLES, CAVITY DRAINAGE, 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

#### 3.07 CLEANING

- A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes
  2. Protect adjacent surfaces from contact with cleaner.
  3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  4. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

**END OF SECTION**

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## **SECTION 04 22 10 - CONCRETE MASONRY (LOAD BEARING)**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Concrete masonry construction (CMU), including:
  - a. Standard concrete masonry.
2. Integral water repellent admixture.
3. Masonry special inspection.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

#### **1.03 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements..
- C. Division 03 - Concrete..
- D. Division 04 - Masonry Systems
- E. Division 07 - Joint Sealants.

#### **1.04 REFERENCED STANDARDS**

- A. American Concrete Institute (ACI)/American Society of Civil Engineers (ASCE)/The Masonry Society (TMS):
  1. ACI 530.1/ASCE 6/TMS 602, Specification for Masonry Structures.
- B. ASTM International (ASTM):
  1. C33, Standard Specification for Concrete Aggregates.
  2. C90, Standard Specification for Loadbearing Concrete Masonry Units.
  3. C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
  4. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
  5. C231, Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
  6. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
  7. C426, Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.

8. C744, Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
  9. C1194, Standard Test Method for Compressive Strength of Architectural Cast Stone.
  10. C1195, Standard Test Method for Absorption of Architectural Cast Stone.
  11. C1314, Standard Test Method for Compressive Strength of Masonry Prisms
  12. C1357, Standard Test Methods for Evaluating Masonry Bond Strength.
  13. C1364, Standard Specification for Architectural Cast Stone
  14. D2244, Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
  15. E514, Standard Test Method for Water Penetration and Leakage Through Masonry.
- C. Cast Stone Institute (CSI):
1. Technical Manual With Case Histories.
- D. National Concrete Masonry Association (NCMA):
1. TEK 2-3A, Architectural Concrete Masonry Units.
  2. TEK 3-4B, Bracing Concrete Masonry Walls During Construction.
  3. TEK 8-2A, Removal of Stains from Concrete Masonry.
  4. TEK 8-3A, Control and Removal of Efflorescence.
- E. Building code:
1. International Code Council (ICC):
    - a. International Building Code and associated standards, 2006 Edition including all amendments, referred to herein as Building Code.
- F. 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 (5) years' experience producing masonry units containing manufacturer's admixture.
- G. Testing laboratory shall have a minimum of 10 years' experience in the testing of concrete masonry units using the method(s) specified.
- H. Technician conducting tests shall have a minimum of five (5) years' experience in the testing of concrete masonry units using the method(s) specified.

## 1.05 DEFINITIONS

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



## 1.06 SUBMITTALS

### A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. 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.
3. Drawings:
  - a. Scaled (minimum 1/8 IN 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.
4. 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.
5. Qualifications of testing lab and technician.
6. Test results for all masonry testing.

### B. Informational Submittals:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

#### 1.07 QUALITY ASSURANCE

- A. All masonry units of any one (1) particular type, color or face style shall be from the same production run.
  1. Special shapes shall be factory fabricated unless noted otherwise.

#### 1.08 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 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

#### 2.01 MANUFACTURERS

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

#### 2.02 MATERIALS

- A. Cement: Type I or II Portland, ASTM C150.
- B. Aggregate: ASTM C33.
- C. Reinforcing Bars: Refer to Specification Section 03 13 00.
- D. Mortar: Refer to Specification Section 04 05 14.
- E. Masonry Grout: Refer to Specification Section 04 05 14.
- F. Masonry Accessories: Refer to Specification Section 04 20 10.
- G. Sealants: Refer to Specification Section 07 92 00.
- H. Integral Concrete Masonry Water Repellent:
  1. Liquid polymeric admixture.
  2. Grace "DRY-BLOCK".

## 2.03 MANUFACTURED UNITS

### A. General:

1. Fabricated in the manufacturing plant.
2. Provide square corners unless noted otherwise.

### B. Concrete Masonry Units:

1. Modular units: ASTM C90.
  - a. Normal weight units: Minimum of 125 LB/CF.
2. Color:
  - a. Interior units: Standard gray.
  - b. Exposed exterior units: Precolored,.
3. Design compressive strength:  $f'_m=1,500$  psi minimum.
  - a. Determine in accordance ACI 530.1/ASCE 6/TMS 602.
    - 1) Unit strength method.
4. Provide masonry units manufactured with integral water repellent admixture for the following exposures:
  - a. Exterior single-wythe construction.
  - b. Exterior composite wall construction.
  - c. Interior areas defined as wet and/or corrosive.
    - 1) See Specification Section 07 92 00 for definition of wet and/or corrosive areas.

## 2.04 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 HRS, using the rating criteria specified in ASTM E514.
2. Flexural bond strength of masonry: An increase of 10 percent, 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 of masonry prisms: Maximum 5 percent decrease in compressive strength of prisms shall occur as a result of adding integral water-repellent concrete masonry and mortar admixtures when compared to a control (containing no mortar admixtures) concrete masonry and mortar when tested in accordance with ASTM C1314.

4. Drying shrinkage of masonry: Maximum 5 percent 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 percent 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

### 3.01 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.

### 3.02 INSTALLATION

- A. General:
  1. Build cavity walls to thickness indicated on Drawings.
  2. Build composite walls to thickness indicated on Drawings.
  3. Build in flashing, reinforcing, reglets, weeps, weep vents and related accessory items.
    - a. See Specification Section 04 20 10 for installation of accessory items.
  4. Perform all cutting with masonry saws using masonry saw blades.
  5. Drill holes with power drill using masonry drill bits.
  6. Holes made by chipping unit will not be accepted.
  7. Install field units in running bond, unless noted otherwise.
    - a. Provide special coursing where indicated on the Drawings.
  8. Cut as required to maintain bond pattern.
  9. Use solid units where cutting or laying would expose holes and as noted on Drawings.
  10. Avoid use of less than half size units, whenever possible.
  11. Do not use chipped, cracked, spalled, stained or imperfect units exposed in finish work.
  12. Provide units of uniform color, within the range demonstrated on the approved mock-up.
  13. Do not wet concrete masonry units.
  14. Build chases and recesses as indicated and required for work of other trades.

- a. Provide not less than 8 IN of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses unless detailed otherwise on the Drawings.
- 15. 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 14 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 IN joint widths.
    - a. Cut joints flush where concealed.
    - 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 IN wide.
    - 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 FT 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 IN in 10 FT.
  - b. 3/8 IN in a story height not to exceed 20 FT.
  - c. 1/2 IN in 40 FT or more.
2. Maximum variation from plumb for external corners, expansion joints, and other conspicuous lines:
  - a. 1/4 IN in any story or 20 FT maximum.
  - b. 1/2 IN in 40 FT or more.
3. Maximum variation from level of grades for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
  - a. 1/4 IN in any bay or 20 FT.
  - b. 1/2 IN in 40 FT or more.
4. Maximum variation from plan location of related portions of columns, walls, and partitions:
  - a. 1/2 IN in any bay or 20 FT.
  - b. 3/4 IN in 40 FT or more.
5. Maximum variation in cross-sectional dimensions of columns and thicknesses of walls from dimensions shown on Drawings:
  - a. Minus 1/4 IN.

- b. Plus 1/2 IN.
- 6. Maximum variation in mortar joint width:
  - a. Bed joints: 3/32 IN in 10 FT.
  - b. Head joints:
    - 1) Minus 1/8 IN.
    - 2) Plus 1/8 IN.
- F. Protect against weather when work is not in progress.
  - 1. During inclement weather conditions, cover top of walls with translucent waterproof membrane.

### 3.03 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 HRS 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.
- a. Provide special inspection in accordance with the Building Code Table 1704.5.1 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.

### 3.04 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**



## **SECTION 04 72 00 - CAST STONE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Cast stone sill and cap.

#### **1.02 SUBMITTALS**

##### **A. Product Data:** Include dimensions of individual components.

##### **B. Shop Drawings:** Show fabrication and installation details for cast stone units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.

##### **C. Samples:** For each color and texture of cast stone required.

##### **D. Colored Mortar Samples:** For each mortar color required.

##### **E. Qualification Data:** For manufacturer.

##### **F. Material Test Reports.**

#### **1.03 QUALITY ASSURANCE**

##### **A. Manufacturer Qualifications:** A qualified manufacturer of cast stone units similar to those indicated for this Project, with sufficient production capacity to manufacture required units.

1. Manufacturer is a producing member of the Cast Stone Institute.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

##### **A. Available Manufacturers:** Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

##### **B. Manufacturers:** Subject to compliance with requirements, provide products by one of the following:

1. Architectural Cast Stone Corp.
2. Continental Cast Stone Manufacturing, Inc.
3. Custom Cast Stone, Inc.
4. Dallas Cast Stone Co., Inc.
5. Or Approved Equal.

#### **2.02 CAST STONE UNITS**

##### **A. Provide cast stone units complying with ASTM C1364 using the wet-cast method.**

1. Freeze-Thaw – The CPWL shall be less than 5 percent after 300 cycles of freezing and thawing.
  2. Slope exposed horizontal surfaces 1:12, unless otherwise indicated.
  3. Provide raised fillets at backs of sills and at ends indicated to be built into jambs.
  4. Provide drips on projecting elements, unless otherwise indicated.
  5. Compressive strength – 6,500 psi minimum for products at 28 days.
  6. Absorption – 6 percent max by the cold water method, or 10 percent max by the boiling method for products at 28 days.
  7. Air Content – 4-8 percent for units exposed to freeze-thaw environments.
  8. Linear Shrinkage – Shall not exceed 0.065 percent.
- B. Cure units by one of the following methods:
1. Cure units with steam in enclosed curing room at temperature of 105 DegF or above and 95 to 100 percent relative humidity for 6 hours.
  2. Cure units with dense fog and water spray in enclosed warm curing room at 95 to 100 percent relative humidity for 24 HRS.
  3. Cure units to comply with one of the following:
    - a. Not less than 5 days at mean daily temperature of 70 DegF or above.
    - b. Not less than 6 days at mean daily temperature of 60 DegF or above.
    - c. Not less than 7 days at mean daily temperature of 50 DegF or above.
    - d. Not less than 8 days at mean daily temperature of 45 DegF or above.
- C. Acid etch units after curing to remove cement film from surfaces to be exposed to view.
- D. Colors and Textures: As selected by Architect from manufacturer's full range. All surfaces exposed to view shall have a fine-grained texture similar to natural stone, with no air voids in excess of 1/32 IN and the density of such voids shall be less than 3 occurrences per any 1 in. 2 and not obvious under direct daylight illumination at a 5 FT distance.

## 2.03 ACCESSORIES

- A. Anchors and Dowels: Type 304 stainless steel.
- B. Proprietary Acidic Cleaner: Manufacturer's standard-strength, general-purpose cleaner complying with requirements in Section 04 20 10 - "Unit Masonry System" and approved for intended use by cast stone manufacturer and approved by cleaner manufacturer for use on cast stone and adjacent masonry materials.

## 2.04 MORTAR

- A. Comply with requirements in Section 04 20 10 - "Unit Masonry System" for mortar materials and mixes.
1. For setting mortar, use Type S.
  2. For pointing mortar, use Type S.

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3. Pigmented Mortar: Use colored cement product.

## 2.05 SOURCE QUALITY CONTROL

- A. Employ an independent testing agency to sample and test cast stone units according to ASTM C1364.

## PART 3 - EXECUTION

### 3.01 SETTING CAST STONE IN MORTAR

- A. Install cast stone units to comply with requirements in Section 04 20 10 - "Unit Masonry System".
- B. Set units in full bed of mortar with full head joints, unless otherwise indicated.
  1. Fill dowel holes and anchor slots with mortar.
  2. Fill collar joints solid as units are set.
  3. Build concealed flashing into mortar joints as units are set.
  4. Keep head joints in coping and other units with exposed horizontal surfaces open to receive sealant.
  5. Keep joints at shelf angles open to receive sealant.
- C. Rake out joints for pointing with mortar to depths of not less than 3/4 IN. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
- D. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 IN. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
- E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.
- F. Provide expansion, control, and pressure-relieving joints of widths and at locations indicated. Keep joints free of mortar and other rigid materials.
- G. Prepare joints indicated to receive sealant and apply sealant of type and at locations indicated to comply with applicable requirements in Section 07 92 00 - "Joint Sealants".

### 3.02 SETTING ANCHORED CAST STONE WITH SEALANT-FILLED JOINTS

- A. Set cast stone units accurately in locations indicated with edges and faces aligned.
  1. Install anchors, supports, fasteners, and other attachments to secure units in place.
  2. Shim and adjust anchors, supports, and accessories.
- B. Fill anchor holes with sealant. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.
- C. Set cast stone supported on clip or continuous angles on resilient setting shims. Hold shims back from face of cast stone a distance at least equal to width of joint.

- D. Keep joints free of mortar and other rigid materials. Remove temporary spacers from joints after anchors and supports are secured in place and cast stone units are anchored.
- E. Prepare joints and apply sealant of type and at locations indicated to comply with applicable requirements in Section 07 92 00 - "Joint Sealants".

### 3.03 INSTALLATION TOLERANCES

- A. Variation from Plumb: Do not exceed 1/8 IN in 10 FT, 1/4 IN in 20 FT maximum.
- B. Variation from Level: Do not exceed 1/8 IN in 10 FT, 1/4 IN in 20 FT.
- C. Variation in Joint Width: Do not vary joint thickness more than 1/8 IN in 36 IN or 1/4 of nominal joint width, whichever is less.
- D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 IN, except due to warpage of units.

### 3.04 ADJUSTING AND CLEANING

- A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Cast stone may be repaired if methods and results are approved by Architect.
  - 1. Replace units in a manner that shows no evidence of replacement.
- B. In-Progress Cleaning: Clean cast stone as work progresses.
  - 1. Remove mortar fins and smears before tooling joints.
  - 2. Remove excess sealant immediately, including spills, smears, and spatter.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed cast stone to comply with requirements in Section 04 20 10 - "Unit Masonry System".

### 3.05 WATER REPELLANT

- A. Apply silane or siloxane water repellant for weatherproofing cast stone in accordance with manufacturer's instructions.
- B. Apply water repellant after pointing, repair, cleaning, inspection, and acceptance are completed.

## **END OF SECTION**

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

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Structural steel framing members, support members, sag rods, struts and as shown.
2. Base plates, shear stud connectors and expansion joint plates.
3. Grouting under base plates.

#### **1.02 REFERENCED STANDARDS**

##### **A. American Institute of Steel Construction (AISC):**

1. Code of Standard Practice, Manual of Steel Construction Allowable Stress Design (ASD).

##### **B. ASTM International (ASTM):**

1. A36, Structural Steel.
2. A53/A 53M, Steel Pipe.
3. A325, High Strength Bolts for Structural Steel Joints.
4. A500, Steel Tube.
5. A568/A568M, General Requirements for Steel, Carbon and High-Strength Low-Alloy Hot- Rolled Sheet and Cold-Rolled Sheet.
6. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.

##### **C. American Welding Society (AWS):**

1. A2.4, Symbols for Welding, Brazing, and Nondestructive Examination.
2. D1.1, Structural Welding Code.

##### **D. Steel Structures Painting Council (SSPC):**

1. Painting Manual.

#### **1.03 SUBMITTALS FOR REVIEW**

##### **A. Submit under provisions of Section 01 33 00.**

##### **B. Shop Drawings:**

1. Indicate profiles, sizes, spacing, and locations of structural members, openings, attachments, and fasteners.
2. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

#### 1.04 SUBMITTALS FOR INFORMATION

- A. Submit under provisions of Section 01 33 00.
- B. Manufacturer's Mill Certificate: Certify that Products meet or exceed specified requirements.
- C. Mill Test Reports: Submit indicating structural strength, destructive and non-destructive test analysis.
- D. Welders' Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

#### 1.05 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC Code of Standard Practice.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Structural Steel Members: ASTM A572 (Fy = 50 ksi) and ASTM A36.
- B. Bolts, Nuts, and Washers: ASTM A325 bolts.
- C. Anchor Bolts: ASTM A307.
- D. Welding Materials: AWS D1. 1; type required for materials being welded.
- E. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
- F. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B or C, structural tubing.
- G. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing a minimum compressive strength of 7,000 psi (48 MPa) at 28 days.
- H. Shop and Touch-up Primer: SSPC 15, Type 1, red oxide or primer compatible with finish paint specified.

#### 2.02 FABRICATION

- A. Continuously seal joined members by continuous welds. Grind exposed welds smooth. Fabricate connections for bolt, nut, and washer connectors.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Coordination and Meetings: Verification of existing conditions prior to beginning work.

### 3.02 ERECTION

- A. Surveys: Employ at Contractor's expense, a registered Professional Engineer or land surveyor, for accurate erection of structural steel. Check elevations of concrete and masonry bearing surface and locations of anchor bolts, and similar devices, before erection work proceeds, and report discrepancies to Architect. Do not proceed with erection until corrections have been made, or until compensating adjustments to structural steel work have been agreed upon with Architect.
- B. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.
- C. Allow for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- D. Field welded components and shear studs indicated on Drawings and/or shop drawings.
- E. Field connected members with threaded fasteners; torque to required resistance.
- F. Do not field cut or alter structural members without approval of Architect/Engineer.
- G. After erection, welds shall be primed.
- H. Grout under base plates in accordance with Section 04 05 13. Trowel grouted surface smooth; splay neatly to 45 degrees.
- I. Subgrade Coating: Coat bottom 2 FT of exterior columns with subgrade coating after erection.

### 3.03 ERECTION TOLERANCES

- A. Maximum Variation from Plumb: 1/4 IN (6 mm) per story, non-cumulative.  
Maximum Offset from True Alignment: 1/4 IN (6 mm).

### 3.04 FIELD QUALITY CONTROL

- A. An independent testing laboratory shall be retained in accordance with Section 01 43 26 to provide testing and inspection services.
- B. The independent testing laboratory shall make verification tests in the field on welded and bolted connections. Failures may result in additional testing as deemed necessary by the Engineer. Retesting and repairs shall be made at no cost to the owner. All testing is to be under the guidance of the Designer.
  - 1. Bolted Connections: Testing and inspection shall be done in accordance with "Structural Joints Using ASTM A325 or A490 Bolts; approved by the Research Council on Structural Connections of the Engineering Foundation 1985. A 100 percent visual inspection shall be made to determine that all connections have the proper number of bolts.

2. Welded Connections:

- a. Nondestructive testing of full penetration welds shall be by ultrasonic testing for material 3/8 IN thick or thicker and by magnetic particles for material less than 3/8 IN thick. The steel fabricator shall have a certified welding inspector check all full penetration welds that are done in the shop. Fillet welds are to be visually checked.
- b. All field full penetration welds shall be checked by the independent testing lab. All fillet welds done in the field shall be visually inspected by the lab inspector. Contractor shall verify that all field welders are properly certified for the type of work they perform.
- c. All inspections and tests shall be made in accordance with AWS by use of nondestructive methods such as ultrasonic and magnetic particles. Surface preparation for nondestructive testing will be performed by the Contractor as required by the testing laboratory. All connections not certified by testing laboratory shall be replaced and retested without additional costs.
- d. Shear Connectors: Ten percent of field applied shear studs shall be bent 15 degrees as described under the shear stud specification. If the failure rate is greater than ten percent, repairs shall be made before further testing.

**END OF SECTION**



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

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Manufactured metal roof deck.
2. Manufactured metal composite deck.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 00 07 00 - General Conditions.
- B. Division 01 - General Requirements.
- C. Section 09 90 00 - Painting and Protective Coatings.

#### **1.03 REFERENCED STANDARDS**

##### **A. American Iron and Steel Institute (AISI):**

1. S100, Specification for the Design of Cold-Formed Steel Structural Members.

##### **B. ASTM International (ASTM):**

1. A36/A36M, Standard Specification for Carbon Structural Steel.
2. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
4. 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.
5. D746, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
6. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.

##### **C. American Welding Society (AWS):**

1. D1.1/D1.1M, Structural Welding Code - Steel.
2. D1.3/D1.3M, Structural Welding Code - Sheet Steel.

##### **D. Steel Deck Institute (SDI):**

1. 31, Design Manual for Composite Decks, Form Decks and Roof Decks.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

UP General Specifications

METAL DECK

Issued: 03-26-2019

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1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Fabrication and/or layout drawings:
  - a. Detailed Shop Drawings showing the following:
    - 1) Complete framing and erection layouts.
    - 2) Location, length, type, cross section, thickness, and markings of metal deck units.
      - a) Size and location of openings.
      - b) Accessories and reinforcing.
    - 3) Sequence and procedure to be followed for erecting, fastening, and securing the deck units.
    - 4) Shop applied coatings.
    - 5) Location of required shoring for composite.
    - 6) Details and gages of accessories and miscellaneous items showing sump pans, cant strips, ridge and valley plates, closure and filler strips and insulation supports.
    - 7) Welding procedures for installation including size, number, type and location of all welds required to install deck units.
    - 8) Recommended welding rod size, type, burn off rate and welder setting for deck thickness to be joined.
      - a) Define welds by use of standard AWS welding symbols.
    - 9) Correct fitting of members and accessories.
    - 10) Size and location of all openings in deck and all conditions requiring closure panels and supplementary framing.
    - 11) Shop Drawings shall not be reproductions of the Contract Drawings.
3. Product technical data including:
  - a. Metal deck manufacturer's specifications and installation instructions.
  - b. Manufacturer's specifications and installation instructions for:
    - 1) Welds and welding procedure.
    - 2) Galvanizing repair paint.
    - 3) Screws.
    - 4) Joint sealing compound.
  - c. Manufacturer's load tables for deck to be furnished on this project, including:
    - 1) Allowable gravity load for metal roof deck.
    - 2) Allowable diaphragm shear values for metal roof deck.
    - 3) Allowable superimposed load for metal deck.
    - 4) Allowable unshored span lengths for composite.

4. Manufacturers certification that metal deck complies with specified requirements:
  - a. Manufacturer member of SDI.
  - b. Deck material, manufacturing, and shop testing and inspection are in accordance with SDI requirements.
  - c. Welder qualifications.
5. Test reports.

#### 1.05 QUALITY ASSURANCE

##### A. Qualifications:

1. Manufacturer:
  - a. Member of SDI.
  - b. Structural design of manufactured deck shall be prepared by a qualified professional engineer retained by the manufacturer.
2. Welding work:
  - a. Qualify welding processes, operations, and operators in accordance with requirements of AWS D1.1 and AWS D1.3.
  - b. Welding operators to have been qualified during the 12 month period prior to commencement of welding, and be experienced in welding light gage metal.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

##### A. Deliver, store, and handle metal deck as recommended by SDI.

1. Exercise care to avoid damage to deck.
- B. Protect materials from rusting, denting or crushing.
  1. Store metal deck on project site off the ground with one end elevated to provide drainage and protected from the elements with a waterproof covering, ventilated to avoid condensation.
  2. Prevent rust, deterioration and accumulation of foreign material.

#### 1.07 PROJECT CONDITIONS

##### A. Do not overload supporting members.

1. Until the entire assembly is complete, the structural elements may not be stable or capable of supporting code or stated design loads.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

##### A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. 1-1/2 IN deep composite floor deck:

- a. Vulcraft, Type 1.5 VL.
- b. Verco Decking, Inc., PLB FORMLOK.
- c. New Millennium Building Systems, 1.5 CD.
- d. Consolidated Systems, Inc. CFD 1.5.
- e. DACS, Inc., 1-1/2 IN Composite Deck.

B. Submit request for substitution in accordance with Specification Section 01 33 00.

## 2.02 COMPOSITE FLOOR DECK

### A. Composite Floor Deck:

- 1. Minimum depth and gage as indicated on the Drawings.
- 2. Minimum superimposed load capacity:
  - a. 150 PSF.
  - b. Design in accordance with SDI 31.
- 3. Fabricate deck from steel conforming to AISI S100, Section A3.
- 4. Finish: Galvanized coating conforming to ASTM A653 G60 zinc coating.
- 5. Metal closures and pour-stops:
  - a. Manufacturers standard, 20 GA minimum.
  - b. Finish: Galvanizing conforming to ASTM A653 G60, minimum.
  - c. Form to configuration required to provide mortar-tight closures.

B. Provide composite deck to act as bottom form for cast-in-place concrete slabs and which will become positive slab reinforcement through mechanical anchorage after concrete hardens.

### C. Maximum Deflection:

- 1. Deck as a form: Less than 1/180 of span or 3/4 IN, whichever is smaller, under the weight of wet concrete and steel deck.
- 2. Composite slab with deck: Less than 1/360 under superimposed loads.

## 2.03 ACCESSORIES

### A. Metal Closures:

- 1. Form to configuration required to provide tight-fitting closures at open ends and sides of deck.
- 2. Minimum thickness before galvanizing: 0.0358 IN (20 GA).

### B. Welding Washers:

- 1. 16 GA bent steel plate with 3/8 IN center hole.
- 2. Use at all deck units thinner than 20 GA.

C. Filler Sheet: Flat or formed 20 GA galvanized steel.

- D. Venting: Slotted openings in bottom flutes in accordance with manufacturer's standards.
- E. Metal Pour Stops: Form to configuration required to provide mortar-tight closures at open sides and ends of deck.
- F. Primer Paint: Deck manufacturer's baked on, rust-inhibitive paint applied at plant to chemically cleaned and phosphate chemically treated metal surfaces.
- G. Galvanized coating for metal deck accessories: Conform to ASTM A653 G60 zinc coating.
- H. Galvanized Repair Paint: Comply with Specification Section 09 90 00 and ASTM A780 for repair of damaged galvanized surfaces.
- I. Screws:
  - 1. Self-drilling, self-tapping, #12 size minimum hex washer head sheet metal screws.
  - 2. Carbon steel by Hilti.
    - a. Organic zinc chromate coated, Hilti Kwik-cote.
- J. Miscellaneous Steel Shapes: Comply with ASTM A36.
- K. Sheet Metal Accessories: Same material and finish as deck members.

#### 2.04 FABRICATION

##### A. Standard Deck Profiles:

DEPTH	TYPE	RIB SPACING	TOP SURFACE MAXIMUM RIB OPENING	MINIMUM BOTTOM OF RIB WIDTH
1-1/2 IN	Composite Floor Deck	6 IN	2-1/2 IN	1-3/4 IN

##### B. Minimum Deck Thickness:

- 1. Where gage of metal is indicated, provide the minimum uncoated thickness as specified by SDI.
  - a. Delivered thickness of the uncoated steel: No less than 95 percent of the design thickness.
- 2. Use steel with a minimum yield stress of 33 ksi.

##### C. Fabrication:

- 1. Fabricate deck units in lengths to span three or more support spacings with flush, telescoped or nested 2 IN end laps.
  - a. End laps shall occur on supporting members.
  - b. Provide deck units having overlapping male and female type side laps or joints to provide positive vertical and lateral alignment of adjacent deck units.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Examine areas and conditions under which metal deck is 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 metal deck until supporting work is in place and secured.
- D. Deck will be subject to rejection if metal deck:
  - 1. Units do not comply with requirements of SDI specifications and requirements herein.
  - 2. Is improperly manufactured, painted or installed.
  - 3. Is damaged so that strength is impaired.
  - 4. Is not installed as specified.

### 3.02 INSTALLATION

- A. Install roof composite deck units and accessories as indicated, in accordance with SDI 31, manufacturer's recommendations, final approved Shop Drawings and as specified herein.
  - 1. Furnish manufacturer's standard accessories as needed to complete the deck installation.
- B. Locate deck bundles to prevent overloading of structure.
- C. Do not overload metal deck or supporting members:
  - 1. Contractor is solely responsible for safety, construction means, methods and sequencing of the Work.
  - 2. Until the entire assembly is complete, the structural elements may not be stable or capable of supporting code or stated design loads.
  - 3. Use care to assure deck construction loads are less than the recommendation of SDI 31, except where temporary shoring is installed.
- D. Place each deck unit on supporting structural frame, adjust to final position and accurately align with ends bearing on supporting members.
  - 1. Lap roof deck units at ends no less than 2 IN.
  - 2. Provide a minimum of 1-1/2 IN of bearing of deck on supports, tape the joint as needed to prevent concrete leakage.
  - 3. Interlock units at sides without stretching, contracting, or deforming.
  - 4. Place deck units flat and square and secure to framing without warp or excessive deflection.
  - 5. Place units in accurate and close alignment for entire length of run and with close registration of flutes of one unit with those of abutting unit.
- E. Plug weld sizes specified are effective fusion diameter of welds.

1. Weld metal shall penetrate all layers of deck material and have good fusion to supporting members.
  2. Do not burn through deck.
- F. Prevent overtightening of screw fasteners by using a tool with a depth limiting nosepiece and a clutch.
- G. Fastening of Composite and Form Deck:
1. Secure deck units to supporting frame and side laps as indicated on the drawings.
- H. Remove and replace deck which is structurally weak or unsound or which has burn holes due to improper welding or damage which Engineer declares defective.
- I. Cut and fit deck units and accessories around other work projecting through or adjacent to decking.
1. Make cutting and fitting neat, square and trim.
    - a. Cut deck by mechanical means, not by burning.
  2. Neatly and accurately install reinforcing at all openings except:
    - a. Circular openings less than 6 IN DIA.
    - b. Rectangular openings having no side dimension greater than 6 IN.
  3. Reinforce openings that have not been framed between 6 and 12 IN with 20 GA flat steel sheet 12 IN greater in each dimension than opening.
    - a. Place sheet around opening and fusion weld to top surface of deck at each corner and midway along each side.
- J. Install metal accessories to close all openings and gaps between deck and other construction, at objects projecting through deck, at locations where deck changes direction, and at open ends of deck units where deck units terminate.
1. Weld into position to provide a complete installation.
- K. Install pour stops continuous around the perimeter:
1. Locate so that the slab terminates beyond the perimeter support centerline a distance as indicated on the Contract Drawings.
  2. Weld into position adequately to resist forces due to placement and finishing of concrete and in accordance with manufacturer's recommendations.
- L. Clean and Touch Up:
1. Remove all surplus materials and debris from surface of deck after installation.
  2. Repair damaged galvanized surfaces in accordance with Specification Section 09 90 00.

### 3.03 FIELD QUALITY CONTROL

- A. Remove and replace defective or damaged deck units.
- B. Testing:
1. Make the following test in the presence of the Testing Agency employed on the project on the first deck panel to be installed.

2. Place one (1) end of panel over a perimeter support and attach it only to that support with two (2) welds as specified 6 IN apart.
3. Move the opposite end of the panel in plane parallel to the span of the panel until shear distress is noted in the weld.
4. Make the welds of sufficient quality to cause local distortions in the panel around the welds and show good perimeter contact between the welds and the panel.
5. When the results of this test are satisfactory and approved by the Testing Agency, install the remainder of the deck using the same weld rod size and type, amperage setting, and procedures used in the tested deck.
6. Visually inspect the remainder of the welds.
  - a. When, in the opinion of the Testing Agency, any weld is of poor quality, provide an additional weld adjacent to the rejected weld.
  - b. Place the new weld on sound, unburned deck a sufficient distance away from the rejected weld.

**END OF SECTION**



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

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Load bearing formed steel stud exterior wall and roof framing.
2. Formed steel purlin and slotted channel, framing and bridging

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - General Requirements.
- C. Section 06 16 44 – Exterior Gypsum Sheathing
- D. Section 09 21 16 – Gypsum Board Assemblies

#### **1.03 REFERENCED STANDARDS**

- A. AISI - American Iron and Steel Institute - Cold-Formed Steel Design Manual.
- B. ASTM A446 - Steel Sheet, Zinc-Coated (Galvanized) by Hot Dip Process, Physical (Structural) Quality.
- C. ASTM A525 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- D. ASTM A568 - Steel, Sheet, Carbon and High-Strength, LowAlloy, Hot-Rolled and Cold-Rolled,.General Requirements For.
- E. ASTM A591 Steel Sheet, Cold-Rolled, Electrolytic Zinc Coated.
- F. ASTM C955 Load-Bearing (Transverse and Axial) Steel Studs, Runners (Track), and Bracing or Bridging, for Screw Application of Gypsum Board and Metal Plaster Bases.
- G. AWCI (Association of Wall and Ceiling Industries) Specifications Guide for Cold Formed Steel Structural Members.
- H. AWS D1.1 - Structural Welding Code.
- I. AWS D1.3 - Light Steel Welding Code.
- J. SSPC (Steel Structures Painting Council) - Steel Structures Painting Manual.
- K. MFMA (Metal Framing Manufacturers Association) Guidelines for the Use of Metal Framing.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements

2. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.
  - c. Manufacturer's load tables for style indicated.

#### 1.05 SYSTEM DESCRIPTION

- A. Maximum Allowable Deflection: 1/360 span.
- B. Design wall and roof systems to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
- C. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

#### 1.06 QUALITY ASSURANCE

- A. Calculate structural properties of framing members in accordance with AWCI, MFMA and AWS D1.3 requirements.

#### 1.07 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- B. Installer: Company specializing in performing the work of this section with minimum three years documented experience and approved by manufacturer.
- C. Design structural elements under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State where the Site is located.

#### 1.08 FIELD MEASUREMENTS

- A. Verify that field measurements are as instructed by the manufacturer.

#### 1.09 COORDINATION

- A. . Coordinate work under provisions of Division 01 - General Requirements.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Unimast Incorporated.
  2. USG.
  3. Or approved equal

## 2.02 FRAMING MATERIALS

- A. Studs: ASTM 653, A525 sheet steel, formed to channel shape, punched web, knurled faces
- B. Track: Formed steel; channel shaped; same width as studs, tight fit; 18 gage thick, solid web

## 2.03 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered.
- B. Plates, Gussets, Clips: Formed sheet steel, thickness determined for conditions encountered.

## 2.04 FASTENERS

- A. Self-drilling, Self-tapping Screws, Bolts, Nuts and Washers: ASTM A123, hot dip galvanized to 1.25 oz/sq. ft.
- B. Anchorage Devices: Power actuated, drilled expansion bolts, and screws with sleeves.
- C. Welding: In conformance with AWS D1.1 and AWS D1.3.

## 2.05 FABRICATION

- A. Fabricate assemblies of framed sections of sizes and profiles required; with framing members fitted, reinforced, and braced to suit design requirements
- B. Fit and assemble in largest practical sections for delivery to site, ready for installation.

## 2.06 FINISHES:

- A. Studs: Galvanize to G90 coating class.
- B. Tracks and Headers: Galvanize to G90 coating class.
- C. Bracing, Furring, Bridging: Same finish as framing members.
- D. Plates, Gussets, Clips: Same finish as framing members.

# PART 3 - EXECUTION

## 3.01 EXAMINATION

- A. Verify that substrate surfaces and building framing components are ready to receive work.

## 3.02 ERECTION OF STUDDING

- A. Install components in accordance with manufacturer's instructions.
- B. Align floor and ceiling tracks; locate to wall layout. Secure in place as indicated by designer of structural elements. Coordinate installation of sealant with floor and ceiling tracks.

- C. Place studs not more than 2 inches (50 mm) from abutting walls and at each side of openings. Space studs as indicated by designer of structural elements. Connect studs to tracks using fastener or welding method.
  - D. Construct corners using minimum three studs.
  - E. Construct openings at door and window jambs with double studs, unless noted otherwise.
  - F. Erect load bearing studs one piece full length. Splicing of studs is not permitted.
  - G. Erect load bearing studs, brace, and reinforce to develop full strength, to achieve design requirements.
  - H. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
  - I. Install intermediate studs above and below openings to align with wall stud spacing.
  - J. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
  - K. Attach cross studs to studs for attachment of fixtures anchored to walls.
  - L. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
  - M. Touch-up field welds and damaged galvanized surfaces with primer.
  - N. Complete framing ready to receive gypsum board or standing seam roof systems.
- 3.03 ERECTION TOLERANCES
- A. Maximum Variation from True Position: 1/8 inch (3 mm).
  - B. Maximum Variation of any Member from Plane: 1/8 inch (3 mm).

## **END OF SECTION**

## **SECTION 05 50 10 - METAL FABRICATIONS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. The schedule is a list of principal items only. Refer to Drawing details for items not specifically scheduled.
  - a. Miscellaneous shop fabricated ferrous metal items.
  - b. Bollards: Schedule 40 steel pipe, concrete filled, as detailed, paint.
  - c. Plumbing chase strap reinforcing: Bent steel plates; prime paint.
  - d. Pipe rails.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 03 30 00 - Cast-In-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 05 12 00 - Structural Steel: Structural steel column, beams and anchor bolts.
- C. Section 09 90 00 - Paint and Protective Coatings.

#### **1.03 REFERENCED STANDARDS**

##### **A. ASTM International (ASTM):**

1. A36, Structural Steel.
2. A53, Hot-Dipped, Zinc-coated welded and Seamless Steel Pipe.
3. A123, Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip.
4. A153, Zinc - Coating (Hot-Dip) on Iron and Steel Hardware.
5. A283, Carbon Steel Plates, Shapes, and Bars.
6. A307, Carbon Steel Externally Threaded Standard Fasteners.
7. A325, High Strength Bolts for Structural Steel Joints.
8. A386, Zinc-Coating (Hot-Dip) on Assembled Steel Products.
9. A500, Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
10. A501, Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
11. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
12. B177, Chromium Electroplating on Steel for Engineering Use.

##### **B. American Welding Society (AWS):**

1. A2.4, Standard Welding Symbols.
  2. D1.1, Structural Welding Code.
- C. Steel Structures Painting Council (SSPC).

#### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
- C. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

#### 1.05 FIELD MEASUREMENTS

- A. Verify that field measurements are as indicated on Drawings.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Steel Sections: ASTM A572 (Fy = 50 ksi) and ASTM A36.
- B. Plates: ASTM A283.
- C. Steel Pipe: ASTM A53, standard weight (Schedule 40) unless otherwise indicated, or another weight required by structural loads.
- D. Bolts, Nuts, and Washers: ASTM A325; ASTM A307. Unfinished bolts and nuts shall be regular hexagon- head types.
- E. Welding Materials: AWS D1. 1; type required for materials being welded.
- F. Shop and Touch-up Primer: SSPC 15, Type 1, red oxide.

#### 2.02 FABRICATION

- A. Fit and shop assemble in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
  - a. Supply components required for anchorage of fabrication. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

## 2.03 FINISHES

- A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- B. Do not prime surfaces in direct contact with concrete or where field welding is required.
- C. Prime paint items with one coat of specified primer at spreading rate not to exceed 400 SQ FT/GAL.
- D. Galvanize in accordance with ASTM A123, structural steel members. Provide minimum 1.25 OZ/SQ FT (380 g/SQ m) galvanized coating.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Beginning of installation means erector accepts existing conditions.

### 3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete with setting templates, to appropriate sections.

### 3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated on Drawings. Perform field welding in accordance with AWS D1.1.
- D. Obtain Architect/Engineer approval prior to site cutting or making adjustments not scheduled.
- E. After erection, prime welds abrasions and surfaces not shop primed, except surfaces to be in contact with concrete.

### 3.04 PIPE RAILINGS AND GRAB BARS

- A. Pipe railings and grab bars shall be of continuous welded construction as detailed, fabricated from A. S. A. Schedule 40 steel pipe, of sizes shown. Bends shall be heated and bent smoothly and without distortion, or made with welding ells, intersections neatly formed, welded and ground smooth.
- B. Handrails shall be constructed of round pipe, size and shape as shown, with closed ends. Provide all required anchorage pieces. Include all required anchorage devices for attachment to walls and floors. Ends of handrails shall be returned or shall terminate in safety terminals.

**END OF SECTION**

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## **SECTION 05 51 00 – METAL STAIRS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Straight run, steel-framed stairs.
2. Steel pipe handrails and railing systems attached to metal stairs.
3. Steel pipe handrails attached to walls adjacent to metal stairs.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

#### **1.03 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Section 09 90 00 - Paint and Protective Coatings.

#### **1.04 SUBMITTALS FOR REVIEW**

##### **A. Submit under provisions of Section 01 33 00.**

##### **B. Shop Drawings:**

1. Shop drawings detailing fabrication and installation of steel stairs.
  - a. Include plans, elevations, sections, and details of steel stairs and their connections.
  - b. Show anchorage and accessory items including bracing elements.
  - c. Provide templates for anchors and bolts specified for installation under other sections.
2. Delegated-Design Submittal: For installed steel stairs indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional engineer who was responsible for their preparation. Indicate profiles, sizes, spacing, and locations of structural members, openings, attachments, and fasteners.
3. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

#### **1.05 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Firm experienced in producing steel stairs similar to those indicated for this Project with a record of successful in-service performance and with sufficient production capacity to produce required units without delaying the Work.
- B. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code--Sheet Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering preassembled stair units that may be incorporated in the Work include, but are not limited to, the following:
  1. Alfab, Inc.
  2. American Metal Works, Inc.
  3. American Stair Corp., Inc.
  4. The Sharon Companies, Ltd

### 2.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Engineer, fabricate, and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each of the respective components of each metal fabrication.
  1. Treads of Steel Stairs: Capable of withstanding a uniform load of 100 lbf per sq. Ft. or a concentrated load of 300 lbf on a area of 4 sq. inches located in the center of the tread, whichever produces the greater stress.
  2. Platforms of Steel Stairs: Capable of withstanding a uniform load of 100 lbf per sq. ft..
  3. Stair Framing: Capable of withstanding stresses resulting from loads specified above as well as stresses resulting from railing system loads. Also capable of resisting lateral and longitudinal loads by providing additional bracing between the staircase support columns or connections to masonry wall.
  4. Top Rail of Guardrail Systems: Capable of withstanding the following loads applied as indicated:
    - a. Concentrated horizontal load of 200 lbf applied at any point and in any direction or 50 pounds per linear foot at top of rails in any direction.
    - b. Above load need not be assumed to act concurrently with loads on top rails of railing systems in determining stress on guard.

### 2.03 METALS

- A. Metal Surfaces, General: For surfaces exposed to view in the completed Work, provide materials selected for their surface flatness, smoothness, and freedom from surface blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, roughness, or, for steel sheet, variations in flatness exceeding those permitted by referenced standards for stretcher-leveled sheet.
- B. Steel Plates, Shapes, and Bars: ASTM A 36.

- C. Steel Tubing: Product type (manufacturing method) and as follows:
  - 1. Cold-Formed Steel Tubing: ASTM A 500.
  - 2. Hot-Formed Steel Tubing: ASTM A 501.
    - a. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating per ASTM A 53.
- D. Steel Pipe: ASTM A 53, standard weight (schedule 40), unless otherwise indicated, or another weight required by structural loads.
  - 1. Black finish, unless otherwise indicated.
  - 2. Galvanized finish for exterior installations and where indicated.
  - 3. Cold-Rolled Structural Steel Sheet: ASTM A 611, grade as follows:
    - a. Grade A, unless otherwise indicated or required by design loading.
  - 4. Commercial Quality: ASTM A 526, G 90 coating designation, unless otherwise indicated.
- E. Wire Mesh Panels for use in Stairs and Railing Systems;
  - 1. Plain steel welded or woven wire panels. Square opening, 3" maximum bar spacing, 1/8" minimum bar diameter. Panels to be shop primed to receive field applied coat, or prefinished black powder coating.
- F. Welding Rods and Bare Electrodes: Select according to AWS specifications for the metal alloy to be welded. Continuously seal joined members by continuous welds. Grind exposed welds smooth. Fabricate connections for bolt, nut, and washer connectors

#### 2.04 FASTENERS

- A. General: Provide plated fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating, for exterior use or where built into exterior walls and where indicated. Select fasteners for the type, grade, and class required.

#### 2.05 PAINT

- A. Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with performance requirements of FS TT-P-664, selected for good resistance to normal atmospheric corrosion, compatibility with finish paint systems indicated, and capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.
- B. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, and complying with DOD-P-21035 or SSPC-Paint 20

#### 2.06 CAST ABRASIVE NOSINGS

- A. Fabricate units of material, sizes, and configurations indicated. If not indicated, provide cast-iron units with integral abrasive finish. Furnish in lengths required to accurately fit each opening or conditions.

1. Cast units with an integral abrasive grit consisting of aluminum oxide, silicon carbide, or a combination of both.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
  1. American Safety Tread Co., Inc.
  2. Amstep Products.
  3. Armstrong Products, Inc.
  4. Balco/Metalines, Inc.
  5. Safe-T-Metal Co.
  6. Wooster Products Inc.
- C. Drill for mechanical anchors with countersunk holes located not more than 4 inches from ends and not more than 12 inches o.c., evenly spaced between ends, unless otherwise indicated. Provide closer spacing if recommended by the manufacturer.
- D. Provide a plain surface texture, except where fluted or cross-hatched surfaces are indicated.

## 2.07 GROUT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
  1. Nonshrink, Nonmetallic Grouts:
    - a. B-6 Construction Grout; W. R. Bonsal Co.
    - b. Euco N-S Grout; Euclid Chemical Co.
    - c. Crystex; L&M Construction Chemicals, Inc.
    - d. Masterflow 928 and 713; Master Builders Technologies, Inc.
    - e. Sealtight 588 Grout; W. R. Meadows, Inc.
    - f. SonogROUT 14; Sonneborn Building Products--ChemRex, Inc.

## 2.08 FABRICATION, GENERAL

- A. Form steel stairs from materials of size, thickness, and shapes indicated, but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support.
- B. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
- C. Shear and punch metals cleanly and accurately.
- D. Remove sharp or rough areas on exposed surfaces.

- E. Ease exposed edges to a radius of approximately 1/32 IN, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- F. 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. Remove welding flux immediately.
  - 3. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing, and welded surface matches contours of adjoining surfaces.
- G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.
- H. Shop Assembly: Preassemble in shop to greatest extent possible to minimize field splicing and assembly. Use connections that maintain structural value of joined pieces. Clearly mark units for field assembly and coordinated installation.
- I. Fabricate joints that will be exposed to weather in a manner to exclude water, or provide weep holes where water may accumulate.

## 2.09 STEEL-FRAMED STAIRS

- A. General: Construct stairs to conform to sizes and arrangements indicated. Join pieces together by welding, unless otherwise indicated. Provide complete stair assemblies, including metal framing, hangers, columns, handrails, railing systems, newels, balusters, struts, clips, brackets, bearing plates, or other components necessary for the support of stairs and platforms, and as required to anchor and contain the stairs on the supporting structure.
  - 1. Fabricate treads and platforms of exterior stairs to accommodate slopes to drain in finished traffic surfaces.
- B. Stair Framing: Fabricate stringers of structural steel channels, plates, or a combination thereof, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to stringers; and bolt or weld newels and framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finish surfaces.
- C. Steel Floor Plate Treads and Platforms: Provide raised pattern steel floor plate in pattern indicated or, if not indicated, as selected from manufacturer's standard patterns.

## 2.10 STEEL PIPE HANDRAILS AND RAILING SYSTEMS

- A. General: Fabricate pipe handrails and railing systems to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of pipe, post spacing, and anchorage, but not less than that required to support structural loads.

- B. Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator's option, unless otherwise indicated.
  - 1. At tee and cross intersections, cope ends of intersecting members to fit contour of pipe to which end is joined, and weld all around.
- C. Form changes in direction of handrails and rails as detailed or as follows:
  - 1. By radius bends of radius indicated.
- D. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
- E. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.
- F. Close exposed ends of pipe by welding 3/16-IN thick steel plate in place or with prefabricated fittings, except where clearance of end of pipe and adjoining wall surface is 1/4 IN or less.
- G. Fabricate newels of steel tubing and provide newel caps of pressed steel, as shown.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of handrails and railing systems to other work. Furnish inserts and other anchorage devices for connecting handrails and railing systems to concrete or masonry work.
  - 1. Connect railing posts to stair framing by direct welding, unless otherwise indicated.
- I. Fillers: Provide steel sheet or plate fillers of thickness and size indicated or required to support structural loads of handrails where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses. Size fillers to produce adequate bearing to prevent bracket rotation and overstressing of substrate.
- J. For nongalvanized steel handrails and railing systems, provide nongalvanized ferrous metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages, including concrete inserts, weld plates, and anchor bolts. Coordinate delivery of such items to Project site.

### 3.02 INSTALLATION, GENERAL

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing steel stairs to in-place construction; include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors as required.

- B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing steel stairs. Set units accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.
- C. Install steel stairs by welding stair framing to steel structure or to weld plates cast into concrete, except where otherwise indicated.
- D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.
- E. 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 the surfaces of exterior units that have been hot-dip galvanized after fabrication and are intended for bolted field connections.
- F. 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 that no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

### 3.03 INSTALLING STEEL PIPE RAILING AND HANDRAILS

- A. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:
  - 1. Anchor posts to steel by welding directly to steel supporting members.
  - 2. Anchor handrail ends into concrete and masonry with steel round flanges welded to rail ends and anchored into wall construction with drilled-in expansion anchors.
- B. Secure handrails to wall with wall brackets and end fittings. Provide bracket with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads. Secure wall brackets and wall return fittings to building construction as follows:
  - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
  - 2. For concrete and solid masonry anchorage, use drilled-in expansion anchor.
  - 3. For hollow masonry anchorage, use toggle bolts having square heads.

### 3.04 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on steel stairs are specified in Division 9 Section "Painting."
- B. For galvanized surfaces, clean welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

**END OF SECTION**



## SECTION 05 52 05 - STEEL RAILINGS

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Section Includes:

1. Steel handrail, stair rail and guardrail.
2. Steel guardrail gates.

#### 1.02 RELATED REQUIREMENTS (SECTIONS)

- A. Division 00 07 00 - General Conditions.
- B. Division 01 - General Requirements.
- C. Section 05 50 10 - Metal Fabrications.
- D. Section 09 90 00 - Painting and Protective Coatings.

#### 1.03 REFERENCED STANDARDS

##### A. American Architectural Manufacturers Association (AAMA):

1. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.

##### B. U.S. Department of Justice, Architectural and Transportation Barriers Compliance Board (Access Board):

1. Americans with Disabilities Act (ADA):
  - a. Accessibility Guidelines for Buildings and Facilities (ADAAG).

##### C. ASTM International (ASTM):

1. A36, Standard Specification for Carbon Structural Steel.
2. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
6. A276, Standard Specification for Stainless Steel Bars and Shapes.
7. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
8. {A392 Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.}

9. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
  10. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
  11. {A580, Standard Specification for Stainless Steel Wire.}
  12. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- D. American Welding Society (AWS):
1. D1.1, Structural Welding Code - Steel.
- E. National Association of Architectural Metal Manufacturers (NAAMM):
1. AMP 521, Pipe Railing Systems Manual.
- F. Occupational Safety and Health Administration (OSHA):
1. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
- G. Building code:
1. International Code Council (ICC):
    - a. International Building Code and associated standards, 2006 Edition including all amendments, referred to herein as Building Code.

#### 1.04 DEFINITIONS

- A. Hardware: As defined in ASTM A153/A153M.
- B. Galvanizing: Hot-dip galvanizing per ASTM A123/A123M or ASTM A153/A153M with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.
- C. Guardrail: A system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level.
- D. Handrail: A railing provided for grasping with the hand for support.
- E. Railing: A generic term referring to guardrail, handrail and/or stair rails.
- F. Stair Rail: A guardrail, installed at the open side of stairways with either a handrail mounted to the inside face of the guardrail, or where allowed by applicable codes, with the top rail mounted at handrail height and serving the function of a handrail.

#### 1.05 SUBMITTALS

- A. Shop Drawings:
  1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  2. Fabrication and/or layout drawings.
    - a. Plan showing profile, location, section and details of each railing, and type and details of anchorage system.

- b. Location and type of expansion joints.
- c. Materials of construction including shop-applied coatings.
- 3. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.

B. Informational Submittals:

- 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
- 2. Certification of welders and welding procedures indicating compliance with AWS.
- 3. Certification that railings have been designed and fabricated to meet the loading requirements specified.

1.06 QUALITY ASSURANCE

- A. Qualify welding procedures and welding operators in accordance with AWS.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver and handle railings to preclude damage.
- B. Store railings on skids, keep free of dirt and other foreign matter which will damage railings or finish and protect from corrosion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Welded railing systems:
    - a. Any manufacturer meeting this Specification Section.
  - 2. Galvanizing repair paint:
    - a. ZRC Products.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

2.02 MATERIALS

- A. Pipe: ASTM A53, Types E or S, Grade B, or ASTM A501.
- B. Steel Sheet, Bar (Pickets) and Plate: ASTM A36.
- C. Galvanizing Repair Paint:
  - 1. High zinc dust content paint for regalvanizing welds and abrasions.
  - 2. Dried film shall contain not less than 95 percent zinc dust by weight.

3. ZRC Products "ZRC."

D. Expansion and Adhesive Anchors: See Specification Section 05 50 10.

E. Welding Electrodes: AWS D1.1, E70 Series.

2.03 FABRICATION

A. General:

1. Verify field conditions and dimensions prior to fabrication.
2. For fabrication of items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names and roughness.
  - a. Remove blemishes by grinding and buffing or by welding and grinding, prior to cleaning, treating and application of surface finishes.
3. Form exposed work with smooth, short radius bends, accurate angles and straight edges.
  - a. Ease exposed edges to a radius of approximately 1/32 IN.
  - b. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
4. Form exposed connections with flush, smooth, hairline joints, using galvanized steel splice locks to splice sections together or by welding.
5. Provide for anchorage of type indicated on the Drawings or as required by field conditions.
  - a. Drill or punch holes with smooth edges.
6. Design railing and anchorage system in accordance with NAAMM AMP 521 to withstand loading as required by Building Code.
7. Design railings in accordance with accessibility requirements per the Building Code and ADAAG.

B. Custom fabricate pipe railings to dimensions and profiles indicated.

1. Guardrails:
  - a. 1-1/2 IN nominal diameter pipe.
  - b. Top rails and intermediate rails: Schedule 40.
  - c. Vertical posts: Schedule 80.
2. Handrails mounted to walls or guardrail vertical posts: 1-1/4 IN nominal diameter Schedule 40 pipe.
3. Where details are not indicated, space intermediate rails to requirements of the Building Code or OSHA Standards, whichever requires the more restrictive design.
4. Space vertical posts as required by loading requirements but not more than 4 FT OC.
  - a. Avoid locating vertical posts at changes in direction of railing.

- b. Hold vertical post back from corner and provide radiused corners.
  - 5. Space handrail brackets as required by loading requirements but not more than 4 FT OC.
  - 6. Base plate for vertical guardrail posts mounted to top of concrete surface:
    - a. 3/8 x 6 x 6 IN square plate welded to the vertical post.
    - b. Predrilled to accept four (4) anchors.
  - 7. Base plate for vertical guardrail post mounted to metal structure:
    - a. 3/8 x 2-1/2 x 8 IN plate welded to the vertical post.
    - b. Predrilled to accept two (2) fasteners.
  - 8. Mounting bracket for vertical guardrail post mounted to vertical concrete surface or web of metal structural member:
    - a. Pair of 3/8 IN angles or bent plates welded to vertical posts.
    - b. Predrilled to accept two (2) fasteners each.
    - c. Provide 1/4 x 4 IN high toe boards at elevated walkways and platforms, where indicated on the Drawings or required by OSHA Standards.
      - 1) Clearance between bottom of toe board and walking surface shall not exceed 1/4 IN.
    - a. Guardrail gates:
      - 1) Constructed of same material and sizes as the guardrail system.
      - 2) Width of gate as shown on Drawings.
      - 3) Hinges:
        - a) Self-closing.
          - (1) Stainless steel torsion spring.
        - b) Similar to Wagner, Model "IR100."
      - 4) Gate latch and stop:
        - a) Spring-loaded pin latch.
          - (1) Stainless steel spring.
        - b) Similar to Wagner, Model "IR101."
- C. Welded Railing Fabrication:
- 1. All welding to be continuous in accordance with AWS D1.1.
    - a. All welded railing joints shall have full penetration welds.
  - 2. All exposed welds to be ground and buffed smooth and flush to match and blend with adjoining surfaces.
    - a. NAAMM AMP 521, Type 2.
  - 3. No ragged edges, surface defects, or undercutting of adjoining surfaces will be accepted.

4. Fit exposed ends of guardrails and handrails with solid terminations.
    - a. Return ends of handrails to wall but do not attach to wall.
  5. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly of units at project site.
- D. Install weeps to drain moisture from hollow sections of railing at exterior locations and in high humidity areas.
1. Drill 1/4 IN weep hole in railings closed at bottom:
    - a. 1 IN above walkway surface at bottom of posts.
      - 1) 1 IN above solid rod at removable railing sections.
    - b. At low point of intermediate rails.
    - c. Drill hole prior to galvanizing.
    - d. Do not drill weep holes:
      - 1) In bottom of base plate.
- E. Expansion Joints:
1. Joints to be designed to allow expansion and contraction of railing and still meet design loads required.
    - a. Top rail splices and expansion joints shall be located within 8 IN of post or other support.
    - b. Where railings span building or tank expansion joints; provide a railing expansion joint in the span crossing the building or tank expansion joint.
  2. Provide expansion joints in any continuous run exceeding 20 FT in length.
    - a. Space expansion joints at not more than 40 FT on center.
  3. Provide minimum 0.10 IN of expansion joint for each 20 FT length of top rail for each 25 DegF differential between installation temperature and maximum design temperature.
    - a. Maximum expansion joint width at time of installation shall not exceed 3/8 IN.
      - 1) Provide additional expansion joints as required to limit expansion joint width.
  4. Provide slip-joint with internal sleeve.
    - a. Extend slip joint min 2 IN beyond joint at maximum design width.
    - b. Fasten internal sleeve securely to one side
      - 1) Provide allen-head set screw located in bottom of rail.
      - 2) Rivets or exposed screw heads are not acceptable.
- F. Finish: Galvanized after fabrication.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Prior to installation, inspect and verify condition of substrate.
- B. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.

### 3.02 INSTALLATION

- A. Install handrails and guardrails to meet loading requirements of the Building Code.
- B. Install products in accordance with NAAMM AMP 521 and manufacturer's instructions.
- C. Set work accurately in location, alignment and elevation; plumb, level, and true.
  - 1. Measure from established lines and items which are to be built into concrete, masonry or similar construction.
- D. Align railings prior to securing in place to assure proper matching at butting and expansion joints and correct alignment throughout their length.
  - 1. Provide shims as required.
- E. Install proper sized expansion joints based on temperature at time of installation and differential coefficient of expansion of materials in all railings as recommended by manufacturer.
  - 1. Lubricate expansion joint splice bar for smooth movement of railing sections.
- F. Provide removable railing sections where indicated on Drawings.
- G. Attach handrails to walls or guardrails with brackets designed for condition.
  - 1. Provide brackets which provide a minimum 1-1/2 IN clearance between handrail and nearest obstruction.
    - a. Handrails shall not project more than 4-1/2 IN into required stairway width.
  - 2. Anchor handrail brackets to concrete or masonry walls with 1/2 IN stainless steel adhesive anchors and stainless steel hex head bolts.
- H. Anchor railings to concrete with minimum 1/2 IN stainless steel adhesive anchors with stainless steel bolts, nuts and washers unless noted otherwise in the Contract documents.
  - 1. Where exposed, bolts shall extend minimum 1/2 IN and maximum 3/4 IN above the top nut.
    - a. If bolts are cut off to required height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nut.
    - b. Bevel the top of the bolt after cutting to provide a smooth surface.
- I. Anchor railings to metal structure with minimum 3/4 IN stainless steel bolts, nuts and washers.
- J. Install toeboards to fit tight to the walking surface.
  - 1. Attach to railing vertical post with manufacturer's standard mounting clamp:

- a. Adjustable.
  - b. Designed to engage in extruded slot on back of toeboard.
- 2. Provide splice bars, corner splices and brackets:
  - a. Manufacturer's standard items as required for a complete installation.
- 3. Notch toeboards at base plates or other obstructions.
- 4. Bottom of toeboard shall not exceed 1/4 IN above walking surface.
- K. Repair damaged galvanized surfaces in accordance with ASTM A780.
  - 1. Properly prepare surface in accordance with galvanizing repair paint manufacturer's recommendations.
  - 2. Apply minimum 6 mils DFT of galvanizing repair paint in accordance with manufacturer's recommendations.
- L. Prepare and paint railings in accordance with Specification Section 09 90 00.
- M. Provide railings as required for stair construction identified in Specification Section 05 50 10.
- N. Install guardrail gate plumb and level in location shown on Drawings.
  - 1. Center gate in opening.
  - 2. Top of gate to match top of guardrail.
  - 3. Fasten hinges to gate and jamb post:
    - a. Minimum three (3) 1/4 IN stainless steel countersunk machine screws per leaf.
    - b. Drill and tap into railing and gate vertical posts.
  - 4. Provide not less than two (2) hinges per gate.
  - 5. Install gate latch and stop on strike side of opening.
    - a. Fasten to gate with 1/4 IN stainless steel countersunk machine screws.
    - b. Drill and tap into gate vertical post.
    - c. Drill hole in railing vertical post to receive latch pin.
  - 6. Adjust to provide smooth operation:
    - Self-closing and self-latching.

**END OF SECTION**



## **SECTION 06 10 00 - ROUGH CARPENTRY**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Wood blocking and nailers.
2. Wood furring
3. Wood sleepers
4. Plywood backing panels.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR, Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.

#### **1.03 DEFINITIONS**

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  1. NELMA - Northeastern Lumber Manufacturers Association.
  2. NLGA - National Lumber Grades Authority.
  3. RIS - Redwood Inspection Service.
  4. SPIB - Southern Pine Inspection Bureau.
  5. WCLIB - West Coast Lumber Inspection Bureau.
  6. WWPA - Western Wood Products Association.

#### **1.04 SUBMITTALS**

- A. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
  1. Preservative-treated wood.
  2. Fire-retardant-treated wood.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

## PART 2 - PRODUCTS

### 2.01 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
  - 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  - 3. Provide dressed lumber, S4S, unless otherwise indicated.
  - 4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2 IN nominal (38 mm actual) thickness or less, unless otherwise indicated.

### 2.02 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP C2 (lumber) and AWP C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWP C31 with inorganic boron (SBX).
  - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction.
- B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:
  - 1. Wood, nailers, blocking and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2. Wood sills, blocking and similar concealed members in contact with masonry or concrete.

### 2.03 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, provide materials that comply with performance requirements in AWP C27 (plywood). Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.
  - 1. Use treatment for which chemical manufacturer publishes physical properties of treated wood after exposure to elevated temperatures, when tested by a qualified independent testing agency according to and ASTM D5516, for plywood.
  - 2. Use treatment that does not promote corrosion of metal fasteners.
  - 3. Use Exterior type for exterior locations and where indicated.

4. Use Interior Type A High Temperature (HT), unless otherwise indicated.

#### 2.04 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.

#### 2.05 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including the following:
  1. Nailers.
  2. Blocking.
- B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber with 19 percent maximum moisture content and any of the following species:
  1. Mixed southern pine; SPIB.
  2. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
  1. Mixed southern pine; No. 2 grade; SPIB.

#### 2.06 PLYWOOD BACKING PANELS

- A. Comm. Room: Communication and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4 IN thick. A side out, painted.

#### 2.07 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
  1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: CABO NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M).
- F. Bolts: Steel bolts complying with ASTM A307, Grade A (ASTM F568M, Property Class 4.6); with ASTM A563 (ASTM A563M) hex nuts and, where indicated, flat washers.

- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E488 conducted by a qualified independent testing and inspecting agency.
  - 1. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2 (ASTM F738M and ASTM F836M, Grade A1 or A4).
- H. Screws for fastening to cold-formed metal framing: ASTM 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION, GENERAL**

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- C. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. CABO NER-272 for power-driven fasteners.
  - 2. Published requirements of metal framing anchor manufacturer.
  - 3. Table 2305.2 "Fastening Schedule", in the Boca National Building Code.
- D. Use common wire 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; predrill as required.
- E. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

#### **3.02 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. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.

### **END OF SECTION**

## **SECTION 06 16 44 - EXTERIOR GYPSUM SHEATHING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes.**

1. Fiberglass-mat faced, moisture resistant exterior gypsum sheathing.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Section 05 40 00 – Cold Formed Metal Framing
- D. Section 07 21 00 - Building Insulation.
- E. Section 09 21 16 - Gypsum Board Assemblies.

#### **1.03 REFERENCED STANDARDS**

##### **A. ASTM International (ASTM):**

1. C473, Standard Test Methods for Physical Testing of Gypsum Panel Products.
2. C1177, Standard Specification for Glass Mat Gypsum Substrate for use as Sheathing.
3. C1280, Standard Specification for Application of Gypsum Sheathing.

#### **1.04 QUALITY ASSURANCE**

- A. Qualifications of workmen: Provide sufficient workmen and supervisors who shall be present at all times during execution of this portion of the Work and who shall be thoroughly familiar with the type of construction involved and the materials and techniques specified.

#### **1.05 PRODUCT HANDLING**

##### **A. Protection:**

1. Store all materials in such a manner as to ensure proper ventilation and drainage to protect against damage and the weather.
2. Keep all material clearly identified; keep all damaged material clearly identified as damaged, and separately store to prevent its inadvertent use.
3. Do not allow installation of damaged or otherwise non-complying material.
4. Use all means necessary to protect the installed work and materials of all other trades.

- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

#### 1.06 SUBMITTALS

- A. Product Data: Manufacturer's specifications and installation instructions for each product specified.

#### 1.07 WARRANTY

- A. Five (5) years against manufacturing defects.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Georgia-Pacific Gypsum LLC.
  - 1. Fiberglass-Mat Faced Gypsum Sheathing: DensGlass Gold.
- B. Product referenced is intended to establish the preferred quality level and performance desired. Products of other manufacturers that meet or exceed this level of quality may be submitted for approval.

#### 2.02 MATERIALS

- A. Alternative Materials submitted for approval must comply with the following minimum standards:
  - 1. Fiberglass-Mat Faced Gypsum Sheathing: ASTM C1177.
    - a. Thickness: 1/2 IN.
    - b. Width: 4 FT.
    - c. Length: 8 FT.
    - d. Weight: 1.9 LBS/SQ FT.
    - e. Edges: Square.
    - f. Surfacing: Coated fiberglass mat on face, back and long edges.
    - g. Racking Strength: ASTM E72 Not less than 540 LBS/SQ FT dry.
    - h. Flexural Strength, Parallel: ASTM C473, 80 LBF, parallel.
    - i. Humidification Deflection: ASTM C1177, Not more than 1/4 IN.
    - j. Permeance: ASTM E96, 23 perms.
    - k. R-Value: ASTM C518, 0.56.

#### 2.03 ACCESSORIES

- A. Screws: ASTM C1002, corrosion resistant treated.

### PART 3 - EXECUTION

#### 3.01 SURFACE CONDITIONS

- A. Inspection:

1. Prior to all Work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
2. Verify that work may be performed in strict accordance with the original design and all pertinent codes, regulations and that installation may proceed in accordance with the manufacturer's printed instructions.

B. Discrepancies:

1. In the event of discrepancy, immediately notify the Architect.
2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.02 WORKMANSHIP

A. General: All sheathing shall be installed in such a manner as to produce joints true, tight, and well secured with all members assembled in accordance with the Drawings and with all pertinent codes and regulations.

B. Manufacturer's Recommendations:

1. Install product per current Manufacturer's printed recommendations.

3.03 GENERAL INSTALLATION

A. General:

1. Install product in strict accordance with manufacturer's printed instructions.
2. Contractor shall keep a copy of the manufacturer's printed instructions on site at all times while work is progressing.

B. Application:

1. Install in a manner to minimize the number of abutting joints.
2. Install panels with face side out.
3. Install panels with 1/4 gap where panels abut other construction or penetrations. Do not force product into place.
4. Support all panel edges securely on framing members.
5. Attach to framing with corrosion resistant screws.

3.04 PROTECTION

- A. Protect installed products from damage due to weather, construction, and other causes natural or otherwise during the remainder of the construction period.
- B. Remove and replace any damaged or defective panels at no cost to Owner.

**END OF SECTION**

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## **SECTION 06 20 00 - FINISH CARPENTRY**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Finish carpentry items other than shop fabricated work.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 06 41 10 - Architectural Cabinetwork and Millwork: Shop fabricated cabinetwork.
- B. Section 08 14 16 - Flush Wood Doors.
- C. Section 08 70 00 - Finish Hardware.
- D. Section 09 90 00 - Painting and Protective Coatings: Painting and finishing of finish carpentry items.

#### **1.03 REFERENCED STANDARDS**

- A. AWI - Quality Standards.
- B. FS L-P-508 - Plastic Sheet, Laminated, Decorative, and Non-Decorative.
- C. FS MM-L-736 - Lumber – Hardwood.
- D. FS MMM-A-130 - Adhesive: Contact.
- E. PS 1 - Construction and Industrial Plywood.
- F. PS 20 - American Softwood Lumber Standard.
- G. PS 58 - Basic Hardwood.
- H. NLGA - National Lumber Grading Authority.

#### **1.04 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Indicate materials, component profiles, fastening methods, jointing details, finishes, accessories, and a minimum scale of 1-1/2 IN to 1 FT (1:10).
- C. Shop drawings, product data, and manufacturer's instructions.
- D. Samples.

#### **1.05 QUALITY ASSURANCE**

- A. Perform finish carpentry work in accordance with AWI Quality Standards, custom grade.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wood materials under provisions of Section 01 65 50 - Delivery, Storage and Handling.
- B. Store indoors, in ventilated areas with constant minimum temperature of 60 Deg. F and maximum relative humidity of 55 percent.

## PART 2 - PRODUCTS

### 2.01 LUMBER MATERIALS

- A. Softwood lumber: PS 20; premium grade in accordance with AWI; maximum moisture content of 6 percent of interior work.
- B. Hardwood Lumber: Premium grade in accordance with A101; maximum moisture content of 6 percent; plain sliced red oak, suitable for transparent finish.

### 2.02 SHEET MATERIALS

- A. Softwood Plywood – PS 1; premium grade in accordance with AWI; core material of lumber or particleboard; thickness 3/4 IN unless otherwise noted.
- B. Hardwood Plywood – Premium grade in accordance with AWI and HPVA Grade AA; core material of lumber, or particleboard; thickness 3/4 IN unless otherwise noted; plain-sliced red oak suitable for transparent finish.
- C. Wood Particleboard – 44 to 48 LB, medium density, composed of wood chips made with water resistant adhesive; thickness 3/4 IN unless otherwise noted.
- D. Hardboard – Pressed wood fiber with resin binder; tempered grade.

### 2.03 FINISH MATERIALS

- A. Plastic Laminate – 0.050 IN general purpose grade; color as shown on Drawings or specified in specific sections.
- B. Plastic Laminate Backing – High pressure paper base laminate without a decorative finish; 0.020 IN thick, smooth surface finish.

### 2.04 ADHESIVE

- A. Contact Adhesive: Type recommended by manufacturer.

### 2.05 ACCESSORIES

- A. Nails: Size and type to suit application.
- B. Bolts, Nuts, Washers, Lags, and Screws: Size and type to suit application; non-corrosive for exterior, high humidity, and treated wood locations; plain finish at other interior locations.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Set and secure materials and components in place, plumb and level.

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- B. Verify mechanical, electrical, and building items affecting this section are placed and ready to receive this work.
- C. Prime paint surfaces of items or assemblies in contact with cementitious materials.
- D. Fit exposed edges of plywood and particleboard shelving with 3/8 IN thick hardwood edging. Width is thickness of plywood or particleboard.
- E. Install hardware supplied by Section 08 70 00 in accordance with manufacturer's instructions.
- F. Apply plastic laminate finishes where indicated. Adhere with adhesive over entire surface. Make joint and corners hairline. Match patterns. Slightly bevel arises. Cap exposed edges with plastic laminate of same finish and pattern. Apply laminate backing on reverse side of plastic laminate finished surfaces.

### 3.02 PREPARATION FOR FINISHING

- A. Sand work smooth and set exposed nails and screws. Apply wood filler in exposed nail and screw indentations.

### 3.03 SCHEDULE

- A. Interior:
  - 1. Door and glazed light frames.
  - 2. Moldings, bases, casings, and miscellaneous trim and stops.
  - 3. Loose Shelving – Finish as detailed.

## **END OF SECTION**

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## **SECTION 06 41 10 - ARCHITECTURAL CABINETWORK AND MILLWORK**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Architectural cabinetwork.
2. Cabinet Hardware.
3. Plastic laminate countertops.
4. Solid Surface countertops and window sills.
5. Stainless steel laminate.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR, Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.
- C. UPRR Section III Specifications.
- D. Division 22 - Plumbing.
- E. Division 26 - Electrical.

#### **1.03 REFERENCED STANDARDS**

##### **A. American National Standards Institute (ANSI):**

1. A208.1, Particleboard, Mat-Formed Wood.

##### **B. ASTM International (ASTM):**

1. A269, Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
2. A423, Specification for Seamless and Electric-Welded Low-Alloy Steel Tubes.
3. A480, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
4. E84, Test Method for Surface Burning Characteristics of Building Materials.

##### **C. Architectural Woodwork Institute (AWI):**

1. Architectural Woodwork Quality Standards.

##### **D. National Electrical Manufacturers Association (NEMA):**

1. LD-3, High Pressure Decorative Laminates.
2. LD-3.1, Application, Fabrication, and Installation of High-Pressure Decorative Laminates.

#### 1.04 SUBMITTALS

##### A. Shop Drawings:

1. See UPRR Division 01.
2. Show location of each item, dimensioned plans and elevations, large- scale details, attachment devices, and other components.
3. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.

##### B. Miscellaneous Submittals.

1. See UPRR Division 01.
2. Millwork fabricator experience qualifications.
3. Listing of millwork fabricators projects within last two years with similar scope.

##### C. Samples:

1. Provide (1) set of samples of plastic laminate and solid surface material showing full range of manufacturer's colors and finishes for Architect's initial selection.
2. After final selection, provide (4) Samples 2 IN x 3 IN of each plastic laminate, solid surface & stainless steel showing color and finish for Architect's use.

#### 1.05 QUALITY ASSURANCE

##### A. Qualifications:

1. Fabricator shall have minimum of 10 years' experience in design and fabrication of architectural cabinetwork with minimum of three successfully completed projects with similar scope in the last 2 years.

##### B. Miscellaneous:

1. Construction details, fastening, tolerances and workmanship: Architectural Woodwork Institute (AWI) custom grade standards with exceptions indicated.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- ##### A.
1. Deliver all millwork items to the project site to allow material to acclimate to the surrounding environment a minimum 96 HRS prior to installation.

### PART 2 - PRODUCTS

#### 2.01 WOOD MATERIALS

- ##### A. Softwood Lumber: PS 20; graded in accordance with AWI premium grade; maximum moisture content of 6 percent; species and grade as follows:
1. Cabinet Frame: Douglas Fir, plain or rotary cut.

## 2.02 SHEET MATERIALS

- A. Softwood Plywood: PS 1; graded in accordance with AWI premium grade; core material of lumber or medium density particleboard.
- B. Semi-Exposed Surfaces: 3/4 IN, 44 LB medium-density particleboard with almond color melamine.

## 2.03 LAMINATE MATERIALS

- A. Plastic Laminate – NEMA LD 3, GP – 50 general purpose type, color as selected; matte finish.
- B. Laminate Backing Sheet – LD3 BK20 Backing Grade.
- C. Acceptable laminate manufacturers:
  - 1. Formica.
  - 2. Nevamar.
  - 3. Wilsonart.
  - 4. Pionite.
  - 5. Substitutions – Under provisions of Section 01 33 00.
- D. Melamine for Interior Cabinet Surfaces:
  - 1. Compatible with primary cabinet laminate manufacturer's standard melamine interior surfacing.

## 2.04 SOLID SURFACE MATERIAL COUNTERTOPS AND INTERIOR WINDOW SILLS

- A. Countertops: Provide countertops with the following front and backsplash style:
  - 1. Front: Radius edge with apron, 2 IN high with 3/8 IN radius.
  - 2. Backsplash: Radius edge with 3/8 IN radius.
  - 3. Endsplash: Matching backsplash.
  - 4. 1/2 IN thick, solid surface material.
  - 5. Backsplashes: 1/2 IN thick, solid surface material.
- B. Window Sills: Provide window sills as indicated on the drawings:
  - 1. 1/2 IN thick, solid surface material.

## 2.05 STAINLESS STEEL MATERIAL

- A. 22 gauge, Type 304 stainless steel sheets.

## 2.06 ACCESSORIES

- A. Adhesive: Type recommended by laminate manufacturer to suit application.
- B. Fasteners: Size and type to suit application.

## 2.07 HARDWARE

- A. Cabinet Shelf Standards and Rests: K&V #225 recessed standards with #256 supports, US26D finish.
- B. Drawer and Door Pulls: Stanley 4484 – US26D finish.
- C. Cabinet Locks: National C8103 or equal – US26D finish.
- D. Drawer Slides: Blum 430E series.
- E. Hinges: Stanley 1592 x 4 x 641, one (1) pair doors to 48 IN height 1-1/2 pair doors 48 IN to 7 FT height.
- F. Catches: Stanley SP41: Magnetic.
- G. Touch Latch: Ives #821.
- H. Grommets: Minimum 1-1/2 IN DIA plastic grommets for countertops, color to match.
- I. Mail Box Label Holders; brushed stainless steel
- J. Shelving Standards and Brackets: K&V #87 recessed standards with #187 brackets, US26D finish.

## 2.08 FABRICATION

- A. Shop assembles casework for delivery to site in units easily handled and to permit passage through building openings.
- B. Fit shelves, doors, and exposed edges with 3/8 IN matching hardwood edging. Use full length pieces only.
- C. Door and Drawer Fronts: 3/4 IN thick.
- D. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and side cutting.
- E. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Make corners and joints hairline. Locate counter butt joints minimum 2 FT from sink cut-outs.
- F. Cap exposed plastic laminate edges with material of same finish and pattern unless shown otherwise on Drawings.
- G. Mechanically fasten backsplashes to countertops.
- H. Apply laminate backing sheet to reverse side of plastic laminate surfaces.
- I. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and other fixtures and fittings. Verify locations of cutouts from on-site dimensions. Prime paint contact surfaces of cut edges.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Verify dimensions at site.

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- B. Verify adequacy of backing and support framing.
- C. Verify locations of items furnished in other sections.

### 3.02 INSTALLATION

- A. Set and secure casework in place; rigid, plumb, and level.
- B. Use purpose designed fixture attachments at concealed locations for wall mounted components.
- C. Use threaded steel concealed joint fasteners to align and secure adjoining cabinet units.
- D. Carefully scribe casework which is against other building materials, leaving gaps of 1/32 IN maximum. Do not use additional overlay trim for this purpose.
- E. Secure cabinet and counter bases to floor using appropriate angles and anchorages.
- F. Countersink anchorage devices at exposed locations used to wall mount components, and conceal with solid plugs of species to match surrounding wood. Finish flush with surrounding surfaces.
- G. Cut holes in countertops where shown on drawings or required for electrical cords. Fill hole with plastic grommet with plug (cap) to be installed when cord is not in use.
- H. Provide backer sheet on each plastic laminated item.
- I. Provide all trim, fillers, closures, stands, supports, sleeves, collars, escutcheons, brackets, braces or other miscellaneous items required for complete installation.
- J. Install extra locks where directed; deliver unused locks and keys to Owner.

### 3.03 ADJUSTING AND CLEANING

- A. Adjusting doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly and correctly.
- B. Clean casework, counters, shelves, hardware, fittings and fixtures.

### **END OF SECTION**

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## **SECTION 06 64 00 – PLASTIC PANELING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Requirements for furnishing and installing fiberglass reinforced plastic panels according to manufacturer's recommendations.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Section 09 21 16 - Gypsum Board Assemblies.

#### **1.03 SUBMITTALS**

##### **A. Submit in accordance with Section 01 33 00.**

1. Color samples of each type of panel, each type of trim and fastener.
  - a. After Architect's selection, provide 4 samples of selected panel color
2. Manufacturer's Installation Guide.

#### **1.04 QUALITY ASSURANCE**

- A. Provide panels and molding only from the same manufacturer to ensure warranty and color harmonization of accessories.
- B. Qualifications of installers:
  1. Use only thoroughly trained and experienced installers who are completely familiar with the requirements of this Work and the recommendations contained in the referenced standards.
  2. In acceptance or rejection of installed work, no allowance will be made for lack of skill on the part of the installer.
- C. Codes and Standards: In addition to complying with all pertinent codes and regulations:
  1. Meet ASTM E84, flame spread less than 200, smoke developed less than 450.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery of Materials: Package sheets on skids or pallets for shipment to project site.
- B. Storage of Materials: Store panels indoors in a dry place at the project site.
- C. Handling: Remove foreign matter from face of panel by use of a soft bristle brush, avoiding abrasive action.

1.06 PROJECT CONDITIONS:

- A. Installation shall not begin until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from concrete work has dissipated.
- B. During installation and for not less than 48 HRS before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
- C. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

PART 2 - PRODUCTS

2.01 PLASTIC SHEET PANELING

- A. Glass Fiber Reinforced Plastic Paneling:
  - 1. Shall be manufactured by Marlite or an approved equal.
  - 2. Interior (face) skin shall be .090 IN fire-rated (FRP) reinforced fiberglass.
  - 3. Color shall be selected by Architect from manufacturer's standard color selection.
  - 4. Surface Finish: Smooth
  - 5. Stabilizer sheet under face shall be 6-mm thick non-asbestos fiber reinforced cement sheet.
  - 6. Size tolerance:
    - a. Width:  $\pm 1/8$  IN.
    - b. Length:  $\pm 1/8$  IN.
    - c. Thickness:  $\pm 1/16$  IN.
- B. Adhesive:
  - 1. The adhesive used in laminating shall be polyurethane reactive (PUR), hot melt type, applied heated 250 DegF.
  - 2. The entire composite shall be pressed with maximum pressure under controlled and consistent pressure to develop the maximum possible tensile strength.
- C. Sealants: Panels to be sealed with Class A grade sealant.
- D. Division Bars, Corner Trim, Moldings: Panel manufacturer's standard length extruded vinyl pieces; longest length possible - to eliminate end joints. Color to match panels.
- E. Fasteners: Non-corrosive drive rivets in harmonizing colors. Refer to Manufacturer's Installation Guide for rivet pattern and installation instructions.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.
- B. Do not begin installation until backup surfaces are put into satisfactory condition.

### **3.02 APPLICATION**

- A. Do all cutting and drilling with carbide tipped saw blades or drill bits, or cut with snips.
- B. Install panels with manufacturer's recommended gap for panel field and corner joints.
- C. Fastener holes in the panels must be predrilled 1/8 IN (3.2 mm) oversize.
- D. Using products acceptable to manufacturer, install the FRP panel system in accordance with panel manufacturer's printed instructions.

### **3.03 CLEANING**

- A. Remove any adhesive or excessive sealant from panel face using solvent or cleaner recommended by panel manufacturer.

**END OF SECTION**

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## **SECTION 06 71 13 - FIBERGLASS GRATING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Fiberglass-reinforced plastic grating and stair treads used for outdoor platforms, trench covers, track pan crossings, stairs, and raised walkways. Contractor shall furnish all labor, materials, tools, equipment and services as required.
- B. Completely coordinate with other related work, structural framing work in particular.
- C. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure and complete installation.

#### **1.02 REFERENCED STANDARDS**

##### **A. ASTM International (ASTM):**

1. C581, Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass-Fiber-Reinforced Structures Intended for Liquid Service.
2. D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
3. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

#### **1.03 SUBMITTALS**

##### **A. Submit under provisions of Section 01 33 00.**

##### **B. Submittals required by this section include, but are not limited by, the following:**

1. Manufacturer's product data for grating and accessory components, including product load and deflection information.
2. Shop drawings for the fabrication and installation layout of the grating.
3. Product sample: 4 x 4 IN square.

### **PART 2 - PRODUCTS**

#### **2.01 FIBERGLASS GRATING**

- A. Grating shall be fiberglass roving reinforced thermoset plastic, constructed to provide thorough wetting of the glass by the polyester resin. The resin shall be fire-resistant, producing a Class 1 flame spread below 25 and a fuel contribution of zero (0) when tested in accordance with ASTM E84.
- B. The grating shall be made in a mold and of single piece construction so the reinforcing glass of the bearing bars is interwoven with the glass of the crossbars.
- C. Design:

1. Grating grid pattern shall be 1-1/2 x 1-1/2 x 1-1/2 IN thick and capable of supporting a 100 LBS/SQ FT uniform load with a deflection of less than 0.25 IN when spanning 36 IN. Approved pultruded grating with alternate grid pattern may be submitted for review.
2. Angular silica particles shall be integrally embedded or flooded to a maximum depth of 3/16 IN, in the top surface of the grating as an anti-slip surface.

## 2.02 FIBERGLASS STAIR TREAD

- A. Stair tread shall be fiberglass roving reinforced polyester 1-1/2 IN high, having a grid pattern with bearing bars 1-1/2 IN and cross bars 6 IN OC, construction to provide thorough wetting of the glass by the polyester resin. The resin shall be fire-retardant, producing a Class 1 flame spread below 25 and a fuel contribution of zero (0) when tested in accordance with ASTM E84.
- B. The tread shall be made in a mold and of single piece construction so the reinforcing glass of the bearing bars is interwoven with the reinforcing glass of the crossbars.
- C. The solid nose construction shall be made integral with the tread and shall be 1-3/4 IN wide. The nose of the tread shall be a darker color to distinctively contrast with the rest of the walking surface.
- D. Design:
  1. The stair tread grid pattern shall be 1-1/2 x 6 x 1-1/2 IN thick and capable of supporting a concentrated load of 1,000 LBS with a deflection of less 0.65 IN when spanning 36 IN.
  2. Angular silica particles shall be integrally embedded or flooded, to a maximum depth of 3/16 IN, in the top surface of the grating as an anti-slip surface.

## 2.03 GRADING CLIPS

- A. Clips shall be recommended and supplied by grating manufacturer.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Grating and stair tread shall be as free, as commercially possible, from visual defects such as foreign inclusions, de-lamination, blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish (except for grit top surfaces) with an average of not over four (4) surface pits per square foot of surface area, with no pits exceeding 1/8 IN DIA, or 1/32 IN depth.

### 3.02 STORAGE AND HANDLING

- A. Store grating and stair tread on pallets and cover. Do not top load. Separate each piece with a non-scratching spacer, such as wood.
- B. Protect from damage. Avoid sharp or impinging loads such as chain slings. Do not drag panels across one another unless separated by a non-scratching spacer.
- C. Sand and re-surface coat any scratches, crushed or shipped edges or cuts required in the field.



### 3.03 INSTALLATION

- A. Perform all installation in accordance with the drawings and approved submittals.
- B. Check supporting structures and correct layout and alignment. Verify that support surfaces are free of debris. Check measurement of grading and stair tread to determine fit.
- C. Set the work accurately in location, alignment and elevation; plumb, level, true and free from rack; measured from established lines and levels.
- D. Fit grading panels together to form 1/4 IN joints at adjoining panels and at exterior curbs, unless otherwise indicated. Align bars of adjoining panels of grating.
- E. Tolerances of cuts and of fitting panels shall be  $\pm 1/8$  IN.
- F. Field-cut or sanded surfaces shall be coated with resin furnished by manufacturer and applied in accordance with manufacturer's instructions.
- G. Provide bottom support under the periphery of all panels unless shown otherwise on the drawings (such as the use of end panel connectors where panels butt together). All connectors are to be specified and determined to be suitable.
- H. Each grating panel shall have hold-down clips through-bolted to each supporting beam, with a minimum of two clips at each beam, and a maximum spacing along the beam between clips of 4 FT apart. Bolts shall be stainless steel, 1/4 IN DIA, with locknuts. Clips shall be "M" type. At joints between adjacent grating panels which do not occur over a beam, the panels shall be attached to each other (between supports) to prevent differential vertical deflections, using grating manufacturer's standard clips.
- I. If the scope of work requires the contractor to perform additional tasks that may damage the installed grating, the contractor is responsible for covering the grating with plywood, or other suitable protective material.

**END OF SECTION**

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## **SECTION 07 19 00 - WATER REPELLENTS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This Section includes clear water-repellent coatings for the following vertical and non-traffic horizontal surfaces:
  - 1. Concrete Masonry Units.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.

#### **1.03 SUBMITTALS**

- A. Product Data: Include manufacturer's specifications, surface preparation and application instructions, recommendations for water repellents for each surface to be treated, and protection and cleaning instructions. Include data substantiating that materials are recommended by manufacturer for applications indicated and comply with requirements.

#### **1.04 PERFORMANCE REQUIREMENTS**

- A. Provide water repellents with the following properties based on testing manufacturer's standard products, according to test methods indicated, applied to substrates simulating Project conditions using same materials and application methods to be used for Project.
  - 1. Absorption: Minimum 90 percent reduction of absorption after 24 HRS in comparison of treated and untreated specimens.
    - a. Concrete Unit Masonry: ASTM C140.
  - 2. Water-Vapor Transmission: Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E96.
  - 3. Water Penetration and Leakage through Masonry: Maximum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E514.
  - 4. Durability: Maximum 5 percent loss of water repellency after 2500 HRS of weathering in comparison to specimens before weathering, per ASTM G53.
  - 5. Permeability: Minimum 80 percent breathable in comparison of treated and untreated specimens, per ASTM D1653.

#### **1.05 PROJECT CONDITIONS**

- A. Weather and Substrate Conditions: Do not proceed with application of water repellent under any of the following conditions, except with written instruction of manufacturer:

1. Ambient temperature is less than 40 DegF.
2. Concrete surfaces and mortar have cured for less than 28 days.
3. Rain or temperatures below 40 DegF are predicted within 24 HRS.
4. Application is earlier than 24 HRS after surfaces have been wet.
5. Substrate is frozen or surface temperature is less than 40 DegF.
6. Windy condition exists that may cause water repellent to be blown onto vegetation or surfaces not intended to be coated.

#### 1.06 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written warranty, executed by the applicator and water repellent manufacturer, covering materials and labor, agreeing to repair or replace materials that fail to provide water repellency within the specified warranty period. Warranty does not include deterioration or failure of coating due to unusual weather phenomena, failure of prepared and treated substrate, formation of new joints and cracks in excess of 1/16 IN wide, fire, vandalism, or abuse by maintenance equipment.
  1. Warranty Period: 5 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the following:
  1. Siloxanes: With more than 3.3 LB/GAL (400 g/L) VOCs.
    - a. Prime-A-Pell 200; Chemprobe Technologies.
    - b. Klere-Seal 908-SX; Pecora Corporation.
    - c. Weather Seal Siloxane; ProSoCo, Inc.

#### 2.02 WATER REPELLENTS

- A. Siloxanes: Penetrating water repellent. Alkylalkoxysiloxanes that are oligomeric with alcohol, ethanol, mineral spirits, water, or other proprietary solvent carrier.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Clean substrate of substances that might interfere with penetration or performance of water repellents. Test for moisture content, according to repellent manufacturer's written instructions, to ensure surface is sufficiently dry.

- B. Test for pH level, according to water repellent manufacturer's written instructions, to ensure chemical bond to silicate minerals.
- C. Protect adjoining work, including sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live plants and grass.
- D. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
  - 1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.

### 3.02 APPLICATION

- A. Apply a heavy-saturation spray coating of water repellent on surfaces indicated for treatment using low-pressure spray equipment. Comply with manufacturer's written instructions for using airless spraying procedure, unless otherwise indicated.
- B. Apply a second saturation spray coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.

### 3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized technical service representative to inspect and approve the substrate before application and to instruct the applicator on the product and application method.

### 3.04 CLEANING

- A. Protective Coverings: Remove protective coverings from adjacent surfaces and other protected areas.
- B. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Repair damage caused by water-repellent application. Comply with manufacturer's written cleaning instructions.

## END OF SECTION

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## **SECTION 07 21 00 - BUILDING INSULATION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Extruded polystyrene foam-plastic board for foundation and slab insulation
2. Glass Fiber Batt and Blanket type building thermal insulation.
3. Glass Fiber Batt and blanket sound attenuation insulation.
4. Simple-Saver Pre Engineered Building insulation.
5. Required R-Values shall be as identified on the Drawings. If R-Values are not referenced on the Drawings, the Contractor will provide the following minimum R-Values.
  - a. Roof: R-30.
  - b. Exterior Walls: R-19.
  - c. Foundation and slab: R-5.5.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Section 03 30 00 - Cast-In-Place Concrete.
- D. Section 07 25 00 – Weather Barrier
- E. Section 07 26 10 – Vapor Retarders
- F. Section 13 34 19 - Metal Building Systems.

#### **1.03 DEFINITIONS**

- A. Thermal Resistivity: Where the thermal resistivities of insulation products are designated by "R-values," they represent the reciprocal of thermal conductivity (k-values). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 IN thick. Thermal resistivities are expressed by the temperature difference in degrees F between the two exposed faces required to cause one BTU to flow through one square foot per hour at mean temperatures indicated.

#### **1.04 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Product Data for each type of insulation product specified.

- C. Product test reports from and based on tests performed by a qualified independent testing agency evidencing compliance of insulation products with specified requirements including those for thermal resistance, fire-test-response characteristics, water-vapor transmission, water absorption, and other properties, based on comprehensive testing of current products.

#### 1.05 QUALITY ASSURANCE

- A. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test- response characteristics indicated on Drawings or specified elsewhere in this Section as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
  - 1. Surface-Burning Characteristics: ASTM E84.
  - 2. Fire-Resistance Ratings: ASTM E119.
  - 3. Combustion Characteristics: ASTM E136.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
  - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
  - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
  - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

### PART 2 - PRODUCTS

#### 2.01 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

- A. Manufacturers: Subject to compliance with requirements, provide insulation products by one of the following:
  - 1. Extruded-Polystyrene Board Insulation:
    - a. Amoco Foam Products Company.
    - b. DiversiFoam Products.
    - c. Dow Chemical Co.



- d. UC Industries, Inc.; Owens-Corning Co.
- B. Extruded-Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation formed from polystyrene base resin by an extrusion process using hydrochl or fluorocarbons as blowing agent to comply with ASTM C578 for type and with other requirements indicated below:
  - 1. Type IV, 1.60 LB /CU FT minimum density, unless otherwise indicated.
  - 2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 75 and 450, respectively.
    - a. Recycled Content: Not less than 50 percent blend of post-consumer and recovered polystyrene resins

## 2.02 GLASS FIBER BLANKET EXTERIOR WALL INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide insulation products by one of the following:
  - a. Certainteed Corporation.
  - b. Johns-Manville.
  - c. Owens-Corning Fiberglas Corporation.
  - d. Knauf Insulation – Fiberglass
- B. Glass-Fiber Blanket, Reinforced-Foil Faced: ASTM C 665, Type III (reflective faced), Class A (faced surface with a flame-spread index of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil scrim, foil-scrim kraft, or foil-scrim polyethylene
  - 1. Flanged Units: Provide blankets fabricated with facing incorporating 5 IN wide flanges along edges for attachment to framing members.

## 2.03 GLASS FIBER BLANKET INTERIOR SOUND INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide insulation products by one of the following:
  - a. Certainteed Corporation.
  - b. Johns-Manville.
  - c. Owens-Corning Fiberglas Corporation.
  - d. Knauf Insulation – Fiberglass
- B. 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. STC = 50 for walls.

## 2.04 SIMPLE SAVER SYSTEMS:

- A. Manufacturers: Subject to compliance with requirements, provide insulation products by one of the following:
  - a. Thermal Design Inc.

- B. Reinforced Vinyl Faced Batt (Standing Seam Roof): Thermal insulation using glass fibers to comply with ASTM C665, Type II, Class C with PSK reinforced vinyl facing. Passing ASTM E136 for testing of combustion. Characteristics of unfaced material. Maximum frame speed and smoke developed values of twenty-five (25) and fifty (50) respectively. Welded pin with spacing at manufacturer's recommendation to support insulation:
  - 1. R-Value = R 30 at Roof.

## 2.05 ACCESSORIES

- A. Slag-Wool-Fiber Board Safing Insulation: Semi-rigid boards designed for use as a fire stop at the openings between edge of slab and exterior wall panels, produced by combining slag-wool-fibers with thermosetting resin binders to comply with ASTM C612, Type IA and IB; nominal density of 4 LB/CU FT; passing ASTM E 136 for combustion characteristics; thermal resistivity of 4 Deg. F x h x SQ FT/Btu x IN at 75 Deg. F.
- B. Caulking Compound: Material approved by manufacturer of safing insulation for sealing joint between foil backing of safing insulation and edge of concrete floor slab against penetration of smoke.
- C. Safing Clips: Galvanized steel safing clips approved by manufacturer of safing insulation for holding safing insulation in place.
- D. Eave Ventilation Troughs: Preformed rigid fiberboard or plastic sheets designed and sized to fit between roof framing members and to provide cross ventilation between insulated attic spaces and vented eaves

## 2.06 VAPOR RETARDERS

- A. See Section 07 26 10 – Vapor Retarders

# PART 3 - EXECUTION

## 3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected.

## 3.02 PREPARATION

- A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or that interfere with insulation attachment.

## 3.03 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, unsoiled, and unexposed to ice and snow.

- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Apply single layer of insulation to produce thickness indicated.

#### 3.04 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

- A. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
- B. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection board. Set in adhesive according to written instructions of insulation manufacturer.
- C. Protect top surface of horizontal insulation from damage during concrete work by applying protection board.

#### 3.05 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Seal joints between closed-cell (non-breathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are placed. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by manufacturer.
- C. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
  - 1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
- D. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:
  - 1. Use blanket widths and lengths that fill cavities formed by framing members. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
  - 2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. For metal stud construction with unfaced blankets, friction fit insulation between adjoining studs and cover with vapor barrier.
- E. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 LB/CU FT.

3.06 INSTALLATION OF SAFING INSULATION

- A. Install safing insulation to fill gap between top of CMU wall and sheet metal closure. Fill voids in metal deck at rated walls. Cut safing insulation wider than gap to be filled to ensure compression fit and seal joint between insulation and edge of slab with caulking approved by safing insulation manufacturer for this purpose. Leave no voids in completed installation.

3.07 PROTECTION

- A. General: Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. 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**

## **SECTION 07 25 00 - WEATHER BARRIER**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Building wrap.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.

#### **1.03 ACTION SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: For each type of product.

#### **1.04 INFORMATIONAL SUBMITTALS**

- A. Evaluation Reports: For water-resistive barrier and flexible flashing from ICC-ES.

### **PART 2 - PRODUCTS**

#### **2.01 WATER-RESISTIVE BARRIER**

- A. Building Wrap: ASTM E1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E84; UV stabilized; and acceptable to authorities having jurisdiction.
  1. Products: Subject to compliance with requirements] provide one of the following:
    - a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
    - b. DuPont (E. I. du Pont de Nemours and Company); Tyvek CommercialWrap.
    - c. Ludlow Coated Products; Barricade Building Wrap.
    - d. Pactiv, Inc.; GreenGuard Classic Wrap.
  2. Water-Vapor Permeance: Not less than 50 g through 1 SQ m of surface in 24 HRS per ASTM E96/E96M, Desiccant Method (Procedure A).
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

#### **2.02 MISCELLANEOUS MATERIALS**

- A. Flexible Flashing: Self-adhesive butyl rubber or [rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 IN.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; [Vycor Plus Self- Adhered Flashing] [Vycor V40 Self-Adhered Flashing].
  - b. Polyguard Products, Inc.; [Polyguard JT-20 Tape] [Polyguard JT-30 Tape].

### **PART 3 - EXECUTION**

#### **3.01 WATER-RESISTIVE BARRIER INSTALLATION**

- A. Cover sheathing with water-resistive barrier as follows:
  1. Cut back barrier 1/2 IN on each side of the break in supporting members at expansion- or control-joint locations.
  2. Apply barrier to cover vertical flashing with a minimum 4 IN overlap unless otherwise indicated.
- B. Building Paper: Apply horizontally with a 2 IN overlap and a 6 IN end lap; fasten to sheathing with galvanized staples or roofing nails.
- C. Building Wrap: Comply with manufacturer's written instructions.
  1. Seal seams, edges, fasteners, and penetrations with tape.
  2. Extend into jambs of openings and seal corners with tape.

#### **3.02 FLEXIBLE FLASHING INSTALLATION**

- A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
  1. Lap seams and junctures with other materials at least 4 IN except that at flashing flanges of other construction, laps need not exceed flange width.
  2. Lap flashing over water-resistive barrier at bottom and sides of openings.
  3. Lap water-resistive barrier over flashing at heads of openings.

**END OF SECTION**

## **SECTION 07 26 10 – VAPOR RETARDERS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Polyvinyl chloride vapor retarders under concrete slabs.
2. Polyethylene vapor retarders at exterior building walls.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Section 03 30 00 - Cast-in-Place Concrete
- D. Section 07 21 00 – Building Insulation
- E. Section 07 25 00 - Weather Barrier

#### **1.03 SUBMITTALS**

- A. Submit manufacturer's literature to the Architect for review.

#### **1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver all materials free from damage in original packages bearing manufacturer's label.
- B. Store all materials on a clean, level surface in a dry place protected from sun and weather such that the temperature stays between 40 DegF and 90 DegF. Stand roll goods in such a way to prevent damage to the ends. Store all materials containing solvents in a dry, cool storage with proper fire and safety precautions.

### **PART 2 - PRODUCTS**

#### **2.01 UNDER-SLAB VAPOR RETARDER**

- A. Vapor Retarder Material: Nervastral Inc. "Barrier," or approved equal, polyvinyl chloride plastic membrane sheeting, 10 mils thick. Sheets shall be as wide as practicable for proper application which will result in the least number of laps.
- B. Adhesive: "Nerva-Plast" cement, or approved equal, synthetic rubber base cement especially manufactured for use with polyvinyl chloride membrane material for cold application. Asphaltic base adhesives will not be accepted.
- C. Tape: Tape for the sealing of laps and joints shall be a pressure-sensitive neoprene or vinyl- chloride rubber adhesive tape as recommended by the manufacturer of the vapor barrier material. Tape shall be a minimum of 3 IN wide.

## 2.02 EXTERIOR WALL VAPOR RETARDER

- A. Polyethylene Vapor Retarder: ASTM D4397, minimum 6 mils thickness, with maximum permeance rating of 0.13 perm.
- B. Tape: Pressure-sensitive tape pf type recommended by vapor retarder manufacturer for sealing joints and penetrations in vapor retarder

## PART 3 - EXECUTION

### 3.01 INSTALLATION

#### A. Under-slab Vapor Retarder:

1. Vapor retarder sheets shall be laid directly over the compacted gravel or rock fill just before reinforcing is placed and concrete is poured, and shall be carefully installed to avoid puncture or tear.
2. Punctures and tears occurring during subsequent operations shall be patched. Edges shall be lapped not less than 4 IN and end joints shall be lapped not less than 6 IN, with all laps continuously sealed with tape.
3. Barrier shall be carried over any pipes laid on the fill and shall be sealed in waterproof manner to any pipes or conduits which penetrate the fill.
4. Membrane shall be turned up a minimum of 2 IN at the edges and secured to exterior wall foundations or footings, with specified adhesive.
5. Vapor barrier shall be applied to walls, where required, with the same specified adhesive.
6. The placing of stakes through vapor barrier membranes for screening of concrete slabs will not be permitted.

#### B. Exterior Wall Vapor Retarder

1. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
2. Seal vertical joints in vapor retarders over framing by lapping not less than two (2) wall studs. Fasten vapor retarders to framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 IN (406 mm) OC.
3. Seal overlapping joints in vapor retarders with adhesives or vapor-retarder tape according to vapor retarder manufacturer's instructions. Seal butt joints and fastener penetrations with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
4. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor retarder manufacturer.
5. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.



6. Repair any tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

### 3.02 PROTECTION

- A. General: Protect installed vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes.

**END OF SECTION**

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## **SECTION 07 54 00 – THERMOPLASTIC MEMBRANE ROOFING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

**A. Section Includes:**

1. Fully Adhered membrane roofing system.
2. Vapor retarder.
3. Roof insulation

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Division 6 - "Miscellaneous Carpentry" for wood nailers, curbs, and blocking
- D. Division 7 - "Building Insulation" for insulation beneath the roof deck.
- E. Division 7 - "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counter flashings.
- F. Division 7 - "Joint Sealants."
- G. Division 32 for roof drains.

#### **1.03 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.
  1. Base flashings and membrane terminations.
  2. Tapered insulation, including slopes.
  3. Insulation fastening patterns.
- C. Samples for Verification: For the following products:
  1. 12-by-12-inch square of sheet roofing, of color specified, including T-shaped side and end lap seam.
  2. 12-by-12-inch square of roof insulation.
  3. 12-inch length of metal termination bars.
  4. 12-inch length of battens.
  5. Six insulation fasteners of each type, length, and finish.
  6. Six roof cover fasteners of each type, length, and finish.
- D. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

- E. Qualification Data: For Installer and manufacturer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of roofing system.
- G. Research/Evaluation Reports: For components of membrane roofing system.
- H. Maintenance Data: For roofing system to include in maintenance manuals.
- I. Warranties: Special warranties specified in this Section.
- J. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

#### 1.04 DEFINITIONS

- A. Source Limitations: Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.
- B. Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," before multiplication by a safety factor.
- C. Factored Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," after multiplication by a safety factor.

#### 1.05 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.
- C. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist the factored design uplift pressures calculated according to SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems."
- D. Roof Insulation System. All foam plastic roof insulation shall meet UL Standard 1256.

#### 1.06 QUALITY ASSURANCE

- A. Installer Qualifications: 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 warranty.
- B. Manufacturer Qualifications: A qualified manufacturer that has UL listing for membrane roofing system identical to that used for this Project.

- C. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.
- D. Source Limitations: Obtain components for membrane roofing system approved by roofing membrane manufacturer.
- E. Fire-Test-Response Characteristics: Provide membrane roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.
  - 1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
  - 2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
  - 1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
- C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.
- D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

#### 1.08 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

#### 1.09 WARRANTY

- A. Special Warranty: Manufacturer's standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.
  - 1. Special warranty includes roofing membrane, base flashings, roofing accessories, roof insulation, fasteners, and other components of membrane roofing system.
  - 2. Warranty Period: 15 years from date of Substantial Completion

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### 2.02 THERMOPLASTIC SINGLE PLY ROOFING

- A. Thermoplastic Polyolefin (TPO) Sheet:
  - 1. Carlisle Syntec Systems; Carlisle Corp.
  - 2. Versico, Inc.
  - 3. GenFlex
- B. Thickness: 60 mils nominal.
- C. Exposed Face Color: White or Gray or as approved by the Architect

### 2.03 AUXILIARY MATERIALS

- A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
  - 1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.
- B. Sheet Flashing: 60-mil-thick EPDM, partially cured or cured, according to application.
- C. Bonding Adhesive: Manufacturer's standard bonding adhesive.
- D. Seaming Material: Single-component butyl splicing adhesive and splice cleaner
- E. Lap Sealant: Manufacturer's standard single-component sealant, color to match roofing membrane.
- F. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.
- G. Metal Termination Bars: Manufacturer's standard predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.
- H. Metal Battens: Manufacturer's standard aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.
- I. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane 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, in-seam sealants, termination reglets, cover strips, and other accessories

## 2.04 ROOF INSULATION

- A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and of thicknesses indicated.
- B. Products: Provide roof insulation in thicknesses as shown on the Drawings. Note Bidders may select from the following list of products. Minimum Design R Value shall be R-20 for all roof areas.
  - 1. Polyisocyanurate Board Insulation as manufactured by:
    - a. Apache Products Co.
    - b. Atlas Roofing Corporation.
    - c. Celotex Corp. (The).
    - d. GAF Materials Corp.
    - e. NRG Barriers, Inc.
  - 2. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.6-lb/cu. ft. minimum density, square edged. Must meet UL 1256. as manufactured by:
    - a. Dow Chemical Company.
    - b. Owens Corning.
    - c. Tenneco Building Products.
- C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 3/16 inch per 12 inches , unless otherwise indicated.
- D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

## 2.05 INSULATION ACCESSORIES

- A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatible with membrane roofing.
- B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.
- C. Cold Fluid-Applied Adhesive: Manufacturer's standard cold fluid-applied adhesive formulated to adhere roof insulation to substrate.
- D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/2 inch thick.
  - 1. Product: Subject to compliance with requirements, provided "Dens-Deck" manufactured by Georgia-Pacific Corporation.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:
  - 1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
  - 2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
  - 3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 5 Section "Steel Deck."
  - 4. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.
- B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
- C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

### 3.03 INSULATION INSTALLATION

- A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.
- B. Comply with membrane roofing system manufacturer's written instructions for installing roof insulation.
- C. Install tapered insulation under area of roofing to conform to slopes indicated.
- D. Install one or more layers of insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2 inches or greater, install 2 or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
- E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.
- F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
  - 1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.



- G. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
  - 1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.
- H. Mechanically Fastened and Adhered Insulation: Install each layer of insulation and secure first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
  - 1. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
  - 2. Install subsequent layers of insulation in a cold fluid-applied adhesive.
- I. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Loosely butt cover boards together and fasten to roof deck.
  - 1. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

#### 3.04 ADHERED ROOFING MEMBRANE INSTALLATION

- A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.
- B. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
- C. Bonding Adhesive: Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.
- D. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing.
- E. Apply roofing membrane with side laps shingled with slope of roof deck where possible.
- F. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping roofing membranes according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing membrane terminations.
  - 1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.
- G. Repair tears, voids, and lapped seams in roofing that does not meet requirements.
- H. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

#### 3.05 BASE FLASHING INSTALLATION

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane 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 bonding adhesive to seam area of flashing.
- C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.
- D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.
- E. Terminate and seal top of sheet flashings.

### 3.06 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
  - 1. Notify Architect or Owner 48 hours in advance of date and time of inspection.
- C. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

### 3.07 PROTECTING AND CLEANING

- A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing 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 membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

### 3.08 ROOFING INSTALLER'S WARRANTY

- A. Upon acceptance of inspection the roofing manufacturer and installer shall provide to the Owner the manufacturer's standard written warranty as required under the provisions stated in Part 1 herein this section

## **END OF SECTION**

## **SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Sheet metal flashing and trim in the following categories:
  - a. Thru-wall flashing.
  - b. Miscellaneous sheet metal flashing and trim not included in the Pre-Engineered Metal Building packages.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Division 07 - Joint Sealants.
- D. Division 13 - Metal Building Systems.

#### **1.03 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.
- C. Shop Drawings of each item specified showing layout, profiles, methods of joining, and anchorage details.
- D. Samples of sheet metal flashing, trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.
  1. 4 IN square samples of specified sheet materials to be exposed as finished surfaces.
- E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experience Installer who has completed sheet metal flashing and trim work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

## 1.05 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing.
- B. Fabricate and install flashings at roof edges to comply with recommendations of FM Loss Prevention Data Sheet 1-49 for the following wind zone:
  - 1. Wind Zone 4: Winds up to 250 mph.

## 1.06 PROJECT CONDITIONS

- A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

## PART 2 - PRODUCTS

### 2.01 METALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated and with not less than the strength and durability of alloy and temper designated below:
  - 1. Factory-painted aluminum sheet: ASTM B209 (ASTM B209M), 5005-H14, with a minimum thickness of 0.032 IN, unless otherwise indicated.
- B. Lead Sheet: ASTM B749, Type L51121, copper-bearing lead sheet, with a minimum thickness of 0.0625 IN, except not less than 0.0937 IN thick for applications where burning (welding) is involved.
- C. Galvanized steel: ASTM A525, coating G90, mill phosphatized for paint adhesion, 24 gauge unless otherwise shown or specified.

### 2.02 CONCEALED THROUGH-WALL SHEET METAL FLASHING

- A. Material: Fabricate from the following metal:
  - 1. Copper fabric flashing: 5 OZ/SQ FT.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:
  - 1. Advanced Flashing; Advanced Building Products.
  - 2. Sandell Flashing; Sandell Manufacturing Co.
  - 3. York Flashing; York Manufacturing, Inc.

### 2.03 MISCELLANEOUS MATERIALS AND ACCESSORIES

- A. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.
- B. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coat.

- C. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- D. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Section 07 92 00 - Joint Sealants.
- E. Epoxy Seam Sealer: 2-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior and interior nonmoving joints, including riveted joints.
- F. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.
- G. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.
- H. Roofing Cement: ASTM D4586, Type I, asbestos free, asphalt based.
- I. Underlayment: Self-adhering modified-bitumen sheet with polyethylene sheet on exposed surface, type specially formulated for application under metal roofing.

#### 2.04 FABRICATION, GENERAL

- A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.
- B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.
- D. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- E. Expansion Provisions: Space movement joints at maximum of 10 FT with no joints allowed within 24 IN of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 IN deep, filled with mastic sealant (concealed within joints).
- F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
- G. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.
- H. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

- I. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.

- 1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

## 2.05 SHEET METAL FABRICATIONS

- A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.

- B. Exposed Trim, Pit Pans, and Metal Hood: Fabricate from the following material.

- 1. Aluminum: 0.063 IN thick.

## 2.06 ALUMINUM FINISHES

- A. General: Comply with Aluminum Association's (AA) "Designation System for Aluminum Finishes" for finish designations and application recommendations.

- B. Surfaces Concealed from View: Mill finish or clear satin anodized as selected by fabricator.

- C. Exposed Aluminum Surfaces: High-Performance Organic Coating Finish, AA-C12C42R1x (Organic Coating: as specified below).

- 1. Prepare, pretreat, and apply coating to to comply with coating and resin manufacturer's instructions. Fluoropolymer 2-Coat Coating System.
  - 2. Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 605.2.
  - 3. Color and Gloss: As selected by Architect from manufacturer's standard range of choices for color and gloss.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that Work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.

- B. Install exposed sheet metal Work that is without excessive oil canning, 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 and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- C. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10 FT with no joints allowed within 24 IN of corner of intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 IN deep, filled with mastic sealant (concealed within joints).
- D. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- E. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.

### 3.03 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.
- B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

### **END OF SECTION**

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## **SECTION 07 72 14 - ROOF ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Self-supporting roof curbs.
2. Pipe penetration seals.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.

#### **1.03 COORDINATION**

- A. Contractor shall verify roof penetration size requirements and locations.

#### **1.04 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, sections, details, and attachments to roof and/or roof purlins.
- C. Coordination Drawings: Roof plans and coordinating penetrations and roof-mounted items. Show the following:
  1. Size and location of roof accessories specified in this Section.
  2. Method of attaching roof accessories to roof or building structure.

#### **1.05 QUALITY ASSURANCE**

- A. Standards: Comply with the following:
  1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
  2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Self-supporting roof curbs shall be similar and equal to Model SSI-8 as manufactured by Custom Curb, Inc.

## 2.02 MATERIALS, GENERAL

- A. Galvanized Steel Sheet: ASTM A653/A653M with G90 (Z275) coating designation; commercial quality, minimum 18 gauge thickness.
- B. Fasteners: Same as metal being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by manufacturer. Match finish of exposed fasteners with finish of material being fastened.
- C. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.
- D. Bituminous Coating: SSPC-Paint 12, solvent-type bituminous mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil (0.4-mm) dry film thickness per coating.
- E. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.
- F. Elastomeric Sealant: Generic type recommended by unit manufacturer that is compatible with joint surfaces; ASTM C920, Type S, Grade NS, Class 25, and Uses NT, G, A, and, as applicable to joint substrates indicated, O.

## 2.03 ROOF CURBS AND COVERS

- A. General: Provide roof curbs capable of supporting superimposed live and dead loads, including equipment loads and other construction to be supported on roof curbs. Coordinate dimensions of existing penetrations and new exhaust fans.
- B. Fabrication: Unless otherwise indicated or required for strength, fabricate units from minimum 18 gauge thick, galvanized steel sheet; factory finished to match roof coating with welded corner joints for a weathertight seal.
  - 1. Form flange at perimeter bottom to interlock with support channels.
  - 2. Fabricate units to minimum height of 8 IN above finished roof, unless otherwise indicated.
  - 3. Insulation: 1-1/2 IN, 3 LB density fiberglass.
  - 4. Fabricate curb units with water diverter or cricket and with height tapered to match slope to level tops of units.
  - 5. Fabricate curb covers (if required for larger or multiple penetrations) from the same material as the roof curbs.

## 2.04 PIPE PENETRATION SEALS

- A. General: Provide diverter pipe flashing or approved alternative.

## 2.05 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. General: Comply with manufacturer's written instructions. Coordinate installation of roof accessories with installation of roof panels, flashing, penetrations, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor roof accessories securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.
- B. Install roof accessory items according to construction details of NRCA's "Roofing and Waterproofing Manual," unless otherwise indicated.
- C. Separation: Separate metal from incompatible metal or corrosive substrates, according to manufacturer's written instructions.
- D. Provide temporary weathertight covers for Owner supplied exhaust fans.

### 3.02 CLEANING AND PROTECTION

- A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

**END OF SECTION**

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## **SECTION 07 72 33 - ROOF HATCHES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Roof hatches with ladder assist post

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.

#### **1.03 COORDINATION**

- A. Contractor shall verify roof penetration size requirements and locations.
- B. Coordinate with installation of roofing, roof curbs and related flashings

#### **1.04 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details. Indicate dimensions, weights, loadings, required clearances, method of field assembly, and components. Include plans, sections, details, and attachments to roof and/or roof purlins.

#### **1.05 QUALITY ASSURANCE**

- A. Standards: Comply with the following:
  1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
  2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

#### **1.06 DELIVERY, HANDLING AND STORAGE**

- A. Package products adequately and protect during shipment, and inspect for damage upon delivery to the project site.
- B. Remove damaged products that cannot be restored to original undamaged condition from the site and replace at no additional cost to the Owner.
- C. Handle products carefully and store to avoid damage before installation.

#### **1.07 WARRANTY**

- A. Provide manufacturer's five year warranty against defects in material or workmanship.
- B. Warranty period shall commence on the Date of Substantial Completion.
  - 1.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

#### A. Acceptable Manufacturers:

1. Babcock-Davis; a Cierra Products Inc. Company.
2. Bilco Company
3. Milcor Inc.; a Gibraltar Company.

### 2.02 PRODUCTS

#### A. Roof Hatches:

1. Unit: 36" x 36" size; single leaf. Fabricate roof hatches with insulated double-wall lids and 14 gauge galvanized steel curb construction with full welded corner joints; with integral deck mounting flange and lid frame counterflashing. Provide continuous weathertight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.
  - a. Fabricate cover of 14 gauge prime-painted galvanized steel, welded neatly and ground at corners with 1" thick rigid glass fiber insulation fully covered and protected by a 22 gauge prime-painted galvanized steel liner.
  - b. Fabricate metal curb and counterflashing of the same gauge and material as hatch with 3-1/2 inch wide mounting flanges. Insulate exterior of curb with 1" thick fiberboard insulation.
2. Opening Hardware: Manufacturer's standard manually operating type capable of ensuring effortless control and smooth operation without causing damage to hatches and roofing system; capable of being opened from inside and outside. Provide automatic hold-open and operating arms with handle grips.
3. Hinges: Heavy duty pintle type of galvanized steel.
  - a. Assemble hatch completely with hinges, compression spring operators enclosed in telescopic tubes, positive snap latch with turn handles and padlock hasp inside, and neoprene draft seal. Use only zinc plated hardware.

#### B. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.

1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
2. Height: 42 inches above finished roof deck.
3. Material: Steel tube
4. Post: 1-5/8-inch diameter pipe.
5. Finish: Manufacturer's standard baked enamel or powder coat color as selected by Architect from manufacturer's full range

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. General: Comply with manufacturer's written instructions. Coordinate installation of roof hatch with installation of roof panels, flashing, penetrations, and other construction involving roof accessories to ensure that each element of the Work performs properly and that combined elements are waterproof and weathertight. Anchor roof hatch securely to supporting structural substrates so they are capable of withstanding lateral and thermal stresses, and inward and outward loading pressures.
  - 1. Comply with all roof guarantee requirements.
- B. Install roof accessory items according to construction details of NRCA's "Roofing and Waterproofing Manual," unless otherwise indicated.
- C. Separation: Separate metal from incompatible metal or corrosive substrates, according to manufacturer's written instructions.
- D. Provide temporary weathertight covers for Owner supplied exhaust fans.

### 3.02 CLEANING AND PROTECTION

- A. Clean exposed surfaces according to manufacturer's written instructions. Touch up damaged metal coatings.

**END OF SECTION**

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## **SECTION 07 72 53 - SNOW GUARDS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Snow-guards for installation on standing seam metal roofing.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Submit manufacturer's product data, installation instructions and color samples.
- C. Samples: Submit one full-size snow-guard in color and material selected for approval.

#### **1.04 DELIVERY, STORAGE, AND HANDLING**

##### **A. Protection:**

1. Store all materials in such a manner as to ensure proper ventilation and drainage to protect against damage and the weather.
2. Keep all material clearly identified with all grade marks legible; keep all damaged material clearly identified as damaged, and separately store to prevent its inadvertent use.
3. Do not allow installation of damaged or otherwise non-complying material.
4. Use all means necessary to protect the installed work and materials of all other trades.

- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURER**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Berger Building Products, Inc. E- Rail Snow Retention System or comparable product approved by the Architect.
- B. Provide a dual rail, low profile snow retention system.
- C. Color and finish to be selected by Architect.

UP General Specifications

SNOW GUARDS

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## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Prior to start of installation, inspect existing conditions to ensure surfaces are suitable for installation of snow- guards.

### 3.02 INSTALLATION

- A. Snow-Guard Installation: Comply with manufacturer's installation instructions. Use manufacturer's recommended installation materials and installation tools. Attach snow-guards securely. Clean adjacent surfaces after installation.

**END OF SECTION**

## **SECTION 07 84 13 - THROUGH-PENETRATION FIRESTOP SYSTEMS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:
  - a. Fire Rated walls and partitions.
  - b. Smoke barriers.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Division 03 - Cast-in-Place Concrete for construction of openings in concrete slabs and walls.
- D. Division 07 - Building Insulation for saving insulation and accessories.
- E. Division 09 - Gypsum Board Assemblies.
- F. Division 26 Sections specifying cable and conduit penetrations.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: For each type of through-penetration firestop system product indicated.
- C. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.
  1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
  2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire- protection engineer.

- D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.
- F. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

#### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed through-penetration firestop systems similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:
  - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
  - 2. Through-penetration firestop systems are identical to those tested per ASTM E814. Provide rated systems complying with the following requirements:
    - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
    - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
    - c. UL in "Fire Resistance Directory."

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

#### 1.06 PROJECT CONDITIONS

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

#### 1.07 PERFORMANCE REQUIREMENTS

- A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.
- B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
  - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
  - 2. For floor penetrations with annular spaces exceeding 4 IN in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.
  - 3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread ratings of less than 25 and smoke-developed ratings of less than 450, as determined per ASTM E84.

#### 1.08 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until Owner's inspecting agency and building inspector, if required by authorities having jurisdiction, have examined each installation.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. DAP Inc.
  - 2. International Protective Coatings Corp.-Flame Safe.
  - 3. Isolatek International - TPS.
  - 4. 3M Fire Protection Products - Fire Barrier.
  - 5. United States Gypsum Company - Fire Code Compound & Thermafiber.
  - 6. Safing Insulaiton.

### 2.02 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
  - 1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-/rock-wool-fiber insulation.
    - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    - c. Fillers for sealants.
  - 2. Temporary forming materials.
  - 3. Substrate primers.
  - 4. Collars.
  - 5. Steel sleeves.

### 2.03 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

- B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- E. Intumescent Putties: Non-hardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a non-shrinking, homogeneous mortar.
- H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.
- I. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces and non-sag formulation for openings in vertical and other surfaces requiring a nonslumping, gunnable sealant, unless indicated firestop system limits use to non-sag grade for both opening conditions.
  - 2. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
  - 3. Grade for Vertical Surfaces: Non-sag formulation for openings in vertical and other surfaces.

## 2.04 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

### 3.03 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of the firestop system.
- C. Install fill materials for the firestop system by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.



### 3.04 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect through-penetrations firestop systems and prepare test reports.
  - 1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.
- B. Proceed with enclosing through-penetration firestop system with other construction only after inspection reports are issued.
- C. Where deficiencies are found. Repair or replace through-penetration firestop system so they comply with requirements.

### 3.05 IDENTIFICATION

- A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. In general, labels shall be attached above suspended acoustical ceiling system, concealed from public view. Include the following information on labels:
  - 1. The words: "Warning--Through-Penetration Firestop System--Do Not Disturb. Notify Building Management of Any Damage."
  - 2. Contractor's name, address, and phone number.
  - 3. Through-penetration firestop system designation of applicable testing and inspecting agency.
  - 4. Date of installation.
  - 5. Through-penetration firestop system manufacturer's name.
  - 6. Installer's name.

### 3.06 CLEANING AND PROTECTION

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

### 3.07 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to the alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.

- B. Firestop Systems for Metallic Pipes, Conduit, or Tubing FS-1: Comply with the following:
  - 1. UL-Classified Systems: W-L-1039.
  - 2. Type of Fill Materials: One or more of the following:
    - a. Mortar.
- C. Firestop Systems for Electrical Cables FS-2: Comply with the following:
  - 1. UL-Classified Systems W-L-3023.
  - 2. Type of Fill Materials: One or more of the following:
    - a. Intumescent putty.
    - b. Silicone foam.
- D. Firestop Systems for Insulated Pipes FS-3: Comply with the following:
  - 1. UL-Classified Systems: W-L-5044.
  - 2. Type of Fill Materials: One or more of the following:
    - a. Intumescent putty.
    - b. Silicone foam.
- E. Firestop Systems for Miscellaneous Mechanical Penetrations FS-4: Comply with the following:
  - 1. UL-Classified Systems: W-L-7001.
  - 2. Type of Fill Materials: One or both of the following:
    - a. Safing.
    - b. Mortar.
- F. Firestop Systems for Head of Wall at Fluted Deck FS-5: Comply with the following:
  - 1. UL-Classified Systems: H-WD-0001.
  - 2. Type of Fill Materials: One or more of the following:
    - a. Safing.
    - b. Mortar.
- G. Firestop Systems for head of wall at fluted deck FS-6: Comply with the following:
  - 1. UL Classified System: H-WD-0009.
  - 2. Type of fill materials: One or more of the following:
    - a. Safing.
    - b. Mortar

**END OF SECTION**

## SECTION 07 92 00 – JOINT SEALANTS

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Section Includes.

1. Exterior joints in the following vertical surfaces and non-traffic horizontal surfaces:
  - a. Control and expansion joints in unit masonry.
  - b. Joints between architectural precast concrete units.
  - c. Joints between different materials.
  - d. Perimeter joints between materials listed above and frames of doors and windows.
  - e. Other joints as indicated.
2. Exterior joints in the following horizontal traffic surfaces:
  - a. Control, expansion, and isolation joints in cast-in-place concrete slabs.
  - b. Joints between different materials listed above.
  - c. Other joints as indicated.
3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
  - a. Control and expansion joints on exposed interior surfaces of exterior walls.
  - b. Perimeter joints of exterior openings where indicated.
  - c. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
  - d. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
  - e. Perimeter joints between interior wall surfaces and plumbing fixtures.
  - f. Other joints as indicated.
4. Interior joints in the following horizontal traffic surfaces:
  - a. Control and expansion joints in cast-in-place concrete slabs.
  - b. Other joints as indicated.

#### 1.02 RELATED REQUIREMENTS (SECTIONS)

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Division 07 – Sheet Metal Flashing and Trim
- D. Division 08 - Glazing.

UP General Specifications

JOINT SEALANTS

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### 1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product Data: For each joint-sealant product indicated.
- C. Samples for Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.
- B. Single Source Limitations for Joint Sealant Materials: Obtain each type of joint sealant through one source from a single manufacturer.

### 1.05 PRODUCT HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

### 1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with installation of joint sealants under the following conditions:
  - 1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer.
  - 2. When joint substrates are wet.
- B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience

## 2.02 ELASTOMERIC JOINT SEALANTS

- A. [ES-1] - Low-Modulus Nonacid-Curing Silicone Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
1. Products: Provide one of the following:
    - a. 790; Dow Corning.
    - b. Silpruf; GE Silicones.
    - c. UltraPruf SCS2300; GE Silicones.
    - d. 864; Pecora Corporation.
    - e. PSI-641; Polymeric Systems, Inc.
    - f. Omniseal; Sonneborn Building Products Div., ChemRex Inc.
    - g. Spectrem 1; Tremco.
  2. Type and Grade: S (single component) and NS (nonsag).
  3. Class: 25.
  4. Additional Movement Capability: 50 percent movement in extension and 50 percent movement in compression for a total of 100 percent movement.
  5. Use Related to Exposure: NT (nontraffic).
  6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
- B. [ES-2] - Medium-Modulus Neutral-Curing Silicone Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
1. Products: Provide one of the following:
    - a. 791; Dow Corning.
    - b. HiFlex 393; NUCO Industries, Inc.
    - c. Silglaze II; GE Silicones.
    - d. 895; Pecora Corporation.
    - e. PSI-631; Polymeric Systems, Inc.
    - f. SM5731 Poly-Glaze; Schnee-Morehead, Inc.
    - g. Spectrem 2; Tremco.
  2. Type and Grade: S (single component) and NS (nonsag).
  3. Class: 25.
  4. Use Related to Exposure: NT (nontraffic).
  5. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
- C. [ES-3] - High-Modulus Neutral-Curing Silicone Sealant; Where joint sealants of this type are indicated, provide products complying with the following:
1. Products: Provide one of the following:

- a. 799; Dow Corning.
  - b. NuFlex 319, NUCO Industries, Inc.
  - c. SM5734 Controlled Flow Poly-Glaze; Schnee-Morehead, Inc.
- 2. Type and Grade: S (single component) and NS (nonsag).
- 3. Class: 25.
- 4. Use Related to Exposure: NT (nontraffic).
- D. [ES-4] - Multicomponent Nonsag Urethane Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
  - 1. Products: Provide one of the following
    - a. Chem-Calk 2641; Bostik Inc.
    - b. Vulkem 922; Mameco International.
    - c. Elasto-Thane 920 Gun Grade; Pacific Polymers, Inc.
    - d. Dynatred; Pecora Corporation.
    - e. PSI-270; Polymeric Systems, Inc.
    - f. NP 2; Sonneborn Building Products Div., ChemRex Inc.
  - 2. Type and Grade: M (multicomponent) and NS (nonsag).
  - 3. Class: 25.
- E. [ES-5] - Low Modulus Silicone Sealant Where joint sealants of this type are indicated, provide products complying with the following:
  - 1. Products: Provide one of the following
    - a. 880; Dow Corning.
- F. [ES-6] - Pourable Silicone Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
  - 1. Products: Provide one of the following
    - a. 890-SL; Dow Corning .
- G. [ES-7] - Mildew-Resistant Silicone Sealant; Where joint sealants of this type are indicated, provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with the following:
  - 1. Products: Products: Provide one of the following
    - a. 786 Mildew Resistant; Dow Corning.
    - b. Sanitary 1700; GE Silicones.
    - c. NuFlex 302; NUCO Industries, Inc.
    - d. 898 Silicone Sanitary Sealant; Pecora Corporation.
    - e. PSI-611; Polymeric Systems, Inc.

- f. Tremsil 600 White; Tremco.
- 2. Type and Grade: S (single component) and NS (nonsag).
- 3. Class: 25.
- 4. Use Related to Exposure: NT (nontraffic).
- H. [ES-8] - Multicomponent Nonsag Urethane Sealant: Where joint sealants of this type are indicated, provide products complying with the following:
  - 1. Products Products: Provide one of the following:
    - a. Chem-Calk 2641; Bostik Inc.
    - b. Vulkem 227; Mameco International.
    - c. Elasto-Thane 920 Gun Grade; Pacific Polymers, Inc.
    - d. Dynatrol II-SG Pecora Corporation.
    - e. PSI-270; Polymeric Systems, Inc.
    - f. NP 2; Sonneborn Building Products Div., ChemRex Inc.
  - 2. Type and Grade: M (multicomponent) and NS (non-sag).
  - 3. Class: 25.
  - 4. Additional Movement Capability: 50 percent movement in extension and 50 percent in compression for a total of 100 percent movement.
  - 5. Related to Exposure: T (traffic).

### 2.03 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, of type indicated below and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:
  - 1. Type C: Closed-cell material with a surface skin.
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

## 2.04 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants with joint substrates.
- C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.



- B. Joint Priming: Prime joint substrates where recommended in writing by joint sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

### 3.03 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations of ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability:
  - 1. Do not leave gaps between ends of joint fillers..
  - 2. Do not stretch, twist, puncture, or tear joint fillers.
  - 3. Remove absorbent joint fillers that have become wet before sealant application and replace them with dry material.
- D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.
- E. Tooling of Non-sag Sealants: Immediately after sealant application and prior to skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
- F. Provide recessed joint configuration, per Figure 5C in ASTM C 1193, of recess depth and at locations indicated.

### 3.04 CLEANING

- A. Clean off excess sealants 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.

### 3.05 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 and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work.

### 3.06 SEALANT APPLICATION TABLE

#### A. Exterior Joints in Vertical Surfaces and Non-Traffic Horizontal Surfaces

1. Location: Joints in cast in place concrete and precast concrete
  - a. Sealant. Low Modulus One-part Non-Acid Curing Silicone Sealant [ES-1].
2. Location: Joints in precast concrete and between metal and precast concrete
  - a. Sealant. Low Modulus One-part Non-Acid Curing Silicone Sealant [ES-1].
3. Location: Perimeter joints between materials listed above and frames of doors, windows, aluminum entrances and storefronts.
  - a. Sealant. Medium Modulus, Non-Acid Curing Silicone Sealant [ES-2].
4. Location: Exposed joints within sheet metal copings, flashings and trim, aluminum entrance and storefront system.
  - a. Sealant: High-Modulus Neutral-Curing Silicone Sealant [ES-3].

#### B. Exterior Joints in Horizontal Traffic Surfaces

1. Location: Control, expansion, and isolation joints in cast in place concrete slabs not exposed to vehicular traffic.
  - a. Sealant: Low Modulus One-part Non-Acid Curing Silicone Sealant [ES-1].
2. Location Control, expansion, and isolation joints in cast in place concrete slabs subject to vehicular traffic.
  - a. Sealant. Low Modulus Silicone Sealant [ES-5].
3. Location Joints between concrete and asphalt, and joints where asphalt impregnated compressible fillers are used
  - a. Sealant; Pourable Silicone Sealant [ES-6].

#### C. Interior Joints in Vertical Surfaces and Horizontal Non-Traffic Surfaces

1. Location: Control and expansion joints on exposed interior surfaces of exterior precast walls.
  - a. Sealant. Low Modulus One-part Non-Acid Curing Silicone Sealant [ES-1].
2. Location: Perimeter joints of exterior openings where indicated.
  - a. Sealant. Medium Modulus, Non-Acid Curing Silicone Sealant [ES-2].
3. Location: Tile control and expansion joints, except paver tile used in vertical application.
  - a. Sealant. Mildew-Resistant Silicone Sealant [ES-7].
4. Location: Tile control and expansion joints, paver tile used in vertical application.
  - a. Sealant. Medium Modulus, Non-Acid Curing Silicone Sealant [ES-2].
5. Location: Perimeter joints between interior wall surfaces and frames of interior doors, and windows.
  - a. Sealant. Medium Modulus, Non-Acid Curing Silicone Sealant [ES-2].

6. Location: Perimeter joints of toilet fixtures.
  - a. Sealant. Mildew-Resistant Silicone Sealant [ES-7].

D. Interior Joints in Horizontal Traffic Surfaces

1. Location: Control and expansion joints in cast in place concrete subject to traffic.
  - a. Sealant. Multicomponent Non-sag Urethane Sealant [ES-8] Traffic Rated.

**END OF SECTION**

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## **SECTION 08 11 20 - STANDARD STEEL DOORS AND FRAMES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Flush, insulated, galvanized standard steel doors for exterior and interior openings.
2. Frames: Pressed steel frames for doors - welded unit type.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Division 08 - Finish Hardware.
- D. Division 09 - Paint and Protective Coatings.

#### **1.03 REFERENCED STANDARDS**

- A. ASTM E152, Methods of Fire Tests of Door Assemblies.
- B. NFPA 80, Fire Doors and Windows.
- C. SDI-100, Standard Steel Doors and Frames.
- D. SDI-105, Recommended Erection Instructions for Steel Frames.

#### **1.04 SUBMITTALS**

- A. General: Submit in accordance with Division 01 sections.
- B. Product data for each type of door and frame specified, including details of construction, materials, dimensions, hardware preparation, core, label compliance, sound ratings, profiles, and finishes.
- C. Shop drawings showing fabrication and installation of standard steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
  1. Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.
- D. Label Construction Certification: For door assemblies required being fire-rated and exceeding limitations of labeled assemblies, submitting manufacturer's certification that each door and frame assembly has been constructed to conform to design, materials and construction equivalent to requirements for labeled construction.

## 1.05 QUALITY ASSURANCE

- A. Provide doors and frames complying with Steel Door Institute "Recommended Specifications Standard Steel Doors and Frames" ANSI/SDI-100 and as herein specified.
- B. Fire-Rated Assemblies:
  - 1. Wherever a fire-resistance classification (3 HR, 1-1/2 HR, etc. or "A", "B", etc.) is shown or scheduled for hollow metal work, provide fire-rated hollow metal doors, frames and lites investigated and tested as a fire door assembly, complete with type of fire door hardware to be used. Identify each fire door and frame with UL labels, indicating applicable rating of both door and frame.
  - 2. Fire rated door and frame construction to conform to ASTM E152.
  - 3. Installed frame and door assembly to conform to NFPA 80 for fire rated class indicated in Door and Frame Schedule.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Inspect doors and frames upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Architect; otherwise, remove and replace damaged items as directed.
- C. Store doors and frames at building site under cover. Avoid use of non-vented plastic or canvas shelters that could create a humidity chamber.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide standard steel doors and frames by one of following:
  - 1. Standard Steel Doors and Frames:
    - a. Amweld Building Products, Inc.
    - b. Ceco Corp.
    - c. Curries Company.
    - d. Republic Builders Products.
    - e. Steelcraft Manufacturing Co.

### 2.02 MATERIALS

- A. Hot-Rolled Steel Sheets and Strip: Commercial quality carbon steel, pickled and oiled, complying with ASTM A569 and ASTM A568.
- B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A366 and ASTM A568.

- C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A526, or drawing quality, ASTM A642, hot dipped galvanized in accordance with ASTM A525, with A60 or G60 coating designation, mill phosphatized.
- D. Supports and Anchors: Fabricate of not less than 18-gage sheet steel; galvanized where used with galvanized frames.
- E. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize in compliance with ASTM A153, Class C or D as applicable.
- F. Shop Applied Paint: Apply after fabrication.
  - 1. Primer: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints complying with ANSI A224.1, "Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames."

## 2.03 DOORS

- A. Provide metal doors of SDI grades and models specified below and as indicated on drawings or schedules:
  - 1. Exterior and Interior Doors: ANSI/SDI-100, Level 3, extra heavy-duty, Model 2, minimum 16-gage galvanized steel faces.
  - 2. Storm Shelter Doors: ANSI/SDI-100, Level 4, extra heavy-duty, Model 2, minimum 14-gage galvanized steel faces.
  - 3. Doors shall be full flush seamless construction and shall have continuous vertical mechanical inter-locking joints at lock and hinge edges with visible edge seam filled and ground smooth.

## 2.04 FRAMES

- A. General: Provide steel frames for doors, transoms, sidelights, borrowed lights, and other openings that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.
  - 1. Fabricate frames with mitered corners, continuously welded construction.
  - 2. Form exterior and interior door frames from 14-gage galvanized steel.
- B. Plaster Guards: Provide minimum 26-gage steel plaster guards or mortar boxes at back of hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.
- C. Door Silencers: Except on frames equipped with weather stripping, drill stops to receive 3 silencers on strike jambs of single door frames and 2 silencers on beads of double door frames.
- D. Head Reinforcing:
  - 1. For frames over 4 FT-0 IN wide provide 2 continuous steel angles not less than 2 IN x 2 IN x 12 gauge and width of opening, welded to back of frame at head, unless otherwise shown.

## 2.05 FABRICATION

- A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site. Comply with ANSI/SDI-100 requirements.
  - 1. Internal Construction: One of the following manufacturer's standard core materials according to SDI standards:
    - a. Rigid polystyrene conforming to ASTM C578.
  - 2. Clearances: Not more than 1/8 IN at jambs and heads except between non-fire-rated pairs of doors not more than 1/4 IN. Not more than 3/4 IN at bottom.
    - a. Fire Doors: Provide clearances according to NFPA 80.
- B. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Steel Doors and Frames".
- C. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel.
- D. Fabricate exterior and interior doors, panels, and frames from galvanized sheet steel in accordance with SDI-112. Close top and bottom edges of exterior doors as integral part of door construction or by addition of minimum 16-gage inverted steel channels.
- E. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- F. Thermal-Rated (Insulating) Assemblies: At exterior and interior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C236 or ASTM C976 on fully operable door assemblies.
  - 1. Unless otherwise indicated, provide thermal-rated assemblies with U factor of 0.067 (R=14.9) or better.
- G. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware in accordance with final Door Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 Series Specifications for door and frame preparation for hardware.
  - 1. Hinge reinforcements shall be 7 gauge. Lock reinforcements shall be 16 gauge and closer reinforcements, 12 gauge.
- H. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied hardware may be done at project site.
- I. Locate hardware as indicated on final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware on Standard Steel Doors and Frames," published by Door and Hardware Institute.
- J. Attach fire rated label to each frame and door unit.



K. Jamb Anchors:

1. Furnish jamb anchors as required to secure frames to adjacent construction, formed of not less than 18 gauge galvanized steel.
  - a. Masonry Construction:
    - 1) Adjustable, flat or corrugated or perforated, T-shaped to suit frame size with leg not less than 2 IN wide by 10 IN long. Furnish at least 3 anchors per jamb up to 7 FT-6 IN height, 4 anchors up to 8 FT-0 IN jamb height, one additional anchor for each 24 IN or fraction thereof over 8 FT-0 IN height.
  - b. Metal Stud Framing:
    - 1) Insert type to engage metal building jamb, welded to back of frames. Provide at least 4 anchors for each jamb for frames up to 7 FT-6 IN in height; 5 anchors up to 8 FT-0 IN jamb height; one additional anchor each 24 IN or fraction thereof over 8 FT-0 IN height.

L. Floor Anchors:

1. Provide floor anchors for each jamb and mullion which extends to floor, formed of not less than 16 gauge galvanized steel sheet, as follows:
  - a. Monolithic Concrete Slabs:
  - b. Clip Type anchors with 2 holes to receive fasteners, welded to bottom of jambs and mullions.

M. Glazing Stops:

1. Provide non-removable stops on outside of exterior doors.
2. Provide screwless snap-in type glazing beads on inside of glass.

N. Spreader Bars:

1. Provide 2 removable spreader bars across bottom of frames, tack welded to jambs and mullions.

O. Shop Painting: Clean, treat and paint exposed surfaces of steel door and frame units, including galvanized surfaces.

1. Clean steel surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials before application of paint.
2. Apply shop coat of prime paint of even consistency to provide a uniformly finished surface of not less than 0.75 mils ready to receive finish paint.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. General: Install standard steel doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.

- B. Placing Frames: Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames," unless otherwise indicated.
  - 1. Place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
  - 2. In masonry construction, locate 3 wall anchors per jamb adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb.
  - 3. Place fire-rated frames in accordance with NFPA Standard No. 80.
- C. Door Installation: Fit hollow metal doors accurately in frames, within clearances specified in ANSI/SDI-100.
  - 1. Place fire-rated doors with clearances as specified in NFPA Standard NO. 80.

### 3.02 ADJUST AND CLEAN

- A. Prime Coat Touch-up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
- B. Final Adjustments: Check and readjust operating hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition. Remove and replace defective work, including doors or frames that are wrapped, bowed or otherwise damaged.

### **END OF SECTION**

## **SECTION 08 14 16 - FLUSH WOOD DOORS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Division 08 - Glazing for glass view panels in flush wood doors.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: For each type of door. Include details of core and edge construction and trim for openings.
- C. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
  1. Indicate dimensions and locations of mortises and holes for hardware.
  2. Indicate requirements for veneer matching.
  3. Indicate fire ratings for fire doors.
- D. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following.
  1. Faces of Factory Finished Doors: Show the full range of colors available for stained finishes.
- E. Samples for Verification:
  1. Factory finishes applied to actual door face materials, approximately 8 x 10 IN 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 the finished work.

#### **1.04 QUALITY ASSURANCE**

- A. Source Limitations: Obtain flush wood doors through one source from a single manufacturer.
- B. Quality Standard: Comply with NWWDA I.S.1-A, "Architectural Wood Flush Doors."

- C. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.

- 1. Test Pressure: Test at atmospheric pressure.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

#### 1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

#### 1.07 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by Manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 IN in a 42 x 84 IN section, or show telegraphing of core construction in face veneers exceeding 0.01 IN in a 3 IN span.
  - 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
  - 2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
    - a. Solid-Core Interior Doors: Life of installation.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Flush Wood Doors:
    - a. Algoma Hardwoods Inc.
    - b. Marshfield.
    - c. VT Industries.

## 2.02 DOOR CONSTRUCTION, GENERAL

### A. Doors for Transparent Finish:

1. Grade: Custom (Grade A faces).
2. Species and Cut: Red oak, plain sliced.
3. Match between Veneer Leaves: Book match.
4. Assembly of Veneer Leaves on Door Faces: Balance match.
5. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
6. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.

## 2.03 SOLID-CORE DOORS

### A. Particleboard Cores: Comply with the following requirements:

1. Particleboard: ANSI A208.1, Grade LD-2.
2. Wood Blocking: Provide lumber or engineered-wood blocking in particleboard-core doors as follows:
  - a. 5 IN top-rail blocking, in doors indicated to have closers.
  - b. 5 IN lock blocking in doors receiving mortise locks.
  - c. 5 IN mid-rail blocking, in doors indicated to have exit devices.

### B. Interior Veneer-Faced Doors:

1. Core: Particleboard.
2. Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

### C. Fire-Rated Doors:

1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as required to provide fire rating indicated.
2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as follows:
  - a. 5 IN top-rail blocking, in doors indicated to have closers.
  - b. 5 IN lock blocking in doors receiving mortise locks.
  - c. 5 IN mid-rail blocking, in doors indicated to have exit devices.
  - d. Other locations as required by fire-rating criteria.
3. Edge Construction:
  - a. Lumber or engineered-wood stiles and rails.
  - b. Apply face-matching veneer to stile faces, prior to application of face veneers.

## 2.04 FABRICATION

- A. Fabricate doors in sizes indicated for Project-site fitting.
- B. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
  - 1. Comply with clearance requirements of referenced quality standard for fitting. Comply with requirements in NFPA 80 for fire-rated doors.
- C. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
  - 1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
  - 2. Metal Astragals: Pre-machine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

## 2.05 FACTORY FINISHING

- A. General: Comply with referenced quality standard AWI's "Architectural Woodwork Quality Standards Illustrated" for factory finishing.
- B. Finish doors at factory.
- C. Transparent Finish:
  - 1. Grade: Premium
  - 2. Finish: Manufacturer's standard finish with performance comparable to AWI System TR-6 catalyzed polyurethane.
  - 3. Staining: Color shall be as selected by Architect from manufacturer's standard range for the species.
  - 4. Effect: Open-grain finish.
  - 5. Sheen: Satin.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
  - 1. Verify that 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.

### 3.02 INSTALLATION

- A. Hardware: For installation, see Division 08 "Finish Hardware."

- B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
  - 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.
    - a. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining or scheduled, provide 1/4 IN from bottom of door to top of threshold.
  - 2. Comply with NFPA 80 for fire-rated doors.
  - 3. Bevel non-fire-rated doors 1/8 IN in 2 IN at lock and hinge edges.
  - 4. Bevel fire-rated doors 1/8 IN in 2 IN at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- C. Factory Finished Doors: Restore Finish before installation of if fitting or machining is required at project site.

### 3.03 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or 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**

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## **SECTION 08 31 13 - ACCESS DOORS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Access doors.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Division 09 - Gypsum Board Assemblies for gypsum board walls and ceilings.
- D. Division 09 - Ceramic Tile for ceramic tile walls.

#### **1.03 COORDINATION**

- A. Determine specific locations and sizes for access doors needed to gain access to concealed equipment.

#### **1.04 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.

##### **B. Shop Drawings:**

1. Include complete schedule, including types, general locations, sizes, wall and ceiling construction details, latching or locking provisions, and other data pertinent to installation.

##### **C. Product Data:**

1. Product data for each type of access door assembly specified, including details of construction relative to materials, individual components, profiles, finishes, and fire- protection ratings (if required).

### **PART 2 - PRODUCTS**

#### **2.01 ACCESS DOORS**

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acudor Products Inc.
2. Bar-Co, Inc. Div., Alfab, Inc.
3. J.L. Industries.
4. Larsen's Manufacturing Co.
5. Milcor, Inc.

**B. Product Description:**

1. Trimless, Recessed Doors for Gypsum Board and Perforated Metal Assemblies: Units consisting of frame with concealed edge trim, door, hardware, and complying with the following requirements:
  - a. Concealed, Gypsum Board Edge Trim: 0.298 IN (0.76-mm) zinc-coated steel sheet gypsum board edge trim formed to receive joint compound.
  - b. Hinge: Concealed, pivoting-rod type.
  - c. Locks: Flush to finished surface, screwdriver-operated cam.

**PART 3 - EXECUTION**

**3.01 JOB CONDITIONS**

- A. Advise Installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices. Furnish inserts and anchoring devices for access doors that must be built into other construction. Coordinate delivery with other work to avoid delay.

**3.02 FABRICATION**

- A. General: Manufacture each access door assembly as an integral unit ready for installation.
- B. Steel Access Doors and Frames: Continuous welded construction. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
- C. Exposed Flange: Nominal 1 to 1-1/2 IN (25.4 to 38.1 mm) wide around perimeter of frame.
- D. For gypsum board assemblies or gypsum veneer plaster, furnish frames with edge trim for gypsum board or gypsum base.
- E. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.

**3.03 INSTALLATION**

- A. Comply with manufacturer's instructions for installing access doors.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finished surfaces.
- C. Install concealed-frame access doors flush with adjacent finish surfaces.

**3.04 ADJUSTING**

- A. Adjust hardware and panels after installation for proper operation.
- B. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

**END OF SECTION**

## **SECTION 08 33 23 - OVERHEAD COILING DOORS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. The following types of overhead coiling doors:
  - a. Insulated service doors, motorized. R-7 Minimum.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Division 26: All applicable sections.

#### **1.03 DEFINITIONS**

- A. Operation Cycle: One complete cycle of a door begins with the door in the closed position. The door is then moved to the open position and back to the closed position.

#### **1.04 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:
  1. Wind Load: Uniform pressure (velocity pressure) of 20 LBF/SQ FT acting inward and outward.
- B. Operation-Cycle Requirements: Design overhead coiling door components and operator to operate for not less than 10,000 cycles.

#### **1.05 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: For each type and size of overhead coiling door and accessory. Include details of construction relative to materials, dimensions of individual components, profiles, and finishes. Provide roughing-in diagrams, operating instructions, and maintenance information. Include the following:
  1. Setting drawings, templates, and installation instructions for built-in or embedded anchor devices.
  2. Motors: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.
  3. Control devices: Provide information describing control devices described herein and as required by Division 16.

4. Fire-rated doors: Information describing fire-release system, including testing and resetting instruction.
- C. Shop Drawings: For special components and installations not dimensioned or detailed in manufacturer's data sheets.
  1. Wiring Diagrams: Detail wiring for power, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring and between components provided by door manufacturer and those provided by others.
  2. Samples for verification: Sample sets showing the full range of manufacturer's colors and finishes.
    - a. Curtain Slats: (3) 2 IN x 2 IN samples on actual slats of color and finish selected by Architect.

#### 1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who is an authorized representative of the overhead coiling door manufacturer for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain overhead coiling doors through one source from a single manufacturer.
  1. Obtain operators and controls from the overhead coiling door manufacturer.
- C. Fire Rated Door Assemblies: Provide assemblies complying with NFPA 80 that are identical to door and frame assemblies tested for fire test response characteristics per IL 10b, and that are labeled and listed for fire ratings indicated by UL, FM, ITS/Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.
- D. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.
  1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
  2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

#### 1.07 WARRANTY

- A. Manufacturer's limited door and operator system, except the counterbalance spring and finish, to be free from defects in materials and workmanship for 3 years or 20,000 cycles, whichever first occurs.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Basis of Design: Overhead Door Corporation, Model #625, or subject to compliance with requirements, provide products by one of the following:
  1. The Cookson Company.

2. Raynor Garage Doors.
3. Wayne-Dalton Corp.

## 2.02 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtain: Fabricate overhead coiling door curtain of interlocking slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of material thickness recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
  1. Steel Door Curtain Slats: Structural-quality, cold-rolled galvanized steel sheets complying with ASTM A653, with G90 zinc coating.
    - a. Provide manufacturer's standard flat-profile slats.
  2. Insulation: Fill slat with manufacturer's standard rigid cellular polystyrene or polyurethane- foam-type thermal insulation complying with maximum flame-spread and smoke-developed indices of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within metal slat faces. R-7 minimum.
  3. Inside Curtain Slat Face: To match material of outside metal curtain slat and as follows:
    - a. Galvanized Steel Sheet Thickness: Not less than 0.028 IN.
- B. Windlocks: Malleable-iron castings, secured to curtain slats with galvanized rivets or high-strength nylon, as required to comply with wind load.
  1. Astragal: Provide a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene, between angles or fitted to shape, as a cushion bumper for interior door.
  2. Provide motor-operated doors with combination bottom astragal and sensor edge.

## 2.03 HOODS AND ACCESSORIES

- A. Hood: Form to entirely enclose coiled curtain and operating mechanism at opening head and act as weatherseal. Contour to suit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sag.
  1. Fabricate steel hoods, for steel doors, of not less than 0.028 IN thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A653.
  2. Shape: Round.
- B. Smoke Seals: Provide UL-listed and -tested smoke-seal perimeter gaskets.

- C. Weatherseals: Provide replaceable, adjustable, continuous, compressible weather-stripping gaskets fitted to bottom and at top of exterior doors, unless otherwise indicated. At door head, use 1/8 IN thick, replaceable, continuous sheet secured to inside of curtain coil hood.
  - 1. Provide motor-operated doors with combination bottom weatherseal and sensor edge.
  - 2. In addition, provide replaceable, adjustable, continuous, flexible, 1/8 IN thick seals of flexible vinyl, rubber, or neoprene at door jambs for a weathertight installation.
- D. Push/Pull Handles: For push up operated or emergency-operated doors, provide galvanized steel lifting handles on each side of door.
  - 1. Provide pull-down straps or pole hooks for doors more than 84 IN high.
- E. Fabricate locking device assembly with lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.
  - 1. Locking Bars: Single-jamb side, operable from inside only.
- F. Where door unit is power operated, provide safety interlock switch to disengage power supply when door is locked.
- G. Provide automatic-closing device inoperative during normal door operations, with governor unit complying with requirements of NFPA 80, with easily tested and reset release mechanism, and designed to be activated by the following.
  - 1. Governor: Oscillating type.
  - 2. Temperature rise and melting point of 165 Deg. F replaceable fusible links interconnected an on both sides of wall of door opening.

#### 2.04 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of adjustable-tension steel helical torsion spring, mounted around a steel shaft and contained in a spring barrel connected to door curtain with required barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of hot-formed, structural-quality, welded or seamless 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. Provide spring balance of 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. Provide cast-steel barrel plugs to secure ends of springs to barrel and shaft.
- D. Fabricate torsion rod for counterbalance shaft of cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Provide mounting brackets of manufacturer's standard design, cast-iron or cold- rolled steel plate with bell-mouth guide groove for curtain.

## 2.05 FINISHES, GENERAL

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.06 ALUMINUM FINISHES

- A. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.
- B. Powder-Coat-Applied Finish: Apply manufacturer's standard powder-coat applied finish consisting of primer and topcoat(s) according to coating manufacturer's written instructions for cleaning, pretreatment, application, thermosetting, and minimum dry film thickness.
  - 1. Color and Gloss: shall be selected by architect from manufacturer's standard colors.

## 2.07 ELECTRIC DOOR OPERATORS

- A. General: Provide electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operational life specified, with electric motor and factory- prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote- control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
- B. Comply with NFPA 70.
- C. Disconnect Device: Provide hand-operated disconnect or mechanism for automatically engaging sprocket-chain operator and releasing brake for emergency manual operation while disconnecting motor, without affecting timing of limit switch. Mount disconnect and operator so they are accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.
- D. Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency auxiliary operator.
- E. Provide 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.
- F. Door-Operator Type: Provide wall-, hood-, or bracket-mounted, jackshaft, gear-head hoist-type door operator unit consisting of electric motor, enclosed worm-gear running-in-oil primary drive, chain and sprocket secondary drive, and auxiliary chain-hoist and floor level disconnect.

- G. Electric Motors: Provide high-starting torque, reversible, continuous-duty, Class A insulated, electric motors, complying with NEMA MG 1, with overload protection, sized to start, accelerate, and operate door in either direction, from any position, at not less than 2/3 fps or more than 1 fps, without exceeding nameplate ratings or considering service factor.
1. Type: Polyphase, medium-induction type.
  2. Service Factor: According to NEMA MG 1, unless otherwise indicated.
  3. Coordinate wiring requirements and electric characteristics of motors with building electrical system.
  4. Provide totally enclosed, non-ventilated or fan-cooled motors, fitted with plugged drain, and controller with NEMA ICS 6, Type 4 enclosure where indicated, along with an "on/off" key switch for exterior surface-mounted station.
- H. Remote-Control Station: Provide momentary-contact, 3-button control station with push-button controls labeled "Open," "Close," and "Stop."
1. Provide interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
  2. Provide exterior units, full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.
- I. Obstruction Detection Device: Provide each motorized door with indicated external automatic safety sensor able to protect full width of door opening. Activation of sensor immediately stops and reverses downward door travel.
1. Sensor Edge: Provide each motorized door with an automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor immediately stops and reverses downward door travel. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    - a. Provide electrically actuated automatic bottom bar.
    - b. Monitoring Type: Provide continuously monitoring safety device, per UL 325, as required.
- J. Limit Switches: Provide adjustable switches, interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.



## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. General: Install door and operating equipment complete with necessary hardware, jamb and head mold strips, anchors, inserts, hangers, and equipment supports according to Shop Drawings, manufacturer's written instructions, and as specified.
  - 1. Install door controls, operators, switches, motors, low voltage transformers and remote control stations complete with all wiring, conduit and terminations. Installation shall meet the requirements of Division 26 of this specification and NFPA 70. Single point connection of power shall be provided by the Electrical contractor. Coordinate all work with other trades prior to rough-in of conduit and boxes.
  - 2. Install fire rated doors to comply with NFPA 80.

### 3.02 ADJUSTING

- A. Lubricate bearings and sliding parts; adjust doors to operate easily, free from warp, twist, or distortion and fitting weathertight for entire perimeter.

### 3.03 DEMONSTRATION

- A. Startup Services: Engage a factory-authorized service representative to perform startup services and to train Contracting Officer's Technical Representative maintenance personnel as specified below:
  - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
    - a. Test door closing when activated by detector or alarm connected fire-release system. Reset door-closing mechanism after successful test.
  - 2. Train Contracting Officer's Technical Representative Maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance, and procedures for testing and resetting release devices.
  - 3. Review data in the maintenance manuals. Refer to Section 01 77 10 - Project Closeout and Cleaning.
  - 4. Schedule training with Owner with at least 7 days' advance notice.

**END OF SECTION**

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## **SECTION 08 33 24 - RUBBER IMPACT DOORS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes:
  - 1. Rubber impact doors used for shop buildings.
- B. Doors shall be overhead coiling type, of the sizes indicated, complete with necessary guides, hoods, hardware fastenings, mechanisms and accessories as indicated and specified.
- C. Doors shall be installed complete and in proper operating condition in the openings. indicated on the drawings and as specified, except that electrical conduit and wiring form the power source to the door control equipment to motors, and to disconnect switches will be furnished and installed under the electrical section.
- D. Details of doors, guides, hoods and accessories shall be as indicated on the drawings and as specified herein.
- E. Doors shall be the product of a manufacturer who is regularly engaged in manufacturing the items specified.

#### **1.02 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Complete detail and installation drawings shall be submitted in accordance with the submittals section. Drawings shall indicate construction details, clearance requirements, metal thickness, finish, counter-balancing, method of anchoring, location of guides, motors, switches, controls, and fusible links, power requirements and wiring diagrams.

#### **1.03 DELIVERY, STORAGE, AND HANDLING**

- A. Door shall be protected from damage during transportation, at the jobsite and during construction.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Rubber impact doors shall be M&I Door Systems Limited "Re-Coil Away Outboard Springs Roll-Door."

#### **2.02 MATERIALS**

- A. Curtain: Styrene butadiene rubber, 1/4 IN thick.
- B. Hood: Sheet steel, galvanized, cold roll formed.
- C. End Locks: Malleable iron.
- D. Bottom Bar and Guides: Steel angles or channels at least 3/16 IN thick.

- E. Bottom Weather Seal: Rubber or vinyl.
- F. Roller Shaft: Steel pipe or tubing.
- G. Roller Ends: Cast iron, ASTM A48.
- H. Spring: Oil-tempered steel.
- I. Brackets and Gearing: Cast iron or steel.
- J. Operating Chain: Steel; hot-dip galvanized, ASTM A153 and A385; or zinc plated, ASTM B633, SC4.
- K. Anchor Bolts: As specified in the anchor bolts an expansion anchors section.

## 2.03 FABRICATION

- A. Doors shall be fabricated for installation on the interior face of the wall, with the hood mounted above the opening.
- B. Door Curtain:
  - 1. The curtain shall have tensile strength of 1,760 psi and shall be designed to resist a wind load of 20 LBS/SQ FT. The curtain shall roll up on a drum supported at the head of the opening and shall be balanced by helical springs. SBR material shall provide normal resiliency at temperatures from -40 to 150 Deg. F.
  - 2. The curtain shall be equipped with a combination end and wind lock. Combination end locks shall have a flat surface engaging a seal of metal or other suitable material mounted on or in the guides, in a manner which will provide an effective seal against wind and water.
  - 3. Each curtain shall be provided with a bottom bar having a "break-away" feature and extending the full width of the curtain, attached in a manner which will provide an effective seal to suit sill construction.
- C. Guides: Guides shall form a pocket of sufficient depth to retain the curtain in place under the specified maximum wind pressure. Guides shall be attached in a manner to suit sill construction. Each exterior door shall be furnished with a replaceable, compressible weather seal fastened to the bottom bar.
- D. Roller Shaft:
  - 1. The Roller Shaft shall be designed so that deflection does not exceed 0.03 IN per foot of span. Ends of the roller shall be closed with plugs machined to fit and fastened with pins and screws. Welding will not be acceptable.
  - 2. The counterbalancing spring installed inside the roller shall be capable of producing sufficient torque to permit easy operation of the curtain from any position. The spring tension shall be adjustable from outside the bracket without moving the hood.
- E. Brackets: Brackets shall close the ends of roller-shaft housing and shall support the hood. Ends of the roller shaft shall be journalized into bracket hubs. The shaft shall be fitted with self-lubrication sintered bronze bearings or double sealed, grease lubricated ball bearings.

- F. Hood: The hood shall be fabricated of at least 24 gauge steel, shall be formed to fit the contours of the brackets, and shall be reinforced with steel rods, rolled beads, or a stiffening flange at top and bottom edges. Hoods at openings larger than 12 FT wide shall be fitted with intermediate supporting brackets.
  - 1. A flexible weather baffle, mounted internally or externally, shall be provided to prevent airflow around the coil, and provisions shall be included in the design of the hood to prevent the ingress of birds.
- G. Doors indicated on the drawings to be motor operated shall be provided with electric motor operators and auxiliary chain gear operation.

#### 2.04 FINISH

- A. Hood and bottom rails shall be galvanized and primed in the shop. All other exposed metal parts of the door and accessories, except bearings and chains, shall be shop primed.
- B. Galvanizing shall comply with ASTM A526 for commercial steel sheets and ASTM A386 for assembled steel products. Galvanized surfaces shall be phosphatized before painting.

#### 2.05 ELECTRICAL WORK

- A. Power supply to electrical operators will be 480 volts, 60 Hz, 3 phase.
- B. All manual or automatic control devices necessary for proper operation of the doors shall be provided. Motors and accessories shall be pre-wired at the factory to the extent practicable, with connections brought to terminal strips in the controller enclosure.

#### 2.06 ELECTRICAL MOTOR OPERATORS

- A. Electrical motor operators shall be of a type recommended by the door manufacturer and shall be complete with an electrical motor, reduction gearing, magnetic brake, brackets, push button controls, limit switches, magnetic reversing starters, and other accessories required for proper operation. Each operator shall be designated so that the motor may be removed without disturbing the limit switch adjustment and without affecting the emergency auxiliary operators. Provisions shall be made for immediate manual operation of the door in case of electric power failure.
- B. The emergency opening mechanism shall be arranged to be activated and deactivated from the floor, and its use shall not affect the adjustment of the limit switches. Whenever the mechanism is engaged, it shall be disconnected from the motor. Electric motors operators shall be wall-mounted near the head of the door.
- C. Motors:
  - 1. Motors shall be of sufficient horsepower to move doors in either direction from any position at a rate between 0.5 FT and 1 FT per second when operating under full wind load conditions.
  - 2. Motors shall conform to the applicable portions of the General Equipment Stipulations.

## 2.07 CONTROL SYSTEM

- A. Each door shall be equipped with an automatic control system arranged to control the opening, closing, and stopping of curtain travel, and to automatically reverse closing travel when the lower edge of the door curtain meets an obstruction. The control system shall be mounted in a NEMA Type 1 enclosure.

## 2.08 MOTOR CONTROLLER

- A. The motor controller shall be a full voltage, reversing, magnetic type, with 480 volt, 60 Hz, 3 phase contactors; automatically reset thermal overload relays; 120 volt AC operating coil; and 480 to 120 volt dry-type control transformer complete with one secondary lead fused and the other grounded. Starters shall be at least NEMA Size 1.
- B. Three thermal overload relays, rated as required to provide the motor from damage due to overload, shall be furnished with each motor starter.
- C. The motor controller enclosure shall be sized and arranged to house the control power transformer and fuses, relays if required, and a marked terminal block on which all control wiring from all devices shall be terminated. The terminal block on which all control wiring for all devices shall be terminated. The terminal block shall be located for easy installation and maintenance. All control wiring shall be 14 AWG or larger.

## 2.09 CONTROL SWITCHES

- A. Remote control switches shall be located on the interior and exterior of the openings as indicated in the project drawings. Each switch control station shall be of the three-button, momentary contact type, with the buttons marked "Open", "Close" and "Stop." When the "Stop" button is pressed, the door shall stop instantly and remain in the stopped position until the "Open" or "Close" button is pushed. Push buttons shall be of the fully guarded type to prevent accidental operation.
- B. Control switches located on the building exterior shall be mounted in NEMA Type 4 enclosures. Interior control switches shall be NEMA Type 12.
- C. Limit switches shall automatically stop the doors in their fully opened and fully closed positions. The limit switches shall be readily adjustable.

## 2.10 SAFETY DEVICE

- A. The bottom edge of each electric motor operated door shall be equipped with a safety device which will immediately stop the door upon contact with an obstruction and reverse its downward travel. The safety device shall be connected with the "Closed" limit switch to prevent opening a closed door by tripping the safety device. The safety device shall not serve as a substitute for a limit switch.
- B. Type S cable equipped with a spring-loaded automatic take-up reel, or an equivalent device, shall be provided between the safety device and the fixed cable supports.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Doors shall be installed in accordance with details, drawings, and manufacturer's directions.
- B. All anchors and inserts for guides, brackets, motors, controls, switches, and other devices shall be accurately located.
- C. After installation, doors shall be free from warp, twist, or distortion, and shall be lubricated and properly adjusted to operate freely and smoothly.

### 3.02 CLEANING

- A. After installation, factory finished metal surfaces shall be thoroughly cleaned and touched-up as recommended by the manufacturer. Abrasive, caustic, or acid cleaning agents shall not be used.

**END OF SECTION**

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## **SECTION 08 41 14 - ALUMINUM STOREFRONT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Exterior manual-swing entrance doors and door-frame units.
2. Interior manual-swing entrance doors and door-frame units.
3. Sidelights.
4. Transoms.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Division 07 - Joint Sealants.
- D. Division 08 - Glazing.
- E. Division 08 - Finish Hardware.

#### **1.03 REFERENCED STANDARDS**

##### **A. The Aluminum Association (AA):**

1. Designation System For Aluminum Finishes.

##### **B. American Architectural Manufacturers Association (AAMA):**

1. 1503.1, Voluntary Test Method for Thermal Transmittance of Windows, Doors and Glazed Wall Sections.

##### **C. Americans with Disabilities Act (ADA):**

1. Accessibility Guidelines for Buildings and Facilities.

##### **D. American Society of Civil Engineers (ASCE):**

1. 7-95, Minimum Design Loads for Buildings and Other Structures.

##### **E. American Society for Testing and Materials (ASTM):**

1. A924, Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
2. B221, Specification for Aluminum and Aluminum-Alloy, Extruded Bars, Rods, Wire, Profiles, and Tubes.
3. E283, Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.
4. E330, Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

5. E331, Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

F. American Welding Society (AWS):

1. D1.3, Structural Welding Code Aluminum.

#### 1.04 DEFINITIONS

- A. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.

1. Installer and applicator are synonymous.

- B. All weather: Capable of operation from -30 to +120 DegF.

#### 1.05 SUBMITTALS

- A. Shop Drawings:

1. See UPRR Division 01.

- B. Product technical data for framing system and major accessories including:

1. Entrance door.
2. Product data sheet for each hardware item specified.
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.
3. Elevation drawings indicating all frame and door dimensions and details.
4. Warranty.
5. Test reports.

- C. Samples:

1. Metal samples showing range of colors of anodized units.
2. After initial color selection, provide minimum three 2 x 3 IN samples of each color and finish selected.

#### 1.06 QUALITY ASSURANCE

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

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store units in vertical position off ground with wood spacers between each unit. Store in accordance with manufacturer's instructions.

#### 1.08 WARRANTY

- A. Written warranty signed jointly by fabricator, installer, and Contractor, agreeing to repair or replace any items of work performed under this Section that fail.

1. Failure includes defects in materials, installation, workmanship, water tightness of assembly, calking, glazing or any other defects in storefront system which affects its ability to perform as weather tight envelope.
2. Warranty period is 5 years from date of acceptance.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Storefront system:
    - a. Kawneer Co., Inc.
    - b. PPG.
    - c. Amarlite.
- B. Submit requests for substitution in accordance with UPRR Division 01.

### 2.02 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
  1. Basis of Design: Kawneer 500
  2. Door Construction: 2 IN overall thickness, with minimum 0.188 IN 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.
    - a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior
  3. Door Design: Wide stile; 5 IN top rail, minimum 5 IN stiles and 10 IN bottom rail.
  4. Glazing Stops and Gaskets: Square snap-on, extruded-aluminum stops and preformed gaskets.
    - a. Provide nonremovable glazing stops on outside of door.
- B. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 IN thick and reinforced as required to support imposed loads.
  1. Basis of Design: Kawneer 450
  2. Nominal Size: 2 IN by 4-1/2 IN
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
  - a. Sheet and Plate: ASTM B 209 (ASTM B 209M).
  - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
  - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
  - d. Structural Profiles: ASTM B 308/B 308M.
2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.
  - a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
  - b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
  - c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.03 ENTRANCE DOOR HARDWARE

- A. Refer to Division 08 - Finish Hardware.

2.04 GLAZING

- A. Glazing: Comply with Division 08 "Glazing."
- 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.

2.05 FABRICATION

- A. General:
1. Fully degrease and clean members prior to assembly or application of protective coatings.
  2. Weld using methods recommended by manufacturer and AWS to avoid discoloration.
  3. Grind exposed welds smooth and restore finish.
  4. Ease corners of cut edges to a radius of approximately 1/64 IN.
  5. Conceal fasteners wherever possible.
  6. Fit and assemble work at shop to maximum extent possible.
  7. Maintain true continuity of line and accurate relation of planes and angles.
  8. Provide secure attachment and support at mechanical joint, with hairline fit of contacting members.
  9. Reinforce work as necessary to withstand wind loadings and to support system.

10. Separate dissimilar metal with bituminous paint or preformed separators to prevent corrosion.
11. Separate metal surfaces at moving joints with plastic inserts or other nonabrasive concealed inserts to permanently prevent freeze-up of joint.
12. Prepare and reinforce frames for hardware. Refer to Section 08 70 00 for hardware.
13. Structural steel reinforcement hot-dip galvanized after fabrication meeting G-90 ASTM A934 requirements. Provide dissimilar metals protection.
14. All structural reinforcement requirements shall be determined by the frame manufacturer.
15. Minimum wall thickness of 0.090 IN for all frame components.

## 2.06 FINISHES:

- A. Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
1. Color: As selected by Architect from full range of industry colors and color densities.

## 2.07 PERFORMANCE REQUIREMENTS

### A. General Test Requirements:

1. Utilize independent testing laboratories specifically qualified to conduct all performance tests required.
2. Performance tests may be conducted in manufacturer's laboratories provided they are witnessed and certified by qualified independent testing laboratory personnel.
3. Perform all tests on "Test Unit": Full-sized storefront unit for Project or a minimum 5 FT x 8 Ft unit mounted in test chamber in exact accord with job conditions including anchorage system, calking, sealing, etc. Test unit to be completely assembled and glazed. Thermal tests may be conducted on 4 x 6 FT unit.
4. Test air infiltration first, water resistance second. Other tests may be in any order.

### B. Air Infiltration Tests (Doors):

1. Test in accord with ASTM E283.
2. Air infiltration: 0.50 cfm/LF of perimeter crack of fixed wall area when tested at 1.567 PSF pressure differential.

### C. Air Infiltration Tests (Storefront Framing):

1. Test in accordance with ASTM E283.
2. Air infiltration: 0.06 CFM/Min/SF of wall area when tested at 6.24 PSF.

### D. Water Resistance Test:

1. Test in accordance with ASTM E331.
2. No leakage allowed with a test pressure difference of 8 PSF.

E. Uniform Load Structural Test:

1. Subject unit to minimum load of 30 PSF applied to unit.
2. Test in accordance with ASTM E330.
3. No failure of parts allowed.

F. Thermal Tests:

1. Perform all thermal tests on unit sized as required to produce representative areas of framing, vision glass, and spandrel glass.
2. Provide test unit that reflects most restrictive situation on project (i.e., worst framing, glass, spandrel proportions for producing desired thermal results).
3. Test in accordance with AAMA 1503.1.
4. Thermal transmittance of insulated glass and framing areas: Average U-value of 0.65 BTUH/SF/DegF, maximum.
5. Condensation resistance test:
  - a. Determine in accordance with ASTM C236 and AWWA 1503.1.
  - b. Provide condensation resistance factor (CRF) not less than 50.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

A. Verify suitability of substrate to accept installation. Correct defects. Installation assumes responsibility for performance.

B. 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 non-movement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

C. 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 installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

D. Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades.

- F. Install glazing as specified in Division 08 "Glazing."
  - G. 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.
    - 2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- 3.02 CLEANING
- A. Clean surface promptly after installation.
  - B. Remove excess glazing, sealant compounds and dirt, and leave clean.
  - C. Clean glass inside and out and apply cross streamers attached to frame.

**END OF SECTION**

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## SECTION 08 51 13 - ALUMINUM WINDOWS

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Section Includes:

1. The following types of aluminum-framed windows:
  - a. Fixed windows.

#### 1.02 RELATED REQUIREMENTS (SECTIONS)

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Division 08 - Glazing, for glazing requirements for aluminum windows, including those specified to be factory glazed.

#### 1.03 DEFINITIONS

- A. Performance grade number, included as part of the AAMA/NWWDA product designation code, is actual design pressure in pounds force per square foot used to determine structural test pressure and water test pressure.
- B. Structural test pressure, for uniform load structural test, is equivalent to 150 percent of design pressure.
- C. Minimum test size is smallest size permitted for performance class (gateway test size). Products must be tested at minimum test size or at a size larger than minimum test size to comply with requirements for performance class.

#### 1.04 PERFORMANCE REQUIREMENTS

- A. Product Standard: AAMA/WDMA/CSA 101/I.S.2/A440.
- B. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.58 BTU/SQ FT x h x DegF.
- C. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.40.
- D. Condensation-Resistance Factor (CRF): Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 59.
- E. Air Infiltration: Maximum rate not more than indicated when tested according to AAMA/NWWDA 101/I.S.2, Air Infiltration Test.
  1. Maximum Rate: 0.3 CFM/SQ FT of area at an inward test pressure of 1.57 LBF/SQ FT.
- F. Water Resistance: No water leakage as defined in AAMA/NWWDA referenced test methods at a water test pressure equaling that indicated, when tested according to AAMA/NWWDA 101/I.S.2, Water Resistance Test.

1. Test Pressure: 20 percent of positive design pressure, but not more than 12 LBF/SQ FT.
- G. Condensation-Resistance Factor: Provide aluminum windows tested for thermal performance according to AAMA 1503, showing a CRF of 45, where windows are indicated to be "thermally improved."
- H. Thermal Movements: Provide aluminum windows, including anchorage, that accommodate thermal movements of units resulting from the following maximum change (range) in ambient and surface temperatures without buckling, distortion, opening of joints, failure of joint sealants, damaging loads and stresses on glazing and connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to solar heat gain and nighttime-sky heat loss.
  1. Temperature Change (Range): 120 Deg. F, ambient; 180 Deg. F material surfaces.

#### 1.05 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions for each type of aluminum window indicated.
- C. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other Work and operational clearances.
- D. Samples for Initial Selection: Metal samples showing full range of colors of anodized units.
  1. After initial color selection, provide minimum three 2 x 3 IN samples of each color and finish selected.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency, for each type, grade, and size of aluminum window. Test results based on use of down-sized test units will not be accepted.

#### 1.06 QUALITY ASSURANCE

- A. Source Limitations: Obtain aluminum windows through one source from a single manufacturer.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aluminum windows' aesthetic effects and performance characteristics. 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. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
  1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

- C. Fenestration Standard: Comply with AAMA/NWWDA 101/I.S.2, "Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors," for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

#### 1.07 PROJECT CONDITIONS

- A. Field Measurements: Verify aluminum window openings by field measurements before fabrication and indicate measurements on Shop Drawings.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating aluminum windows without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

#### 1.08 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace aluminum windows that fails in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:
  - 1. Failure to meet performance requirements.
  - 2. Structural failures including excessive deflection.
  - 3. Water leakage, air infiltration, or condensation.
  - 4. Faulty operation of movable sash and hardware.
  - 5. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  - 6. Insulating glass failure.
- B. Warranty Period: Two years from date of Substantial Completion.
- C. Warranty Period for Metal Finishes: 10 years from date of Substantial Completion.
- D. Warranty Period for Glass: 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Fixed Windows:
    - a. Kawneer Company, Inc.
    - b. Graham Architectural Products Corp.
    - c. Wausau Windows
    - d. Custom Window Company.
    - e. DeSCo Windows.
    - f. EFCO Corporation.

- B. Basis of Design: Series Traco-9950, thermally broken, fixed window by Kawneer

## 2.02 GLAZING

- A. Glass: Tinted, insulating, low-e glass units. Color: As selected by Architect from the full range of industry colors.
- B. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

## 2.03 FABRICATION

- A. General: Fabricate aluminum windows, in sizes indicated, that comply with AAMA/NWWDA 101/I.S.2 for performance class and performance grade indicated. Include a complete system for assembling components and anchoring windows.
- B. Fabricate aluminum windows that are reglazable without dismantling sash or ventilator framing.
- C. Factory-Glazed Fabrication: Glaze aluminum windows in the factory where practical and possible for applications indicated.

## 2.04 FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- C. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: non-specular as fabricated; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
  - 1. Color: As selected by Architect from the full range of industry colors and color densities.

# PART 3 - EXECUTION

## 3.01 EXAMINATION

- A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances; rough opening dimensions; levelness of sill plate; coordination with wall flashings, vapor retarders, and other built-in components; operational clearances and other conditions affecting performance of work.
  - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
  - 2. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. General: Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components; Drawings; and Shop Drawings.
- B. Install windows level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.
- C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- D. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- E. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in "Dissimilar Materials" Paragraph in Appendix B in AAMA/NWWDA 101/I.S.2.

### 3.03 PROTECTION AND CLEANING

- A. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.
- B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.
- C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.
- D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

### **END OF SECTION**

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## **SECTION 08 70 00 - FINISH HARDWARE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Hardware as indicated in Hardware Schedule and on Drawings.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR, Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements
- C. Division 08 - Standard Steel Doors and Frames.
- D. Division 08 - Flush Wood Doors.
- E. Division 08 - Aluminum Storefront.

#### **1.03 SUBMITTALS**

##### **A. Submit under provisions of Section 01 33 00.**

##### **B. Product Data:**

1. Submit manufacturer's data for each item of finish hardware.
  - a. Include any information that may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and exposed finishes.
  - b. Wherever needed, furnish templates to fabricators of other work to receive finish hardware. Indicate by transmittal that copy of applicable data has been distributed to installer.

##### **C. Letter of Authorization:**

1. Provide Letter of Authorization for Owner's signature for all restricted keyway systems, key blanks, cylinders and cores

##### **D. Hardware Schedule:**

1. Submit final hardware schedule in manner and format specified, complying with actual construction progress schedule requirements.
  - a. Include separate key schedule, showing clearly how Owner's final instructions on keying of locks have been fulfilled.
  - b. Hardware schedules are intended for coordination of work. Review and acceptance by Architect or Owner does not relieve Contractor of his exclusive responsibility to fulfill requirements as shown and specified.

2. Finish Hardware Schedule: Based on finish hardware requirements as indicated (including drawings, schedules and specifications), organize schedule into "hardware sets", indicating complete designation of every item required for each door or opening.
  - a. Furnish initial draft of schedule at earliest possible date, in order to facilitate fabrication of other work (such as hollow metal frames) that may be critical in project construction schedule.
  - b. Furnish final draft of schedule after samples, manufacturer's data sheets, and coordination with shop drawings for other work, delivery schedules and similar information has been completed and accepted.

#### 1.04 QUALITY ASSURANCE

##### A. Manufacturer:

1. To greatest extent possible, obtain each kind of hardware (latch and lock sets, hinges, closers, etc.) from only one manufacturer, even though several may be specified as acceptable manufacturers.

##### B. Supplier:

1. Subcontract furnishing of hardware, as specified herein, only to a recognized builders' hardware supplier who has been furnishing hardware in same area as project for a period of not less than 2 years, and who has in his employment an experienced hardware consultant who is available, at reasonable times during course of work, for project hardware consultation to Owner, Architect and Contractor.

##### C. Installer:

1. Assign installation of hardware to experienced tradesmen in compliance with trade union jurisdictions; either at door and frame fabrication plant or at project site, at Contractor's option except as otherwise indicated. It is assumed that carpentry trade will install hardware items, except as otherwise required by manufacturer, or otherwise directed by Contractor, or otherwise specified.

##### D. Scheduled Designations:

1. Except as otherwise indicated, use of one manufacturer's numeric designation system in schedules does not imply that another manufacturer's products will not be acceptable, unless they are not equal in design, size, weight, finish, function, or other quality of significance. See Hardware Schedule in this Section for list of acceptable manufacturers.

- E. Where no hardware is specified herein for an opening requiring hardware (nor listed as not included under this Section of Specifications), or where hardware specified herein will not function correctly, hardware supplier shall notify Contractor and Architect of such conditions promptly, to enable changes or corrections to be made in time so that construction of project will not be delayed. Failure of supplier of hardware to make such notification in writing will be supplier's responsibility for furnishing hardware required or hardware that will function and operate to satisfaction of Architect.

##### F. Codes and Standards:



1. All hardware shall comply with applicable fire and building code requirements and the American's with Disabilities Act.
2. All controls, operating mechanisms and hardware in accessible spaces, along accessible routes or a part of accessible elements, shall be accessible.

#### 1.05 COORDINATION

- A. Coordinate hardware with other work.
  1. Tag each item or package separately, with identification related to final hardware schedule and include basic installation instructions in package.
- B. Furnish hardware items of proper design for use on doors and frames of the thicknesses, profile, swing, security and similar requirements indicated, as necessary for proper installation and function, regardless of omissions or conflicts in the information in contract documents.
- C. Deliver individually packaged hardware items at times and to locations (shop or field) for installation, as directed by Contractor.
- D. Templates:
  1. Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check shop drawings of such other work to confirm that adequate provisions will be made for proper installation of hardware.
- E. Security:
  1. Where required, coordinate installation of door hardware, keying, and access control with Owner.
    - a. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- F. Provide temporary cylinders for exterior door locks during construction. Permanent cylinders for these locks shall be installed by Contractor at completion of work. Provide Owner with 2 keys for temporary construction locks.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Provide secure lock-up for hardware delivered to project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable, so that completion of work will not be delayed by hardware losses, both before and after installation.
- B. Delivery:
  1. Hardware shall be delivered to job site in one shipment with door number on each package clearly marked and shall be checked on job site by supplier's personnel and contractor's representative. Hardware shall be stored in a clean, dry, secure room until ready for installation.
  2. Deliver keys and permanent cores to Owner's representative by registered mail or overnight package service

## PART 2 - PRODUCTS

### 2.01 MATERIALS

#### A. Hardware Materials and Fabrication:

1. Produce hardware units of basic metal indicated, using manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified for the applicable hardware units by FS FF-H-106, FS FF-H-111, FS FF-H-116 and FS FF-H-121. Do not substitute "optimal" materials for those indicated, except as otherwise permitted by other sections of these specifications.
2. Form the base metal into required shapes and sizes by method indicated (cast, wrought, forged, rolled, pressed, etc.), or if not indicated, by manufacturer's standard production method for class or quality of hardware units required. Do not substitute "optional" methods of forming for those indicated, except when commercially recognized as a superior method, and except as otherwise permitted by other sections of these specifications.
3. Fasteners: Manufacturer hardware to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.
4. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match finish of such other work, as closely as possible, except as otherwise indicated.
5. Provide concealed fasteners for hardware units that are exposed when door is closed, except to extent no standard-manufactured units of type specified are available with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed under any condition, except where it is not possible to adequately reinforce work and use machine screws or concealed fasteners of another standard type, to satisfactorily avoid use of through bolts.
6. Provide fasteners compatible with both unit fastened and substrate and which will not cause corrosion or deterioration of hardware, base material or fastener.
7. Hand of Door: Drawings show swing or hand of each door leaf (left, right, reverse bevel, etc.). Furnish each item of hardware for proper installation and operation of door swing as shown.

#### B. Hardware Finishes:

1. General:
  - a. Match finish of every hardware unit at each door or opening, to greatest extent possible, and except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where base metal or metal forming process is different for individual units of hardware exposed at same door or opening. In general, match all items to manufacturer's standard finish for latch and lock set for color and texture.

- b. The Architect will be sole judge of whether hardware units match accepted samples and match each other satisfactorily. Units will be judged when held 2 FT-0 IN apart at 3 FT-0 IN distance.
  - c. Provide finishes which match those established by BHMA or, if none established, match Architect's samples.
  - d. 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 for applicable units of hardware by FS FF-H-106, FS FF-H-111, ES FF-H-116 and FS FF-H-121.
  - e. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze and aluminum, except as otherwise indicated. Suffix "NL" is used with standard finish designations to indicate "no lacquer".
2. Standard Finish Designations:
- a. Designations used in schedules and elsewhere to indicate hardware finishes are those listed in "Materials and Finishes Standard 1301" by BHMA, including coordination with traditional U.S. finishes shown by certain manufacturers for their products.
  - b. Manufacturer's Standard: Aluminum lacquer or bronze lacquer (as required for approximate match with other hardware finishes); for USP finish on iron and steel; primarily on door closer arms and cases.
  - c. Rust Resistant Finish: For iron and steel base metal, required for exterior work and in areas shown as "High Humidity" areas (and also when designated with suffix "-RR"), provide 0.2 mil thick copper coating on base metal before applying brass, bronze, nickel or chromium plated finishes.

## PART 3 - EXECUTION

### 3.01 HARDWARE MOUNTING HEIGHTS

- A. Mount hardware units at following locations on each door or door opening, except as otherwise specifically indicated, or required to comply with governing regulations, and except as may be otherwise directed by Architect:
  - 1. Lowest Hinge - 10 IN above floor to bottom of unit.
  - 2. Highest Hinge - 5 IN below top of door to top of unit.
  - 3. Intermediate Hinges - equally spaced between lowest and highest hinge units.
  - 4. Lock and Latch Set - knobs centered 38 IN above floor.
  - 5. Dead Lock - cylinder and turn centered 60 IN above floor.
  - 6. Special Pulls and Other Special Units - units mounted at height recommended by manufacturer.

### 3.02 INSTALLATION

- A. Install each hardware item in compliance with manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, install each item completely and then remove and store in a secure place during finish application. After completion of finishes, re-install each item. Do not install surface-mounted items until finishes have been completed on substrate.

### 3.03 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Lubricate moving parts with type of lubrication recommended by manufacturer (graphite-type if no other recommended). Replace units which cannot be adjusted and lubricated to operate freely and smoothly as intended for application made.
- B. Final Adjustment:
  - 1. Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to work during week prior to acceptance or occupancy, and make a final check and adjustment of all hardware items in such space or area. Clean and re-lubricate operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- C. Instruct Owner's personnel in proper adjustments and maintenance of hardware and hardware finishes, during final adjustment of hardware.

### 3.04 KEYS AND KEYING

- A. Master Key System: Change keys and a master key operate cylinders.
  - 1. Provide three cylinder change keys and five master keys.
- B. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
  - 1. Notation: "DO NOT DUPLICATE."

### 3.05 HARDWARE SCHEDULE

- A. Manufacturers:
  - 1. Butt hinges shall be of size and type as listed in hardware schedule. All hinges 4-1/2 IN x 4-1/2 IN unless noted otherwise in Schedule. Basis for design is Hager BB1191 Stainless Steel (satin finish) with Stainless Steel Non-Removable Pins (or equal). Butt hinges shall be manufactured by:
    - a. Hager Co. St. Louis, Missouri
    - b. Stanley Hardware New Britain, Connecticut
    - c. Lawrence Bro Sterling, Illinois
    - d. McKinney Scranton, Pennsylvania
  - 2. Continuous Hinges shall be Stanley 660 Series Continuous Hinge design made of 6065 T5 Aluminum Finish or equal as manufactured by the following:

- a. Stanley Hardware                      New Britain, Connecticut
  - b. Hager Co.                                      St Louis, MO.
  - c. Lawrence Bros                              Sterling, IL
  - d. McKinney                                      Scranton, PA
3. Door closers and holders: Basis for design is Norton Series 7500 with hold-open and multi-spring power adjustment, Aluminum Finish (or equal) as manufactured by the following:
  - a. Norton                                      Bensenville, Illinois
  - b. Yale    Charlotte, North Carolina
  - c. LCN    Princeton, Illinois
4. Locks, latches and cylinders are to be mortise type. Basis for design is Schlage L-series lever and trim, finish 630 (satin stainless steel) as indicated in hardware schedule and by the following:
  - a. Schlage Lock Company              Colorado Springs, Colorado
5. Pushbutton Locksets and Cylinders shall be KABA/ILCO "PowerLever" Series Model # 455AI with lever handles and Best Model 1C7 cores. Finish: US26D (Satin Chrome) as indicated in hardware schedule and by the following:
  - a. Kaba Ilco CorWinston              Salem, North Carolina
6. Thresholds shall be Hager 520S series, finish AL (aluminum) (or equal). Weatherstripping shall be Reese DS70C (or equal) and Sill Protection shall be Reese 323A (or equal) as manufactured by the following:
  - a. Reese    Rosemont, Minnesota
  - b. Hager Co.                                      St. Louis, Missouri
  - c. Pemko Mfg. Co.                              Emeryville, CA
  - d. Zero Mfg. Co.                              New York, New York
  - e. National Guard Products, In Memphis, Tennessee
7. Stops shall be Hager series 241F floor dome stops and Hager series 230W convex wall stops, finish 26D (or equal) as manufactured by the following:
  - a. Glynn-Johnson Co.                      Indianapolis, Indiana
  - b. Ives    Wallingford, Connecticut
  - c. Hager Co.                                      St. Louis, Missouri
8. Auto Flushbolts shall be Hager 291D/292D (or equal) and dustproof strikes shall be Hager 280X (or equal) as manufactured by the following:
  - a. Hager Co.                                      St. Louis, Missouri
  - b. Glynn-Johnson Co.                      Indianapolis, Indiana
  - c. Ives    Wallingford, Connecticut
9. Auto Flushbolts for Storm Shelter Doors

- a. Sargent / Assa Abloy                      Canada
- 10. Kickplates shall be Hager series 193S, stainless steel, beveled or equal as manufactured by the following:
  - a. Hager Co.                                      St. Louis, Missouri
  - b. Lindstrom Co.                                Washington, D.C.
  - c. Baldwin Hardware                          Reading, Pennsylvania
  - d. Brookline Industries                        Chicago, Illinois
- 11. Hardware for Storm Shelter Doors (where scheduled)
  - a. Sargent / Assa Abloy                      Canada
  - b. Schlage Lock Company                    Colorado Springs, Colorado

B. Schedule:

- 1. Items shown in Hardware Schedule shall be of type, size, function and finish shown above; equal to or superior to manufacturer's products listed. Subject to compliance with requirements, products of other manufacturers listed in Paragraph A. may be used.
- 2. Hardware Schedule – Provide Master key system for each building.
  - a. MANUFACTURERS ABBREVIATIONS:
    - 1) A/R      ADAMS RITE MFG
    - 2) GJ       GLYNN-JOHNSON CORP
    - 3) HA       HAGER CO
    - 4) ILCO    KABA/ILCO MFG
    - 5) LCN      LCN CLOSERS
    - 6) NGP     NATIONAL GUARD PRODUCTS
    - 7) TR       TRIMCO INDUSTRIES
    - 8) SCH     SCHLAGE LOCK
    - 9) SGT      SARGENT / ASSA ABLOY
    - 10) VD     VON DUPRIN CORP

HARDWARE SET NO. 1 – EXTERIOR VESTIBULE ALUMINUM DOOR

(each to have)

<i>Qty.</i>	<i>Hardware</i>	<i>Manufacturer/Type/Style</i>	<i>Finish</i>
1 set	Alum Door Pivots	Aluminum Door Manufacturer Standard	628
1 ea.	Deadbolt	Adams Rite MS1850	630
1 ea.	MortiseCylinder Turn	Schlage 09-905 118	626
1 ea.	SFIC Mortise Cyl.	Schlage 80-302	626
1 ea.	Push Pull Set	Ives 9190HD-10"-NO	630
1 ea	Surface Closer	LCN 4111 AVB SCUSH MC	689
1 ea	Mounting Plate	LCN 4110-18	689

1 ea	Cush Shoe Support	LCN 4110-30	689
1 ea	Blade Stop Spacer	LCN 4110-61	689
1 ea.	Stop	Trimco 1211 ES	689
1 ea.	Seal	Door Mfr Standard seals	628

HARDWARE SET NO. 2A – INTERIOR VESTIBULE ALUMINUM DOOR W/  
CARD READER

(each to have)

<i>Qty.</i>	<i>Hardware</i>	<i>Manufacturer/Type/Style</i>	<i>Finish</i>
1 set	AlumDoor Pivots	AluminumDoor Manufacturer Standard	628
1 ea.	SFIC Mortise Cyl	Schlage 80-302	626
1 ea	Card Reader	Javelin S874-EX-KP	---
1 ea.	Electric Strike	Von Duprin 6211	628
1 ea.	Surface Closer	LCN 4111 AVB SCUSH MC	689
1 ea	Mounting Plate	LCN 4110-18	689
1 ea	CushShoe Support	LCN 4110-30	689
1 ea	Blade Stop Spacer	LCN 4110-61	689
1 set	Seal	Door Mfr Standard seals	689
1 ea.	Floor Stop	Trimco 1211 ES	689

Card Reader to match existing system in Intermodal Yard, General Contractor to coordinate with Mike Miller, Security Equipment Inc., 402-778-3716 and UPRR TeleComm Department

HARDWARE SET NO. 2B – INTERIOR VESTIBULE ALUMINUM DOOR W/  
KEYPAD

(each to have)

<i>Qty.</i>	<i>Hardware</i>	<i>Manufacturer/Type/Style</i>	<i>Finish</i>
1 set	AlumDoor Pivots	AluminumDoor Manufacturer Standard	628
1 ea.	SFIC Mortise Cyl	Schlage 80-302	626
1 ea	Keypad	Kaba Powerplex 2000	626
1 ea.	Surface Closer	LCN 4111 AVB SCUSH MC	689
1 ea	Mounting Plate	LCN 4110-18	689
1 ea	CushShoeSupport	LCN 4110-30	689
1 ea	Blade Stop Spacer	LCN 4110-61	689
1 set	Seal	Door Mfr Standard seals	689
1 ea.	Floor Stop	Trimco 1211 ES	689

HARDWARE SET NO. 3 – EXTERIOR HOLLOW METAL DOOR *(each to have)*

Qty.	Hardware	Manufacturer/Type/Style	Finish
1 ea.	Continuous Hinge	Ives 224HD	628
1 ea.	Storeroom Lock	Schlage L9080BD 03A	630
1 ea.	SFIC Everest Core	Schlage 80-037	626
1 ea.	Surface Closer	LCN 1461 EDA	626
1 ea.	Overhead Stop	Glynn Johnson 90S	630
1 ea.	Threshold	NGP 896S	AL
2 ea.	Door Sweep	NGP 101VA	CL
1 set.	Seals	NGP 700SA	AL

HARDWARE SET NO. 4 – EXTERIOR HOLLOW METAL PAIR OF DOORS

*(each to have)*

Qty.	Hardware	Manufacturer/Type/Style	Finish
2 ea.	Continuous Hinge	Ives 224HD	628
2 ea.	Manual Flush Bolt	Ives FB458	626
1 ea.	Dust Proof Strike	Ives DP1/DP2	626
1 ea.	Entrance w/ Deadbolt	Schlage L9453BD 03A	630
1 ea.	SFIC Everest Core	Schlage 80-037	626
1 ea.	Overhead Stop	Glynn Johnson 90S	630
1 ea.	Surface Closer	LCN 4111 AVB SCUSH MC	689
1 set	Seals	NGP 7000SA	CL
1 set	Astragal	NGP 125NSS	CL
1 ea.	Rain Drip	Pemko 346	DB
2 ea.	Door Sweep	NGP 101VA	CL
1 ea.	Threshold	NGP 896S	AL

HARDWARE SET NO. 5 – EXTERIOR HOLLOW METAL COMM DOOR

*(each to have)*

Qty.	Hardware	Manufacturer/Type/Style	Finish
1 ea.	Continuous Hinge	Ives 224HD	628
1 ea.	Entrance Lock	TO BE PROVIDED BY COMM DEPT	630
1 ea.	Cylinder	TO BE PROVIDED BY COMM DEPT	630
1 ea.	Surface Closer	LCN 4111 AVB SCUSH MC	626
1 ea.	Overhead Stop	Glynn Johnson 90S	630
1 ea.	Threshold	NGP 896S	AL
1 ea.	Rain Drip	Pemko 346	DB
2 ea.	Door Sweep	NGP 101VA	CL
1 set.	Seals	NGP 700SA	AL

Cylinder to be provided by Communications Dept. – Abloy Protect FSIC core, no keys, ACY419NLK locking system



#### HARDWARE SET NO. 6 – INTERIOR DOOR WITH ENTRANCE LOCK

(each to have)

<i>Qty.</i>	<i>Hardware</i>	<i>Manufacturer/Type/Style</i>	<i>Finish</i>
3 ea	HW Hinge	Ives 5BB1HW 4.5 X 4.5	630
1 ea.	Entrance Lock	Schlage ND53BD TLR	626
1 ea.	SFIC Everest Core	Schlage 80-037	626
1 ea.	Floor Stop	Ives FS436	626
3 ea.	Silencers	Ives SR64	Gray

#### HARDWARE SET NO. 7 – INTERIOR HOLLOW METAL SERVICE DOORS WITH ENTRANCE LOCK

(each to have)

<i>Qty.</i>	<i>Hardware</i>	<i>Manufacturer/Type/Style</i>	<i>Finish</i>
1 ea.	Continuous Hinge	Ives 224HD	626
1 ea.	Entrance Lock	Schlage ND53BD TLR	626
1 ea.	SFIC Everest Core	Schlage 80-037	626
1 ea.	Surface Closer	LCN 1461 EDA	689
1 ea.	Floor Stop	Ives FS436	626
3 ea.	Silencers	Ives SR64	Gray

#### HARDWARE SET NO. 8 - INTERIOR HOLLOW METAL COMM DOOR

(each to have)

<i>Qty.</i>	<i>Hardware</i>	<i>Manufacturer/Type/Style</i>	<i>Finish</i>
1 ea	Continuous Hinge	Ives 224HD	628
1 ea.	Office/Entry Lock	TO BE PROVIDED BY COMM DEPT	630
1 ea.	Cylinder	TO BE PROVIDED BY COMM DEPT	630
1 ea.	Surface Closer	LCN 1461 EDA	689
1 ea	Floor Stop	Ives FS436	630
1 ea.	Threshold	NGP 896S	AL
2 ea.	Door Sweep	NGP 101VA	CL
1 set.	Seals	NGP 700SA	AL

Cylinder to be provided by Communications Dept. – Abloy Protect FSIC core, no keys, ACY419NLK locking system

#### HARDWARE SET NO. 9 – TOILET DOORS (each to have)

<i>Qty.</i>	<i>Hardware</i>	<i>Manufacturer/Type/Style</i>	<i>Finish</i>
1 ea	Cont Hinge	Ives 224HD	628
1 ea	Push Plate	Ives 8200 4" X 16"	630
1 ea	Pull Plate	Ives 8303 10" 4" X 16"	630
1 ea	Surface Closer	LCN 1461	689
1 ea	Kickplate	Ives 8400 10" X 2" LDW B4E CS	630
1 ea	Mop Plate	Ives 8400 4" X 2" LDW	630
1 ea.	Floor Stop	Ives FS436	626
3 ea.	Silencers	Ives SR64	Gray

#### HARDWARE SET NO. 10 – INTERIOR DOOR WITH PRIVACY LOCK

*(each to have)*

Qty.	Hardware	Manufacturer/Type/Style	Finish
3 ea	HW Hinges	Ives 5BB1HW 4.5 X 4.5	630
1 ea.	Privacy Lock	Schlage ND40S TLR	626
1 ea.	Floor Stop	Ives FS436	626
3 ea.	Silencers	GJ 64	Gray

#### HARDWARE SET NO. 11 - INTERIOR PAIR OF DOORS WITH PASSAGE SET

*(each to have)*

Qty.	Hardware	Manufacturer/Type/Style	Finish
2 ea	Continuous Hinge	628	US26D
1 ea.	Manual Flush Bolt	Ives FB458	626
1 ea.	Cylinder	Schlage 23-030 IC Core	626
1 ea.	Closers w/ Hold	LCN 4110 H on active leaf only	US26D
1 set	Flush Bolts	Glynn Johnson FB6 (on inactive leaf)	B26D

#### HARDWARE SET NO. 12 - INTERIOR PAIR OF COMM DOORS WITH LOCK

*(each to have)*

Qty.	Hardware	Manufacturer/Type/Style	Finish
1 ea	Continuous Hinge	Ives 224HD	628
2 ea.	Manual Flush Bolt	Ives FB458	626
1 ea	Dust Proof Strike	Ives DP1/DP2	626
1 ea.	Entrance w/ Deadbolt	Schlage L9453BD 03A	630
1 ea	Cylinder	TO BE PROVIDED BY COMM DEPT	630
1 ea.	Overhead Stop	Glynn Johnson 90S	630
1 ea.	Surface Closer	LCN 4111 AVB SCUSH MC	689
1 set	Astragal	NGP 125NSS	CL
1 ea	Threshold	NGP 896S	AL

Cylinder to be provided by Communications Dept. – Abloy Protect FSIC core, no keys, ACY419NLK locking system

## HARDWARE SET NO. 13 – STORM SHELTER DOOR

*(each to have)*

Note: requires a 3 point lock system and hardware must comply with FEMA 361 Requirements for Tornado Shelter

Qty.	Hardware	Manufacturer/Type/Style	Finish
1 ea.	Continuous Hinge	Stanley 660 Series	626
1 ea.	Lockset	Schlage L9070BD-03A	626
1 ea.	Cylinder	Schlage 80-037	626
1 ea.	Concealed Vertical Rods	Schlage	626
1 ea.	Closer	LCN P1461-TB	626
1 ea.	Floor Stop	Trimco 1215	AL
3 ea.	Silencers	GJ 64	Gray

**END OF SECTION**

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## **SECTION 08 81 00 - GLAZING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
  - a. Interior borrowed lites.
  - b. Exterior low-e, tinted; single and insulating glass units; float and tempered.
  - c. Mirrors.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR, Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements
- C. Division 08 - Standard Steel Doors and Frames.
- D. Division 08 – Aluminum Storefront
- E. Division 08 - Aluminum Windows.

#### **1.03 DEFINITIONS**

- A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.
- B. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delaminating materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
- C. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for 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.

#### **1.04 PERFORMANCE REQUIREMENTS**

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

- B. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Provide glass lites for various size openings in nominal thicknesses indicated.

#### 1.05 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Glazing Schedule: Use same designations indicated on Drawings for glazed openings in preparing a schedule listing glass types and thicknesses for each size opening and location.
- C. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.
- D. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 IN square.

#### 1.06 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Source Limitations for Laminated Glass: Obtain laminated-glass units from one manufacturer using the same type of glass lites and interlayers for each type of unit indicated.
- C. Source Limitations for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.
- D. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
- E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: GANA'S "Glazing Manual" and "Laminated Glass Design Guide."

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Clear glass - tempered, float and heat strengthened:
  - a. Libbey-Owens-Ford.
  - b. PPG.
  - c. Viracon.
  - d. Visteon.
2. Tinted glass - tempered, float and heat strengthened:
  - a. Libbey-Owens-Ford.
  - b. PPG.
  - c. Viracon.
  - d. Visteon.
3. Wire glass:
  - a. Guardian Industries.
  - b. Nippon Glass Works.
4. Low emissivity glass:
  - a. Libbey-Owens-Ford.
  - b. PPG.
  - c. Viracon.
  - d. Visteon.
5. Insulating glass units - tinted and clear:
  - a. Libbey-Owens-Ford.
  - b. PPG.
  - c. Viracon.
  - d. Visteon.
6. Insulated low emissivity glass units:
  - a. Libbey-Owens-Ford.
  - b. PPG.
  - c. Viracon.
  - d. Visteon.
7. Spandrel glass:

- a. Libbey-Owens-Ford.
  - b. PPG.
  - c. Viracon.
  - d. Visteon.
- 8. Gaskets, glazing compounds, setting blocks, spacers, sealant, sealant tape, etc., as recommended by glass manufacturer, glass unit fabricator, or as required by NFPA.
  - 9. Submit requests for substitution in accordance with UPRR Division 01.

## 2.02 GLASS

### A. General:

- 1. For all glass, provide the type and thickness shown on the Drawings or specified herein.
- 2. Where type or thickness, or both, are not shown on the Drawings or specified herein, provide type and thickness directed by the Architect.

## 2.03 EXTERIOR INSULATING GLASS:

### A. Insulated Low Emissivity Glass Units: Similar to Viracon "Solarscreen 85."

- 1. Two sheets of 1/4 IN glass sealed together at edges with spacers and sealant.
- 2. Coating applied to second surface.
- 3. 1/2 IN air space.
- 4. Visible light transmittance: 47 percent.
- 5. Visible light reflectance outside: 7 percent.
- 6. Solar energy transmittance: 29 percent.
- 7. U value summer/winter: .31/.32.
- 8. Shading coefficient: .46.
- 9. Relative heat gain: 96.
- 10. Color: As selected by architect from full range of colors.

## 2.04 CLEAR GLASS:

- A. 1/4" Float Glass - Type I, Quality q3, clear.
- B. Tempered Glass: Provide glazing to match adjacent applications including tinting, thickness shading coefficients and etc. Install at locations indicated on floor plans or as scheduled.

## 2.05 PLATE GLASS MIRRORS

- A. Clear plate glass (FS DD-G-451, Type I, Class I, Quality q2), 1/4" thick, with silver coating, copper protective coating and 2 mil thick paint coating; complying with C527.



1. Mirror Mastic: Type recommended by mirror manufacturer for spot-application system with less than 25% coverage and 1/8"-1/2" thickness of setting bed, with mirror supported only at lower edge.

## 2.06 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C1281 and AAMA 800 for products indicated below:
  1. AAMA 804.3 tape, where indicated.
- B. Expanded Cellular Glazing Tape: Closed-cell, PVC foam tape; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
  1. Type 1, for glazing applications in which tape acts as the primary sealant.
  2. Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

## 2.07 GLAZING GASKETS

- A. Lock-Strip Gaskets: Neoprene extrusions in size and shape indicated, fabricated into frames with molded corner units and zipper lock strips, complying with ASTM C542, black.
- B. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
  1. EPDM, ASTM C864.
  2. Silicone, ASTM C1115.
  3. Thermoplastic polyolefin rubber, ASTM C1115.
  4. Any material indicated above.
- C. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C509, Type II, black; and of profile and hardness required to maintain watertight seal:
  1. EPDM.
  2. Silicone.
  3. Thermoplastic polyolefin rubber.
  4. Any material indicated above.

## 2.08 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with contacted in installation.
- B. Cleaners, Primers, and Sealants: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

## 2.09 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

## 2.10 MIRRORS

- A. Where shown on the Drawings, provide 1/4 IN polished float/plate glass, triple-silvered, electro-copper plated with baked enamel backing and guaranteed against silver spoilage for 15 years. Smooth polished edges, Units furnished with bright nickel finish steel mounting clips and concealed screws and clear coated aluminum frames. Provide in the dimensions and arrangements indicated on the drawings.
- B. Shall be mounted to meet ADA standards.

# PART 3 - EXECUTION

## 3.01 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep system.
  - 3. Minimum required face or edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.02 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

### 3.03 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. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where the length plus width is larger than 50 IN (1270 mm) as follows:
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8 IN (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width with glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

### 3.04 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. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until just before each glazing unit is installed.

### 3.05 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance 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. 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. Install gaskets so they protrude past face of glazing stops.

### 3.06 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

### 3.07 LOCK-STRIP GASKET GLAZING

- A. Comply with ASTM C716 and gasket manufacturer's written instructions. Provide supplementary wet seal and weep system, unless otherwise indicated.

### 3.08 PROTECTION AND CLEANING

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

- C. 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 build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.

**END OF SECTION**

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## **SECTION 09 21 16 - GYPSUM BOARD ASSEMBLIES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Interior gypsum wallboard.
2. Non-load-bearing steel framing.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR, Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements

#### **1.03 DEFINITIONS**

- A. Gypsum Board Terminology: Refer to ASTM C11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

#### **1.04 SUBMITTALS**

- A. Manufacturer's Literature and Product Data Sheets: For each type of product indicated.

#### **1.05 QUALITY ASSURANCE**

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

#### **1.07 PROJECT CONDITIONS**

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, whichever is the most stringent.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products of the following:

UP General Specifications  
GYPSUM BOARD ASSEMBLIES

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1. Steel Framing and Furring:
  - a. Dale Industries, Inc. - Dale/Incor.
  - b. National Gypsum Company.
  - c. Scafco Corporation.
  - d. ClarkDietrich
2. Gypsum Board and Related Products:
  - a. American Gypsum Co.
  - b. G-P Gypsum Corp.
  - c. National Gypsum Company.
  - d. United States Gypsum Co.

## 2.02 STEEL SUSPENDED CEILING AND SOFFIT FRAMING

- A. Components, General: Comply with ASTM C 754 for conditions indicated.
- B. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.0625 IN DIA wire, or double strand of 0.0475 IN DIA wire.
- C. Hangers: As follows:
  1. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.162 IN DIA.
- D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base metal thickness of 0.0538 IN, a minimum 1/2 IN wide flange, with manufacturer's standard corrosion-resistant zinc coating.
  1. Depth: 1-1/2 IN.
- E. Furring Channels (Furring Members): Commercial-steel sheet with manufacturer's standard corrosion-resistant zinc coating.
  1. Cold Rolled Channels: 0.0538 IN bare steel thickness, with minimum 1/2 IN wide flange, 1/2 IN deep.
  2. Steel Studs: ASTM C645.
    - a. Minimum Base Metal Thickness: 0.0179 IN.
    - b. Depth: As indicated.
    - c. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 IN deep. Minimum Base Metal Thickness: 0.0179 IN.
- F. Grid Suspension System for Interior Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armstrong World Industries, Inc.; Furring Systems/Drywall.
    - b. USG Interiors, Inc.; Drywall Suspension System.



## 2.03 STEEL PARTITION AND SOFFIT FRAMING

- A. Components, General: As follows:
  - 1. Comply with ASTM C754 for conditions indicated.
  - 2. Steel Sheet Components: Complying with ASTM C645 requirements for metal and with manufacturer's standard corrosion-resistant zinc coating.
- B. Steel Studs and Runners: ASTM C645.
  - 1. Minimum Base Metal Thickness: 20 gage. Refer to schedule on drawings.
  - 2. Depth: As indicated.
  - 3. Studs used as furring and attached to masonry substrate: 22 gage minimum thickness.
- C. Deep-Leg Deflection Track: ASTM C645 top runner with 2 IN deep flanges.
- D. Proprietary Deflection Track: Steel sheet top runner manufactured to prevent cracking of gypsum board applied to interior partitions resulting from deflection of structure above; in thickness indicated for studs and in width to accommodate depth of studs.
  - 1. Product: Subject to compliance with requirements, provide one of the following:
    - a. Delta Star, Inc., Superior Metal Trim; Superior Flex Track System (SFT).
    - b. Metal-Lite, Inc.; Slotted Track.
    - c. Deitrich.
    - d. Marino.
- E. Proprietary Firestop Track: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
  - 1. Product: Subject to compliance with requirements, provide one of the following:
    - a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
    - b. Metal-Lite, Inc.; The System.
- F. Cold-Rolled Channel Bridging: 0.0538 IN bare steel thickness, with minimum 1/2 IN wide flange.
  - 1. Depth: As indicated.
  - 2. Clip Angle: 1-1/2 by 1-1/2 IN, 0.068 IN thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C645.
  - 1. Minimum Base Metal Thickness: 25 gage.
  - 2. Depth: 7/8 IN.
- H. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

#### 2.04 INTERIOR GYPSUM WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Gypsum Wallboard: ASTM C 36.
  - 1. Regular Type:
    - a. Thickness: 5/8 IN.
    - b. Long Edges: Tapered.
  - 2. Type X:
    - a. Thickness: 5/8 IN.
    - b. Long Edges: Tapered.
- C. Moisture-Resistant Gypsum Wallboard: ASTM C36.
  - 1. Core: Moisture-resistant.
  - 2. Long Edges: Tapered.
  - 3. Location: At each wall with plumbing fixture and other areas indicated on drawings.

#### 2.05 EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Exterior Gypsum Soffit Board: ASTM C931/C931M, with manufacturer's standard edges.
  - 1. Core: As indicated regular type and Type X.
- C. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M.
  - 1. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, "Dens-Glass Gold" by G-P Gypsum Corp.
  - 2. Product: Subject to compliance with requirements, provide "Dens-Glass Gold" by G-P Gypsum Corp.
  - 3. Core: As indicated regular type and Type X.

#### 2.06 TILE BACKING PANELS

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Location:
  - 1. All walls of showers.
- C. Cementitious Backer Units: ANSI A118.9.
  - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Custom Building Products; Wonderboard.
  - b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
  - c. United States Gypsum Co.; DUROCK Cement Board.
2. Thickness: 1/2 IN.

## 2.07 TRIM ACCESSORIES

### A. Interior Trim: ASTM C1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:
  - a. Cornerbead: Use at outside corners, unless otherwise indicated.
  - b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
  - c. Expansion (Control) Joint: Use where indicated.

### B. Exterior Trim: ASTM C1047.

1. Material: Hot-dip galvanized steel sheet or rolled zinc.
2. Shapes:
  - a. Cornerbead: Use at outside corners.
  - b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
  - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening. Use where indicated.

### C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Fry Reglet Corp.
  - b. Gordon, Inc.
  - c. MM Systems Corporation.
  - d. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

## 2.08 JOINT TREATMENT MATERIALS

### A. General: Comply with ASTM C475.

### B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
  2. Exterior Gypsum Soffit Board: Paper.
  3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
  4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
1. Prefilling: At open joints, rounded or beveled panel edges, 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 Exterior Applications:
1. Exterior Gypsum Soffit Board: Use setting-type taping and setting-type, sandable topping compounds.
  2. Glass-Mat Gypsum Sheathing Board: As recommended by manufacturer.
- E. Joint Compound for Tile Backing Panels:
1. Cementitious Backer Units: Thin-set cement and open-weave fiberglass tape, as recommended by manufacturer.

## 2.09 ACOUSTICAL SEALANT

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
- B. Products: Subject to compliance with requirements, provide one of the following:
1. Acoustical Sealant for Exposed and Concealed Joints:
    - a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
    - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
  2. Acoustical Sealant for Concealed Joints:
    - a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
    - b. Pecora Corp.; BA-98.
    - c. Tremco, Inc.; Tremco Acoustical Sealant.

- C. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
- D. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.

## 2.10 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
- C. Steel Drill Screws: ASTM C1002, unless otherwise indicated.
  - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 IN thick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- D. Isolation Strip at Exterior Walls:
  - 1. Asphalt-Saturated Organic Felt: ASTM D226, Type I (No. 15 asphalt felt), nonperforated.
  - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 IN thick, in width to suit steel stud size.
- E. Sound Attenuation Blankets: As specified in Section 07 21 00 - Building Insulation.
- F. Thermal Insulation: As specified in Section 07 21 00 - Building Insulation.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C754, and ASTM C840 requirements that apply to framing installation.

- B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."
- C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.
  - 1. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip- type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
- D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

### 3.03 APPLYING AND FINISHING PANELS

- A. Installation Standards: Comply with ASTM 840.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4 to 1/2 IN 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.
- D. Install 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.
  - 1. Aluminum Trim: Install according to ASTM C840.
  - 2. Control Joints: Install control joints according to ASTM C840.
  - 3. Interior Trim: Install in the following locations:
    - a. Cornerbead: Use at outside corners.
    - b. Bullnose Bead: Use at outside corners.
    - c. LC-Bead: Use at exposed panel edges where gypsum board abuts another material.
    - d. U-Bead: Use at exposed panel edges where gypsum board abuts another material
- E. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
  - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  - 2. Level 2: Panels that are substrate for tile.

- 3. Level 4: At panel surfaces that will be exposed to view.
  - a. Primer and its application to surfaces are specified in Section 09 90 00.
- 4. Level 5: Where indicated on Drawings.
  - a. Primer and its application to surfaces are specified in Section 09 90 00.
- H. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- I. Remove and replace panels that are wet, moisture damaged, and mold damaged.

**END OF SECTION**

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## **SECTION 09 30 13 - CERAMIC TILE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Ceramic Wall Tile.
2. Ceramic Floor Tile.
3. Porcelain Floor Tile.
4. Combination Waterproofing and Adhesive.
5. Grout.
6. Leveling Compound.
7. Marble Transition Strips.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - General Requirements.
- C. Division 07 - Joint Sealants.
- D. Division 09 - Gypsum Board Assemblies.

#### **1.03 REFERENCED STANDARDS**

##### **A. American National Standards Institute (ANSI):**

1. A108.1, Installation of Ceramic Tile.
2. A108.11, Specification for Interior Installation of Cementitious Backer Units.
3. A137.1, Ceramic Tile.

#### **1.04 DEFINITIONS**

##### **A. Installer or Applicator: Installer or applicator is the person actually installing or applying the product in the field at the Project site.**

1. Installer and applicator are synonymous.

#### **1.05 SUBMITTALS**

##### **A. Submit under provisions of Section 01 33 00**

##### **B. Shop Drawings:**

1. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.

C. Miscellaneous Submittals:

1. Certification of installer qualifications.
2. Letter from grout and adhesive manufacturer stating that grout and tile adhesive being used is compatible with cement backer board.

D. Samples:

1. Complete range of tile and grout color samples including all accent, bright and custom colors for selection by Architect.
  - a. Unless noted otherwise, tile selection shall be made from complete range of available sizes, colors, styles, profiles and finishes
  - b. Tile trim may be contrasting color.
2. After selection of colors, types, patterns and sizes, provide (4) 2 x 2 IN samples.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. Installer must have minimum 5 years' experience installing similar products with similar substrates.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Ceramic Tile:
  - a. American Olean Tile Co.
  - b. Dal-Tile Corp.
2. Adhesives, mortars, grouts and leveling compounds (except combination waterproofing and adhesive):
  - a. Bonsal Co.
  - b. Bostik Construction Products.
  - c. H.B. Fuller (TEC).
  - d. Laticrete International Inc.
  - e. Mapei Canada, Inc.
3. Combination waterproofing and adhesive:
  - a. Mapei Canada Inc.

B. Submit requests for substitution in accordance with UPRR Division 01.

2.02 MATERIALS

A. General:

1. Ceramic Wall Tile: 4 IN x 4 IN Glazed Ceramic Wall Tile.
  2. Ceramic Floor Tile: 2 IN x 2 IN Blended Mosaic Pattern with Matte Finish.
  3. Porcelain Floor Tile: 12 IN x 12 IN
- B. Adhesives for Ceramic Tile:
1. Dry-set Portland cement mortars: ANSI A118.1.
  2. Latex-Portland cement mortars: ANSI A118.4.
  3. Assure adhesives are compatible with cement backer board.
  4. Combination waterproofing and adhesive:
    - a. Two-component elastomeric urethane adhesive.
    - b. Mapei Canada Inc. "Planicrete W."
- C. Grout: Portland cement-based material, containing quartz aggregate, colorfast pigments and Portland cement:
1. Custom Building Products:
  2. Alternate Color: Mapei,
- D. Sealant: One- or two-component, non-sag, polyurethane or silicone sealant, as specified in Section 07 92 00.
- E. Leveling Compounds: As recommended by tile manufacturer.
- F. Edging: Marble floor edge strips – Provide at exposed edges where a change in elevation occurs.
- G. Expansion Joint Strips: Neoprene filler recessed type. Neoprene thickness 1/8 IN (3 mm).
- H. Ceramic Tile Base and Associated Trim:
1. Factory made trim shapes for all curbs, caps, corners, bullnose, bases, coves, beads, depressions, moldings, chair rails, etc.
    - a. Top trim (for wainscot installation): 1/4 IN radius bullnose cap 2 x 6 IN.

## 2.03 MAINTENANCE MATERIALS

- A. Extra Material:
1. Furnish Owner with the following extra materials:
    - a. 2 percent of each different size, pattern, style, and/or color of tile used, including trim shapes, with minimum of 1 full size tile of each for maintenance purposes.
    - b. Enough extra grout mix of each different color and/or type to allow for full 2 percent of tile to be replaced.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Locate expansion joints prior to product installation.
- B. Verify that substrate is ready to accept tile installation. Correct surface defects or conditions that may interfere with or prevent a satisfactory installation.

### 3.02 INSTALLATION

- A. General:
  - 1. Install products in accordance with manufacturer's instructions and ANSI A108.
  - 2. Place tile in grid pattern.
  - 3. Align tile joints on adjoining walls/floors.
  - 4. Lay out and center tile in both directions in each space or on each wall area.
  - 5. Avoid use of tile less than 1/2 size.
  - 6. Adjust tile to minimize cutting.
  - 7. Provide uniform joint widths insofar as practicable. Provide joint widths as recommended by tile manufacturer.
  - 8. Provide leveling beds as required.
  - 9. Grout tile joints same day tile is set.
    - a. After grouting, remove surplus grout.
  - 10. Provide edging at exposed edges where there is a change of level
- B. Install expansion joints where indicated on Drawings:
  - 1. If not indicated on Drawings, place joints 12 - 16 FT OC or on column lines each way (whichever is smaller).
  - 2. Install over construction or expansion joints in backing.
  - 3. Install where backing material changes.
  - 4. Install where floors abut vertical surface.
  - 5. Maintain nominal 1/4 IN wide joint at perimeter of tiled floor areas and caulk with sealant.
- C. Installation of Tile on Walls Over Combination Waterproofing and Adhesive:
  - 1. Provide combination waterproofing and adhesive for all tile installed on walls in shower rooms full height.

### 3.03 CLEANING

- A. After installation, clean in accordance with manufacturer's instructions.

3.04 PROTECTION

- A. Permit no traffic on floors for 72 HRS after grouting and protect installed tile work with kraft paper or other non-staining covering during construction to prevent damage.

**END OF SECTION**

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## **SECTION 09 51 13 - ACOUSTICAL PANEL CEILINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. All labor, equipment and materials, for the installation of non fire-rated acoustical panel ceiling and suspension system.
2. Suspended metal grid system.
3. Acoustical panels.
4. Perimeter trim and accessories.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR, Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements
- C. Division 09 - Gypsum Board Assemblies.
- D. Division 23 – Mechanical: Air distribution devices in ceilings.
- E. Division 26 - Electrical: Light fixtures in ceiling systems.

#### **1.03 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product data for each type of product specified.
- C. Submit shop drawings and show the following:
  1. Grid Layout and ceiling suspension system members.
  2. Indicate primary and secondary supports
  3. Method of attaching suspension system hangers to building structure.
  4. Related dimensioning.
  5. Interrelations of mechanical and electrical items
  6. Minimum Drawing Scale: 1/8 IN = 1 FT.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experienced Installer who has completed acoustical panel ceilings similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

- B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
  - 1. Surface-burning characteristics of acoustical panels comply with ASTM E1264 for Class A materials as determined by testing identical products per ASTM E84.
- C. Single-Source Responsibility for Ceiling Units: Obtain each type of acoustical ceiling panel from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- D. Single-Source Responsibility for Suspension System: Obtain each type of suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

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

#### 1.06 PROJECT CONDITIONS

- A. Space Enclosure and Environmental Limitations: Maintain uniform temperature of minimum 60 DegF and humidity of 20 to 40 percent prior to and during installation.
- B. Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet-work in spaces is completed and dry, work above ceilings is complete and ambient temperature and humidity conditions are met.

#### 1.07 COORDINATION

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

#### 1.08 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering and storage, and are identified with labels clearly describing contents.
  - 1. Acoustical Ceiling Tile: Furnish quantity of full-size units equal to 2.0 percent of amount installed.
  - 2. Suspension System Components: Furnish quantity of each component equal to 2.0 percent of amount installed.



## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products specified in each of the following sections.

### 2.02 ACOUSTICAL PANELS

#### A. Acoustical Panel Standard:

1. Basis of Design Products: Armstrong "Cirrus, Tegular", 24 IN x 48 IN x 7/8 IN or 24 IN x 24 IN x 7/8 IN as indicated on plans.
2. Acoustical Panel Characteristics: Provide panels complying with ASTM E 1264 for characteristics described below:
3. Types: Type III, Form 1 - Nodular Cast or molded mineral-base panels with painted finish.
4. Color: White.
5. Light Reflectance Coefficient: LR 0.86.
6. Noise Reduction Coefficient: NRC 0.70.
7. Ceiling Attenuation Class: CAC 0.40.
8. Edge Detail: Angled Tegular, Reveal sized-to-fit flange of exposed suspension system member.
9. Thickness: 7/8 IN.
10. Size: 24 by 48 IN or 24 by 24 IN, per plan
11. Suspension System Type: Provide suspension system that complies with requirements in Part 2 "Non-Fire-Resistance-Rated, Direct-Hung Suspension Systems" 1-5/16 IN exposed, standard face, capped, double-web, steel suspension system.

### 2.03 METAL SUSPENSION SYSTEMS, GENERAL

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Basis of Design: USG Interiors, Inc.
  2. Armstrong World Industries, Inc.
  3. Celotex Corporation (The); Building Products Division; Architectural Ceilings Marketing Dept.
  4. Chicago Metallic Corporation.
- B. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C635 requirements.
- C. Finishes and Colors: Provide manufacturer's standard factory-applied finish for type of system indicated.

- D. Attachment Devices: Size for 5 times the design load indicated in ASTM C635, Table 1, Direct Hung unless otherwise indicated.
- E. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
  - 1. Zinc-Coated Carbon Steel Wire: ASTM A641, Class 1 zinc coating, soft temper.
  - 2. Size: Select wire diameter so that its stress at 3 times the hanger design load (ASTM C635, Table 1, Direct Hung) will be less than the yield stress of wire, but provide not less than 0.106 IN DIA wire.
- F. Hanger Rods: Mild steel, zinc coated, or protected with rust-inhibitive paint.
- G. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's product designations, complying with the following requirements:
  - 1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of finish indicated and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B221 (ASTM B221M) for alloy and temper 6063-T5.
- H. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: Cleaned with inhibited chemicals; Chemical Finish: Acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel according to paint manufacturer's specifications for cleaning, conversion coating, and applying organic coating.
  - 1. Organic Coating: Manufacturer's standard thermosetting coating system with a minimum dry film thickness of 0.8 to 1.2 mil.
  - 2. Color: As selected by Architect from manufacturer's standard colors.
- I. Hold-Down Clips for Non-Fire-Resistance-Rated Ceilings: For interior ceilings composed of acoustical panels weighing less than 1 LB per SQ FT, provide hold-down clips spaced 24 IN OC on all cross tees.
- J. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system design to absorb impact forces against acoustical panels.

#### 2.04 NON-FIRE-RESISTANCES-RATED, DIRECT-HUNG SUSPENSION SYSTEMS

- A. Standard, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from prepainted or electrolytic zinc-coated, cold-rolled steel sheet, with prefinished 15/16 IN wide metal caps on flanges; other characteristics as follows:
  - 1. Structural Classification: Intermediate system.
  - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type, as standard with manufacturer.
  - 3. Cap Material and Finish: Steel sheet painted white.
- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. 15/16 IN Exposed, Standard Face, Capped, Double-Web, Steel Suspension Systems:

- a. Armstrong World Industries, Inc.
- b. Chicago Metallic Corporation.
- c. USG Interiors, Inc.

## 2.05 ACOUSTICAL SEALANT

- A. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C834 and the following requirements:
  - 1. Product is effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies per ASTM E90.
- B. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Acoustical Sealant for Exposed and Concealed Joints:
    - a. AC-20 FTR Acoustical and Insulation Sealant; Pecora Corp.
    - b. SHEETROCK Acoustical Sealant; United States Gypsum Company.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates and 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. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other ceiling anchors whose installation is specified in other Sections.
- B. Measure each ceiling area and establish the layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and conform to the layout shown on reflected ceiling plans.

### 3.03 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with publications referenced below per manufacturer's instructions and CISCA "Ceiling Systems Handbook."
  - 1. Standard for Ceiling Suspension System Installations: Comply with ASTM C636.
  - 2. CISCA Recommendations for Acoustical Ceilings: Comply with CISCA "Recommendations for Direct-Hung Acoustical Tile and Lay-In Panel Ceilings."
- 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 the supporting structure or of the ceiling suspension system.

2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counters playing, or other equally effective means.
  3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
  4. Secure wire hangers to ceiling suspension members and to supports above with a screws, or other devices that are secure, that are appropriate for substrate, and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  5. Secure bracing wires to ceiling suspension members and to supports with a minimum of 4 tight turns. Fasten bracing wires to concrete with cast-in-place or post installed anchors.
  6. Do not support ceilings directly from permanent metal forms. Fasten hangers to cast-in-place hanger inserts, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
  7. Do not attach hangers to steel deck tabs.
  8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  9. Space hangers not more than 48 IN OC along each member supported directly from hangers, unless otherwise shown; and provide hangers not more than 8 IN from ends of each member.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attached moldings to substrate at intervals not over 16 IN OC and not more than 3 IN from ends, leveling with ceiling suspension system to a tolerance of 1/8 IN in 12 FT. Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fitted accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide neat, precise fit.
1. Install panels with pattern running in one direction parallel to long axis of space.
  2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  3. Paint the cut panel edges remaining exposed after installation; match color of exposed panel surfaces using coating recommended for this purpose by acoustical panel manufacturer.

4. Install hold-down clips in areas indicated and in areas required by governing regulations, or for fire-resistance ratings; space as recommended by panel manufacturer, unless otherwise indicated or required.

#### 3.04 CLEANING

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

**END OF SECTION**

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## **SECTION 09 65 16 - RESILIENT SHEET FLOORING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Providing and installing commercial resilient sheet flooring per manufacturer's installation requirements and recommendations.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR, Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements

#### **1.03 SUBMITTALS**

- A. Product Data: Submit manufacturer's product data and installation instructions for watertight application.
- B. Samples: Submit representative sample of each material specified, indicating visual characteristics and finish.

#### **1.04 QUALITY ASSURANCE**

- A. Contractor will assure compliance with Article 2.02 to allow for proper installation.
- B. Comply with local governing codes and regulations.
- C. Use PROTECT-ALL factory trained installers that are approved or recommended by manufacturer.
- D. Manufacturer provides a limited 10 year product warranty against manufacturing defects.
  1. Warranty does not in any way cover installation-related issues.

#### **1.05 EXTRA MATERIALS**

- A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage and identified with labels clearly describing contents.
  1. Furnish not less than one package for each 10 packages or fraction thereof, of each class, wearing surface, color, pattern and size of resilient flooring installed.

### **PART 2 - PRODUCTS**

#### **2.01 PRODUCTS**

- A. PROTECT-ALL Commercial Flooring as manufactured by Oscoda Plastics, Inc.
  1. Sheets 5 FT x 5 FT x 1/4 IN thicknesses, in color chosen from manufacturer's samples in matte finish.

2. Interlocking sheets 18 IN x 18 IN x 1/4 IN thickness, in color chosen from manufacturer's samples in matte finish.
3. PROTECT-ALL Flooring Adhesives.
4. PROTECT-ALL V-Rod Welding Rod.
5. Stainless Steel drain rings & Transition strips as provided by Oscoda Plastics.
  - a. Oscoda Plastics stainless steel fasteners and anchors for drain rings & transition strips
6. Other installation materials as required and supplied by Oscoda Plastics, Inc.

B. Contact Information

Oscoda Plastics  
 5585 N. Huron Ave. P.O. Box 189  
 Oscoda, MI 48750

800-544-9538 Phone  
 989-739-1494 Fax  
 sales@oscodaplastics.com  
 www.protect-allflooring.com

## 2.02 VERIFICATION OF JOB CONDITIONS

A. Proper Substrate:

1. Assure that the substrate material is suitable for installation of flooring as indicated by manufacturer. Approved substrates include: marine-grade wood, cement board, and concrete (non-gypsum based only), properly cleaned and prepared per manufacturers guidelines.
  - a. PROTECT-ALL is not to be installed over any existing finish, such as quarry tile, any paint, or any type of tile.
  - b. PROTECT-ALL should not be installed in an "operating environment," meaning an environment that is not prepared to close entirely for the duration of the installation.
2. Slab substrates must be dry and free of curing compounds, sealers, hardeners, and other materials whose presence would interfere with bonding of adhesive. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by floor covering manufacturer.
3. Verify a clean, dry, and structurally sound surface to accept adhesive, free of cracks, ridges, depression, scales, and foreign deposits of any kind.
4. Use only cementitious patching and filling compounds (3500 PSI). Consult manufacturer for details. (ACI 302.2R-06 ch. 9.5)
5. Assure that the levelness (FL 15), and flatness (F20 5/16 in 10 FT) of surface is in compliance with manufacturer's guidelines.
6. Verify that sub-floor surfaces (concrete, marine-grade plywood, cement board) are ready for resilient flooring installation by testing moisture emission rate and alkalinity, in accordance with ASTM F710; obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer. Reference ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
7. The following standards apply:



- a. ASTM E1745-97 – Standard Specification for Water Vapor Retarders.
- b. ASTM E1643 – Standard Practice for Installation of Water Vapor Retarders used in contact with Earth or Granular Fill Under Concrete Slabs.
- c. ASTM E96-00 – Standard Test Method for Water Vapor Transmission of Materials.
- d. ACI 302.1R-04 – Guide for Floor and Concrete Slab Construction.
- e. ACI 302.2R-06 – Guide for Concrete Slabs That Receive Moisture-Sensitive Flooring Materials.
- f. ASTM F710-08 – Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- g. ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

B. Environmental Conditions:

- 1. The contractor and installer of product is responsible for providing and maintaining a proper installation environment.
- 2. Installation area must be enclosed and watertight with all walls, wall finishes, doors, and floor penetrations in place.
- 3. Proper temperature acclimation of flooring material is required prior to installation. Minimum of 36 HRS.
- 4. Assure confinement of space during installation and curing of adhesives to prevent other trades from damaging the product or compromising the adhesion.
- 5. Maintain a constant temperature during the installation and throughout the curing of adhesives.
- 6. Provide a secure area to store materials for installation.
- 7. Building must be completely enclosed and water-tight. HVAC system must be on at least 7 days prior to installation beginning, keeping the interior temperature at 70 DegF. This temperature should be maintained during the installation, and an additional 8 days after completion.
  - a. PROTECT-ALL cannot have any foot traffic or rolling load traffic until flooring adhesive has fully cured, 7 – 8 days.

C. Proper Drain and Other Floor Penetration Elevations.

- 1. All drains to be installed level and with proper slope, no more than the thickness of the PROTECT-ALL MATERIAL 1/4 IN above surface of sub floor.
- 2. When “dishing” of drain area is specified, the “dish” should not be less than 12 IN DIA and more than 1 IN in depth.
- 3. All other penetrations should be installed no more than the thickness of the PROTECT- ALL 1/4 IN above surface and provide accommodation for proper sealing.

4. Penetrations not terminating at floor surface must be a minimum of 6 IN above the surface of floor and be installed in such a way as to not interfere with the installation of the flooring and allow adequate space for sealant to be applied to the entire perimeter, and finished off with manufacturer specified detail.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

##### **A. General:**

1. Follow manufacturer recommendations for laying sheets out.
2. Flooring must be cut tight to all penetrations.
3. Stainless steel transitions as provided by the manufacturer must be used in doorways and transition areas. Use stainless steel fasteners, and lead anchors to secure.

##### **B. 5 FT x 5 IN sheets in Toilet and Locker Rooms:**

1. Adhere the floor material using manufacturer's recommended adhesive for the particular substrate type, job conditions, and in compliance with spread rate and proper trowel size.
2. Roll floor into adhesive with 100# roller immediately and 1 hour later, as per manufacturer directions.
3. Install stainless steel drain rings around all drains and other surface penetrations. Rings are to be routed into floor surface and mounted flush with top of flooring. Secure drain rings using stainless steel fasteners and lead anchors that will properly anchor the ring to the substrate.
4. Heat-weld all field material seams using manufacturer's welding rod, proper tools, and installation methods as approved by manufacturer.
5. All exposed edges are to be sealed with manufacturer's recommended sealant to assure a watertight seal.

#### **3.02 CLEANING**

- ##### **A.**
- Sweep-clean the floor after installation and clear area of scrap materials. The floor can be saturated and then deck brushed, power washed, or power scrubbed to remove construction debris. Installer must provide two copies of manufacturer's cleaning recommendations for contractor and owner use.

**END OF SECTION**

## **SECTION 09 65 20 - RESILIENT TILE FLOORING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Vinyl floor tile.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.
- C. Division 09 - Resilient Wall Base and Accessories, for resilient wall base, reducer strips, and other accessories installed with resilient floor tiles.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: For each type of product specified.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors and patterns available for each type of product indicated.
- D. Samples for Verification: Full-size tiles of each different color and pattern of resilient floor tile specified, showing the full range of variations expected in these characteristics.
- E. Maintenance Data: For resilient floor tile to include in the maintenance manuals specified in Division 01.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.
- B. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Fire-Test-Response Characteristics: Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
  1. Critical Radiant Flux: 0.45 w/SQ cm or greater when tested per ASTM E698.
  2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E662.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.
- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 Deg. F (10 and 32 Deg. C).
- C. Store tiles on flat surfaces.
- D. Move products into spaces where they will be installed at least 48 HRS before installation, unless longer conditioning period is recommended in writing by manufacturer.

## 1.06 PROJECT CONDITIONS

- A. Maintain a temperature of not less than 70 Deg. F (21 Deg. C) or more than 95 Deg. F (35 Deg. C) in spaces to receive products for at least 48 HRS before installation, during installation, and for at least 48 HRS after installation, unless manufacturer's written recommendations specify longer time periods. After post-installation period, maintain a temperature of not less than 55 Deg. F (13 Deg. C) or more than 95 Deg. F (35 Deg. C).
- B. Do not install products until they are at the same temperature as the space where they are to be installed.
- C. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.
- D. Install tiles and accessories after other finishing operations, including painting, have been completed.
- E. Do not install flooring over concrete slabs or toppings until slabs and toppings have cured and are sufficiently dry to bond with adhesive, as determined by flooring manufacturer's recommended bond and moisture test.

## PART 2 - PRODUCTS

### 2.01 RESILIENT TILE FLOORING

- A. General: Products complying with ASTM F1066 and with requirements specified
- B. Vinyl Composition Floor Tile (VCT): Provide solid vinyl floor tile complying with the following:
  - 1. Products: As follows:
    - a. Armstrong World Industries, Inc.; Imperial Texture Standard Excelon, #51899 Cool White.
    - b. Mannington Mills, Inc.; Essentials, #141 Cool White.
  - 2. Wearing Surface: Smooth.
  - 3. Thickness: 1/8 IN (3.2 mm).
  - 4. Size: 12 by 12 IN (304.8 by 304.8 mm).

UP General Specifications  
RESILIENT TILE FLOORING  
Issued: 03-26-2019

## 2.02 INSTALLATION ACCESSORIES

- A. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

## 2.03 INSTALLATION MATERIALS

- A. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
  - 1. Adhesives shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. VCT and Asphalt Tile Adhesives: Not more than 50 g/L.
    - b. Rubber Floor Adhesives: Not more than 60 g/L.
    - c. Terrazzo Floor Tile Adhesives: Not more than 65 g/L.
  - 2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Seamless-Installation Accessories:
  - 1. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.
    - a. Chemical-bonding compound shall have a VOC content of 350 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Chemical-bonding compound shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Trowelable Leveling and Patching Compounds: Latex-modified, Portland-cement based formulation provided or approved by flooring manufacturer for applications indicated.

## 2.04 PERFORMANCE REQUIREMENTS

- A. FloorScore Compliance: Resilient tile flooring shall comply with requirements of FloorScore Standard.
- B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by flooring manufacturer.
  - 2. Subfloor finishes comply with requirements specified in Section 03 30 00 - Cast-in-Place Concrete for slabs receiving resilient flooring.
  - 3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. General: Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.03 TILE INSTALLATION

- A. General: Comply with tile manufacturer's written installation instructions.
- B. Lay out 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 of a tile at perimeter.
  - 1. Lay tiles square with room axis, unless otherwise indicated.
- C. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles with grain running in one direction.

- D. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.
- E. Extend tiles into toe spaces, door reveals, closets, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, non-staining marking device.
- G. Adhere tiles to flooring substrates using a full spread of adhesive applied to substrate to comply with tile manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.
- H. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.
- I. Hand roll tiles according to tile manufacturer's written instructions.

### 3.04 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing resilient products:
  - 1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
  - 2. Sweep or vacuum floor thoroughly.
  - 3. Do not wash floor until after time period recommended by flooring manufacturer.
  - 4. Damp-mop floor to remove marks and soil.
- B. Protect flooring against mars, marks, indentations, and other 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 flooring manufacturer.
  - 1. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.
  - 2. Apply 2 coats protective floor wax to floor surfaces that are free from soil, visible adhesive and surface blemishes as recommended in writing by manufacturer.
    - a. Use commercially available product acceptable to flooring manufacturer.
  - 3. Cover product installed on floor surfaces with undyed, untreated building paper until inspection for substantial completion.

### END OF SECTION

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## **SECTION 09 65 73 - RESILIENT WALL BASE AND ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

**A. Section Includes:**

1. Resilient wall base.
2. Resilient flooring accessories.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.**
- B. Division 09 - For all flooring.**

#### **1.03 SUBMITTALS**

- A. Product Data:** For each type of product specified.
- B. Samples for Initial Selection:** Manufacturer's standard sample sets consisting of sections of units showing the full range of colors and patterns available for each type of product indicated.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications:** Engage an experienced installer to perform work of this Section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.
- B. Source Limitations:** Obtain each type and color of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.
- C. Fire-Test-Response Characteristics:** Provide products with the following fire-test-response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.
1. Critical Radiant Flux: 0.45 W/SQ cm or greater when tested per ASTM E648.
  2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E662.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.**

- B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 DegF (10 and 32 DegC).
- C. Move products into spaces where they will be installed at least 48 HRS before installation, unless longer conditioning period is recommended in writing by manufacturer.

#### 1.06 PROJECT CONDITIONS

- A. Maintain a temperature of not less than 70 DegF (21 DegC) or more than 95 DegF (35 DegC) in spaces to receive resilient products for at least 48 HRS before installation, during installation, and for at least 48 HRS after installation, unless manufacturer's written recommendations specify longer time periods. After post installation period, maintain a temperature of not less than 55 DegF (13 DegC) or more than 95 DegF (35 DegC).
- B. Do not install products until they are at the same temperature as the space where they are to be installed.
- C. For resilient products installed on traffic surfaces, close spaces to traffic during installation and for time period after installation recommended in writing by manufacturer.
- D. Coordinate resilient product installation with other construction to minimize possibility of damage and soiling during remainder of construction period. Install resilient products after other finishing operations, including painting, have been completed.

#### 1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet (3 linear m) for each 500 linear feet (150 linear m) or fraction thereof, of each different type, color, pattern, and size of resilient product installed.
  - 2. Deliver extra materials to Owner.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, those indicated in the Resilient Wall Base and Accessory Schedule at the end of Part 3.

#### 2.02 RESILIENT WALL BASE

- A. General: Products complying with FS SS-W-40, Type II
- B. Vinyl Wall Base: Provide vinyl wall base complying with the following:
  - 1. Products:

- a. Burke Mercer Flooring Products; #597 Mocha (Alternate).
  - b. Johnsonite; #29 Moon Rock.
- 2. Style: Cove with top-set toe.
- 3. Color: As selected by Architect from manufacturer's full range of colors
- 4. Minimum Thickness: 0.1250 IN.
- 5. Height: 4 IN (101.6 mm).
- 6. Lengths: Cut lengths 48 IN (1219.2 mm) long or coils in lengths standard with manufacturer), but not less than 96 FT (29.26 m).
- 7. Outside Corners: Premolded.
- 8. Inside Corners: Premolded.
- 9. Surface: Smooth.
- C. Vinyl Accessory Molding: Where required, provide vinyl accessory molding complying with the following:
  - 1. Products:
    - a. Burke Mercer Flooring Products.
    - b. Johnsonite.
  - 2. Color: As selected by Architect from manufacturer's full range of colors produced for vinyl accessory molding complying with requirements indicated.
  - 3. Product Description: Carpet bar for tackless installations. Carpet edge for glue-down applications. Reducer strip for resilient flooring and ceramic tile..
  - 4. Provide all accessories required for complete installation.
  - 5. Profile and Dimensions: Manufacturers standard.

## 2.03 RESILIENT ACCESSORIES

- A. Vinyl Accessories: Products complying with requirements specified in the Resilient Wall Base and Accessory Schedule.

## 2.04 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based formulation provided or approved by resilient product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
- C. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
  - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), except that adhesive for rubber stair treads shall have a VOC content of 60 g/L or less.

2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements, including those for maximum moisture content. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.02 PREPARATION

- A. General: Comply with manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- D. Broom and vacuum clean substrates to be covered immediately before installing resilient products. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.03 INSTALLATION

- A. General: Install resilient products according to manufacturer's written installation instructions.
- B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
  1. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
  2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
  3. Do not stretch base during installation.
  4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
  5. Install premolded outside and inside corners before installing straight pieces.

6. Form outside corners on job, from straight pieces of maximum lengths possible, without whitening at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
  7. Form inside corners on job, from straight pieces of maximum lengths possible, by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.
- C. Place resilient products so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.

### 3.04 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing resilient products:
1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
  2. Sweep or vacuum horizontal surfaces thoroughly.
  3. Do not wash resilient products until after time period recommended by resilient product manufacturer.
  4. Damp-mop or sponge resilient products to remove marks and soil.
- B. Protect resilient products against mars, marks, indentations, and other 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 resilient product manufacturer.
1. Apply protective floor polish to vinyl resilient products installed on floors that are free from soil, visible adhesive, and surface blemishes, if recommended by manufacturer.
    - a. Use commercially available product acceptable to resilient product manufacturer.
    - b. Coordinate selection of floor polish with Owner's maintenance service.
  2. Cover resilient products installed on floors and stairs with undyed, untreated building paper until inspection for Substantial Completion.

### END OF SECTION

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## **SECTION 09 68 14 - CARPET TILE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Direct glue-down carpet tile.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.

#### **1.03 SUBMITTALS**

- A. Product Data: For each product indicated.
- B. Shop Drawings: Per UPRR Division 1 and including the following (as applicable):
  1. Transition and other accessory strips and transition details.
- C. Samples: For each for each carpet and exposed accessory for Architect's selection.
- D. Maintenance data.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: A qualified installer with a minimum of 5 years of successful carpet installation experience.

#### **1.05 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not install carpet until wet work in spaces 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. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by manufacturer.
- C. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

#### **1.06 WARRANTY**

- A. Carpet Warranty: Manufacturer's standard form in which manufacturer agrees to replace carpet that does not comply with requirements or that fails within 10 years from date of Substantial Completion. Warranty does not include deterioration or failure of carpet from unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delaminating.

## 1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Carpet: Quantity equal to 5 percent of amount installed for each type indicated.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURER

- A. Provide Carpet Tile supplied by the following manufacturer:
  - 1. Interface Flooring Systems, Inc.

### 2.02 MATERIALS

- A. Basis of Design: Interface Marrakesh & Paint Box Series, See Interior Finishes "A".
- B. Carpet Construction:
  - 1. Tufted Yarn Weight: 26 OZ/SQ YD.
  - 2. Pile Height: 0/16 IN.
  - 3. Pile Density: 8914.
  - 4. Machine Gauge: 1/10 IN.
  - 5. Texture: Tufted textured loop.
  - 6. Smoke Developed: Per ASTM E662.
  - 7. Static Rating: AATCC 134, 3.0 kv maximum.
  - 8. Flammability: Meet NFPA Class 1.
  - 9. Size: 19.69 x 19.69 IN (50 cm x 50 cm).
  - 10. Yarn System: Antron Lumena / Antron Legacy Type 6,6 Nylon.
- C. Leveling Compound: Cementitious, non-crumbling, non-staining type acceptable to carpet manufacturer; 'Ardex' model K-15, or equal.
- D. Carpet Edging: Vinyl carpet transition reducer of same thickness as carpet.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Comply with the manufacturer's installation instructions and recommendations.
- B. Check matching of carpet before cutting to ensure there is no visible variation between dye lots.
- C. Cut carpet tile using only procedures recommended by the carpet tile manufacturer. Cut from back side of carpet only. Use sharp scissors to cut loop pile after backing has been cut. All cut edges of carpet shall be coated or buttoned with seaming cement to seal edge.



- D. Maintain uniformity of carpet direction and lay of pile. At doorways, center seams under door in closed position. Bind or seal cut edges as recommended by carpet manufacturer.
  - E. Vacuum clean substrate. Spread adhesive in quantity recommended by manufacturer after primer application to ensure proper adhesion over full area of installation. Apply only enough adhesive to permit adhesion of carpet before initial set.
  - F. Install pattern parallel to walls and borders.
  - G. Entire carpet tile installation is to be laid tight and flat to subfloor, well fastened at edges, and present a uniform, pleasing appearance.
- 3.02 CLEANING AND PROTECTION
- A. Install pattern parallel to walls and borders.
  - B. Remove yarns that protrude from carpet tile surface.
  - C. Clean and vacuum carpet surfaces using commercial equipment.
  - D. Remove soiled or damages spots.
  - E. Do not place heavy objects such as furniture on carpeted surfaces for a minimum of 24 HRS or until adhesive has set.

**END OF SECTION**

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## **SECTION 09 78 50 – EPOXY FLOOR COATING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Inspection of surfaces
2. Protective coating on exposed concrete surfaces as indicated on Drawings.
  - a. Interior concrete floors at Maintenance Garages and other areas.
  - b. Locomotive Inspection Pit Floors
  - c. Narrow Aprons Adjacent to Pits
  - d. Foot Traffic Walkways, etc.
  - e. Truck, Crane & Forklift Traffic Areas
  - f. Wear Surfaces for Other Heavy-Load Carrying Vehicles.
  - g. Locomotive Inspection Pit Walls
  - h. Secondary Containment Structure Walls, etc.
  - i. Enclosed Concrete Containment Structures such as Manholes, Lift Stations, Grit Chambers, etc.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Division 03 - Cast-In-Place Concrete
  1. Placed concrete should be moisture cured. No curing compounds or similar surface contaminants, which would impede the adhesion of the polymer coating system to the substrate, shall be used for curing the placed concrete.
- D. Division 03 - Cement Finishes and Surface Treatments
- E. Division 09 - Painting & Protective Coatings, for vertical surfaces, not considered heavy duty industrial use.
- F. Division 09 – High Performance Coatings, for vertical surfaces, pits and non-traffic horizontal concrete.

#### **1.03 SUBMITTALS**

- A. Per UPRR Division 1
- B. Product Data
- C. Samples:
  1. Submit color chips of all available colors.

2. After selection of color, submit samples of coating, not smaller than 6" square, on concrete.
- D. Submit manufacturers' technical data, application instructions and recommended coverage rates for types of surfaces to be treated.
- E. Submit sample warranty form.

#### 1.04 QUALITY ASSURANCE

- A. Qualification of Applicator: The applicator shall be qualified and certified by the coating manufacturer.
- B. Certificate and Summary Statement: Prior to completion of Work, submit a certificate stating that coatings applied conform to approved submittals and all requirements specified; in the certificate, include a summary statement giving following information:
  1. Number of square feet of each surface treated with coating, classified as to the kind of material treated, and open pore or closed pore type.
  2. The quantity of coating, per coat, actually applied to the surface.

#### 1.05 COMPLIANCE WITH REGULATIONS:

- A. All materials shall comply with the current rule and regulations of the local air quality management district, with the rules regarding volatile organic compounds, and with FDA rules and regulations for dangerous materials in coatings.

#### 1.06 WARRANTY

- A. In addition to warranty specified in Division 1, provide manufacturer's five year written warranty against dusting of treated surfaces.

#### 1.07 PRODUCT DELIVERY:

- A. Deliver all coating materials to the site in containers bearing name and batch number of manufacturer, with seals intact.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURER:

- A. These specifications are based on Thermal-Chem products. Equal products by Tnemec that comply with this specification section as judged and approved by the architect may be used.
- B. All products specified in this section shall be provided by a single manufacturer.

#### 2.02 RECOMMENDED CONCRETE COATING / TEXTURE GUIDELINES:

Orientation of Concrete Surface	Usage or Exposure Conditions	Requires Slip-Resistant Texture	Requires Heavy-Duty Wear-Surface	Subject to Constant Immersion	Examples of Concrete Surface Usage
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Horizontal	Foot Traffic Only	<b>YES</b>	<b>NO</b>	<b>NO</b>	Locomotive Inspection Pit Floors Narrow Aprons Adjacent to Pits Foot Traffic Walkways, etc.
Horizontal	Vehicle Traffic or Combination of Vehicle & Foot Traffic	<b>YES</b>	<b>YES</b>	<b>NO</b>	Truck, Crane & Forklift Traffic Areas Wear Surfaces for Other Heavy-Load Carrying Vehicles.
Vertical	Exterior Weathering (e.g., rain, snow, sun, wind, etc.)	<b>NO</b>	<b>NO</b>	<b>NO</b>	Locomotive Inspection Pit Walls Secondary Containment Structure Walls, etc.
Vertical & Overhead	Frequent or Constant Immersion Involving Oily Water	<b>NO</b>	<b>NO</b>	<b>YES</b>	Enclosed Concrete Containment Structures such as Manholes, Lift Stations, Grit Chambers, etc.

## 2.03 COATING TYPES:

### A. Interior Floor and Slab Treatment:

1. Epoxy Floor Coating: 2-part epoxy sealant (2-coat min) available from Thermal-Chem Corp (800)635-3773.
  - a. ArmourClad 735 Base Coat – applied at 120 sg ft per gallon
  - b. Manufacturer’s Aggregate applied at ½ to ¾ lbs per square feet
  - c. ArmourClad Resurfacer 736 TopCoat. – applied at 80 sf ft per gallon
2. Install per manufacturer’s recommendation for slip resistance.
3. Abrasion Resistance, Taber Abrader, CS-17 wheel, 1,000 gram load: Maximum 55 mg loss in 500 cycles.
4. Flexibility: pass with 1/8” mandrel.
5. Per cent solids: clear 45, pigmented 52.
6. Film thickness 5-8 mils, wet, per coat.
7. Color and texture to be selected by Architect from the manufacturer’s full range of colors and textures
8. The texture of the finished epoxy floor surface shall be chosen and approved in writing by the Architect, Owner and/or his Agent prior to commencement of work; from the manufacturer’s selection series or by samples submitted by the contractor.
9. Completed coating shall have semi-gloss sheen

### B. Exterior Concrete Coating / Texture Coverage Rates for UPRR:

1. Foot Traffic Areas
  - a. Two-coat, single broadcast, slip-resistant protective coating system.
  - b. Base Coat - Squeegee and Back Roll
  - c. Top Coat - Dip and Roll Technique

## EXTERIOR FOOT TRAFFIC ONLY

Inspection pit floors, adjacent aprons, walkways, etc.	Base Coat	ArmorClad #735	Approx. 60-70 sq. ft. / gal.
	Broadcast aggregate to point of rejection	Silica #A169	Approx. 2/3 to 3/4 lb. /sq. ft.
	Top Coat	ArmorClad Resurfacer # 736	Approx. 40-45 sq. ft. / gal.

2. Exterior Vehicle Traffic

- a. Three coat, double broadcast, slip-resistant protective coating system.
- b. Base and Second Coats – Squeegee and Back Roll
- c. Third Coat – Dip and Roll Technique

EXTERIOR VEHICLE TRAFFIC ONLY USAGE AREAS OR COMBINATION OF VEHICLE AND FOOT TRAFFIC USAGE			
Trucks, cranes, fork-lifts and other heavy load-carrying vehicles, etc.	Base Coat	ArmorClad #735	Approx. 100 sq. ft. / gal.
	Broadcast aggregate to point of rejection	Silica #A108	Approx. 1/2 to 3/4 lb. / sq. ft.
	Second Coat	ArmorClad #735	Approx. 75-80 sq. ft. / gal.
	Broadcast aggregate to point of rejection	Silica # A169	Approx. 0.7 lb. / sq. ft.
	Third Coat	ArmorClad Resurfacer #736	Approx. 45-50 sq. ft. / gal.

EXTERIOR TRANSVERSIBLE CURBS			
Transversible Curbs	Base Coat	WallGard E #775	Approx. 100 sq. ft. / gal.
	Broadcast aggregate to point of rejection	Silica #A108	Approx. 1/2 to 3/4 lb. / sq. ft.
	Second Coat	WallGard E #775	Approx. 75-80 sq. ft. / gal.
	Broadcast aggregate to point of rejection	Silica # A169	Approx. 0.7 lb. / sq. ft.
	Third Coat	WallGard E #775	Approx. 45-50 sq. ft. / gal.

Notes: Coating should cover entire surface of transversible curb.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Coordinate work of Division 3 to provide water curing only for new slabs to receive floor coating.
- B. Prepare surfaces in accordance with the coating manufacturer's printed instructions. Remove contaminants including dirt, old coatings, loose mortar, rust and other products of corrosion, disintegrated concrete, and other substances that could interfere with adhesion of the coating system to the substrate

#### 3.02 CONCRETE SURFACE PREPARATION

- A. Cure concrete for a minimum of twenty-eight (28) days.

- B. Verify that concrete surfaces have been cleaned and that voids have been patched.
- C. Concrete surfaces shall be cleaned in accordance with ASTM D4258
- D. Mechanically abrade concrete surfaces in accordance with ASTM D4259 as recommended by the coating manufacturer.
- E. Brush-off abraded concrete surfaces in accordance with SSPC-SP-7 to provide profile recommended by the coatings manufacturer.
- F. Test pH of surface to be painted in accordance with ASTM D4262.
- G. If surface pH is not within coating manufacturers required acceptable range, use methods acceptable to coating manufacturer as required to bring pH within acceptable range.
- H. Retest pH until acceptable results are obtained.
- I. Verify that moisture content of surface to be painted is within coating manufacturer's recommended acceptable limits.
- J. Test moisture content of surface to be coated in accordance with ASTM D4263.
- K. After remedial measures have been taken to lower or raise moisture content, retest surface until acceptable results are obtained.

### 3.03 APPLICATION:

- A. By experienced mechanics using methods and spray or roller equipment recommended by coating manufacturer, after surfaces to be treated are dry.
- B. Apply coating in accordance with manufacturer's recommendations. Apply evenly over the surface in 2 coats at minimum film thickness per coat as specified above. Allow the first coat to dry not less than 24 hours prior to application of the second coat.
- C. Keep traffic from treated surfaces until the material is thoroughly cured

### 3.04 FLOOR STRIPING/PHYSICAL HAZARDS

- A. A safety yellow stripe shall be used to mark physical hazards such as striking against, stumbling, falling, tripping and "caught-between". These include building columns in areas of forklift usage, edges of elevated platforms, nosing of stair treads, equipment pits, and projection into a walk/work area or other area where a person needs to be warned of a possible hazard.
- B. In an area with a moving hazard, the entire involved area should be provided with border and diagonal striping. The width of the stripe to be determined by use. Recommended is a minimum 4 IN stripe for most instances with 1 to 2 for stair tread nosing.
- C. Items such as pipe bollards, handrails, building/structural columns shall be painted safety yellow.
- D. For building or structural columns, it is acceptable to paint safety yellow on only the bottom 10 FT of the item.
- E. Walkways shall be painted white with 4 IN border and diagonal stripes.

END OF SECTION





## **SECTION 09 90 00 - PAINTING AND PROTECTIVE COATINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Requirements for surface preparation, coating systems, and methods of application for field painting of buildings and equipment, including structural steel, miscellaneous steel, piping, concrete and all other items requiring a protective or decorative coating.
2. Requirements for the application of protective coatings to equipment which has been previously painted in addition to new work.

##### **B. In addition to painting, all piping shall be identified per Division 23.**

##### **C. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.**

##### **D. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.**

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

##### **E. Floor Striping/Physical Hazards**

1. A safety yellow stripe shall be used to mark physical hazards such as striking against, stumbling, falling, tripping and "caught-between". These include building columns in areas of forklift usage, edges of elevated platforms, nosing of stair treads, equipment pits, and projection into a walk/work area or other area where a person needs to be warned of a possible hazard.
2. In an area with a moving hazard, the entire involved area should be provided with border and diagonal striping. The width of the stripe to be determined by use. Recommended is a minimum 4 inch stripe for most instances with 1 to 2 for stair tread nosing.
3. Items such as pipe bollards and handrails to be painted Safety Yellow.
4. Walkways shall be painted white with 4 inch border and diagonal stripes.

##### **F. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.**

1. Prefinished items include the following factory-finished components:
  - a. Architectural woodwork and casework.
  - b. Metal toilet enclosures.

- c. Metal lockers.
  - d. Finished mechanical and electrical equipment.
  - e. Light fixtures.
  - f. Distribution cabinets.
2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
    - a. Furred areas.
    - b. Ceiling plenums.
    - c. Pipe spaces.
    - d. Duct shafts.
  3. Finished metal surfaces include the following:
    - a. Anodized aluminum.
    - b. Stainless steel.
    - c. Chromium plate.
    - d. Copper.
    - e. Bronze and brass.
  4. Operating parts include moving parts of operating equipment and the following:
    - a. Valve and damper operators.
    - b. Linkages.
    - c. Sensing devices.
    - d. Motor and fan shafts.
- G. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

## 1.02 RELATED REQUIREMENTS (SECTIONS)

- A. UPRR, Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.
- C. Division 8 – shop priming steel doors and frames
- D. Division 9 – surface preparation for gypsum board.
- E. Division 9 – High Performance Coatings where included.

## 1.03 REFERENCED STANDARDS

- A. ASTM International (ASTM):
  1. D16, Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
  2. D2016, Test Method for Moisture Content of Wood.

3. D4258, Standard Practice for Surface Cleaning for Concrete for Coating.
4. D4259, Standard Practice for Abrading Concrete.
5. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
6. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.

B. Steel Structures Painting Council (SSPC):

1. SP 1, Solvent Cleaning: Removes oil, grease, soil, etc. with other methods to remove rust, paint and mill scale.
2. SP 3, Power Tool Cleaning: Removes loose material. Not intended to remove all scale or rust.
3. SP 6, Commercial Blast Cleaning: Two-thirds of each square inch free of all visible residues; remainder only light discoloration.
4. SP 7, Brush-off Blast Cleaning: Removes only loose materials, remaining surface tight and abraded to give anchor pattern.
5. SP 10, Near-White Blast Cleaning: At least 95 percent of each square inch shall be free of all visible residues.
6. SP 11, Power Tool Cleaning to Bare Metal.

#### 1.04 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: For each paint system specified. Include block fillers and primers.

1. Schedule of products to be used for each type of surface which includes surface preparation and application methods.
2. Material List: Provide an inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
3. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use
  - a. If products being used are manufactured by Company other than listed in Article 2.2, provide complete individual cut sheet comparison of proposed products with specified products including application procedure, coverage rates and verification that product is designed for intended use.
4. Contractor's written plan of action for containing airborne particles created by abrasive blasting operations and location of disposal of spent contaminated blasting media.
5. Coating manufacturer's recommendation on abrasive blasting.

C. Certification by manufacturer that products supplied comply with requirements indicated that limit the amount of VOCs in coating products.

D. Samples:

1. Manufacturer's full line of colors for Architect's color selection.
2. After initial color selection by Architect, provide two 8-1/2" x 11" samples of each color selected.

1.05 QUALITY ASSURANCE

- A. Applicator: Company specializing in performing the work of this section with minimum of ten (10) years documented experience.
- B. Source Limitations: Obtain primers and undercoat materials for each coating system from the same manufacturer as the finish coats.
- C. Coating used in all corridors and stairways shall meet requirements of NFPA 101 and ASTM E84.
- D. Deviation from specified mil thickness or product type is not allowed without written authorization of Engineer.
- E. Material may not be thinned unless approved in writing, by paint manufacturer's authorized representative.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
  1. Product name or title of material.
  2. Product description (generic classification or binder type).
  3. Manufacturer's stock number and date of manufacture.
  4. Contents by volume, for pigment and vehicle constituents.
  5. Thinning instructions.
  6. Application instructions.
  7. Color name and number.
  8. VOC content.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue. Protect from freezing.
- C. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.07 PROJECT CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F.
- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F.

- C. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
  - 1. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before proceeding with or continuing coating operation.
  - 2. Work may continue during inclement weather only if areas and surfaces to be coated are enclosed and temperature within the area can be maintained within limits specified by manufacturer during application and drying periods.

#### 1.08 EXTRA MATERIALS

- 1. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with label describing contents. Deliver extra materials to the Owner.
- 2. Quantity: Furnish the Owner with an additional 5 percent, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied. Container shall be clearly marked with color, texture, room or area locations, in addition to the Manufacturer's label

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. The following manufacturers are referred to in the Paint Schedules under Part 3 by use of shortened versions of their names, which are shown in parentheses:
  - 1. Sherwin-Williams Co. (S-W).
  - 2. Porter Paint Company (Porter)
  - 3. Devoe & Raynolds Co. (Devoe).
  - 4. Glidden Co. (Glidden).
  - 5. Benjamin Moore & Co. (Moore).
  - 6. PPG Industries, Inc. (PPG).
  - 7. Pratt & Lambert, Inc. (P & L).
  - 8. Tnemec (Tnemec)
  - 9. DuPont Company, High Performance Coatings (DuPont).
  - 10. ICI Dulux Paints; Devoe Coatings (ICI)..
  - 11. Pittsburgh Paint; PPG Industries, Inc. (PPG).
  - 12. Rust-Oleum Corporation (R-O).

## 2.02 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
- C. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- D. VOC Classification: Provide high-performance coating materials, including primers, undercoats, and finish-coat materials, that have a VOC classification of 450 g/L or less OR as required by state or local regulations or by LEED certification requirements where applicable.
- E. For unspecified materials such as thinner, provide manufacturer's recommended products.
- F. Colors:
  - 1. Refer to drawings and Color Schedule "Option A" for colors.
  - 2. Valves, manhole covers, catch basin covers, etc. painted according to code, UP standard and OSHA.
  - 3. Handrails and bollards painted Safety Yellow.
  - 4. Recovered Oil Tanks and 10K Oil Storage Tank painted SG Black.
  - 5. Other piping and tanks painted SG White, unless other color indicated elsewhere.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
  - 1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
  - 2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
  - 1. If a potential incompatibility of primers applied by others exists, obtain the following from the primer Applicator before proceeding:

- a. Confirmation of primer's suitability for expected service conditions.
- b. Confirmation of primer's ability to be top coated with materials specified.
2. Notify Architect about anticipated problems before using the coatings specified over sub-strates primed by others

### 3.02 PREPARATION, GENERAL

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
  1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
  1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
  1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
  2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
  3. Use only thinners approved by paint manufacturer and only within recommended limits.
- D. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

### 3.03 SURFACE PREPARATION:

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
  1. Provide barrier coats over incompatible primers or remove and re-prime.
  2. Cementitious Substrates: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

- B. Ferrous Metals: Clean un-galvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
1. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
  2. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat
- C. Hollow Metal:
1. Solvent clean in accordance with SSPC SP-1.
- D. Galvanized Metal:
1. Solvent clean in accordance with SSPC SP-1 followed by brush blast in accordance with SSPC SP-7 to provide 1 mil profile.
  2. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- E. Gypsum Wallboard:
1. Repair minor irregularities left by finishers.
  2. Avoid raising nap of paper.
  3. Verify moisture content is less than 8 percent before painting.
- F. Concrete.
1. Cure for minimum of 28 days.
  2. Verify that concrete surfaces have been cleaned and that voids have been patched.
  3. Concrete surfaces shall be cleaned in accordance with ASTM D4258.
  4. Mechanically abrade concrete surfaces in accordance with ASTM D4258 as recommended by coatings manufacturer.
  5. Brush-off blast concrete surfaces in accordance with SSPC SP-7 to provide profile recommended by coatings manufacturer.
  6. Test pH of surface to be painted in accordance with ASTM D4262.
    - a. If surface pH is not within coating manufacturer's required acceptable range, flush with clean water as required to bring pH within acceptable range.
    - b. Retest pH until acceptable results are obtained.
  7. Verify that moisture content of surface to be painted is within coating manufacturer's recommended acceptable limits.
    - a. Test moisture content of surface to be coated in accordance with ASTM D4263.



- b. After remedial measures have been taken to lower or raise moisture content, retest surface until acceptable results are obtained.

G. Concrete Unit Masonry:

1. Allow mortar to cure for minimum of 28 days.
2. Remove all mortar spatter and protrusions.
3. Verify that concrete unit masonry surfaces have been cleaned in accordance with ASTM D4261.
4. Test pH of surface to be painted in accordance with ASTM D4262.
  - a. If surface pH is not within coating manufacturer's required acceptable range, flush surface with clean water as required to bring pH within acceptable limits.
  - b. Retest pH until acceptable results are obtained.
5. Verify that moisture content of surface to be painted is within coating manufacturer's recommended acceptable limits.
  - a. Test moisture content of surface to be coated in accordance with ASTM D4263.
  - b. After remedial measures have been taken to lower or raise moisture content, retest surface until acceptable range is obtained.

3.04 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the schedules.
  2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
  3. Provide finish coats that are compatible with primers used.
  4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convactor covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
  5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  6. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
  7. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
  2. Omit primer on metal surfaces that have been shop primed and touchup painted.
  3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
  4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brush Application: Use brushes best suited for material applied and of appropriate size for the surface or item being coated.
    - a. Apply primers and first coats by brush unless manufacturer's written instructions permit using roller or mechanical applicators.
    - b. Brush out and work brush coats into surfaces in an even film.
    - c. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.
  2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by manufacturer for the material and texture required.
  3. Spray Equipment: Use mechanical methods to apply coating if permitted by manufacturer's written instructions and governing regulations.
    - a. Use spray equipment with orifice size recommended by manufacturer for material and texture required.
    - b. Apply each coat to provide the equivalent hiding of brush-applied coats.
    - c. Do not double back with spray equipment building-up film thickness of two coats in one pass, unless recommended by manufacturer.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturers recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- E. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

- F. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.
- G. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

### 3.05 MECHANICAL AND ELECTRICAL WORK:

- A. Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.
- B. Mechanical items to be painted include, but are not limited to, the following:
  - 1. Piping, pipe hangers, and supports.
  - 2. Tanks
  - 3. Exposed ductwork.
  - 4. Sprinkler Piping
- C. Electrical items to be painted include, but are not limited to, the following:
  - 1. Conduit and fittings.

### 3.06 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
  - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

### 3.07 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
  - 1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA-P1.(Painting & Decorating Contractors of America)

### 3.08 EXTERIOR PAINT SCHEDULE

- A. Concrete Masonry Units
  - 1. Primer - Apply first coat of Porter #9203 QUICK-FILL BLOCK FILLER.

2. Finish Coat - Apply two coats of Porter #739 Acri-Shield Satin Exterior paint at a range of 3.5-4.0 mils WFT to achieve 1.5 mils MDFT per coat.

B. Wood Substrates

1. Prime Coat - Apply one (1) coat Porter #74130 Speedy Prime H.P. Primer.
2. Finish Coat - Apply two (2) coats Porter #739 Acri-Shield Satin at a range of 3.5-4.0 mils WFT to achieve 1.5 mils MDFT per coat.

C. Unpainted Non - Ferrous Metal (galvanized & aluminum)

1. High Abrasion - handrails
  - a. Pretreatment - Clean all non - ferrous metal to be coated as per SSPC-SP 1, Solvent Cleaning, using Porter #5131 (Spraying Thinner) to remove all organic oil contaminants.
2. Galvanized Steel
  - a. Pretreatment - Treat all new galvanized metal with a solution of Porter #5 Galvaprep. Use a stiff nylon brush during application of solution and rinsing stage.
3. Aluminum
  - a. Pretreatment - Treat all aluminum with a solution of Porter #33 Alumiprep. Use a stiff nylon brush during application of solution and rinsing stage.
  - b. Primer - Apply one (1) coat Porter #215 Rust Screen Fast Drying Acrylic Metal Primer at a range of 3.5-4.0 mils WFT to achieve 1.5 mils MDFT per coat.
  - c. Finish Coat - Apply two coats Porter #909 Advantage 900 Interior/Exterior Gloss Acrylic Enamel, superior bonding acrylic; applied at a range of 4.0 - 4.5 mils WFT to achieve 1.5 mils MDFT.

D. Ferrous Metal Substrates

1. High Abrasion - Handrails, Doors, Structural Steel Framing
  - a. The pretreatments and primer for ferrous metal substrates shall be completed in the shop environment. To minimize primer incompatibility and/or the possibility of an inferior "shop primer" being applied, shop applications shall be enforced as well as field applications.
  - b. Shop or Fabricator
    - 1) Cleaning / Degreasing - All surfaces shall be cleaned free of all oil or misc. contaminants via SSPC-SP 1, Solvent Cleaning.
    - 2) Pretreatment - All steel substrates shall be prepared in strict accordance with SSPC-SP10, Near-White Blast Cleaning. Surface profile shall result in a min. of 1.0 mils (25.4 microns) not to exceed 1.5 mils (38.10 microns). All abrasive residual shall be removed from the steel substrate prior to application of coating via solvent wiping unless otherwise specified.

- 3) Primer - Apply one coat International Interlac 298 HS, phenolic modified alkyd primer; at a range of 5.0 - 6.8 mils WFT to achieve 3.0 - 4.0 mils DFT per coat.
- c. Field Application
- 1) Pretreatment (Field Welds) - Welded steel surfaces shall be spot primed in accordance with SSPC-SP 2 or 3, Hand or Power Tool Cleaning, to remove all weld splatter, flux, and smooth sharp edges.
  - 2) Spot Primer - All damaged and/or tooled metal areas shall be spot primed with Porter #296 Glyptex Rust Inhibitive Primer, zinc oxide modified alkyd; at a range of 3.5 - 5.0 mils WFT to achieve 1.8 - 2.6 mils DFT per coat.
  - 3) Finish Coat - Apply two coats Porter #909 Advantage 900 interior/Exterior Gloss Acrylic Enamel, superior bonding acrylic; applied at a range of 4.0 - 4.5 mils WFT to achieve 1.5 mils MDFT per coat.

### 3.09 INTERIOR PAINT SCHEDULE

#### A. Gypsum Wallboard or Plaster

1. Pretreatment - All mudded tape joints and/or rough, patched areas shall be sanded smooth and wiped with a clean tack cloth.
2. Primer - Apply one coat of Porter Paint #767 Painter's Friend Primer Sealer; at a range of 4.0 - 5.0 WFT to achieve a MDFT of 1.1 mils.

#### B. Latex Flat (Ceilings)

1. Finish Coat - Apply one coat of Porter #6019 Interior Flat Paint, vinyl acrylic; applied at 3.2 mils WFT to achieve 1.0 mils MDFT per coat.

#### C. Latex Eggshell (Walls)

1. Finish Coat - Apply two (2) coats Porter #6079 Painters Friend Eggshell, vinyl acrylic; applied at 3.5 mils WFT to achieve 1.4 mils MDFT per coat.

#### D. Concrete Masonry Unit Walls (Latex Eggshell Finish)

1. Pretreatment - all mortar/grout shall cure for a minimum 14 days
2. Pretreatment - Abrade (smooth) all mortar burs and fill large voids with a non-cementitious based patching compound.
3. Primer - Apply one heavy coat Porter #9203 Quick Fil block filler; at a range 80 square feet - 100 square feet per gallon.
4. Finish Coat - Apply two (2) coats Porter #6079 Painters Friend Eggshell, vinyl acrylic; applied at 3.5 mils WFT to achieve 1.4 mils MDFT per coat.

#### E. Pre-primed (metal doors, frames, and misc. metals)

1. Pretreatment - Inspect the surface for damage to the primed surface. Scrapes gauge or misc. damages shall be feather sanded smooth and spot primed with Porter #296 Glyptex Rust Inhibitive Primer.
2. Primer - Apply one coat Porter #215 Rust Screen Fast Drying Acrylic Metal Primer at a range of 3.5 - 4.0 mils WFT to achieve 1.5 mils MDFT per coat.

3. Finish Coat - Apply two (2) coats Porter #909 Advantage 900 Interior/Exterior Gloss Acrylic Enamel, superior bonding acrylic; applied at a range of 4.0 - 4.5 mils WFT to achieve 1.5 mils MDFT per coat.
- F. Unpainted Non-Ferrous Metal (galvanized & aluminum)
1. High Abrasion - Handrails
    - a. Pretreatment - Clean all non-ferrous metal to be coated as per SSPC-SP 1, Solvent Cleaning, using Porter #5131 (Spraying Thinner) to remove all organic oil contaminants.
  2. Galvanized Steel:
    - a. Pretreatment - Treat all new galvanized metal with a solution of Porter #5 Galvaprep. Use a stiff nylon brush during application of solution and rinsing stage.
  3. Aluminum
    - a. Pretreatment - Treat all aluminum with a solution of Porter #33 Alumiprep. Use a stiff nylon brush application of solution and rinsing stage.
    - b. Primer - Apply one coat Porter #215 Rust Screen Fast Drying Acrylic Metal Primer at a range of 3.5 - 4.0 mils WFT to achieve 1.5 mils MDFT per coat.
  4. Finish Coat - Apply two coats Porter #909 Advantage 900 Interior/Exterior Gloss Acrylic Enamel, superior bonding acrylic; applied at a range of 4.0 - 4.5 mils WFT to achieve 1.5 mils MDFT.
  5. Not for coating structural steel, steel joist, galvanized steel, steel (hollow metal) doors, steel (hollow metal) door and window frames, and products with approved factory finishes, and ferrous metals.
  6. May include bare steel handrails, guardrails, piping, stairs, pumps, and similar items.
- G. Structural Steel:
1. Tnemec Series 135 Chembuild VOC=1.90 (Modified Polyamidoamine Epoxy) 1 coat, 4 mils
  2. Tnemec Series 135 Chembuild (Modified Polyamidoamine Epoxy) 1 coat, 4 mils
- H. Tnemec Series 74 Endura-Shield (Aliphatic VOC=2.80 Acrylic Polyurethane Enamel) 1 coat, 2.5 mils
- I. Steel Joists (exposed):
1. Tnemec Series 135 Chembuild VOC=1.90 (Modified Polyamidoamine Epoxy) 1 coat, 4 mils
  2. Tnemec Series 135 Chembuild (Modified Polyamidoamine Epoxy) 1 coat, 4 mils
  3. Tnemec Series 74 Endura-Shield (Aliphatic VOC=2.80 Acrylic Polyurethane Enamel) 1 coat, 4 mils

## END OF SECTION

## **SECTION 09 96 01 – HIGH PERFORMANCE COATINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes:
- B. Requirements for surface preparation, coating systems, and methods of application for field painting of buildings and equipment, including structural steel, miscellaneous steel, piping, concrete and all other items requiring a protective, heavy duty industrial coating.
- C. Requirements for the application of protective coatings to equipment which has been previously painted in addition to new work.
- D. In addition to painting all piping shall be identified per Division 23.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Bidding Requirements, Contract Forms and Conditions of the Contract.
- B. Division 01 – UPRR General Requirements.
- C. Division 03 - Cast-In-Place Concrete
  - 1. Placed concrete should be moisture cured. No curing compounds or similar surface contaminants, which would impede the adhesion of the polymer coating system to the substrate, shall be used for curing the placed concrete.
- D. Division 03 - Cement Finishes and Surface Treatments
- E. Division 09 – Epoxy Floor Coating, for horizontal concrete surfaces
- F. Division 09 - Painting & Protective Coatings, for vertical surfaces, not considered heavy duty industrial use.

#### **1.03 REFERENCED STANDARDS**

- A. ASTM International (ASTM):
  - 1. D16, Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
  - 2. D2016, Test Method for Moisture Content of Wood.
  - 3. D4258, Standard Practice for Surface Cleaning for Concrete for Coating.
  - 4. D4259, Standard Practice for Abrading Concrete.
  - 5. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
  - 6. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
- B. Steel Structures Painting Council (SSPC):

1. SP 1, Solvent Cleaning: Removes oil, grease, soil, etc. with other methods to remove rust, paint and mill scale.
2. SP 3, Power Tool Cleaning: Removes loose material. Not intended to remove all scale or rust.
3. SP 6, Commercial Blast Cleaning: Two-thirds of each square inch free of all visible residues; remainder only light discoloration.
4. SP 7, Brush-off Blast Cleaning: Removes only loose materials, remaining surface tight and abraded to give anchor pattern.
5. SP 10, Near-White Blast Cleaning: At least 95 percent of each square inch shall be free of all visible residues.
6. SP 11, Power Tool Cleaning to Bare Metal.

#### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Submittals required by this section include, but are not limited by, the following:
  1. Schedule of products to be used for each type of surface which includes surface preparation and application methods.
  2. Manufacturer coating system data sheets including color/sheen selection charts.
  3. Holiday test results and measure film thickness for each coating system.
- C. Samples: Submit two (2) samples, 8-1/2 IN by 11 IN in size illustrating selected colors and textures for each color selected.

#### 1.05 QUALITY ASSURANCE

- A. Applicator: Company specializing in performing the work of this section with minimum of three (3) years documented experience.

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide the products in the paint schedules or one of the following of equal quality.
  1. Benjamin Moore.
  2. Sherwin-Williams.
  3. Pratt & Lambert.
  4. ICI Paint Co.
  5. Pittsburgh Paint Co.
  6. Tnemec Company, Inc.



## 2.02 EPOXY COATING:

### A. System E-1:

Manufacturer	Product Designation		
	First Coat	Second Coat	Third Coat
Tnemec	Series N69 Hi-Build Epoxoline II	Series 1074 Endura-Shield II	None
DuPont	25P or 6A25P Epoxy	333 Imron	None
Sherwin-Williams	Macropoxy 646	Acrolon 218 HS	None
Rust-Oleum	9100 Series or 5281 Acrylic Primer	9700 Series or 5200 Series Acrylic	None
Engineer-Approved Equal			

### B. System T-1

Manufacturer	Product Designation		
	First Coat	Second Coat	Third Coat
Tnemec	Series 90-97 Tneme-Zinc	Series N69 Hi-Build Epoxoline II	Series 1074 Endura-Shield II
DuPont	347-Y-912 Zinc	25P Epoxy	333 Imron
Sherwin-Williams	Fast Clad Zinc	Macropoxy 646	Acrolon 218 HS
Rust-Oleum	5687 Grey Zinc	9700 Series or 5200 Series Acrylic	None
Engineer-Approved Equal			

### C. System T-2

Manufacturer	Product Designation		
	First Coat	Second Coat	Third Coat
Tnemec	Series 61-5002 Tneme-Liner	Series 61-5001 Tneme-Liner	None
Ameron	Amercoat 395	Same as First Coat (different color)	None
Sherwin-Williams	Shell-cote II Epoxyamine (5-6 mil DFT)	Same as First Coat (different color)	None
DuPont	Flint-Flex Tank Lining 525-8601	Flint-Flex Tank Lining 525-8603	None
Engineer-Approved Equal			

## 2.03 GENERAL

- A. Materials furnished for each coating system must be compatible to the substrate. When shop-primed surfaces are to be coated, ascertain whether finish materials will be compatible with shop coating. Inform the Engineer of any unsuitable substrate or coating conditions.
- B. System E-1:
  - 1. Used for exterior of above-ground steel piping and equipment (not galvanized), structural and miscellaneous steel including pipe supports and hangers.
  - 2. Surface Preparation and Painting Schedule:
    - a. Surface Preparation: SSPC SP6.
    - b. Surface Paint Adhesion Preparation using Galaxy Associates process, no or equal:
      - 1) Clean surface with GF Prep 626 TP @ 1 percent bv between 110 and 120 degrees.
        - a) Surface is sufficiently cleaned when a blue hue is noticeable on the metal surface and water sheet flows off surface.
        - b) Galaxy Associates to provide information to purchase titration kit to test concentration.
        - c) Contractor to capture all run off from cleaning preparation to dispose of properly.
      - 2) Final rinse with GF Seal Prep 639 @ .5 percent bv between 110 and 120 degrees.
        - a) It is important to keep surface wet with GF Prep 626TP until final rinse.
        - b) Galaxy Associates to provide information to purchase titration kit to test concentration.
        - c) Contractor to capture all run off from cleaning preparation to dispose of properly.
        - d) Refer to section 2.02.B.2.b.e for specifications on the chemical injection system for cleaning and rinsing.
    - c. Painting of metal surface to be done within 1 to 2 days after cleaning and rinsing to ensure proper bonding of paint to metal surface.
    - d. If metal surfaces will not be painted shortly after cleaning and rinsing, metal surfaces to be protected from weather until painted.
    - e. The following, at the end of this Section, is the specifications for the chemical injection system used to tie into the heated pressure washer to clean and rinse the metal surface along with a bill of materials. This chemical injection system is not provided by Galaxy Associates.

f. Galaxy Associates representative:

Bill Townsend  
402-676-0809  
[btownsend@galaxy-associates.com](mailto:btownsend@galaxy-associates.com)

3. First Coat: High solids epoxy primer, min 3-4 mils DFT.
4. Second Coat: High build, high solids polyurethane enamel, min. 4-6 mils DFT.
5. Third Coat: None.
6. System Coat Total: 7-10 mils. DFT
  - a. Piping, equipment and steel located inside buildings (not exposed to sunlight require only the First Coat, min of 4 mils.
7. Check for voids in coating with a holiday detector.

C. System T-1:

1. Used for exterior of above-ground steel storage tanks, including appurtenances, ladders, and railings.
2. Surface Preparation and Painting Schedule:
  - a. Surface Preparation: SSPC SP6.
  - b. First Coat: Zinc rich primer, 3-4 mils DFT.
  - c. Second Coat: High solids polyamide epoxy, min. 3-4 mils DFT.
  - d. Third Coat: High-Build, high-solids polyurethane enamel, min 3-4 mils DFT.
  - e. System Coat Total: 9-12 mils DFT.
3. Steel storage tanks located inside buildings require only Second Coat as recommended by the manufacturer.
4. Union Pacific Shield logos on tanks shall be painted in color using the same product as the Third Coat, with a clear coat to protect from color fading as recommended by the manufacturer. Logo usage and specifications can be obtained on the Union Pacific Railroad website at <http://www.uprr.com/logos>.
5. Check for voids in coating with a holiday detector.

D. System T-2:

1. Used for the interior lining of new above-ground storage tanks, both UL 142 and API 650.
2. Surface Preparation and Painting Schedule:
  - a. Surface Preparation: SSPC SP10.
  - b. First Coat: High-solids epoxy, min 6-8 mils DFT.
  - c. Second Coat: Same as First Coat.
  - d. Third Coat: None.

- e. System Coat Total: 12-16 mils DFT.
- 3. Tank Applications:
  - a. API 650 Tanks:
    - 1) Coat entire interior of above-ground steel storage tanks, including the bottom, full length side walls and all interior roof components.
    - 2) Check for voids in coating with a holiday detector.
  - b. UL 142 Tanks:
    - 1) Coat entire interior of above-ground steel storage tanks including the floor, full length sides and top interior surfaces of the interior shell wall.
    - 2) Check for voids in coating with a holiday detector.
  - c. One coat P&L 38 pale trim varnish-satin.

#### 2.04 EPOXY COATING SYSTEMS:

- A. To be used for coating horizontal and vertical concrete surfaces on new installations when called for on the drawings. This coating system is NOT used on every concrete installation unless called for by the engineer.
- B. General Requirements:
  - 1. All UPRR concrete floor and wall surfaces (whether interior or exterior concrete that is older or newly cast-in-place) to be patched and/or coated receive surface preparation (which may include chemical cleaning to remove surface contaminants) but which should always include mechanical abrasion.
  - 2. If the concrete surface is to be coated has previously been exposed to oil, grease, or other contaminants, a bond test may be necessary to determine its cleanliness and soundness prior to coating (or patching).
  - 3. The epoxy and aggregate used must be protected from adverse weather conditions before and during use on a coating or patching project. All materials must be kept dry and in their closed containers.
  - 4. Refer to Thermal-Chem Concrete Surface Preparation Guidelines for more information.
  - 5. All joints to be epoxy sealed and the inside walls also to be epoxy lined and sealed.
  - 6. Use the two-part epoxy coating for inside walls.

#### 2.05 RECOMMENDED CONCRETE COATING / TEXTURE GUIDELINES:

Orientation of Concrete Surface	Usage or Exposure Conditions	Requires Slip-Resistant Texture	Requires Heavy-Duty Wear-Surface	Subject to Constant Immersion	Examples of Concrete Surface Usage
Horizontal	Foot Traffic Only	<b>YES</b>	<b>NO</b>	<b>NO</b>	Locomotive Inspection Pit Floors Narrow Aprons Adjacent to Pits Foot Traffic Walkways, etc.

Horizontal	Vehicle Traffic or Combination of Vehicle & Foot Traffic	<b>YES</b>	<b>YES</b>	<b>NO</b>	Truck, Crane & Forklift Traffic Areas Wear Surfaces for Other Heavy-Load Carrying Vehicles.
Vertical	Exterior Weathering (e.g., rain, snow, sun, wind, etc.)	<b>NO</b>	<b>NO</b>	<b>NO</b>	Locomotive Inspection Pit Walls Secondary Containment Structure Walls, etc.
Vertical & Overhead	Frequent or Constant Immersion Involving Oily Water	<b>NO</b>	<b>NO</b>	<b>YES</b>	Enclosed Concrete Containment Structures such as Manholes, Lift Stations, Grit Chambers, etc.

A. Non-Traffic Areas

1. Two-coat, non-textured protective coating system.

<b>EXTERIOR WEATHER-EXPOSED CONCRETE SURFACES (NOT SUBJECT TO FREQUENT OR CONSTANT IMMERSION)</b>			
Inspection pit walls, secondary containment walls etc.	Base Coat	WallGard E, #775	Approx. 120 sq. ft. / gal.
	Top Coat	WallGard E, #775	Approx. 120 sq. ft. / gal.

<b>VERTICAL AND OVERHEAD CONCRETE SURFACES IN ENCLOSED CONCRETE CONTAINMENT STRUCTURES</b>			
Manholes, lift stations and grit chambers that collect or hold oily water	Base Coat	WallGard HP #776	Approx. 120 sq. ft. / gal.
	Top Coat	WallGard HP #776	Approx. 120 sq. ft. / gal.

2.06 CONCRETE PAINT COATINGS

- A. To be used for painting concrete surfaces on new or existing installations when called for on drawings. Not all concrete surfaces are to be painted unless called for by the engineer. Surfaces shall be prepared per Section 4.02.
- B. Polyamidoamine Epoxy Primer with Polyamidoamide Epoxy Top Coat.
  1. Prime Coat: 4 mils, Series 113 H.B. Tneme-Tufcoat (Waterborne Acrylic Epoxy), VOC=2.03
  2. Finish Coat(s): 4 mils, Series N69 Epoxoline (Polyamidoamide Epoxy)

PART 3 - EXECUTION

3.01 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptance. Labeling shall include manufacturer's name, type of paint, brand name and code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.
- B. Store paint materials in a well ventilated area, between the temperatures of 45 - 90 Deg. F, unless otherwise required by manufacturer's instructions.
- C. Take precautionary measures to prevent fire hazards and spontaneous combustion.

### 3.02 CONCRETE SURFACE PREPARATION

- A. Cure concrete for a minimum of twenty-eight (28) days.
- B. Verify that concrete surfaces have been cleaned and that voids have been patched.
  - 1. Concrete surfaces shall be cleaned in accordance with ASTM D4258.
- C. Mechanically abrade concrete surfaces in accordance with ASTM D4259 as recommended by the coating manufacturer.
- D. Brush-off blast concrete surfaces in accordance with SSPC-SP-7 to provide profile recommended by the coatings manufacturer.
- E. Test pH of surface to be painted in accordance with ASTM D4262.
  - 1. If surface pH is not within coating manufacturers required acceptable range, use methods acceptable to coating manufacturer as required to bring pH within acceptable range.
  - 2. Retest pH until acceptable results are obtained.
- F. Verify that moisture content of surface to be painted is within coating manufacturer's recommended acceptable limits.
  - 1. Test moisture content of surface to be coated in accordance with ASTM D4263.
  - 2. After remedial measures have been taken to lower or raise moisture content, retest surface until acceptable results are obtained.

### 3.03 SURFACE PREPARATION

- A. Prepare surfaces as specified for each coating system conforming to Steel Structures Painting Council Specifications. If grease or oils are present, SP-1 – Solvent Cleaning must precede any other method specified.
- B. Repainting on pre-painted surfaces:
  - 1. Solvent Cleaning SP 1 for oil or grease.
  - 2. Remove all loose paint and use Power Tool Cleaning – SP 3 to develop profile depth.
  - 3. Prepare only those areas which will receive the first coat of the system on the same day.
- C. Inspection: Verify that substrate conditions are ready to receive coating as instructed by the product manufacturer. Report any conditions that potentially affect proper application. Beginning of Work means acceptance of surface conditions.
- D. Preparation:
  - 1. Remove electrical plates, hardware, light fixture trim, fittings, and correct minor surface defects prior to preparing surfaces or finishing.
  - 2. Shellac and seal marks which may bleed through surface finishes.
  - 3. Impervious Surfaces – Remove mildew by scrubbing with a cleaning solution and rinse with clean water and allow surface to completely dry.
  - 4. .

E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
2. Exterior Wood: 15 percent, measured in accordance with ASTM D2016.

### 3.04 APPLICATION

A. Apply coatings in accordance with manufacturer's recommendations to a dry surface.

B. Provide adequate ventilation equipment in all areas of application to ensure that at no time does the solvent content of air exceed the Threshold Limit Value given on the manufacturer's Material Safety Data Sheets (MSDS) for the specific coatings being applied.

C. Protection:

1. Cover and otherwise protect surfaces not being painted, areas not to be painted, and the work of other trades. Remove protective materials when appropriate. Contractor is responsible for repair and/or repainting all items adversely affected by painting operations (i.e. overspray).
2. Provide signs to indicate fresh paint areas.

D. Use properly designed brushes, rollers, and spray equipment for all applications.

E. Dry film thickness of each system shall meet the minimum specified, but not exceed it more than 20 percent.

F. Environmental Conditions:

1. Atmospheric temperatures must be 50 Deg. F or higher 24 HRS before, during and 24 HRS after application, unless approved by coating manufacturer. Do not apply coatings when inclement weather or freezing temperatures may occur within coating curing time requirements.
2. Minimum application temperature for interior or exterior varnish finishes shall be 65 Deg. F, unless approved by the coating manufacturer.
3. Wind velocities for exterior applications shall be at a minimum to prevent overspray or fallout and not greater than coating manufacturers' limits.
4. Relative humidity must be less than 80 percent and the temperature of the surface to be painted must be at least 5 degrees above the dewpoint.

### 3.05 TESTING AND INSPECTION

A. Use wet and dry film gauges to check each application of coating, and the total system when completed.

B. Contractor shall check coatings on metal systems using a non-destructive electric holiday detector operating at the proper voltage.

### 3.06 CLEANING

A. Provide daily cleanup of both storage and working areas and removal of all paint refuse, trash, cloths, etc.

- B. Touch up and restore damaged finishes to original condition as required.
- C. Remove spilled, dripped, or splattered paint from all surfaces during and after the work.

**END OF SECTION**



## **SECTION 09 97 50 - TANK AND PIPE COATINGS FOR FUEL AND OIL SYSTEMS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Requirements for surface preparation, coating systems, and methods of application for field painting piping, storage tanks, and all other items requiring a protective industrial coating.
2. This section also includes the requirements for the application of protective coatings to equipment which has been previously painted in addition to new work.
3. Applicable services include, but not limited to, diesel fuel, lube oil, journal oil, used oil, and related systems.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 00 – Submittal Procedures
- B. Section 03 05 26 – Mechanical Identification

#### **1.03 REFERENCED STANDARDS**

##### **A. American Society of Testing and Materials (ASTM)**

##### **B. Steel Structures Painting Council (SSPC):**

1. SP 1 - Solvent Cleaning. Removes oil grease, soil, etc., with other methods to remove rust, paint, and mill scale.
2. SP 3 - Power Tool Cleaning. Removes loose material. Not intended to remove all scale or rust.
3. SP 6 - Commercial Blast Cleaning. Two-thirds of each square inch free of all visible residues; remainder only light discoloration.
4. SP 7 – Brush-off Blast Cleaning. Remove only loose materials, remaining surface tight and abraded to give anchor pattern.
5. SP 10 – Near-White Blast Cleaning. At least 95% of each square inch shall be free of all visible residues.
6. SP 11 - Power Tool Cleaning to Bare Metal.
7. SSPC PA-2 – Measurement of Dry Paint Thickness with Magnetic Gauges

##### **C. National Association of Corrosion Engineers (NACE):**

1. NACE RP 0188-90 - Holiday Testing

##### **D. National Fire Protection Association (NFPA):**

##### **E. NFPA 30 – Flammable and Combustible Liquids Code**

#### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Submittals required by this Section include, but are not limited by, the following:
  - 1. Schedule of products to be used for each type of surface which includes surface preparation and application methods.
  - 2. Manufacturer coating system data sheets including color/sheen selection charts.
  - 3. Holiday test results and measured film thickness for each coating system.
  - 4. Certification(s) of experience.
  - 5. Certificate of quality control procedures.
  - 6. Proposed testing agency.
  - 7. One gallon container of each color and surface texture applied.
  - 8. Daily reports of environmental conditions.

#### 1.05 QUALITY ASSURANCE

- A. The coating applicator for field operations or for shop operations shall have a minimum of 5 years of experience in the Systems specified. The coating applicator shall certify in writing that the individual has previous experience applying all of the coating systems in this specification for which they are responsible.
- B. Compliance submittals and certification of experience shall be submitted to the Engineer prior to starting the work.
- C. The coating applicator shall provide a certificate of quality control procedures utilized during application of internal and external coatings. The certification shall include surface preparation, film thickness per coat, curing procedures, and holiday testing.
- D. All coatings shall be applied in strict accordance with the manufacturer's recommendations including environmental conditions, surface preparation, coating method and coverage, etc.
- E. Contractor shall ensure painting sequence does not contaminate or overspray existing and/or newly painted equipment. Contractor shall ensure that all newly painted surfaces remain clean and are not contaminated by subsequent blasting and painting operations. Contractor shall clean and/or recoat surfaces deemed not acceptable due to product contamination at no cost to the Owner.
- F. Contractor shall employ the services of a third party testing agency to perform all dry film thickness testing on all field applied coatings. Contractor shall submit to the Engineer the proposed testing agency for approval.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Paint: All materials shall be the top quality available from each manufacturer.
  - 1. Sherwin Williams

2. ICI Paint Co.
3. Pittsburgh Paint Co.
4. Tnemec Company, Inc
5. Dupont
6. Approved equal.

## 2.02 GENERAL

- A. Materials furnished for each coating system must be compatible to the substrate. When shop- primed surfaces are to be coated, ascertain whether finish materials will be compatible with shop coating. Inform the Engineer of any unsuitable substrate or coating conditions.
- B. Materials furnished shall meet all requirements, including VOC limits, of the jurisdiction in which it is to be applied.
- C. When two or more coats are specified, tint or use an alternate color on subsequent coats to enable visual coverage inspection.
- D. Provide a one gallon container of each color and surface texture to Railroad. Container shall be clearly marked with color, texture, room or area locations, in addition to the Manufacturer's label.
- E. Accessory Materials: Provide linseed oil, shellac, turpentine, paint thinners, latex fillers and other materials not specifically indicated but required to achieve the quality finishes specified.

## 2.03 COATING SYSTEMS:

- A. Provide paint or coating system as indicated on the drawings and as specified below.
- B. System E-1:
  1. Exterior of aboveground steel piping, including pipe supports and hangers.
  2. Surface Preparation: SSPC SP6
  3. First coat: High solids epoxy primer, 3 – 5 mils DFT.
  4. Second Coat: High build, high solids polyurethane enamel, 4 – 5 mils DFT.
  5. Third Coat: none.
  6. System Total: 7 – 10 mils DFT
  7. Piping, equipment, and steel located inside buildings (not exposed to sunlight) require only First Coat, min. 4 mils DFT.

<b>System E-1</b>	<b>Product Designation</b>		
<b>Manufacturer</b>	First Coat	Second Coat	Third Coat
Tnemec	Series 66 or 161 High-Build Epoxoline	Series 74 Endura-Shield	-
DuPont	25P or 6AL25P Epoxy	333 Imron	-
Sherwin Williams	MACROPOXY 646 Fast Cure Epoxy	ACROLON ULTRA HP POLYURETHANE	-

C. System E-2:

1. Exterior of buried steel piping and exterior of carrier pipe in double wall systems.
2. Surface Preparation: SSPC SP6
3. First Coat: Shop applied fusion bonded epoxy powder, 15-20 mils DFT. Wipe back the coating 2" from the end of the piping.
4. Second Coat: none.
5. Third Coat: none.
6. System Total: Minimum 15-20 mils DFT.
7. Buried piping is to be pressure tested prior to joint coatings being applied.

<b>System E-2</b>	<b>Product Designation</b>		
<b>Manufacturer</b>	First Coat	Touch Up	Fittings and Field Repairs
3M	Skotch-Kote 6233	Skotch-Kote 226P Hot Melt Patch Kit	-
Special Polymer Coatings	-	-	SP-6888

D. System T-1:

1. Exterior of aboveground steel storage tanks, including appurtenances, ladders, and railing.
2. Surface Preparation: SSPC SP6
3. First Coat: Zinc primer, 3 – 4 mils DFT.
4. Second Coat: High solids polyamide epoxy, 3 – 4 mils DFT.
5. Third Coat: High build, high solids polyurethane enamel, 3 – 4 mils DFT.
6. System Total: 9 – 12 mils DFT
7. Steel storage tanks located inside buildings require only Second Coat as recommended by manufacturer.

<b>System T-1</b>	<b>Product Designation</b>		
<b>Manufacturer</b>	First Coat	Second Coat	Third Coat
Tnemec	Series 90-97 Tneme-Zinc	Series 66 or 161 High-Build Epoxoline	Series 74 Endura-Shield (gloss)
DuPont	347-Y-912 Zinc	25P Epoxy	333 Imron
Sherwin Williams	Zinc Clad VI (water-based)	B73-100 Series Waterbased Tile Clad (water-based)	Centurion B65-700 Series (water-based)

E. System T-2:

1. Interior of aboveground steel storage tanks, including the entire floor and three (3) feet up the sides of the interior shell wall.
2. Surface Preparation: SSPC SP10.
3. First Coat: High solids epoxy, min. 6 mils DFT.
4. Second Coat: same as first coat.
5. Third Coat: none.
6. System Total: 12 – 16 mils DFT

<b>System T-2</b>	<b>Product Designation</b>		
<b>Manufacturer</b>	First Coat	Second Coat	Third Coat
Tnemec	Series 61-5002 Tneme-Liner	Series 61-5001 Tneme-Liner	-
Ameron	Amercoat 395	Same as First (different color)	-
Sherwin Williams	Shelcote II Epoxy amine (5-6 mil DFT)	Same as First (different color)	-
DuPont	Flint-flex tank lining 525-8601	Flint-flex tank lining 525-8603	

F. Colors: See section 33 05 26 for system colors.

### PART 3 - EXECUTION

#### 3.01 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptance. Labeling shall include manufacturer's name, type of paint, brand name and code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.
- B. Store paint materials in a well ventilated between the temperatures of 45-90 degrees F, unless otherwise required by manufacturer's instructions.
- C. Take precautionary measures to prevent fire hazards and spontaneous combustion.

### 3.02 SURFACE PREPARATION

- A. Prepare surfaces as specified for each coating system conforming to Steel Structures Painting Council Specifications. If grease or oils are present, SP 1 - Solvent Cleaning must precede any other method specified.
- B. Repainting on pre-painted surfaces:
- C. Solvent Cleaning SP 1 for any oil or grease.
- D. Remove all loose paint and use Power Tool Cleaning - SP 3 to develop profile depth.
- E. Prepare only those areas which will receive the first coat of the system on the same day.
- F. Inspection: Verify that substrate conditions are ready to receive coating as instructed by the product manufacturer. Report any conditions that potentially affect proper application. Beginning of Work means acceptance of surface conditions.
- G. Preparation:
- H. Remove electrical plates, hardware, light fixture trim, fittings and correct minor surface defects prior to preparing surfaces or finishing.
- I. Shellac and seal marks which may bleed through surface finishes.
- J. Impervious Surfaces: Remove mildew by scrubbing with a cleaning solution and rinse with clean water and allow surface to completely dry.
- K. Spot prime defects after repair.

### 3.03 APPLICATION

- A. Apply coatings in accordance with manufacturer's recommendations to a dry surface.
- B. Provide adequate ventilation equipment in all areas of application to ensure that at no time does the solvent content of air exceed the Threshold Limit Value given on the manufacturer's Safety Data Sheets (SDS) for the specific coatings being applied.

### 3.04 PROTECTION

- A. Cover or otherwise protect surfaces not being painted, areas not to be painted, and the work of other trades. Remove protective materials when appropriate. Contractor is responsible for repair and/or repainting all items adversely affected by painting operations (ie. overspray).
- B. Provide signs to indicate fresh paint areas.
- C. Use properly designed brushes, rollers and spray equipment for all applications.
- D. Dry film thickness of each system shall meet the minimum specified, but not exceed it more than 20 percent.
- E. Environmental Conditions:
  - 1. Atmospheric temperatures must be 50 degrees F or higher 24 hours before, during, and 24 hours after application, unless approved by coating manufacturer. Do not apply coatings when inclement weather or freezing temperatures may occur within coating curing time requirements.

2. Minimum application temperature for interior or exterior varnish finishes shall be 65 degrees F, unless approved by coating manufacturer.
  3. Wind velocities for exterior applications shall be at a minimum to prevent overspray or fallout and not greater than coating manufacturer's limits.
  4. Relative humidity must be less than 80 percent and the temperature of the surface to be painted must be at least 5 degrees above the dew point.
- F. Buried piping is to be pressure tested prior to joint coatings being applied.
- G. Repair all damage to coating systems before holiday testing.
- H. Remove all protective materials when appropriate and before materials such as masking tape becomes difficult to remove. Contractor shall protect the public and the work against disfigurement by paint materials and damage caused by surface preparation. The contractor shall be responsible for damage caused by the contractor's operations to vehicles, persons or property, including plants and animals, and shall provide protective measures to prevent such damages. Paint stains that result in an unsightly appearance shall be removed or obliterated by the contractor. All damage to surfaces resulting from the work shall be cleaned, repaired, and refinished to original condition.
- I. Provide signs to indicate fresh paint areas.
- J. Mask, remove, or otherwise protect finish hardware, control tubing, pressure gauges, control devices, and equipment nameplates as necessary. Provide cover to prevent paints from entering orifices in electrical or mechanical equipment.
- K. Provide daily cleanup of both storage and working areas and removal of all paint refuse, trash, rags, thinners, etc. Dispose of leftover containers, thinners, rags, brushes, rollers, etc. in accordance with applicable regulations.

### 3.05 FIELD QUALITY CONTROL

- A. Field Tests:
1. Use wet film gauges to check each application about every 15 minutes in order to correct low or heavy film build immediately.
  2. Use dry film gauge to check each coat when dry, and the total system when completed per SSPC PA 2.
  3. Use holiday or pinhole detector per NACE to detect and correct voids.
- B. Provide daily reports of environmental conditions including ambient temperature, substrate temperature, relative humidity, and wind speed and direction.

### 3.06 CLEANING

- A. Provide daily cleanup of both storage and working areas and removal of all paint refuse, trash, cloths, etc.
- B. Touch up and restore damaged finishes to original condition as required.
- C. Remove spilled, dripped or splattered paint from all surfaces during and after the Work.

\*\* END OF SECTION \*\*

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## **SECTION 10 11 16 - VISUAL DISPLAY BOARDS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Visual display conference units.
2. Visual display bulletin boards

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.

#### **1.03 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For each type of visual display surface indicated and as follows:
  1. Samples of accessories involving color selection.
- D. Maintenance Data: For visual display surfaces to include in maintenance manuals.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: An authorized representative of visual display unit manufacturer for installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain each type of visual display surface through one source from a single manufacturer.
- C. Product Options: Drawings indicate size, profiles, and dimensional requirements of visual display surfaces and are based on the specific system indicated.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver factory-built visual display boards completely assembled in one piece without joints.
- B. Store visual display units vertically with packing materials between each unit.

#### **1.06 WARRANTY**

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:

- a. Surfaces lose original writing and erasing qualities.
  - b. Surfaces become slick or shiny.
  - c. Surfaces exhibit crazing, cracking, or flaking.
- 2. Warranty Period: Life of the building.
- B. Submit a standard warranty for Bulletin Boards, stating that when installed in accordance with manufacturer's instructions, Bulletin Boards are guaranteed for one year against defects in materials and workmanship.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
  - 1. Basis-of-Design Product: The design for each visual display surface is based on the product specified. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

### 2.02 VISUAL DISPLAY CONFERENCE UNITS

- A. Basis-of-Design Product: Claridge Products & Equipment, Series 1, 120 IN by 48 IN wall- mount, natural aluminum finish, white Porcelain enamel steel LCS markerboard, with marker tray and top tack strip, 12 assorted markers, eraser, and display rail. Comparable products of one of the following manufacturers may be provided:
- B. Manufacturers:
  - 1. ADP/Lemco, Inc.
  - 2. Claridge Products & Equipment, Inc.
  - 3. Egan Visual Inc.
  - 4. PolyVision Corporation.

### 2.03 VISUAL DISPLAY BOARD (BULLETIN BOARD)

- 1. Basis-of-Design Product: Claridge Products & Equipment, Series 1, Type CO, size as indicated on the drawings, wall-mount, natural aluminum finish screw-on frame, mounted Claridge cork tackboard surface

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance.

3.02 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY UNITS

- A. Visual Display Conference Units: Install units in locations and at mounting heights indicated on Drawings, or if not indicated, at height indicated below. Attach to wall surface as recommended by manufacturer.

- 1. Mounting Height: 36 IN above finished floor to bottom of cabinet.

3.03 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

**END OF SECTION**

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## **SECTION 10 14 00 - SIGNAGE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Room Identification signs
2. Interior Toilet signs
3. Interior Changeable Building Directory
4. Interior Changeable Room Identification signs
5. Interior HVAC Instruction sign
6. Exterior UPRR Logo Building sign
7. Exterior Post and Panel Sign
8. Exterior Property Monument Sign

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.

#### **1.03 SUBMITTALS**

- A. Submit in accordance with the requirements of Division 1.
- B. Product Data: Submit product data for specified products. Include material details for each sign specified.
  1. Provide complete instructions and templates for printing and producing additional message strips.
- C. Shop Drawings: The Contractor is to submit shop drawings showing layout, profiles, and product components, including dimensions, anchorage, and accessories.
- D. Samples: The Contractor is to submit the suppliers standard color chart for selection purposes and selected colors for verification purposes.
- E. Installation: The Contractor is to submit the supplier's installation instructions.
- F. Closeout Submittals:
  1. The Contractor is to submit operation and maintenance data for the installed products, including precautions against harmful cleaning materials and methods.
  2. The Contractor is to submit warranty documents specified herein.

#### **1.04 QUALITY ASSURANCE**

- A. Supplier: Obtain all products in this Section from a single supplier.

- B. Regulatory Requirements: Products shall meet the requirements of the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and Local amendments and modifications.
- C. Installer: Installation shall be performed by an installer specialized and experienced in work similar to that required for this project.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. The Contractor is to comply with the requirements of Division 01.
  - 1. Comply with the manufacturer's ordering instructions and lead time requirements to avoid delays.
  - 2. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
  - 3. Store products protected from weather, temperature, and other harmful conditions as recommended by the supplier.
  - 4. Handle products in accordance with the manufacturer's instructions.

#### 1.06 WARRANTY

- A. Project Warranty: Comply with the requirements of Division 01.
- B. Manufacturer's Warranty: Submit the Manufacturer's standard warranty document executed by an authorized company official.
  - 1. Warranty Period: One year from the product ship date.

#### 1.07 MAINTENANCE MATERIAL SUBMITTALS

- A. Changeable sign inserts: Provide full-size, blank strips equal to 10 percent of amount installed for each size indicated, but no fewer than 5 strips.
- B. Provide complete instructions and templates for printing and producing additional message strips in the Operations and Maintenance Manual at Closeout.

### PART 2 - PRODUCTS

#### 2.01 SIGNAGE SYSTEMS

- A. Acceptable Manufacturers:
  - 1. ASI Sign Systems, 6958 North 97th Circle, Omaha, NE. 68122, 402-572-5055, email: [ASIOmaha@aol.com](mailto:ASIOmaha@aol.com).

#### 2.02 ROOM IDENTIFICATION SIGNS – SIGN TYPE 1

- A. ASI Series Framed Intouch Series, ADA Sign
  - 1. Frame: 4-3/8"x 9-3/8" molded plastic frame, 7/16" radius corners, SC-905
  - 2. Color: Black
  - 3. Face: 4-3/32" x 9-3/32"± Intouch photopolymer ADA face, 5/16"radius,
  - 4. Text: 5/8"ADA Compliant Copy, Tactile, SC-905 Black

- a. 24pt. Grade II Braille, 3/8" below copy

## 2.03 INTERIOR TOILET SIGNS – SIGN TYPE 2

### A. ASI Framed InTouch Series, ADA Sign

- 1. Overall Size: 9-3/8"x 9-3/8"
- 2. Face: 9-3/32"x 9-3/32"± Intouch photopolymer ADA face, 5/16"radius,
- 3. Symbols: 4“(h) tactile symbols, raised, SC-905 Black, L=R together
- 4. Text: 5/8" ADA Compliant tactile copy, UC, +85 tracking, SC-905
  - a. Black, T=B
  - b. 24pt. Grade II Braille, 3/8" below copy

## 2.04 INTERIOR CHANGEABLE BUILDING DIRECTORY – SIGN TYPE 3

### A. ASI Series Custom SOG Window Sign Directory

- 1. Size: per drawings
- 2. Backer: Clear Acrylic Window Backer, 1/4" radius corners, painted SC-902 Light Gray, 1st surface
- 3. Face: Matte Acrylic Window Face, 1/4" outside radius corners, 4" Top border and (2) 1"bottom borders, painted 2nd surface, SC-902 Light Gray
- 4. Header: 2" logo, c/c with 3/4" Futura Bold Condensed text, UC, 3/8" interline, FL, Print on Panel (POP), PMS 186 Red, PMS 280 Blue, White and Black, 1st surface
- 5. Borders: 3/8" window borders, cut & painted 2nd surface, SC-905 Black. Window sizes based on overall directory size.
- 6. Provide complete instructions and templates for printing and producing additional message strips. See Submittals.

## 2.05 INTERIOR CHANGEABLE ROOM IDENTIFICATION SIGNS – SIGN TYPE 4

### A. ASI Series Framed Name Plate

- 1. 2" x 9-3/9" molded plastic frame, black to accept clear lens and white paper insert

## 2.06 HVAC INSTRUCTION SIGN – SIGN TYPE 5

### A. ASI Series Intouch Series

- 1. Color: White
- 2. Face: 3" x 6"± Intouch photopolymer, 5/16"radius,
- 3. Text: 5/8"ADA Compliant Copy, Tactile, SC-905 Black

## 2.07 EXTERIOR POST & PANEL SIGN – SIGN TYPE 6

### A. ASI Series Legacy L200 – 1a Double post & panel

### B. 4'2 x 4'2 overall size with 3-1/4" aluminum extruded 5052 round posts

- C. 25" x 4'2" x 3" deep panel from HRP 1100 aluminum extruded body with 0.090" thick aluminum sheeting painted SC-806 Light Beige and 3M black vinyl copy
  - D. Custom break formed aluminum top illuminated Light cap hood, 8" x 4'2", with LED lighting
    - 1. \*illuminated or non-illuminated option
- 2.08 EXTERIOR PROPERTY MONUMENT SIGN – SIGN TYPE 7
- A. ASI Series Legacy L200 Monument Sign – E20.1, double sided with radius corners
  - B. 6'6" x 14'0" x 1'5" deep 2" square 5052 extruded aluminum framework with 0.125" thick aluminum sheeting
  - C. Logo & Copy to be CNC routed backed with 7328 White 3/16" acrylic, copy to have 3M dual film black overlay
  - D. Logo: translucent digital print (to match logo colors)
  - E. LED illumination
- 2.09 EXTERIOR UPRR LOGO BUILDING SIGN: – SIGN TYPE 8
- A. ASI Series LF Fabricated Non-illuminated logo
  - B. 2" deep 0.090" thick aluminum faces with 0.063" thick aluminum returns
    - 1. Overall sign size per Building Elevations
  - C. Logo graphic with frisket paint with 2 part polyurethane paint
  - D. Thread stud mechanical mount

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Site Verification of Conditions: Verify installation conditions previously established under other sections are acceptable for product installation in accordance with the Manufacturer's instructions.
- B. Scheduling of installation by the Owner or their representative implies that substrate and conditions are prepared and ready for production installation. Proceeding with installation implies installer's acceptance of substrate and conditions.

#### 3.02 INSTALLATION

- A. Install product in accordance with the supplier's instructions.
- B. Install product in locations indicated using mounting methods recommended by the sign manufacturer and free from distortion, warp, or defect adversely affecting appearance.
- C. Install product level, plumb, and at heights indicated.
- D. Install product at heights to conform to Americans with Disabilities Act Accessibility Guidelines (ADAAG) and applicable local amendments and regulations.



- E. Install signs within the following tolerances and in accordance with manufacturer's recommendation:
1. Interior Signs: Within 1/4 IN vertically and horizontally of indicated location.
  2. Interior Signs: Install signs on walls adjacent to the latch side of doors using foam tape
  3. Exterior Signs: Install signs on walls adjacent to the latch side of doors with stainless steel screws painted to match sign color.(minimum of two)
  4. Where no adjacent wall space is available, mount signs on nearest adjacent wall.
  5. Mounting of signage shall be such that a person may approach to within 3 inches of sign without encountering any protruding objects or standing in swing of door travel.
  6. Mount 60 inches above finish floor to centerline of sign.

### 3.03 CLEANING, PROTECTION, AND REPAIR

- A. Repair scratches and other damage which might have occurred during installation. Replace components where repairs were made but are still visible to the unaided eye from a distance of 5 FT.
- B. Remove temporary coverings and protection to adjacent work areas. Clean installed products in accordance with manufacturer's instructions prior to the Owners acceptance. Remove construction debris from project in accordance with provisions in Division 01.

### 3.04 SIGN SCHEDULE

- A. Schedule: Refer to Drawings for sizes, locations, and layout of signage types, sign text copy, and graphics.

**END OF SECTION**

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## **SECTION 10 14 36 - IDENTIFYING DEVICES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Signs, including their construction, sizing, lettering, etc.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.
- C. Division 06 - Rough Carpentry.

#### **1.03 SUBMITTALS**

- A. Submit shop drawings under provisions of Section 01 33 00.
- B. Submit shop drawings showing sign layout, lettering, locations, constructions details, and overall dimensions of each sign or graphic.
- C. Submit samples under provisions of Section 01 33 00.

#### **1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store and protect products under provisions of Division 01.

#### **1.05 ENVIRONMENTAL REQUIREMENTS**

- A. Do not install signs when ambient temperature is below 70 DegF. Maintain this minimum during and after installation of signs.

### **PART 2 - PRODUCTS**

#### **2.01 SIGNS**

- A. Interior signs and associated accessories provided by Architect.
- B. Provide Americans With Disabilities Act (ADA) compliant with minimum 5/8 IN cap height tactile text, raised a minimum of 1/32 IN – Full Caps, Grade 2 Braille – and contrasting background uniformly sized be of SPE unframed acrylic: Plaque face only – on backplate by ASI Sign Systems, Inc., colors as selected by The Architect. Signs shall be for exterior or interior use.
- C. Signs shall be as follows (“/” indicates separate sign of each side of door):
- D. Oxy-Acetylene System Signage:
  1. Signage shall meet the requirements of NFPA 51.

2. Oxygen manifold:
  - a. The following sign shall be conspicuously posted at each manifold:

LOW-PRESSURE MANIFOLD  
DO NOT CONNECT  
HIGH-PRESSURE CYLINDERS  
MAXIMUM PRESSURE — 350 PSIG

- b. Gages on oxygen regulators shall be marked "USE NO OIL."
  3. Station outlets shall be clearly marked to indicate the name of the gas in the connected pipe.
  4. Signs clearly establishing the location and identity of section shutoff valves shall be provided.
  5. Piping shall be painted and labeled in accordance with Section 23 05 53.

## 2.02 ACCESSORIES

- A. Provide all mounting hardware as required or as indicated on the Drawings.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Beginning of installation means installer accepts existing surfaces.

### 3.02 INSTALLATION

- A. Install all signage in accordance with manufacturer's instructions and the drawings. Verify all locations with the Architect.
- B. Install signs after surfaces are finished, in locations indicated and as directed.
- C. Level all signage.
- D. Clean and Polish.

**END OF SECTION**

## **SECTION 10 21 13 - TOILET COMPARTMENTS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Toilet compartments and screens and as follows:
  - a. Type: Metal, baked enamel finish.
  - b. Compartment Style: Ceiling hung.
  - c. Screen Style: Wall hung.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.
- B. Section 05 12 00 - "Metal Fabrications" for supports that supports that attach units to overhead structural system.
- C. Section 10 28 14 - "Toilet and Bath Accessories" for toilet paper holders, grab bars, purse shelves, and similar accessories.

#### **1.03 SUBMITTALS**

- A. Product Data: For each type and style of toilet compartment and screen specified. Include details of construction relative to materials, fabrication, and installation. Include details of anchors, hardware and fastenings.
- B. Shop Drawings: For fabrication and installation of toilet compartment and screen assemblies. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: Manufacturer's color charts consisting of sections of actual units showing the full range of colors, textures, and patterns available for each type of compartment or screen indicated.
- D. Samples for Verification: Of each compartment or screen color and finish required, prepared on 6 IN (150-mm) square samples of same thickness and material indicated for work.

#### 1.04 PROJECT CONDITIONS

- A. Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements of Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
  - 1. Established Dimensions: Where field measurements cannot be made without delaying the work, establish dimensions and proceed with fabricating units without field measurements. Coordinate supports, adjacent construction, and fixture locations to ensure actual dimensions correspond to established dimensions.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following.
  - 1. Accurate Partitions Corporation.
  - 2. All American Metal Corporation.
  - 3. American Sanitary Partition Corporation.
  - 4. Ampco Products Inc.
  - 5. Flush-Metal Partition Corporation.
  - 6. General Partitions Manufacturing Corporation.
  - 7. Global Steel Products Corporation.
  - 8. Knickerbocker Partition Corporation.
  - 9. Lambaton/Universal Metal Products.
  - 10. Metpar Steel Products Corporation.
  - 11. The Mills Company.
  - 12. Monarch Toilet Partitions.
  - 13. Sanymetal Products Company.
  - 14. Weis/Robert Partitions, Inc.

#### 2.02 MATERIALS

- A. General: Provide materials that have been selected for surface flatness and smoothness. Exposed surfaces that exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or imperfections on finished units are unacceptable.

- B. Steel Sheets for Color-Coated Finish: Provide mill-phosphatized steel sheet that is leveled to stretcher-leveled flatness complying with the requirements of standards indicated below:
1. Electrolytically Zinc-Coated Steel Sheet: ASTM A591 (ASTM A591M), Class C of the following minimum thicknesses:
    - a. Pilasters (Overhead Braced): 0.0359 IN (0.9 mm).
    - b. Pilasters (Unbraced): 0.0478 IN (1.2 mm).
    - c. Panels and Screens: 0.0359 IN (0.9 mm).
    - d. Panels and Screens: 0.0299 IN (0.75 mm).
    - e. Doors: 0.0299 IN (0.75mm).
    - f. Tapping Reinforcement: 0.0747 IN (1.9 mm).
- C. Core Material for Metal-Faced Units: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 IN (25 mm) minimum for doors, panels, and screens and 1-1/4 IN (32 mm) minimum for pilasters.
- D. Pilaster Shoes and Sleeves (Caps): ASTM A666. Type 302 or 304 stainless steel, not less than 0.0312 IN (0.8 mm) thick and 3 IN (75 mm) high, finished to match hardware.
1. For solid-plastic, polymer-resin pilasters, in lieu of stainless-steel pilaster shoes and sleeves, manufacturer's standard plastic pilaster shoes and sleeves may be provided.
- E. Stirrup Brackets: Manufacturer's standard ear or U-brackets for attaching panels and screens to walls and pilasters of the following material:
1. Material: Chrome-plated, non-ferrous, cast zinc alloy (zamac) or clear-anodized aluminum.
- F. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories of the following material:
1. Material: Chrome-plated, non-ferrous, cast zinc alloy (zamac) or clear-anodized aluminum.
- G. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum strip in manufacturer's standard finish.
- H. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum strip in manufacturer's standard finish.
- I. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware with theft-resistant-type heads. Provide hex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

## 2.03 FABRICATION

- A. General: Provide standard doors, panels, screens, and pilasters fabricated for compartment system. Provide units with cutouts and drilled holes to receive compartment-mounted hardware, accessories and grab bars as indicated. Provide internal reinforcement in metal units for compartment-mounted hardware, accessories and grab bars as indicated.
- B. Metal-Faced Toilet Compartments and Screens: Pressure laminate seamless face sheets to core material and provide continuous, interlocking molding strip or lapped and formed edges. Seal corners by welding or clips. Grind exposed welds smooth.
- C. Ceiling-Hung Compartments: Provide manufacturer's standard corrosion-resistant anchoring assemblies complete with threaded rods, lock washers, and leveling adjustment nuts at pilasters from structure without transmittal load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage. Provide manufacturer's standard 4 IN (100 mm) high, overhead cross bracing.
- D. Wall-Hung Screens:
  - 1. Provide units in sizes indicated of same construction and finish as compartment panels, unless otherwise indicated.
  - 2. Provide metal-faced screens with integral full-height flanges for attachment to wall.
  - 3. Provide V-shaped, metal faced, screens with manufacturer's standard sound-deadening core material bonded to inner surface of face sheets. Provide metal top and bottom caps. Fabricate screens to form unit that is a maximum of 6 IN (150 mm) wide at wall and 1 IN (25 mm) wide at its protruding end. Provide complete with concealed anchoring devices for attachment to wall and mechanical leveling adjustment.
- E. Doors: Unless otherwise indicated, provide 24 IN (610 mm) wide in-swinging doors for standard toilet compartments and 36 IN (914 mm) wide out-swinging doors with a minimum 32 IN (813 mm) wide clear opening for compartments indicated to be handicapped accessible.
  - 1. Hinges - Manufacturer's standard self-closing type that can be adjusted to hold door open at any angle up to 90 degrees.
  - 2. Latch and Keeper - Manufacturer's standard surface-mounted latch unit with combination rubber-faced door strike and keeper designed for emergency access. Provide units that comply with accessibility requirements of authorities having jurisdiction at compartments indicated to be handicapped accessible.
  - 3. Coat Hook - Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent door from hitting compartment-mounted accessories.
  - 4. Door Bumper - Manufacturer's standard rubber-tipped bumpers at out-swinging doors or entrance screen doors.
  - 5. Door Pull - Manufacturer's standard unit that complies with accessibility requirements of authorities having jurisdiction at out-swinging doors. Provide units on both sides at doors at compartments indicated to be handicapped accessible.



## PART 3 - INSTALLATION

### 3.01 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions.
  - 1. Install units rigid, straight, plumb and level.
  - 2. Provide clearances of not more than 1/2 IN (13 mm) between pilasters and panels and not more than 1 IN (25 mm) between panels and walls.
  - 3. Secure units in position with manufacturer's recommended anchoring devices. Secure panels to walls and panels with not less than 2 stirrup brackets attached near top and bottom of panel.
  - 4. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
  - 5. Align brackets at pilasters with brackets at walls.
- B. Ceiling Hung Compartments: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.
- C. Screens: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure. Set units level and plumb and to resist lateral impact.

### 3.02 ADJUSTING AND CLEANING

- A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and swing doors in entrance screens to return fully closed position.
- B. Provide final protection and maintain conditions that ensure toilet compartments and screens are without damage or deterioration at the time of Substantial Completion.

**END OF SECTION**

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## **SECTION 10 21 14 – STAINLESS STEEL TOILET COMPARTMENTS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section includes stainless-steel toilet compartments configured as toilet enclosures and urinal screens.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- C. Division 01 - UPRR General Requirements.
- D. Division 10 - Toilet and Bath Accessories.

#### **1.03 REFERENCED STANDARDS**

- A. ASTM International (ASTM):
  - 1. A385, Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
  - 2. A480, General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
  - 3. A568, Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low Alloy, Hot Rolled and Cold Rolled.
  - 4. D2092, Standard Guide for Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting.

#### **1.04 SUBMITTALS**

- A. Product Data: For each type and style of toilet compartment and screen specified. Include details of construction relative to materials, fabrication, and installation. Include details of anchors, hardware and fasteners. Include the following:
  - 1. Acknowledgement that products submitted meet requirements of standards referenced.
  - 2. Manufacturer's installation instructions.
  - 3. Manufacturer's anchorage device and structural backing recommendations.
- B. Shop Drawings: For fabrication and installation of toilet compartment and screen assemblies. Include the following:
  - 1. Scaled drawings of all areas complete with plans, elevations, sections, details, and attachments.
- C. Samples for verification: Of finish required, prepared on 6 IN square samples of the same thickness and material as specified.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Toilet partitions:
    - a. Accurate Partitions Corp.
    - b. American Sanitary Partition Corp.
    - c. Ampco Products Inc.
    - d. General Steel Products Corporation.
    - e. Global Steel Products Co.
    - f. Knickerbocker Partition Corporation.
    - g. Sanymetal Products Co.

### 2.02 PERFORMANCE REQUIREMENT

- 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 for toilet compartments designated as accessible.

### 2.03 STAINLESS-STEEL TOILET COMPARTMENTS

- A. Toilet-enclosure style: floor and ceiling anchored.
- B. Urinal-screen style: wall hung with integral flanges.
- C. Door, panel, and pilaster construction: seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
  - 1. Core material: manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch (25 mm) for doors and panels and 1-1/4 inches (32 mm) for pilasters.
  - 2. Grab-bar reinforcement: provide concealed internal reinforcement for grab bars mounted on units of size and material adequate for panel to withstand applied downward load on grab bar of at least 250 lbf (1112 N), when tested according to ASTM F 446, without deformation of panel.
  - 3. Tapping reinforcement: provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.
- D. Urinal-screen construction:
  - 1. Flat-panel urinal screen: matching panel construction.

2. Integral-flange, wall-hung urinal screen: similar to panel construction, with integral full-height flanges for wall attachment, and maximum 1-1/4 inches (32 mm) thick.
- E. Facing sheets and closures: stainless-steel sheet of nominal thicknesses as follows:
  1. Pilasters, braced at both ends: manufacturer's standard thickness, but not less than 0.038 inch (0.95 mm).
  2. Panels: manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm).
  3. Doors: manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm).
  4. Flat-panel urinal screens: thickness matching the panels.
  5. Integral-flange, wall-hung urinal screens: manufacturer's standard thickness, but not less than 0.031 inch (0.79 mm).
- F. Pilaster shoes and sleeves (caps): stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.
- G. Brackets (fittings):
  1. Stirrup Type: Ear or U-brackets; stainless steel
- H. Stainless-steel finish: Manufacturer's standard brushed finish on exposed faces. Protect exposed surfaces from damage by application of strippable, temporary protective covering before shipment.

## 2.04 HARDWARE AND ACCESSORIES

- A. Hardware and accessories: manufacturer's standard design, heavy-duty operating hardware and accessories.
  1. Material: Stainless Steel
  2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position
  3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designed as accessible.
  4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
  5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
  6. Door Pull: Manufacturer's standard unit at out-swinging doors at compartments designated as accessible.
- B. Overhead bracing: manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

- C. 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 anchors compatible with related materials

## 2.05 FABRICATION

- A. Fabrication, general: fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories and solid blocking within panel where required for attachment of toilet accessories.
- B. Floor-and-ceiling-anchored units: provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.
- C. Door size and swings: unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments designated as accessible.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

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 Pannels: ½ IN.
  - b. Panels and Walls: 1 IN.
- 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 bracket at walls
- B. Floor-and Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.
- C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid and secured to resist lateral impact.

### 3.03 ADJUSTMENT

- A. Adjust and lubricate hardware for proper operation after installation.
- B. Set hinges on in-swing doors to hold unlatched doors open approximately 30 degrees.
- C. Set hinges on out-swing doors to return to fully closed position.
- D. Repair all scratches in finish with material provided by and using application methods recommended by partition manufacturers.

**END OF SECTION**

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## **SECTION 10 22 13 – WIRE MESH PARTITIONS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Wire mesh partitions as indicated and as specified.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR, Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.

#### **1.03 SUBMITTALS**

- A. Manufacturer's Data: Submit manufacturer's technical data and installation instructions.
- B. Shop Drawings: Submit shop drawings for fabrication and erection. Include plan view elevations and large scale details. Show necessary items. Provide templates as required.
- C. Color Card: For Architect's selection of HVLP applied shop coat of colored enamel finish.

#### **1.04 QUALITY ASSURANCE**

##### **A. Qualifications:**

1. Manufacturer: Company specializing in manufacturing Products specified with minimum 5 years documented experience.
  2. Installer: Company specializing in performing the Work of this Section with minimum 5 years documented experience.
- B. Field Measurements: Confirm field measurements before fabrication, where possible. Allow for adjustments and fittings where required.
  - C. Inserts and Anchorage's: Furnish devices which must be set in concrete or built into masonry. Coordinate with other work.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Protect products during transport, handling and storage.
- B. Deliver materials to jobsite in unopened containers bearing manufacturer's name and content identification.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with project requirements, manufacturer's offering, products which may be incorporated in the work include the following:

CALIFORNIA WIRE PRODUCTS, Corona, CA  
PH (800) 486-7730 FAX (909) 735-1070  
E-MAIL: [INFO@CAWIRE.COM](mailto:INFO@CAWIRE.COM)  
<http://www.cawire.com>

### 2.02 WIRE MESH PARTITIONS

- A. Partitions Frame and Wire Mesh:

1. Steel: Complies with ASTM A36/A36M.
2. Wire: #6 W&M gauge steel wire, 2" diamond intercrimp mesh, clinched and welded to channel frames.
3. Vertical Frames: 1-1/2" X 3/4" x 1/8" channel provided with holes for bolting to adjacent panel.
4. Horizontal Frames: 1-1/2" x 3/4" x 1/8" hot roll channel.
5. Stiffeners: 1" X 1/2" x 1/8" hot roll channel.
6. Top Capping Bar: Hot roll formed 'C' shaped channel C3 x 4.1.
7. Flat Bar Stiffeners: 2 1-2" x 5/16" flat bar, full height of panel to prevent telescoping of channel frames and stiffener runs. Each with base plate and (2) two anchors.
8. Corner Posts: 1-1/4" X 1-1/4" x 1/8" 90° angle.
9. All hardware and anchors are furnished for a complete installation.

- B. Door and Frame:

1. Doors:
  - a. Hinged: Constructed of 1-1/4" x 1/2" x 12 gauge channel frame banded with 1/8" x 1-1/4" flat bar top and sides. 1-1/2" pair butt hinges welded to door sides and jambs.
2. Floor Brace: 3-1/2" x 1-1/2" roll formed 12 gauge channel brace with base plate and mounting anchors.
3. Locks: Doors are equipped with mortise type cylinder locks operated from outside with key, and from inside with recess knob. Padlock hasps also available.

- C. Finish: An HVLP applied shop coat of enamel or hot dipped galvanized.

- D. Nails, Brads, and Staples: ASTM F1667.

- E. Power-Driven Fasteners: CABO NER-272.

- F. Wood Screws: ASME B18.6.1.

- G. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M).

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine the areas and conditions under which mesh partition units are to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected

### 3.02 INSTALLATION

- A. Install Work under this Section in accordance with manufacturer's printed recommendations.
- B. Erect partitions plumb, rigid, properly aligned, and securely fastened in place. Adjust opening and closing units to operate freely without bind.
- C. Provide additional field bracing as necessary for rigid, secure installation.
- D. Install all accessories required for a completed installation.
- E. Touch up paint damaged finish after completion of installation using field-applied paint to match color of shop-applied finish.

**END OF SECTION**

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## **SECTION 10 26 13 - WALL PROTECTION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

A. This Section includes the following:

1. Corner guards.
2. Chair rails

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.
- C. Division 09 - Gypsum Board Assemblies.

#### **1.03 SUBMITTALS**

- A. Product Data: Include construction details, material descriptions, impact strength dimensions of individual components and profiles, finishes and samples for each impact-resistant wall-protection unit.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Testing Agency Qualifications: An independent agency qualified according to ASTM E329 for testing indicated, as documented according to ASTM E548.
- C. Source Limitations: Obtain impact-resistant wall-protection units through one source from a single manufacturer.
- D. Product Options: Refer to Division 01 Section "Product Requirements."
  - 1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
- E. Fire-Test-Response Characteristics: Provide impact-resistant, plastic wall-protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Store impact-resistant wall-protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
  - 1. Maintain room temperature within storage area at not less than 70 DegF during the period plastic materials are stored.

2. Store plastic wall-protection components for a minimum of 72 HRS, or until plastic material attains a minimum room temperature of 70 DegF.

#### 1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install impact-resistant wall-protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 DegF for not less than 72 HRS before beginning installation and for the remainder of the construction period.
- B. Field Measurements: Verify actual locations of walls, columns, and other construction contiguous with impact-resistant wall-protection units by field measurements before fabrication and indicate measurements on Shop Drawings.

#### 1.07 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Include mounting and accessory components. Replacement materials shall be from same production run as installed units.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

#### 2.02 MATERIALS

- A. 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.
- B. Adhesive: Type recommended by manufacturer for use with material being adhered to substrate indicated.

#### 2.03 CORNER GUARDS

- A. Surface-Mounted, Opaque-Plastic Corner Guards (see plan sheet for locations): Fabricated from PVC plastic, acrylic-modified vinyl sheet or opaque polycarbonate sheet; with formed edges; fabricated with 90- or 135-degree turn to match wall condition.
  1. Manufacturer: Korogard Wall Protection Systems.
  2. Style: No. G200.
  3. Height: 48 IN.
  4. Wing Size: Nominal 3 by 3 IN.
  5. Mounting: Countersunk screws through factory-drilled mounting.

6. Color and Texture: As selected by Architect from manufacturer's full range

#### 2.04 CHAIR RAIL

- A. Surface-Mounted, Solid Wood with integrated bumper.
  1. Manufacturer: Korogard Wall Protection Systems.
  2. Style: BW90.
  3. Material / Finish: As selected by Architect from manufacturer's full range.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
  1. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
  2. For impact-resistant wall-protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.02 PREPARATION

- A. Complete finishing operations, including painting, before installing impact-resistant wall-protection system components.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

#### 3.03 INSTALLATION

- A. General: Install impact-resistant wall-protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
  1. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
    - a. Provide anchoring devices to withstand imposed loads.

#### 3.04 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

### END OF SECTION

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## **SECTION 10 26 24 - FIBERGLASS REINFORCED LAMINATED PANELS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Requirements for furnishing and installing fiberglass reinforced laminated plastic panels according to manufacturer's recommendations.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Section 09 21 16 - Gypsum Board Assemblies.**

#### **1.03 SUBMITTALS**

##### **A. Submit in accordance with Section 01 33 00.**

1. Two samples of each type of laminated panel, each type of trim and fastener.
2. Shop Drawings: Indicate the location and dimension of joints and fastener attachment.
3. Manufacturer's Installation Guide.

#### **1.04 QUALITY ASSURANCE**

##### **A. Provide panels and molding only from the same manufacturer to ensure warranty and color harmonization of accessories.**

##### **B. Qualifications of installers:**

1. Use only thoroughly trained and experienced installers who are completely familiar with the requirements of this Work and the recommendations contained in the referenced standards.
2. In acceptance or rejection of installed work, no allowance will be made for lack of skill on the part of the installer.

##### **C. Codes and Standards: In addition to complying with all pertinent codes and regulations:**

1. Meet USDA requirements.
2. Meet ASTM E84, flame spread less than 200, smoke developed less than 450.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

##### **A. Delivery of Materials: Package sheets on skids or pallets for shipment to project site.**

##### **B. Storage of Materials: Store panels indoors in a dry place at the project site.**

##### **C. Handling: Remove foreign matter from face of panel by use of a soft bristle brush, avoiding abrasive action.**

#### 1.06 PROJECT CONDITIONS:

- A. Installation shall not begin until building is enclosed, permanent heating and cooling equipment is in operation, and residual moisture from concrete work has dissipated.
- B. During installation and for not less than 48 HRS before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.
- C. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

##### A. Laminated Panel Material:

- 1. Laminated panels shall be manufactured by Marlite or an approved equal.
- 2. Interior (face) skin shall be embossed .090 IN fiberated (FRP) reinforced fiberglass. Color shall be from manufacturer's standard color selection.
- 3. Stabilizer sheet under face shall be 6-mm thick non-asbestos fiber reinforced cement sheet.
- 4. Size tolerance:
  - a. Width:  $\pm 1/8$  IN.
  - b. Length:  $\pm 1/8$  IN.
  - c. Thickness:  $\pm 1/16$  IN.

##### B. Adhesive:

- 1. The adhesive used in laminating shall be polyurethane reactive (PUR), hot melt type, applied heated 250 DegF.
- 2. The entire composite shall be pressed with maximum pressure under controlled and consistent pressure to develop the maximum possible tensile strength.

##### C. Sealants: Panels to be sealed with Class A grade sealant.

##### D. Division Bars, Corner Trim, Moldings: Panel manufacturer's standard length extruded vinyl pieces; longest length possible - to eliminate end joints. Color to match panels.

##### E. Fasteners: Non-corrosive drive rivets in harmonizing colors. Refer to Manufacturer's Installation Guide for rivet pattern and installation instructions.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.

- B. Do not begin installation until backup surfaces are put into satisfactory condition.

### 3.02 APPLICATION

- A. Do all cutting and drilling with carbide tipped saw blades or drill bits, or cut with snips.
- B. Install laminated panels with manufacturer's recommended gap for panel field and corner joints.
- C. Fastener holes in the panels must be predrilled 1/8 IN (3.2 mm) oversize.
- D. Using products acceptable to manufacturer, install the FRP panel system in accordance with panel manufacturer's printed instructions.

### 3.03 CLEANING

- A. Remove any adhesive or excessive sealant from panel face using solvent or cleaner recommended by panel manufacturer.

**END OF SECTION**

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## **SECTION 10 28 14 - TOILET AND BATH ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Toilet and bath accessories.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.**

##### **B. Division 01 - UPRR General Requirements.**

##### **C. Division 10 – Stainless Steel Toilet Compartments**

#### **1.03 REFERENCED STANDARDS:**

##### **A. Americans with Disabilities Act (ADA):**

1. Accessibility Guidelines for Buildings and Facilities.

##### **B. ASTM International (ASTM):**

1. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
2. A480, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See UPRR Division 01.
2. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.
  - c. Manufacturer's recommendation on fasteners.
3. Schedule of items being provided for each room. Reference rooms using room number designated on Drawings.
4. Catalog cut sheet of each item proposed.

##### **B. Operation and Maintenance Manuals:**

1. See UPRR Division 01.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Product numbers scheduled are manufactured by Kimberly-Clark and Bradley.
- B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. American Specialties, Inc.
  - 2. Bobrick.
  - 3. Bradley Corp.
  - 4. Kimberly-Clark Professional.
- C. Submit requests for substitution in accordance with UPRR Division 01.

### 2.02 MATERIALS

- A. Toilet Accessories:
  - 1. General: ASTM A480, stainless steel.
  - 2. Grab bars: ASTM A269, stainless steel.
- B. Anchoring Devices: Manufacturer's standard.

### 2.03 TOILET ACCESSORIES

- A. General:
  - 1. Satin finish.
  - 2. Items shall meet design requirements of ADA.
- B. Grab bars:
  - 1. Equal to Bradley 812-0593652.
  - 2. Concealed mounting.
  - 3. 3 IN DIA flange.
  - 4. Integral non-slip gripping surface.
  - 5. 1-1/2 IN DIA.
  - 6. Anchoring Devices: Designed to withstand minimum concentrated load of 250 LBS applied at any point on grab bar.
- C. Toilet Tissue Dispenser – Equal to Kimberly-Clark 09603.
- D. Feminine Napkin Disposal – Equal to Bradley 4721-15 and 4722-1015, semi-recessed or recessed per plan.
- E. Roll Towel Dispenser – Equal to Kimberly-Clark 09995
- F. Waste Receptacle – Equal to Bradley 334, semi-recessed or recessed per plan.
- G. Liquid Soap Dispenser – Equal to Kimberly-Clark 92144
- H. Mop and Broom Rack – Equal to Bradley 9953.

1. Mount 72" AFF above mop sink
- I. Toilet Seat Cover Dispenser – Equal to Kimberly-Clark 09505.
- J. Mirrors: By Glazing Contractor See Section 08 81 00.
- K. Shower seat: Bradex Model 956, (if not provided with Shower)
  1. Bradex Model 956, stainless steel frame with fold up plastic seat.
  2. A seat shall be provided in shower stalls. The seat shall be mounted 17 IN to 19 IN from the bathroom floor and shall extend the full depth of the stall. In a 36 IN by 36 IN shower stall, the seat shall be on the wall opposite the controls. The structural strength of seats and their attachments shall comply with A.D.A. guidelines.
- L. Dressing Area Bench: See Section 10 51 13 - Metal Lockers.
- M. Shower Curtain and Rod. (if not provided with Shower):
  1. Heavy duty institutional, commercial grade vinyl-coated nylon.
    - a. Stainless steel grommets every 6 IN across the top.
    - b. Curtain material to be: Antimicrobial protection, flame resistant, stain resistant, anti-static, odor resistant.
  2. Curtain rod to be stainless steel.
- N. Warm Air Hand Dryer:
  1. Xlerator Hand Dryer, #XL-SF, by Excel Dryer Inc., surface mounted high speed hand dryer shall incorporate a vandal resistant design
  2. Green Spec listed.
- O. Surface Mounted Specimen Shelf (as indicated on drawings)
  1. Bradley Model 9095, 6-1/4 IN x 20-1/2 IN stainless steel shelf with roll-formed edges.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Verify adequate backing has been provided in wall or toilet partition.

#### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instruction and in accordance with ADA.
- B. Mount all items with manufacturer's standard anchorage devices.
- C. Install in locations indicated on Drawings.

### END OF SECTION

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## **SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Portable fire extinguishers.
2. Fire-protection cabinets, as indicated on drawings, for the following:
  - a. Portable fire extinguishers.
3. Mounting brackets for fire extinguisher, as indicated on drawings

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.
- C. Division 07 - "Through-Penetration Firestop Systems" for firestopping sealants at fire-rated cabinets.

#### **1.03 SUBMITTALS**

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.
  1. Fire Extinguishers: Include rating and classification.
  2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Samples for Initial Selection: For fire-protection cabinets with factory-applied color finishes. Size: 6 by 6 IN square.
- C. Maintenance Data: For fire extinguishers and fire-protection cabinets to include in maintenance manuals.

#### **1.04 QUALITY ASSURANCE**

- A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.
- B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
  1. Provide fire extinguishers approved, listed, and labeled by FMG.
- D. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E814 for fire-resistance rating of walls where they are installed.

## 1.05 COORDINATION

- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate location of fire-protection cabinets and fire extinguishers with local AHJ and to ensure fit and function.

## 1.06 SEQUENCNG

- A. Apply vinyl lettering on field-painted fire-protection cabinets after painting is complete.

## 1.07 WARRANTY

- A. Special Warranty: Manufacturer's Standard Form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure or hydrostatic test according to NFPA 101.
    - b. Faulty operation of valves or release levers.
  - 2. Warranty period: Six years from date of substantial completion.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by reputable manufacturers and installed in accordance with these Specifications.

### 2.02 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B.
- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
  - 1. Sheet: ASTM B209 (ASTM B 209M).
  - 2. Extruded Shapes: ASTM B221 (ASTM B 221M).
- C. Clear Float Glass: ASTM C1036, Type I, Class 1, Quality q3, 3 mm thick.

### 2.03 PORTABLE FIRE EXTINGUISHERS

- A. Available Manufacturers:
  - 1. JL Industries, Inc.
  - 2. Larsen's Manufacturing Company.
  - 3. Potter Roemer; Div. of Smith Industries, Inc.
- B. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Handles and Levers: Manufacturer's standard.
  2. Instruction Labels: Include pictorial marking system complying with NFPA 101, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.
- C. Multipurpose Dry-Chemical Type in Steel Container FE-1, UL-rated 4-A:60-B:C, 10 LB nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

## 2.04 FIRE-PROTECTION CABINETS

A. Manufacturers:

1. JL Industries, Inc. - Academy 1027 W10.
2. Larsen's Manufacturing Company. - Vertical Duo - B2712 R.
3. Potter Roemer; Div. of Smith Industries, Inc. - ALTA 7045.

B. Cabinet Type: Suitable for fire extinguisher.

C. Cabinet Construction: 1 HR fire rated.

D. Cabinet Material: Aluminum sheet.

1. Shelf: Same metal and finish as cabinet.

E. Recessed Cabinet, as indicated on drawings:

1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

F. Semi-Recessed Cabinet, as indicated on drawings: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.

1. Rolled Edge Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend) of 2-1/2 IN.

G. Cabinet Trim Material: Aluminum sheet.

H. Door Material: Aluminum sheet.

I. Door Style: Vertical duo panel with frame.

J. Door Glazing: Clear float glass.

K. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard pull handle.
2. Provide continuous hinge, of same material and finish as trim permitting door to open 180 degrees.

L. Accessories:

1. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Contracting Officer's Technical Representative.
  - a. Identify fire extinguisher in fire-protection cabinet with the words FIRE EXTINGUISHER.
  - b. Location: Applied to cabinet door.
  - c. Application Process: Pressure-sensitive vinyl letters.
  - d. Lettering Color: Red
  - e. Orientation: Vertical.

M. Finishes:

1. Aluminum: Color anodized.
  - a. Color and Texture: As selected by Architect from manufacturer's full range.

2.05 MOUNTING BRACKETS

A. Available Manufacturers:

1. JL Industries, Inc.
2. Larsen's Manufacturing Company.
3. Potter Roemer; Div. of Smith Industries, Inc.

B. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

1. Color: Black.

C. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Contracting Officer's Technical Representative.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
  - a. Orientation: Vertical.

2.06 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.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

## 2.07 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire-protection cabinets after assembly.
- D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.08 ALUMINUM FINISHES

- A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
- B. Class I, Color Anodic Finish: AA-M12C22A42/A44 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

# PART 3 - EXECUTION

## 3.01 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.
- B. Examine fire extinguishers for proper charging and tagging.
  - 1. Remove and replace damaged, defective, or undercharged units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.02 PREPARATION

- A. Prepare recesses for semi-recessed fire-protection cabinets as required by type and size of cabinet and trim style.

## 3.03 INSTALLATION

- A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated below:
  - 1. Fire-Protection Cabinets: 54 IN above finished floor to top of cabinet.
  - 2. Mounting Brackets: 54 IN above finished floor to top of fire extinguisher.
- B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.
  - 1. Provide inside latch and lock for break-glass panels.

- 2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
- C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
- D. Identification: Apply vinyl lettering at locations indicated.

#### 3.04 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire-protection cabinet doors to operate easily without binding.
- C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory- finished appearance. Use only materials and procedures recommended or furnished by fire- protection cabinet manufacturer.
- E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

#### **END OF SECTION**

## **SECTION 10 51 13 - METAL LOCKERS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Locker units with hinged doors, single or double tier as indicated on Drawings.
2. Fillers and corner filler panels.
3. Sloped tops.
4. End cover panels.
5. Hooks, recessed handle, padlock hasps at top and bottom.
6. Attachment hardware.
7. Locker Bench.
8. Handicap Accessible Bench.
9. 6 IN metal base.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.

#### **1.03 REFERENCED STANDARDS**

##### **A. ASTM International (ASTM):**

1. A446, Steel Sheet, Zinc-coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.

#### **1.04 SUBMITTALS**

- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Include locker types, sizes, configurations, layout of groups of lockers, accessories, and numbering plan.
- C. Provide one sample of standard colors for initial selection.
  1. After initial selection, provide (4) 1" x 3" samples of final color selection.

#### **1.05 PROTECTION**

- A. Store and protect lockers under provisions of Section 01 65 50.
- B. Protect locker finishes and adjacent surfaces from damage during installation.

## PART 2 - PRODUCTS

### 2.01 PERFORMANCE REQUIREMENTS

- A. Accessibility Requirements: for lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

### 2.02 MANUFACTURERS

- A. Basis of Design: Products specified on the Drawings are products of Republic Storage Products. Products of other approved manufacturers shall be allowed provided they meet the quality level and design intent of the specified products.
- B. Manufacturer: Subject to compliance with specified requirements, provide metal lockers equal to specified, provided by the following manufacturer's;
  - 1. Republic.
  - 2. Lyon
  - 3. Art Metal Products
  - 4. Interior/Medart.
  - 5. Substitutions: Under provisions of Section 01 65 50.

### 2.03 MATERIALS

- A. Sheet Steel: Prime, high grade Class I mild annealed, cold-rolled steel; of the following minimum thicknesses:
  - 1. Body and Shelf: 24 gauge.
  - 2. Doors: 14 gauge outer.
  - 3. Door Frames: 16 gauge.
  - 4. Hinges: Standard heavy duty.
  - 5. Top, Trim: 24 gauge.

### 2.04 ACCESSORIES

- A. Provide each locker with two single prong wall hooks, one double ceiling hook, one shelf (at single tier lockers), and a metal number plate.

### 2.05 FABRICATION

- A. Locker Units: See Note on drawings for sizes and tiers, sloped top.
- B. Bodies: Formed and flanged with stiffener ribs; electrically spot welded.
- C. Door Frame: Formed channel shape, welded and ground flush, welded to body.
- D. Doors: Welded inner and outer faces; 1-3/16 IN thickness; channel reinforced top and bottom with intermediate stiffener ribs. Finish edges smooth.
- E. Hinges: Three for doors 42 IN and higher, two for doors under 42 IN high. Weld securely to unit body and rivet to unit door.



- F. Provide recessed locking handle for padlock. Locking device supplier by Owner.
- G. Provide end panels, filler panels, and sloped metal tops to close off all openings.
- H. Provide ventilation openings at top and bottom of each locker.
- I. Finish edges smooth without burrs.
- J. Provide number plates.

#### 2.06 LOCKER ARRANGEMENT

- A. Provide lockers in sizes and arrangements as indicated on the drawings on standard 6' metal base.

#### 2.07 FINISHES

- A. Clean, degrease, and neutralize metal; prime and finish with two coats of baked enamel.
- B. Paint locker doors, bodies and frames.
- C. Color: as selected by Architect from deluxe colors available.

#### 2.08 LOCKER BENCHES

- A. Provide freestanding bench units with laminated clear hardwood top and tubular steel legs in sizes indicated on the drawings.
- B. Provide freestanding ADA bench units with laminated clear hardwood top and tubular steel legs in sizes indicated on the drawings

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Set lockers on base; verify base is acceptable.
- B. Install lockers secure, plumb, square, and in line.
- C. Anchor lockers with appropriate anchor devices to suit materials encountered.
- D. Bolt adjoining locker units together to provide rigid installation.
- E. Install end panels, filler panels, tops, and bases to completely close off openings.

#### **END OF SECTION**

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## **SECTION 10 75 00 - FLAGPOLES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Ground-set flagpoles made from aluminum.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.
- C. Division 03 - "Cast-in-Place Concrete" for concrete footings for flagpoles.
- D. Division 07 - "Joint Sealants" for elastomeric sealant filling the top of the foundation tube.

#### **1.03 PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide flagpole assemblies, including anchorages and supports, capable of withstanding the effects of wind loads, determined according to NAAMM FP 1001, "Guide Specifications for Design of Metal Flagpoles."

#### **1.04 SUBMITTALS**

- A. Product Data: For each type of flagpole required.
- B. Shop Drawings: Include elevations and details showing general arrangement, jointing, fittings and accessories, grounding, and anchoring and supporting systems.
  1. Include details of foundation system for ground-set flagpoles.
- C. Finish Samples for Verification: For each finished material used for flagpoles and accessories.

#### **1.05 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each flagpole as a complete unit, including fittings, accessories, bases, and anchorage devices, from a single manufacturer.
  - a. Obtain flagpoles through one source from a single manufacturer.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. General: Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. American Flagpole; a Kearney-National Inc. Company.
  - 2. Baartol Company Inc. (The).
  - 3. Concord Industries, Inc.
  - 4. Eder Flag Manufacturing Company, Inc.
  - 5. Ewing International.
  - 6. Lingo Inc.; Acme Flagpole Division.
  - 7. Michigan Flagpole Inc.
  - 8. Morgan-Francis Div.; Original Tractor Cab Co., Inc.
  - 9. PLP Composite Technologies, Inc.
  - 10. Pole-Tech Company Inc.

### 2.02 FLAGPOLES

- A. Flagpole Construction, General: Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:
  - 1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
  - 2. For tapered flagpoles, provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.
- B. Exposed Height:
  - 1. Center pole: 35 FT (1 total).
  - 2. Outer poles: 30 FT (per drawings).
- C. Aluminum Flagpoles: Provide tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241, Alloy 6063, with a minimum wall thickness of 3/16 IN. Heat treat after fabrication to comply with ASTM B597, Temper T6.
- D. Sleeve for Aluminum Flagpole: Foundation sleeve, made to fit flagpole, for casting into concrete foundation.
  - 1. Provide flashing collar of same material and finish as flagpole.

### 2.03 FITTINGS

- A. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.

B. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

C. Halyard Flag Snaps: Provide two stainless-steel swivel snap hooks per halyard.

#### 2.04 MISCELLANEOUS MATERIALS

A. Concrete: 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.

B. Sand: ASTM C33, fine aggregate.

C. Elastomeric Joint Sealant: Joint sealant complying with requirements in Section 07 92 00 - "Joint Sealants" for nontraffic use and, as applicable, to joint substrates indicated.

#### 2.05 FINISHES

A. Metal Finishes, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Provide manufacturer's standard aluminum clear coat finish.

### PART 3 - EXECUTION

#### 3.01 FLAGPOLE INSTALLATION

A. General: Install flagpoles where shown and according to manufacturer's written instructions.

B. Foundation-Tube Installation: Install flagpole in foundation tube, seated on bottom plate between steel centering wedges. Plumb flagpole and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2 IN layer of elastomeric joint sealant and cover with flashing collar.

### END OF SECTION

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## **SECTION 10 81 13 –BIRD NETTING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This Section includes the following:
  - 1. Bird Control netting on the underside of the building structure. The bird netting shall stop sparrow, starlings and pigeons from roosting on the building structure.
  - 2. Design Requirements: Select appropriate size net and fastening system as determined by site conditions and mounting surface.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.
- C. Division 13 – Metal Building Systems

#### **1.03 SUBMITTALS**

- A. Submit all descriptive information on products and installation from the manufacturer.
- B. Provide warranty on Material and Installation.
- C. Provide samples of each type of bird netting used, including proposed fastening methods and hardware.
- D. Provide statement by official indicating that they are a certified installation company.

#### **1.04 QUALITY ASSURANCE**

- A. Obtain all technical information on products and installation from the manufacturer.
- B. Utilize Authorized Installers who are knowledgeable in the product installation.
- C. Installer shall visit the site to gather all information of existing site conditions.
- D. Single Source Responsibility: All parts and accessories of the bird netting shall be from one manufacturer.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Protect Bird-B-Gone products from damage before, during and after the installation.
- B. Coordination: Furnish all anchorage devices required to fasten system to and around existing building structure. Coordinate installation with existing conditions and within on-site tolerances.

#### **1.06 WARRANTY**

- A. Bird Netting shall carry a minimum guarantee against U.V. breakdown:
  - 1. 3-year guarantee for White and Stone Netting.

2. 10-year guarantee for Black Netting.
- B. Installation shall be guaranteed for 2 years.
- C. Installation shall be performed by a Certified Installer.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Bird-B-Gone, Inc.
  2. Nixalite of America Inc.
  3. An approved equal

### 2.02 BIRD NETTING

- A. Size: 3/4" Heavy Duty
- B. Color: Architect to select from Manufacturer's standard colors.
- C. Material: U.V. stabilized knotted polyethylene net. Flame resistant (270 Deg. F. melting point). Rot-proof, non-conductive and stable in subzero temperatures.
- D. Construction: Comprised of 6 monofilaments, each 12/1000" thick with U.V. stabilizers added. Monofilaments are twisted together to produce a strong twine with 160-200 twists per meter.
- E. Breaking Strength: 52 lbs. per strand.
- F. Burst Strength: ISO 1806 Mesh Test 48.54 lbs
- G. Hardware: All metal hardware or products are galvanized or stainless steel.

### 2.03 MOUNTING SYSTEMS

- A. Solid Steel: For corner attachments use manufacturer's corner bolts with lock nuts or multipurpose cable brackets with powder actuated fire-in-pins for intermediate attachments.
- B. Steel I-Beams: For corner attachments, use bolts with lock nuts. For intermediate attachments, use the appropriate size manufacturer's girder clips.
- C. Sheet Metal: Use manufacturer's multipurpose cable brackets with self-tapping screws for both corner and intermediate attachments.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine the installation area and note any detrimental or hazardous work conditions. Notify Architect of the detrimental work conditions.
- B. Do not proceed with installation until conditions are corrected.



3.02 PREPARATION

- A. Surface should be thoroughly cleaned and free of bird droppings, nesting materials, or other debris.

3.03 INSTALLATION

- A. Install Bird Net as recommended by the manufacturer. Bird Net shall fit the area to be protected perfectly so pest birds cannot enter the protected area, and so the netting blends perfectly with the architecture.
- B. Bird Net shall be securely attached to underside of purlins and rigid frames.
- C. Bird Net correct mesh size shall be provided to ensure exclusion to the correct pest bird.
- D. Bird Net shall be installed tightly and securely to ensure a long lasting installation that is visually hard to see.

3.04 INSPECTION

- A. Visually inspect Bird Net for any signs of poor installation, including loose screws, fasteners or un-removed debris.
- B. Immediately correct and repair as necessary.

**END OF SECTION**

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## **SECTION 11 13 00 - DOCK EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Dock bumpers; dock levelers; vehicle restraints; safety barrier; and controls.

##### **B. Locations:**

1. Carman Building & RIP Track Canopy.
2. Service Track Building.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - General Requirements.
- C. Section 01 61 03 - Equipment: Basic Requirements.

#### **1.03 REFERENCED STANDARDS:**

- A. National Electrical Manufacturers Association (NEMA):
  1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

#### **1.04 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.

##### **B. Rear Impact Bar: Interstate Commerce Commission Bar (ICC Bar).**

#### **1.05 SUBMITTALS**

##### **A. Submit under provisions of section 01 33 00.**

##### **B. Shop Drawings:**

1. Product technical data.
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.
2. Drawings showing size of all depressions, conduit, pits, trenches, etc., required in concrete work.

3. Complete wiring diagrams and electrical requirements.
4. Complete outline and installation drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished and the operation and maintenance manuals shall be submitted in accordance with the submittals section.
5. Drawings shall include electrical connection diagram and schematics identifying all items requiring electrical control or power in the operation of the dock equipment, and complete details and information on the power feed system.

C. Operation and Maintenance Manuals:

1. Electronic copies of the manuals are sufficient for initial submittal to Railroad. One hard copy print should be provided to Railroad at completion of the project.

1.06 QUALITY ASSURANCE

A. Qualifications:

1. Installer shall be licensed or approved in writing by manufacturer.

B. Dock leveler shall meet ANSI MH30.1-2000 test load specifications from third party.

1.07 WARRANTY

A. Submit under provisions of section 01 78 34.

B. Provide specified manufacturer's standard warranty.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Dock bumpers:

a. Laminated type:

1) Rite Hite

2. Dock levelers:

a. Rite-Hite.

3. Vehicle restraints:

a. Rite-Hite.

4. Safety Barrier

a. Rite-Hite.

5. Dock System Control

a. Rite-Hite.

B. Submit request for substitution in accordance with Specification Section 01 33 00.

## 2.02 MANUFACTURED UNITS

### A. Dock Bumpers:

1. Laminated tread type:
  - a. Fabricate from multiple plies cut from fabric-reinforced rubber truck tires, assembled under high pressure on steel supporting rods or bar with steel closures and attachment assembly.
  - b. Use plies cut to uniform size extending not less than 4 IN from face of dock when in place.

### B. Dock Levelers:

1. Fully hydraulic with minimum capacity to support a 10,000 LB capacity forklift:
  - a. Size: 7 FT – 0 IN x 8 FT – 0 IN.
2. Operating range 12 IN above and 12 IN below dock level.
3. Lip extension minimum 11 IN.
4. When leveler is in stored position, the leveler lip will provide an integral and automatically-positioned, impact rated, solid barrier 5 IN above dock floor to help prevent accidental falls from vacant dock positions.
5. Platform:
  - a. Minimum 1/4 IN thick steel treadplate.
  - b. Lip extension minimum 1/4 IN thick steel treadplate.
  - c. Designed to accommodate canted truck beds up to 4 IN and still remain flush at rear of pit.
  - d. Minimum of eight interior deck beams plus external working range toe guards with no more than 8 IN spacing between beams.
  - e. Factory-painted with manufacturer's standard paint finish.
6. Hydraulics:
  - a. Pump, reservoir and manifold shall be self-contained assembly.
  - b. Provide all required hoses and fittings.
  - c. Hydraulic cylinder shall raise and lower platform and operate extended lip.
7. Electrical:
  - a. Totally enclosed non-ventilating motor, minimum 1 HP.
  - b. Operator controls mounted in gasketed NEMA 12 enclosure.
  - c. Fed from control panel.
  - d. See Part 2.02.E for additional electrical and control requirements.
8. Safety devices:
  - a. Free fall of platform shall be limited to 3 IN.
  - b. Provide unit with lip keeper, toe guards and maintenance strut supports.

- c. Leveler shall automatically return to safe, stored position if the trailer departs.
  - d. Provide positive acting maintenance support system to support lip and deck. System must withstand a 10,000 LB moving load and provide OSHA approved lock-out/tag out capabilities.
- 9. Rite-Hite RHH-4000 Series.
- C. Vehicle Restraint Safety Device (Wall Mounted):
  - 1. Low profile unit capable of accepting and locking rear impact bars as low as 9 IN above the pavement surface.
  - 2. Unit shall be totally enclosed welded steel construction capable of receiving trailers backing into position.
    - a. Zinc coating on housing, hook and all moving parts subject to weather, dirt and debris.
    - b. IP66 rated motor enclosure.
  - 3. Provide anti-theft logic in control panel which will return hook to the locked position during attempt to manually release trailer from outside building.
  - 4. Rite-Hite SHR-5000 with Shadow Hook.
  - 5. Warranty: Manufacturer's standard 5 YR parts and labor warranty.
- D. Safety Barrier
  - 1. Manually positioned barrier.
  - 2. Curtain to be red PVC-coated fiberglass mesh with three heavy-duty polyester safety restraint straps.
  - 3. Warden guards to be painted safety yellow.
  - 4. Rating:
    - a. 10,000 LBS at 4 MPH minimum.
  - 5. Opening width: 9 FT – 2 IN.
  - 6. Total height: 4 FT – 0 IN.
  - 7. Curtain height: 2 FT – 11 ½ IN
  - 8. Integrate into control system. Control box shall identify when the curtain is locked across opening.
  - 9. Rite-Hite Dok-Guardian
  - 10. Warranty: Manufacturer's standard warranty.
- E. Controls
  - 1. Unit shall control dock leveler and vehicle restraint device.
  - 2. Unit shall identify position of safety barrier.
  - 3. Enclosure shall be NEMA 4X rated.
  - 4. Unit shall be UL approved.

5. Flashing red and green traffic style lights inside (for dock attendant) and outside (for truck driver), one set each per dock leveler system.
  - a. Provide flashing red or green lights with signs to instruct truck driver when it is safe to back in or pull out.
  - b. Provide flashing red or green lights with signs to instruct dock attendant when it is safe to perform loading/unloading operations. Lights are in opposite mode from truck driver lights.
6. Provide audible alarm with acknowledge button when rear impact guard has not been properly engaged.
7. Caution signs for inside and outside with right read and reverse read text.
8. Electrical:
  - a. 480 V/3/60.
  - b. Power to dock leveler and vehicle restraint device shall be fed from the control panel.
9. Rite-Hite: Dok-Commander

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Prior to installation, inspect and verify condition of substrate.

#### 3.02 PREPARATION

- A. Correct defects or conditions which may interfere with or prevent a satisfactory installation.

#### 3.03 INSTALLATION

- A. Install in accordance with approved shop drawings and manufacturer's instructions.
- B. For laminated tread type dock bumpers, mount unit with structural steel angle closures not less than 1/4 IN thick.
  1. Size angles to allow face of tread plies to extend not less than 1 IN beyond standing legs of closure angles with other leg sized to allow for attachment.
- C. Install bumpers 1 to 2 IN below dock level and in direction (horizontal or vertical) indicated on Drawings unless directed otherwise by dock leveler manufacturer.
- D. All miscellaneous steel angles, channels, plates, bolts, etc., for installation of dock levelers, restraint device and combination dock leveler/lift table, and all hydraulic hoses and fittings shall be furnished by the device manufacturer.
- E. Galvanized steel conduit for routing electrical and hydraulic lines shall be provided by Contractor.
- F. All units shall be tested after installation and any discrepancies noted shall be repaired or replaced at Contractor expense.
- G. Manufacturer's representative shall be present at the time of installation.

**END OF SECTION**



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## **SECTION 11 13 50 - IN-FLOOR JACKING SYSTEM**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Jacking System for the RIP facility to serve two (2) tracks.
2. Pit covers and cover supporting structure.

##### **B. Description:**

1. Jacking System Provider shall be responsible for the design, manufacture, and installation for a complete functioning system used to elevate and lower rail cars in order to facilitate repairs and as described in this specification. System shall include hydraulic jacks, hydraulic power unit (HPU) with reservoir, operator controls, support structure, and pit covers.
2. The total system shall be comprised of two (2) separate 75/150/75 ton (side frame/center sill/side frame) capacity sets of jacks located on parallel service tracks.
3. Each RIP jack is operated by positioning railcar over the jacks, reviewed for stability and proper positioning and raised to a working height by either a single center sill lifting cylinder or dual side frame lifting cylinders through the use of an associated operators console and central HPU.
4. Pit covers and supporting structure to conceal the equipment pits and provide a working surface around the RIP jacks. Also see Structural Drawings.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Division 1 - UPRR General Conditions.
- B. Section 01 61 03 - Equipment: Basic Requirements.
- C. Section 23 05 53 - Mechanical Identification.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Shop Drawings:
  1. See Section 01 61 03 and Division 01.
  2. Product technical data.
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
  3. Drawings showing all foundation, electrical and other installation requirements for the jacking system.

4. Equipment loads imposed on the support structure.
  5. Equipment foundation outline drawings defining the dimensions of the equipment pits and locations of the equipment, equipment anchor locations, dimensions defining the locations of the equipment pits relative to each other and the shop tracks,
  6. Schedule of delivery of jacking system to site.
  7. General Arrangement and Construction Drawings for all systems (may include; RAM assemblies, pit covers, hydraulic system, control system, etc.).
    - a. Include all required dimensions including, but not limited, to overall equipment envelope, maximum lift elevations, and all other required dimensions to allow for the coordination of the equipment with the equipment foundation outline drawings, and rail car.
    - b. Provide sufficient information for all components including RIP jacks, HPU, and pit covers required for maintenance and operation.
    - c. Define on the drawings equipment capacities, hoisting and lowering speeds, assembled equipment weights and equipment identifiers including serial numbers.
  8. Pit cover and cover support structure plans and details.
  9. Operator's manuals.
  10. Maintenance and parts manuals.
  11. Electrical, Control System, Mechanical, and Hydraulic Schematic Drawings.
  12. Conduit arrangement drawings defining the size and quantities of embedded and above ground electrical conduit. Include wire type and quantity, and termination locations for each wire and conduit.
  13. Recommended spare parts lists.
  14. Hydraulic oil specifications.
  15. Manufacturer's shop testing plan and related testing results.
  16. Manufacturer's field testing and commissioning plan.
  17. Manufacturer's statement of proper installation and start-up.
  18. Complete wiring diagrams and electrical requirements. Include interconnection diagrams and operator station push button and signal light layout.
- C. Operation and Maintenance Manuals:
1. See Division 1.
  2. Electronic copies of the manuals are sufficient for initial submittal to Railroad. One hard copy print should be provided to Railroad at completion of the project.

#### 1.04 QUALITY ASSURANCE

- A. The General Contractor shall be responsible for the coordination of all work relating to the equipment defined in this specification, work at the site and for the work of all trades.

- B. The General Contractor shall have the responsibility for the construction of the equipment foundations and to coordinate/verify the as-built equipment foundation dimensions meet the requirements defined in the Drawings and the manufacturer's equipment shop drawings. Differences shall be resolved prior to installation of the jacking equipment.
- C. All material and components used in the manufacture of this equipment shall be new, selected for the intended purpose of the design. Previously used or refurbished material, equipment and components are not acceptable.
- D. The RIP jack equipment shall be installed in accordance with the manufacturer's drawings. The General Contractor shall verify all equipment foundations are true and fit for the installation of the equipment prior to the installation taking place. All equipment shall be installed complete and made ready for use by the railroad. Equipment shall be level and true. Surfaces marred during the installation of the equipment shall receive a coating of manufacturers supplied touch up paint. All components requiring lubrication shall be checked and lubricant added if required. All fluids shall be added to their recommended levels. All fluids shall be supplied by the equipment provider during testing, startup, and initial operation. Components damaged or distorted during equipment installation shall be repaired or replaced prior to field testing and acceptance by the railroad.

#### 1.05 SAFETY REQUIREMENTS

- A. The equipment and all its related components must meet all applicable requirements for Federal, State, County and OSHA safety codes and regulations in effect at the date of purchase.
  - 1. In the case of discrepancies between the requirements of this specification and applicable safety codes and regulations, the most stringent code, regulation, or standard shall govern.
  - 2. Operator safety must be the utmost consideration in the design and construction of this machine.

#### 1.06 WARRANTY

- A. The Manufacturer shall warrant the materials and workmanship applied to the equipment and all components for a period of not less than two (2) years from the date of acceptance.
  - 1. REPLACEMENT AND INSTALLATION OF DEFECTIVE PARTS, COMPONENTS, OR WORKMANSHIP WILL BE AT NO COST OF THE UNION PACIFIC RAILROAD DURING THE WARRANTY PERIOD INCLUDING ANY ASSOCIATED TRANSPORTATION COSTS FOR EITHER THE EQUIPMENT ITSELF OR ANY OF ITS PARTS.
    - a. Warranty is to include both parts and labor for the covered period.
    - b. The manufacturer will be expected to rectify major warranty concern by making site visit.
    - c. Minor warranty problems will be corrected by Union Pacific with the guidance and assistance of the manufacturer.

- d. The manufacturer will pay for all parts deemed to be defective and reimburse Union Pacific for labor a rate of \$50.00 per hour.
  - e. The manufacturer may also assign a local, reputable Contractor to perform the warranty work on the machine in lieu of Union Pacific.
  - f. The placement of a Contract Representative to perform warranty work as well as other maintenance is preferred.
- B. The quotation must include all warranty information and specify any variances from our indicated warranty policy. Bidders must indicate the nearest source of parts and service to the specified delivery point of the jacking system including; name, address, and phone number.

#### 1.07 VARIANCES

- A. Any and all variances from these specifications must be listed and outlined, including the reason the specification cannot be met, cost changes and alternatives.

#### 1.08 EXCLUSIONS

- A. The equipment shall not be excluded from consideration on the basis of minor variations from specifications, provided that all essential requirements are met relative to safety, operation, materials, and performance.

#### 1.09 SHOP TESTING

- A. Prior to shipment, the machine is to be fully erected, and tested at the successful Bidder's plant.
- 1. The jacking system must meet the requirements described in this specification.
  - 2. Shop testing of the equipment shall conform to the manufacturer's documented plan and procedures.
  - 3. Notice of testing shall be submitted a minimum of 10 days in advance to Union Pacific.
  - 4. Successful completion of the test will constitute the necessary authority to ship the machine as authorized by a representative of Union Pacific.
  - 5. Any failure to meet the specification criteria must be corrected and re-tested at no additional costs to Union Pacific.
  - 6. Changes that must be made to meet this specification will be the responsibility of the successful Bidder.
  - 7. Changes requested by Union Pacific above and beyond the scope of these specifications will be the responsibility of Union Pacific.
  - 8. All changes made to the specifications for this system must be agreed upon by a representative of Union Pacific and placed in writing.
  - 9. Records of the manufacturers shop tests and results including the acceptance criteria and certification the equipment meets the requirements of the shop testing plan shall be provided to the railroad for record.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Jacking System:

a. Whiting Corporation,

1) Contact: Greg Ciecierski, Phone: 708-587-2112, email: gciecier@whitingcorp.com.

B. Submit request for substitution in accordance with Division 1.

### 2.02 MANUFACTURED UNITS

A. Jacking System:

1. System shall be electro-hydraulic type construction and will service two (2) tracks.
  - a. System shall be complete with RIP jacks, HPU, controls, structural steel supports and pit covers capable of raising and lowering railcars.
  - b. Each track with include three (3) RIP jacks, configured as one center sill unit and two (2) side frame units.
  - c. One (1) hydraulic power unit shall be provided to serve both tracks.
2. The system will be operating at a covered, open sided canopy environment with temperatures typically ranging from 27 to 101 Deg. F.
  - a. The pit environment of the system may be dirty, oily and greasy.
  - b. Water may enter the pit from rain, or washing of the RIP floor.
  - c. All components, including controllers, electrical equipment and hydraulic systems, if used, will be expected to operate effectively within this climate.
  - d. All components must be sealed and protected against damage from water, oil, and dust.
3. Capacity:
  - a. Side frame jack: 75 tons (each).
  - b. Center sill jack: 150 tons.
4. Lifting speed:
  - a. Side frame jack: 7 – 8 fpm.
  - b. Center sill jack: 6 – 7 fpm.
5. Maximum lifting height:
  - a. Side frame jack: 5 FT – 0 IN.
  - b. Center sill jack: 3 FT – 0 IN.
6. Jacking System Layout:

- a. System will include a single hydraulic power unit (HPU) to power two (2) total sets of jacks.
  - 1) System will service two (2) tracks each with a single lifting location.
- b. System to be equipped with:
  - 1) All support and locking mechanisms.
    - a) Locking mechanisms may be mechanically, hydraulically, or pneumatically actuated.
  - 2) Ram assemblies.
  - 3) Hydraulic power system including:
    - a) One (1) HPU with reservoir to operate two (2) sets of jacks located on parallel tracks.
      - (1) The HPU shall be designed to operate either the two 75 ton side frame RIP jacks or the 150 ton center sill RIP jack.
    - b) Electrical control system.
    - c) Interconnection piping, fittings, valves, between HPU and jacking equipment.
    - d) Hydraulic oil.
  - 4) Support frame and pit cover assemblies:
    - a) All cover surfaces of the must be equipped with anti-skid steel plates.
7. Jacking system must be equipped with all necessary pumps, motors, fittings, piping, filtration system, and hydraulic fluid tank.
8. Jacking system shall be equipped with controls that must be incorporated to stop the jacks and set the locking mechanism in the event of any hydraulic failure.
9. Jacking System Manufacturer is to furnish all necessary equipment to provide turn-key operation including, but not limited to:
  - a. Motors, drives, controls, piping, wiring, support systems, and all hydraulic components.
10. All machine components must be cleaned, primer coated, and painted in accordance with current OSHA colors for shop machinery.
11. Upon completion of installation, the manufacturer must demonstrate successful operation of the jacking system.
12. Electrical:
  - a. Single point power supply.
  - b. Primary voltage: 480 V/3 Ph.
  - c. Power: 40 HP.
  - d. All in-pit electrical to be in NEMA 4 enclosure.
  - e. Motors to be TEFC.



- f. All electrical control panels and cabinets are to be located above the jacking pit.
- g. Two (2) operator control panels (primary and secondary) shall be included.
  - 1) The primary control panel will include the single point power connection.
  - 2) Panels must include all necessary switches or buttons to achieve all aspects of remote or manual jacking operation.
  - 3) An emergency stop function must be included on each panel.
  - 4) Lights or indicators must be included to indicate table operational status.
- h. All electrical equipment must comply with International Building Codes, as well as all current state, county, and city wiring codes at the time of construction.
- i. The table and all of its operational functions are to be Programmable Logic (PLC):
  - 1) The controller and all related components for machine operation must be included.
  - 2) The controller must be programmed to prevent operation of the jacking system if an unsafe operation of the jacking system if any unsafe mechanical conditions exist.
  - 3) All programming for complete machine operation must be installed.
  - 4) PLC must be capable of simplistic re-programming in case of memory failure.
- j. All electrical enclosures must be weatherproof rated.
- k. All electrical components necessary for turn-key operation must be included.
- l. Provide remote controller operations.
  - 1) Each track will include a remote control.
    - a) Each remote control will be labeled identifying which track it controls.
  - 2) Provide one (1) spare remote for each track.

**B. Equipment Pit Covers:**

- 1. RIP jack system shall be supplied with fabricated welded steel pit covers. See drawings for locations / dimensions.
- 2. Incorporate steel diamond checkered plate as a walking surface.
- 3. Provide lifting eyes for each pit cover to facilitate the installation and removal of the units. The lifting eyes shall be rated for the dead weight of the pit cover and stowed below the top surface when not in use.
- 4. Capacity:
  - a. Cover shall be designed at a minimum to support a forklift with a capacity of 10,000 LBS.

## PART 3 - EXECUTION

### 3.01 FIELD QUALITY CONTROL

- A. Employ and Pay for Services of Manufacturer's Representative to:
  - 1. Inspect final installation.
  - 2. Supervise startup and perform final adjustments.
  - 3. Perform acceptance testing.
  - 4. Manufacturer shall provide a minimum of 12 HRS on-site to conduct operation and maintenance training to Railroad employees, and verify proper installation and operation of system.
  - 5. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

### 3.02 ACCEPTANCE TESTING

- A. Upon the completion of installation and prior to acceptance by the railroad, the RIP jack system shall undergo field testing per the manufacture's approved field testing plan. The railroad shall provide railcars for use in conducting the start-up, testing and commissioning of the equipment. Provide notification a minimum of 14 days prior to the acceptance testing. Manufacturer's representative shall conduct the start-up, commissioning and acceptance testing of the equipment. Upon completion of acceptance testing, the equipment shall be wiped clean and all surfaces marred during acceptance testing touched up with manufacturers supplied paint and items noted during the testing resolved. Records of the acceptance test results shall be provided to the railroad for record.

### 3.03 TRAINING REQUIREMENTS

- A. Provide on-site training for Union Pacific employees for safe operation of this system.
  - 1. Training must include, but not limited to, all aspects of machine motion and control; alignment with tracks; and emergency situations.
  - 2. Safety will be the utmost concern in all aspects of operator training.
  - 3. Upon completion of training, all operators must demonstrate their ability to safely and competently control all aspects of the operation of this equipment.
- B. Training must also be provided for maintenance personnel.
  - 1. Training in this area must include, but not limited to:
    - a. All operational aspects of the system.
    - b. Adjustments and lubrication.
    - c. Preventative maintenance scheduling and procedures.
    - d. General repairs to the equipment.
- C. Safety will be the utmost concern in all aspects of maintenance training.

1. Upon completion of training, all maintenance personnel must demonstrate a general knowledge of the operation of the machine, and competence in its proper care and maintenance.

#### 3.04 PAINTING

- A. All steel shall be primed with rust-preventative epoxy primer and painted yellow with polyurethane enamel.
  1. Apply to non-stainless, non-machined steel components and equipment one (1) prime coat and two (2) finish coats of the manufacturer's standard safety yellow paint. The total dry film thickness of the paint coating shall be a minimum of 3 mils. All fittings, valves and flexible hoses/tubing, and electrical components used in equipment shall be protected from the application of paint.
  2. All surfaces to be coated shall be cleaned of any scale, rust, oil, dirt, or grease prior to the application of paint. Surfaces to be painted shall be prepared in accordance with the paint manufacturer's recommendations.
- B. The hydraulic piping shall be clearly labeled with "HYDRAULIC OIL".
  1. The lettering shall be stenciled in black paint.
  2. See Specification Section 23 05 53 for requirements.

#### **END OF SECTION**

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## **SECTION 11 41 10 - APPLIANCES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Microwave.
2. Commercial Reach-In Refrigerator.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.

#### **1.03 ACTION SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Product Data for appliances indicated, documentation that products are ENERGY STAR rated.

#### **1.04 INFORMATIONAL SUBMITTALS**

- A. Product certificates.
- B. Warranties: Sample of special warranties.

#### **1.05 CLOSEOUT SUBMITTALS**

- A. Operation and maintenance data.

#### **1.06 WARRANTY**

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Five years from date of Substantial Completion.

### **PART 2 - PRODUCTS**

#### **2.01 MICROWAVE OVENS**

##### **A. Microwave Oven:**

1. Basis-of-Design Product: Whirlpool GT4175SPS.
2. Capacity: 1.7 CU FT.
3. Wattage: 1200.
4. Finish: Stainless Steel

## 2.02 REACH-IN REFRIGERATOR

- A. Refrigerator: Commercial Reach In two-door refrigerator.
  - 1. Basis-of-Design Product: Delfield 6051XL-S Two Door.
  - 2. Type: Freestanding with two section full height doors.
  - 3. Finish: Stainless Steel

## PART 3 - EXECUTION

### 3.01 INSTALLATION, GENERAL

- A. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.
- B. Utilities: Comply with plumbing and electrical requirements.

### 3.02 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance- performance parameters.
  - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After installation, start units to confirm proper operation.
  - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
  - 5. Prepare test and inspection reports.

**END OF SECTION**

## **SECTION 11 46 83 - ICE MACHINE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Ice machine with remote condenser as indicated on the Drawings.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

#### **1.03 UPRR - BIDDING REQUIREMENTS, CONTRACT FORMS, AND CONDITIONS OF THE CONTRACT.**

##### **A. Division 01 - UPRR General Requirements.**

##### **B. UPRR Section III Specifications.**

##### **C. Division 22- Plumbing.**

##### **D. Division 26 - Electrical.**

#### **1.04 SUBMITTALS**

##### **A. Product Data: For each type of product indicated, See UPRR Division 01.**

#### **1.05 CLOSEOUT SUBMITTALS**

##### **A. Operation and maintenance data.**

#### **1.06 WARRANTY**

##### **A. Refrigeration Compressor Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace compressors that fail in materials or workmanship within specified warranty period.**

1. Failure includes, but is not limited to, inability to maintain set temperature.

2. Warranty Period from date of Substantial Completion:

- a. Five years on compressor & condenser.

- b. Five years on evaporator.

- c. Three years on all components, including remote condenser.

### **PART 2 - PRODUCTS**

#### **2.01 ICE-MAKING MACHINE**

##### **A. Basis-of-Design Product: Subject to compliance with requirements, provide Scotsman #C0630- 600 LB Cube Ice Machine. Model # 616/280 with Bin #BS30S (30 X 30 X 44) or comparable product approved by the Architect.**

##### **B. Description: Freestanding unit.**

1. Capacity: 600 LBS per 24 HR period.
2. Storage Bin: Stainless Steel, 610 LB.
3. Stainless-steel stand and legs.
4. Water filter.
5. Electrical Service: Equip unit for connection to service indicated on Drawings.

## 2.02 AIR COOLED REMOTE CONDENSER

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Scotsman ERC 311 Series compatible with Ice Maker or comparable product approved by the Architect.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install equipment level and plumb, according to manufacturer's written instructions.
  1. Connect equipment to utilities.
  2. Provide cutouts in equipment, neatly formed, where required to run service lines through equipment to make final connections.
- B. Install equipment with access and maintenance clearances that comply with manufacturer's written installation instructions and with requirements of authorities having jurisdiction.

**END OF SECTION**



## **SECTION 11 81 30 - FALL PROTECTION SYSTEMS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Fall Protection Contractor shall design, build, and install fall arresting systems as defined by OSHA and specified herein.
  - 1. Provide fall protection system at RIP and Service Track Canopy as specified herein.
- B. Related Specification Sections include, but are not necessarily limited to:
  - 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
  - 2. Division 01 - General Requirements.

#### **1.02 REFERENCED STANDARDS**

- A. The publications listed below form a part of this section to the extent referenced:
  - 1. ASTM International (ASTM).
  - 2. American National Standard Institute (ANSI):
    - a. Z359.1, American National Standard Safety Requirements for Personal Fall Arrest Systems and Components.
  - 3. American Welding Society (AWS).
  - 4. Occupational Health and Safety Administration (OSHA):
    - a. 1926.502 Fall Prevention Systems and Criteria and Practices.

#### **1.03 DEFINITIONS**

- A. Fall Protection Contractor: Manufacturer and installer of fall protection system.

#### **1.04 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
  - 1. Product Data:
    - a. Manufacturer's data and product information for manufactured materials and products. Manufacturer's Catalog Data indicating the sizes, descriptions, capacities, test certifications, and other descriptive data showing in sufficient detail that the product complies with the contract requirements shall be submitted. Clearly mark and identify which products in the Manufacturer's Catalog are proposed for the Project.

2. Shop Drawings:
  - a. For fabrication showing the complete fall protection system. Layout Drawings of each system in relation to the supporting structure indicating the locations of all components in the system properly labeled for identification and elevations of system components.
  - b. Material, Equipment, and Fixture Lists shall be submitted for approval.
3. Systems Manual:
  - a. Contractor shall furnish a manual including the following:
    - 1) Maintenance Procedures: Including parts list and maintenance requirements for all equipment.
    - 2) Operation Procedures: Indicating proper use of equipment for safe operation of the systems.
    - 3) Test Certificate: Indicating completion of proof load testing on installed systems.
    - 4) Product Certificate: Containing the manufacturer's serial number, name and part number of each individual component used in the systems. Manufacturer's catalog data indicating the sizes, descriptions, capacities, test certifications, and other descriptive data showing sufficient detail that the product complies with the contract requirements.
    - 5) As-Built Drawings: A copy of as-built drawings shall also be included in the systems manual.
4. Manufacturer's Instructions:
  - a. Indicating the manufacturer's recommended method and sequence of installation shall be submitted for the following:
    - 1) Energy absorbing devices.
    - 2) Body harnesses.
    - 3) Horizontal Lifeline Cable and associated components.

#### 1.05 SYSTEM DESCRIPTION

- A. The Fall Arrest Systems shall allow the user to walk uninterrupted the entire length of the system and provide secure anchorage to arrest a fall by the users. All components shall be included, so as to provide a complete and fully operational system.
- B. System Layout, Design Analysis, and Calculations shall be prepared and certified by a Licensed Professional Civil or Structural Engineer employed by the Fall Protection Contractor as a full-time fall arrest systems designer. System shall not interfere with rail traffic as indicated by the Owner's standard rail clearance diagram.
- C. The Fall Protection Contractor shall maintain all appropriate insurances as applicable for the design and installation of fall protection systems including the endorsement for working within 50 FT of an active railroad. Proof of these insurance listings shall be supplied as part of Submittals from Section 1.06.

- D. The Fall Protection Contractor shall have an approved ISO: 9001 Quality Control Program and shall be fully certified by the manufacture of any pre-engineered components regarding their use. Proof of manufacture's approval shall be in the form of a copy of the Contractor's current certificate issued by the manufacture and supplied as part of Submittals from Section 1.04. The fall protection contractor shall have a minimum of 5 years full time experience in the design and installation similar systems.

#### 1.06 PROJECT CONDITIONS

- A. Field Measurements: Perform prior to preparation of drawings to ensure required fit and dimensions.

#### 1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in manufacturer's original unopened packaging. Store materials in original protective packaging at location specified. Prevent soiling, physical damage or wetting.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Basis of Design:

- 1. Fall protection systems as designed, supplied and installed by:

- a. Flexible Lifeline Systems:

14325 West Hardy Road

Houston, TX 77060

PH: 800-778-9048

FX: 281-448-9225

Contact: Jennifer Howard

Territory Sales Manager

PH: (832) 448-2953

EM: [jennifer.howard@flexiblelifeline.com](mailto:jennifer.howard@flexiblelifeline.com)

- 2. Flexrail System at the RIP and Service Track Canopy Structure. One over each set of tracks.

#### 2.02 SYSTEM DESIGN

- A. The Fall Arrest Systems shall be designed to fully protect the user at all times while in the area of potential fall hazard. The Fall Arrest Systems shall be rated for three (3) simultaneous users per system. A user shall consist of a 400 LB weight including both user and tool weight.

- B. Deceleration Device: Provide three (3) appropriate length self-retracting lifelines per system that meet or exceed applicable standards of ANSI Z359.1 and OSHA 1926.104. Self-retracting lifelines shall be 30 FT Protecta Rebel.
- C. Harnesses: Provide three (3) full body harnesses per system with single back D-ring that meet or exceed applicable standards of ANSI Z359.1 and OSHA 1926.104.
- D. Clearances:
  - 1. RIP Track:
    - a. Install fall protection Flexrail at a minimum elevation of 25'-6".
  - 2. Service Track:
    - a. See Drawings.

## 2.03 SYSTEM DESCRIPTION – FLEXRAIL BASED

- A. Systems to consist of enclosed tracks with a sealed bearing trolley, which provides 1:100 movement- to - weight ratio. Trolley to incorporate sealed ball bearings for ease of movement. Systems are to be totally hands free for the user and allow the user to work with both hands as if normally traveling along the walking surface. Systems are to impose no horizontal end loads on structure.
- B. Fasteners: The Fall Arrest Systems shall be attached to the supporting structure with appropriate fasteners. The fasteners shall be designed to support a load on the system of 2 times the maximum design load without failure.
- C. Other Components: Corner Assemblies, Turnbuckles and other components shall be 316 stainless steel.
- D. System components shall be of same material unless otherwise indicated. Exposed work shall be true to line and level with accurate angles, surfaces and with straight square edges. Coordinate anchorage system connection and loads with supporting structure. Fabricate anchoring devices as recommended by the manufacturer to provide adequate support for intended use.
- E. Fabricate joints in a manner to discourage water accumulation. Provide weep holes to drain any water which could accumulate in the exposed joints. Exposed work shall be true to line and level with accurate angles, surfaces and with straight square edges
- F. Structural Attachments: The Fall Arrest Systems will be designed to be supported by new structural attachments mounted to the underside of the overhead roof support structure. The Fall Protection Contractor will fabricate the required structural attachments using steel tubing with material test certificates for full material traceability. All fabrication will be performed at the Fall Protection Contractor's in-house fabrication facility in accordance with AWS D1.1 by certified welders and inspected by an AWS certified welding inspector. Unless otherwise noted, all structural attachments shall be hot-dipped galvanized.
  - 1. Coordination is required with metal building supplier for loading requirements and connection possibilities. Brace Flexrail as required back to structure to perform as designed.

## 2.04 MATERIALS

- A. All materials shall be new, and completed Fall Protection System shall be the product of one manufacturer or the manufacturer's authorized installer regularly engaged in the design, production and installation of such equipment.
- B. Fall Arrest Systems and Components:
  - 1. All system connectors, cables and bolts shall be manufactured from stainless steel:
    - a. ASTM A666, Type 316.
    - b. All connectors shall comply with OSHA regulation 1926.502. Fabricated supports required for additional support shall be carbon steel with a corrosion resistant finish.
- C. Material Control: All system components shall contain serial numbers, permanently stamped or engraved, identifying the specific job and system they are used for. These serial numbers shall be recorded in the system manual as described in Article 1.04 and submitted to the owner upon completion of the project.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install according to the approved Shop Drawings and manufacturer's instructions.
- B. Fall Protection Systems shall be installed by manufacturer's authorized, trained and certified personnel.
- C. Install anchorage and fasteners in accordance with manufacturer's recommendations to obtain the allowable working loads published in the product literature and in accordance with this Specification.
- D. Do not load or stress Fall Arrest Systems until all materials and fasteners are properly installed and ready for service.

### 3.02 OPERATOR TRAINING

- A. Provide a minimum of 4 HRS of operator training after system has been installed and proof tested. Training is to be for the users of the system conducted at the installation site.

### 3.03 CLEANING

- A. Remove all loose materials, crating and packing materials from premises.

## END OF SECTION

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## **SECTION 11 82 40 - TOILET WASTE VACUUM SYSTEM**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

**A. Section Includes:**

1. Performance specifications for materials, equipment, and manufacturer's startup services for locomotive waste vacuum systems located at or near service tracks.
- B. System shall be completely self-contained skid-mounted unit requiring only field connection of waste inlet, waste outlet, and electrical power.
- C. Unit shall be designed to operate outdoors between the temperatures of -20 DegF and 120 DegF. Process product includes sanitary waste and toilet chemical/water and antifreeze properties. All components shall be compatible with sewage and sewage vapors.
- D. Summary of operation: Unit shall be designed to assist in emptying locomotive toilet compartments through an underground pipe network and transferring collected product into a sanitary force main.

**E. Design parameters:**

1. Capable of evacuating 5 GAL locomotive toilet compartments in less than 15 seconds.
2. Maximum frequency shall be one compartment every two minutes (1 minute, 45 second recharge time).

#### **1.02 SUBMITTALS**

**A. The following information shall be submitted along with bid:**

1. Equipment descriptions and performance, connection locations, system schematic.
2. Power requirements, overall system dimensions, weight and anchoring requirements.

**B. The following shall be submitted to the Engineer for approval within 45 calendar days after order has been placed:**

1. Manufacturer's shop drawings showing construction, connections, controls, and complete erection / installation details.
2. Data sheets for all furnished equipment.
3. Operation and Maintenance manual, warranty provider, contact names and numbers.

C. Engineer's Mailing Address:

1. Ryan Gottch  
Union Pacific Railroad  
1400 Douglas St. 9th Floor  
Omaha, Nebraska 68179

1.03 DELIVERY, STORAGE AND HANDLING

- A. Manufacturer shall assume responsibility for packaging and shipment to prevent damage to the system during normal transit and handling.
- B. Flange faces and equipment shall be protected from damage. All openings are to be securely covered to prevent the entrance of dirt, water and debris.
- C. Instructions shall be provided with delivery for unloading and installation. System shall require only positioning of skid and connection of waste inlet / outlet piping and power. Individual components shall be pre-assembled by the manufacturer.

1.04 WARRANTY

- A. All components of the system shall be supplied with a one (1) year warranty. Warranty provider shall make onsite service call within 72 HRS after being notified by the Railroad.

PART 2 - PRODUCTS

2.01 COMPONENTS

- A. Pumps: Provide two (2) vacuum generating pumps that are designed to alternate duty to promote even wear. Each vacuum pump shall be capable of generating a minimum vacuum of 18 IN Hg and 15 CFM of free air.
- B. Sewage pumps: Provide two (2) corrosion resistant sewage grinder pumps with alternating duty that automatically empty the sewage collector tank when it is full or at timed intervals. Minimum pump performance shall be 20 GPM and 40 FT of discharge head.
- C. Control panel: The control panel shall be the electrical control center for the entire system and shall have the following minimum requirements:
  1. Main power disconnect switch, motor overload protection
  2. Three position H-O-A selector switch for each pump.
  3. Indicating lights for power and alarm indications.
  4. NEMA 3 waterproof enclosure or better.
- D. Reservoir/tank: Steel vacuum-rated tank shall have a minimum capacity of 100 GAL and be used for waste storage or designed for additional vacuum capacity. At a minimum, the tank shall have a 3 IN flanged inlet connection, 12 IN minimum diameter manhole for cleaning, outlet, gauge connection, and other fittings as required.
- E. Valves: Provide sufficient material and automatic valves (metallic) to effectively operate the system and allow for maintenance of pumps.



F. Vacuum gauge: Corrosion resistant gauge with 2-1/2 IN DIA minimum face.

## 2.02 OPERATION

- A. System shall be capable of maintaining a vacuum within the tank and piping system between 14 - 18 IN Hg.
- B. Automatic mode: The system shall alternatively start a vacuum pump when the system pressure rises to 14 IN Hg vacuum. Vacuum pump shall continue to operate until system pressure is reduced to 18 IN Hg vacuum. When waste level rises to the set point (or at preset time periods), the system shall relieve vacuum in the tank and alternatively start the sewage ejector pump to discharge into the sewer force main.
- C. Manual Mode:
  - 1. Each pump is turned on and off by selector switch.

## 2.03 ALTERNATE CONFIGURATIONS

- A. The manufacturer is allowed to prepare and submit alternate configurations to essentially accomplish the systems intended task as determined by the Railroad.

# PART 3 - EXECUTION

## 3.01 FIELD STARTUP

- A. Manufacturer shall provide a minimum of 8 HRS on-site to conduct operation and maintenance training to Railroad employees, and verify proper installation and operation of system.
- B. After installation by the Railroad according to the manufacturer's installation instructions, the complete system shall be field tested by the manufacturer to ensure proper operation of equipment and adjustment of pressure set points.

## 3.02 PAINTING

- A. All steel shall be primed with rust-preventative epoxy primer and painted yellow with polyurethane enamel. Interior of tank shall be painted with paint manufacturer's recommended system for sewage tank linings.
- B. The vacuum system shall be clearly labeled with TOILET WASTE VACUUM SYSTEM. The lettering shall be stenciled in black paint, 6 IN in height.

**END OF SECTION**

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## **SECTION 12 21 13 - WINDOW TREATMENT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Window treatments.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.
- C. Division 09 - Paint and Protective Coatings.

#### **1.03 REFERENCED STANDARDS:**

##### **A. American Architectural Manufacturer's Association (AAMA):**

1. 2604, Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See UPRR Division 01.
2. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.
  - c. Color chart for Architect's color selection.
  - d. Window schedule using window numbers established on Drawings showing window treatment utilized.

##### **B. Operation and Maintenance Manuals:**

1. See UPRR Division 01.

### **PART 2 - PRODUCTS**

#### **2.01 ACCEPTABLE MANUFACTURERS**

##### **A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:**

1. Horizontal louver blinds:
  - a. Hunter Douglas.
  - b. Levelor.

c. Bali.

B. Submit requests for substitutions in accordance with UPRR Division 01.

## 2.02 MANUFACTURED UNITS

A. Horizontal Louver Blinds:

1. Adjustable blinds with head rail, blades, bottom rail, lift cord, cord lock, tilter, all hardware and installation brackets:
  - a. Blades tiltable to any angle.
  - b. Blades capable of being fully raised and fully lowered.
  - c. Blades capable of being locked in any intermediate position.
  - d. Provide with tilter at left, lift cord at right.
  - e. Headrail and bottom rail.
  - f. 1", 8-gauge aluminum.
  - g. Operating hardware: Manufacturer's standard.
  - h. Units similar to Levelor Riviera.

## 2.03 FABRICATION

- A. Fabricate such that all components do not require lubrication during normal expected life.
- B. Fabricate units to completely fill openings indicated on Drawings.
- C. For continuous window wall installations, fabricate units so that ends occur only over mullions or other defined vertical separations.
- D. Space louver blades to provide minimum overlap of 3/8 IN when in fully closed position.
- E. Gear all operating equipment so that blinds will operate easily and can be set accurately and smoothly.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Verify actual opening dimensions by site measurements.

### 3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Position units plumb and true.
- C. Anchor securely in place.
- D. Provide adequate clearance between sash and blinds.

**END OF SECTION**

## **SECTION 12 48 13 - FLOOR MATS AND FRAMES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Recessed floor mats and frames.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements.
- C. Division 03 - Concrete.

#### **1.03 REFERENCED STANDARDS:**

##### **A. American Society for Testing and Materials (ASTM);**

1. B221, Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See UPRR Division 01.
2. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.

##### **B. Samples:**

1. Manufacturer's full range of grid inserts and exposed aluminum colors, textures, finishes, and patterns available.
2. Minimum 12 IN long sample of each color and type selected.

### **PART 2 - PRODUCTS**

#### **2.01 ACCEPTABLE MANUFACTURERS**

##### **A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:**

1. Reese.
2. Construction Specialties.
3. Or approved equal.

##### **B. Submit requests for substitution in accordance with UPRR Division 01.**

## 2.02 MANUFACTURED UNITS

### A. Recessed Foot Grid System:

1. Unit shall be similar to PEDIGRID Series DP, as manufactured by C/S Group.
2. Framing members shall be straight frame or ledged frame style.
  - a. Aluminum, minimum 16 GA, 6063-T52 alloy.
3. Grids:
  - a. Tread rails shall be aluminum 6063-T52.
  - b. Lock bars shall be aluminum 6061-T6.
    - 1) Maximum 10 IN OC spacing.
  - c. Grid inserts shall be carpet.
    - 1) Color of carpet grid insert shall be chosen by Architect.
  - d. Tread spacing shall be between 1-1/4 and 1-3/4 IN OC.
  - e. Finish: All exposed aluminum surfaces shall receive mill finish. Concealed aluminum surfaces shall have mill finish.
4. Structural loading: All grid and framing sections, when completely installed, shall be capable of supporting a minimum of 200 LB/SF uniform loading.
5. All aluminum members that will come in contact with concrete or masonry shall receive dissimilar materials protection.
6. Unit shall be completely prefabricated and preassembled at the factory and shall be provided with watertight minimum 16 GA aluminum pan. Pan shall be attached to bottom surface of the frame.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Verify substrate and correct all unsatisfactory conditions. Installation of unit indicates acceptance of substrate.

### 3.02 INSTALLATION

- A. Follow manufacturer's printed instruction for installation.
- B. Set units flush with surrounding floor finish level if unit is recessed.
- C. Provide all trim, fillers, inserts, anchors or other miscellaneous items required for complete installation.
- D. Provide temporary wood filler in recess and cover frames with minimum 1/2 IN plywood or fiberglass.
- E. Protect installed unit from damage until acceptance by Owner.

## END OF SECTION

## **SECTION 13 34 19 - METAL BUILDING SYSTEMS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Metal building systems that consist of integrated sets of mutually dependent components including structural framing, roof panels, wall panels, soffit panels, including gutters and downspouts, roof mounted equip curbs, insulation and accessories.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements
- C. Section 03 30 00 - Cast-in-Place Concrete, for concrete foundations, slabs, and anchor-bolt installation.
- D. Division 7 - Joint Sealants.
- E. Division 9 - Paint and Protective Coatings.
- F. Division 23 - Mechanical rough-in utilities.
- G. Division 26 - Electrical rough-in utilities.

#### **1.03 SYSTEM PERFORMANCE REQUIREMENTS**

- A. Structural Performance: Provide metal building systems capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  1. Engineer metal building systems according to procedures in MBMA's "Metal Building Systems Manual."
  2. Design Loads: As indicated on Drawings.
  3. Design Loads: As required by MBMA's "Metal Building Systems Manual", ASCE 7, "Minimum Design Loads for Buildings and Other Structures", and local building codes, whichever is more stringent.
  4. Wall panels shall not be used in diaphragm action to resist any lateral loadings.
- B. Seismic Performance: Design and engineer metal building systems capable of withstanding the effects of earthquake motions determined according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 9, "Earthquake Loads."

- C. Thermal Movements: Provide metal panel systems that allow for thermal movements resulting from the following: maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- D. Thermal Performance: Provide insulated metal panel assemblies with the following maximum U- factors and minimum R-values for opaque elements when tested according to ASTM C1363 or ASTM C518:
  - 1. Metal Roof Panel Assemblies:
    - a. R-Value: R-30.
  - 2. Metal Wall Panel Assemblies:
    - a. R-Value: R-19.
  - 3. Skylight light panels:
    - a. U-factor: 1.
- E. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for Class 90.

#### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: For each type of metal building system component indicated.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 2. Anchor-Bolt Plans: Submit anchor-bolt plans before foundation work begins. Include location, diameter, and projection of anchor bolts required to attach metal building to foundation. Indicate column reactions at each location.
  - 3. Structural-Framing Drawings: Show complete fabrication of primary and secondary framing; include provisions for openings. Indicate welds and bolted connections, distinguishing between shop and field applications. Include transverse cross-sections.
  - 4. Metal Roof and Wall Panel Layout Drawings: Show layouts of metal panels including methods of support. Include details of edge conditions, joints, panel profiles, corners, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work; show locations of exposed fasteners.
- D. Samples: Submit samples of each type of building component and for each color and texture required from manufacturer's standard colors.
  - 1. Provide 4 samples of final color selections to the Architect.



E. Submittals for Building Permit

1. It is the responsibility of the manufacturer to submit to the Architect manufacturer's required drawings, specifications, and engineering design calculations conforming to all applicable building code requirements, sealed by a registered professional engineer licensed in the State where the Site is located and shall make available a trained design engineer to answer any questions of design by the Governing Review Agency in order to obtain a building permit.
2. The certified drawings and calculations shall be submitted to the Governing Review Agency in quantities as necessary in order to obtain a building permit.
3. Three (3) copies of certified drawings and calculations as submitted to obtain a building permit shall be submitted to the Architect for record file.

F. Letter of Design Certification: Signed and sealed by a qualified professional engineer. Include the following:

1. Name and location of Project.
2. Order number.
3. Name of manufacturer.
4. Name of Contractor.
5. Building dimensions including width, length, height, and roof slope.
6. Indicate compliance with AISC standards for hot-rolled steel and AISI standards for cold-rolled steel, including edition dates of each standard.
7. Governing building code and year of edition.
8. Design loads and load combinations.
9. Building-use category.
10. AISC Certification for Category MB: Include statement that metal building system and components were designed and produced in an AISC-Certified Facility by an AISC- Certified Manufacturer.

G. Welding certificates.

H. Erector Certificate: Signed by manufacturer certifying that erector complies with requirements.

I. Manufacturer certificate.

J. Surveys: Show final elevations and locations of major members. Have surveyor who performed surveys certify their accuracy.

1.05 QUALITY ASSURANCE

A. Erector Qualifications: An experienced erector who has specialized in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

B. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.

1. AISC Certification for Category MB: An AISC-Certified Manufacturer that designs and produces metal building systems and components in an AISC-Certified Facility.
  2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
  - C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-- Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
  - D. Structural Steel: Comply with AISC's "Specification for Structural Steel Buildings-- Allowable Stress Design, Plastic Design," or AISC's "Load and Resistance Factor Design Specification for Structural Steel Buildings," for design requirements and allowable stresses.
  - E. Cold-Formed Steel: Comply with AISI's "Specification for the Design of Cold-Formed Steel Structural Members," or AISI's "Load and Resistance Factor Design Specification for Steel Structural Members," for design requirements and allowable stresses.
  - F. Pre-Erection Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to metal building systems including, but not limited to, the following:
    1. Inspect and discuss condition of foundations and other preparatory work performed by other trades.
    2. Review structural load limitations.
    3. Review required testing, inspecting, and certifying procedures.
- 1.06 DELIVERY, STORAGE, AND HANDLING
- A. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness and with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
- 1.07 PROJECT CONDITIONS
- A. Established Dimensions for Foundations: Comply with established dimensions on approved anchor-bolt plans, establishing foundation dimensions and proceeding with fabricating structural framing without field measurements. Coordinate anchor-bolt installation to ensure that actual anchorage dimensions correspond to established dimensions.
- 1.08 COORDINATION
- A. Coordinate size and location of concrete foundations and casting of anchor-bolt inserts into foundation walls and footings. Concrete, reinforcement, and formwork requirements are specified in Section 03 30 00 - "Cast-in-Place Concrete."
  - B. Coordinate installation of roof accessories specified in Division 7.
  - C. Coordinate installation of roof curbs equipment supports and roof penetrations specified in Division 23 – Heating, Ventilating, and Air Conditioning.

## 1.09 WARRANTY

- A. Special Warranty on Metal 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. Siliconized Polyester Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 15 Hunter units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 2 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 3. Finish Warranty Period: 20 years from date of Substantial Completion.
  - 4. Standing-Seam Roof Panel Weathertightness: Written warranty, signed by manufacturer agreeing to repair or replace standing-seam roof panel assemblies that fail to remain weathertight within 20 years from date of Substantial Completion.
  - 5. Provide a 3 year warranty of the completed installation of the prefabricated structures against all defects in materials and workmanship including roof, building trim and sidewall panel leaks.
  - 6. Provide a 20 year warranty to include coverage for exterior pre-finished surfaces to cover pre-finished color coat against chipping, cracking or crazing, blistering, peeling, chalking or fading.
  - 7. Provide a 20 year warranty for weather tightness of building enclosure elements after installation.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Basis of Design: Products specified on the Drawings are products of Butler Manufacturing. Products of other approved manufacturers shall be allowed provided they meet the quality level and design intent of the specified products.
- B. Manufacturer: Subject to compliance with specified requirements, provide metal building systems provided by the following manufacturer's;
  - 1. Butler Manufacturing Co.
  - 2. Varco Pruden Building Systems
  - 3. Ceko Building Systems

4. American Buildings
5. Nucor Building Systems
6. or approved equal.

## 2.02 STRUCTURAL FRAMING MATERIALS

- A. W-Shapes: ASTM A992/A992M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
- B. Channels, Angles, M-Shapes, and S-Shapes: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55 ; or ASTM A529/A529M, Grade 50 or 55.
- C. Plate and Bar: ASTM A36/A36M; ASTM A572/A572M, Grade 50 or 55; or ASTM A529/A529M, Grade 50 or 55.
- D. Steel Pipe: ASTM A53/A53M, Type E or S, Grade B.
- E. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B or C, structural tubing.
- F. Structural-Steel Sheet: Hot-rolled, ASTM A1011/A1011M, Structural Steel (SS), Grades 30 through 55, or High-Strength Low Alloy Steel (HSLAS), Grades 45 through 70; or cold-rolled, ASTM A1008/A1008M, Structural Steel (SS), Grades 25 through 80, or High-Strength Low Alloy Steel (HSLAS), Grades 45 through 70.
- G. Metallic-Coated Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grades 33 through 80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80; with G60 coating designation; mill phosphatized.
- H. Metallic-Coated Steel Sheet Pre-painted with Coil Coating: Steel sheet metallic coated by the hot- dip process and pre-painted by the coil-coating process to comply with ASTM A755/A755M.
  1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grades 33 through 80 or High-Strength Low Alloy Steel (HSLAS), Grades 50 through 80; with G90 coating designation.
  2. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A792/A792M, Structural Steel (SS), Grade 50 or 80; with Class AZ50 (AZM150) coating.
- I. Non-High-Strength Bolts, Nuts, and Washers: ASTM A307, Grade A, carbon-steel, hex-head bolts; ASTM A563 carbon-steel hex nuts; and ASTM F844 plain (flat) steel washers.
  1. Finish: Plain.
- J. High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy hex steel structural bolts; ASTM A563 heavy hex carbon-steel nuts; and ASTM F436 hardened carbon-steel washers.
  1. Finish: Plain.
  2. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex-head steel structural bolts with splined ends.
    - a. Finish: Plain.

- K. High-Strength Bolts, Nuts, and Washers: ASTM A490, Type 1, heavy hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563 heavy hex carbon- steel nuts; and ASTM F436 hardened carbon-steel washers, plain.
- L. Unheaded Anchor Rods: ASTM A307, Grade A.
  - 1. Configuration: Straight.
  - 2. Nuts: ASTM A563 heavy hex carbon steel.
  - 3. Plate Washers: ASTM A36/A36M carbon steel.
  - 4. Washers: ASTM F436 hardened carbon steel.
  - 5. Finish: Galvanized.
- M. Headed Anchor Rods: ASTM A307, Grade A, straight.
  - 1. Nuts: ASTM A563 heavy hex carbon steel.
  - 2. Plate Washers: ASTM A36/A36M carbon steel.
  - 3. Washers: ASTM F436 hardened carbon steel.
  - 4. Finish: Galvanized.
- N. Threaded Rods: ASTM A307, Grade A.
  - 1. Nuts: ASTM A563 heavy hex carbon steel.
  - 2. Washers: ASTM A36/A36M carbon steel.
  - 3. Finish: Galvanized.
- O. Primer: SSPC-Paint 15, Type I, red oxide.

## 2.03 MISCELLANEOUS MATERIALS

- A. Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide fasteners with heads matching color of materials being fastened by means of plastic caps or factory-applied coating.
  - 1. Fasteners for Metal Roof Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with a stainless-steel cap or zinc-aluminum-alloy head and EPDM or neoprene sealing washer.
  - 2. Fasteners for Metal Wall Panels: Self-drilling or self-tapping, zinc-plated, hex-head carbon-steel screws, with nylon or polypropylene washer.
  - 3. Fasteners for Metal Roof and Wall Panels: Self-drilling Type 410 stainless-steel or self-tapping Type 304 stainless-steel or zinc-alloy-steel hex washer head, with EPDM or PVC washer under heads of fasteners bearing on weather side of metal panels.
- B. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4- mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

- C. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30- minute working time.
- D. Metal Panel Sealants:
  - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing.
  - 2. Joint Sealant: ASTM C920; one-part elastomeric polyurethane, polysulfide, or silicone- rubber sealant.

#### 2.04 FABRICATION, GENERAL

- A. Tolerances: Comply with MBMA's "Metal Building Systems Manual": Chapter IV, Section 9, "Fabrication and Erection Tolerances."
- B. Metal Panels: Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of metal panel.

#### 2.05 STRUCTURAL FRAMING

- A. General:
  - 1. Primary Framing: Shop fabricated framing components to indicated size and section with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.
    - a. Make shop connections by welding or by using high-strength bolts.
    - b. Join flanges to webs of built-up members by a continuous submerged arc-welding process.
    - c. Brace compression flange of primary framing with steel angles or cold-formed structural tubing between frame web and purlin or girt web, so flange compressive strength is within allowable limits for any combination of loadings.
    - d. Shop Priming: Prepare surfaces for shop priming according to SSPC-SP 2. Shop prime primary structural members with specified primer after fabrication.
  - 2. Secondary Framing: Shop fabricate framing components to indicated size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.
    - a. Shop Priming: Prepare uncoated surfaces for shop priming according to SSPC- SP 2. Shop prime uncoated secondary structural members with specified primer after fabrication.

- B. Primary Framing: Manufacturer's standard structural primary framing system, designed to withstand required loads and specified requirements. Primary framing includes rafter, rake, and canopy beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing. Provide frames with attachment plates, bearing plates, and splice members. Factory drill for field-bolted assembly. Provide frame span and spacing indicated.
1. Rigid Modular Frames: I-shaped frame sections fabricated from shop-welded, built-up steel plates or structural-steel shapes. Provide interior columns fabricated from round steel pipe or tube, or shop-welded, built-up steel plates.
  2. Frame Configuration: Single gable.
  3. Exterior Column Type: Uniform depth or Tapered, as indicated on drawings
  4. Rafter Type: Uniform depth and Tapered.
- C. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly to comply with the following:
1. End-Wall and Corner Columns: I-shaped sections fabricated from structural-steel shapes; shop-welded, built-up steel plates; or C-shaped, cold-formed, structural-steel sheet; with minimum thickness of 0.0598 IN.
  2. End-Wall Rafters: C-shaped, cold-formed, structural-steel sheet; with minimum thickness of 0.0598 IN; or I-shaped sections fabricated from shop-welded, built-up steel plates or structural-steel shapes.
- D. Secondary Framing: Manufacturer's standard secondary framing members, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Fabricate framing from cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet pre-painted with coil coating, unless otherwise indicated, to comply with the following:
1. Purlins: C- or Z-shaped sections; fabricated from minimum 0.0598 IN thick steel sheet, built-up steel plates, or structural-steel shapes; minimum 2-1/2 IN wide flanges.
    - a. Depth: As indicated on the Drawings.
  2. Girts: C- or Z-shaped sections; fabricated from minimum 0.0598 IN thick steel sheet, built-up steel plates, or structural-steel shapes. Form ends of Z-sections with stiffening lips angled 40 to 50 degrees to flange and with minimum 2-1/2 IN wide flanges.
    - a. Depth: As indicated on the Drawings.
  3. Eave Struts: Unequal-flange, C-shaped sections; fabricated from 0.0598 IN thick steel sheet, built-up steel plates, or structural-steel shapes; to provide adequate backup for metal panels.
  4. Flange Bracing: Minimum 2 x 2 x 1/8 IN structural-steel angles or 1 IN DIA, cold-formed structural tubing to stiffen primary frame flanges.
  5. Sag Bracing: Minimum 1 x 1 x 1/8 IN structural-steel angles.
  6. Base or Sill Angles: Minimum 3 x 2 x 0.0598 IN zinc-coated (galvanized) steel sheet.

7. Purlin and Girt Clips: Minimum 0.0598 IN thick, steel sheet. Provide galvanized clips where clips are connected to galvanized framing members.
  8. Secondary End-Wall Framing: Manufacturer's standard sections fabricated from minimum 0.0598 IN thick, zinc-coated (galvanized) steel sheet.
  9. Framing for Openings: Channel shapes; fabricated from minimum 0.0598 IN thick, cold-formed, structural-steel sheet or structural-steel shapes. Frame head and jamb of door openings, and head, jamb, and sill of other openings.
  10. Miscellaneous Structural Members: Manufacturer's standard sections fabricated from cold-formed, structural-steel sheet; built-up steel plates; or zinc-coated (galvanized) steel sheet; designed to withstand required loads.
- E. Bracing: Provide adjustable wind bracing as follows:
1. Rods: ASTM A36/A36M; ASTM A572/A572M, Grade 50; or ASTM A529/A529M, Grade 50 ; minimum 1/2 IN DIA steel; threaded full length or threaded a minimum of 6 IN at each end.
  2. Cable: ASTM A475, 1/4 IN DIA, extra-high-strength grade, Class B zinc-coated, 7-strand steel; with threaded end anchors.
  3. Angles: Fabricated from structural-steel shapes to match primary framing, of size required to withstand design loads.
  4. Rigid Portal Frames: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
  5. Fixed-Base Columns: Fabricate from shop-welded, built-up steel plates or structural-steel shapes to match primary framing; of size required to withstand design loads.
  6. Diaphragm Action of Metal Panels: Design metal building to resist wind forces through diaphragm action of metal panels.
  7. Bracing: Provide wind bracing using any method specified above, at manufacturer's option.
- F. Bolts: Provide plain finish bolts for structural-framing components that are primed or finish painted. Provide hot-dipped galvanized bolts for structural-framing components that are galvanized.
- G. Factory-Primed Finish: Apply specified primer immediately after cleaning and pretreating.
1. Prime primary, secondary, and end-wall structural-framing members to a minimum dry film thickness of 1 mil.
    - a. Prime secondary steel framing formed from uncoated steel sheet to a minimum dry film thickness of 0.5 mil on each side.
  2. Prime galvanized members with specified primer, after phosphoric acid pretreatment.



## 2.06 METAL ROOF PANELS

- A. Butler “MR-24” Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and flat pan between ribs containing cross flutes; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels and engaging opposite edge of adjacent panels.
- B. 24 gage galvanized (G-90 coating), per ASTM A653 (G90), and painted with a full strength, 70 percent Kynar® 500 or Hylar 5000® fluoropolymer coating. Manufacturer shall warrant that coating shall not peel, crack or chip for 25 years. For a period of 25 years chalking shall not exceed ASTM D4214 #8 rating and will not fade more than 5 color difference units per ASTM D2244.
- C. Panels of maximum possible lengths shall be used to minimize endlaps, eave panels shall extend beyond the structural line of the sidewall.
- D. Panels shall be factory punched at panel end to match factory punched holes in the eave structural member. Panel end splices shall be factory punched and factory notched. The panel end laps shall be located directly over, but not fastened to, a supporting secondary roof structural member and be staggered, so as to avoid a four panel lap splice condition. End laps shall be floating which allows the roof panels to expand and contract with roof panel temperature changes.
- E. Ridge assembly shall be designed to allow roof panels to move lengthwise with expansion/contraction as the roof panel temperature changes. Parts shall be factory punched for correct field assembly. Panel closures and interior reinforcing straps shall be installed to seal the panel ends at the ridge. The attachment fasteners shall not be exposed on the weather side. A lock seam plug shall be used to seal the lock seam portion of the panel. A hi-tensile steel ridge cover shall span from panel closure to panel closure and flex as the roof system expands and contracts

## 2.07 CONCEALED FASTENER METAL WALL PANELS

- A. Butler “Stylwall” Concealed-Fastener Embossed Finish Metal Wall Panels: Panels shall be 16 IN wide with interlocking joints and embossed finish. Panels shall be roll formed to provide a flat panel with a hidden joint concealing the fasteners between panels. The flat of panel shall be laminated to Thermax® insulation board to provide rigidity, maintain flatness, and improve thermal performance.
- B. Panels shall be one piece from base to top of wall with a maximum length of 40 FT-0 IN.
- C. Both ends of each panel shall be square cut and unpunched.
- D. Panel design shall be in accordance with the 2004 edition of the AISI “North American Specification for the Design of Cold-Formed Steel Structural Members”, and in accordance with sound engineering methods and practices.
- E. The flat wall panel material as specified shall be a minimum 26 gage galvanized steel conforming to ASTM A653 (G90) latest issue.
- F. The panel exterior shall be pre-finished in a full strength, 70 percent Kynar® 500 or Hylar 5000® fluoropolymer coating. Manufacturer warrants that coating shall not peel, crack or chip for 25 years. For a period of 25 years chalking shall not exceed ASTM D4214 #8 rating and will not fade more than 5 color difference units per ASTM D2244.

## 2.08 METAL SOFFIT PANELS

- A. General: Provide factory-formed metal soffit panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.
- B. Metal Soffit Panels: Match material of metal wall panels.
  - 1. Color and Finish: As selected by Architect from manufacturer's full range.
- C. Concealed-Fastener Metal Soffit Panels: Formed with vertical panel edges and flush surface; with flush joint between panels; with 1 IN wide flange for attaching interior finish; designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps.
  - 1. Material: Zinc-coated (galvanized) steel sheet, 24 GA.
    - a. Exterior Finish: Fluoropolymer.
    - b. Color: As selected by Architect from manufacturer's full range.
  - 2. Panel Coverage: 16 IN.
  - 3. Panel Height: 1.5 IN.

## 2.09 ACCESSORIES

- A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
- B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels, unless otherwise indicated.
  - 1. Closures: Provide closures at eaves, ridges and any other openings, fabricated of same material as metal roof panels.
  - 2. Clips: Manufacturer's standard, formed from stainless-steel sheet, designed to withstand negative-load requirements.
  - 3. Cleats: Manufacturer's standard, mechanically seamed cleats formed from stainless-steel sheet or nylon-coated aluminum sheet.
  - 4. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  - 5. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1 IN thick, flexible closure strips; cut or pre-molded to match metal roof panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

- C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.
  - 1. Closures: Provide closures at top, bottom and all openings, fabricated of same material as metal wall panels.
  - 2. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1 IN thick, flexible closure strips; cut or pre-molded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- D. Flashing and Trim: Formed from minimum 0.0159 IN thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating; finished to match adjacent metal panels.
  - 1. Opening Trim: Minimum 0.0269 IN thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating. Trim head and jamb of door openings, and head, jamb, and sill of other openings.
- E. Gutters and Downspouts: Fabricate of 22 GA aluminum-zinc alloy-coated steel, finished to match roof fascia and rake trim. Match profile of gable trim, complete with end pieces, outlet tubes, and other special pieces as required.
  - 1. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.
  - 2. Fabricate, support straps of same material and finish as gutters and-downspouts, color to match fascia.
  - 3. Gutter Supports: Fabricated from same material and finish as gutters; spaced 36 IN OC.
  - 4. Downspout Mounting Straps: Fabricated from same material and finish as gutters; spaced 10 FT OC.
- F. Roof Curbs: Fabricated from minimum 0.0428 IN thick, metallic-coated steel sheet or aluminum-zinc alloy-coated steel sheet pre-painted with coil coating; finished to match metal roof panels; with welded top box and bottom skirt, and integral full-length cricket; capable of withstanding indicated loads and of size and height indicated.
  - 1. Insulation: 1 IN thick, rigid type.
  - 2. Pipe Flashing: Pre-molded, EPDM pipe collar with flexible aluminum ring bonded to base.

## 2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform the following tests and inspections and to submit reports.

- B. Special Inspector: Owner will engage a qualified special inspector to perform the following tests and inspections and to submit reports. Special Inspector will verify that manufacturer maintains detailed fabrication and quality-control procedures and will review the completeness and adequacy of those procedures to perform the Work.
  - 1. Special inspections will not be required if fabrication is performed by a manufacturer registered and approved by authorities having jurisdiction to perform such Work without special inspection.
    - a. After fabrication, submit certificate of compliance with copy to authorities having jurisdiction certifying that Work was performed according to Contract requirements.
- C. Tests and Inspections:
  - 1. Bolted Connections: Shop-bolted connections shall be inspected according to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts."
  - 2. Welded Connections: In addition to visual inspection, shop-welded connections shall be tested and inspected according to AWS D1.1.

## PART 3 - EXECUTION

### 3.01 ERECTION

- A. Before erection proceeds, engage land surveyor to survey elevations and locations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments to receive structural framing, with Erector present, for compliance with requirements and metal building system manufacturer's tolerances.
- B. Provide temporary shores, guys, braces, and other supports during erection to keep structural framing secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural framing, connections, and bracing are in place, unless otherwise indicated.
- C. Erect metal building system according to manufacturer's written erection instructions and erection drawings.
- D. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.
- E. Set structural framing accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section. Maintain structural stability of frame during erection.
- F. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
  - 2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.

3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- G. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Level and plumb individual members of structure.
- H. Primary Framing and End Walls: Erect framing true to line, level, plumb, rigid, and secure. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist cure grout for not less than seven days after placement.
  1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A325 or A 490 Bolts" for type of bolt and snug-tightened or pre-tensioned joints.
- I. Secondary Framing: Erect framing true to line, level, plumb, rigid, and secure. Fasten secondary framing to primary framing using clips with field connections using non-high-strength bolts.
  1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
  2. Locate and space wall girts to suit openings such as doors and windows.
  3. Provide supplemental framing at entire perimeter of openings, including doors, windows, louvers, ventilators, and other penetrations of roof and walls.
- J. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.
  1. Tighten rod and cable bracing to avoid sag.
  2. Locate interior end-bay bracing only where indicated.
- K. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.
- L. Erection Tolerances: Maintain erection tolerances of structural framing within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

### 3.02 METAL PANEL INSTALLATION, GENERAL

- A. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.
  1. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
  2. Install metal panels perpendicular to structural supports, unless otherwise indicated.

3. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
  4. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
  5. Lap metal flashing over metal panels to allow moisture to run over and off the material.
- B. Lap-Seam Metal Panels: Install screw fasteners with power tools having controlled torque adjusted to compress neoprene washer tightly without damage to washer, screw threads, or metal panels. Install screws in predrilled holes. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation.
- C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.
- D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal panel manufacturer.

### 3.03 METAL ROOF PANEL INSTALLATION

- A. General: Provide metal roof panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Install ridge and hip caps as metal roof panel work proceeds.
- B. Field-Assembled, Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended by manufacturer.
1. Install clips to supports with self-tapping fasteners.
  2. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
  3. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
  4. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels for fasteners.
  5. Provide metal closures at peaks, rake edges, rake walls, and each side of ridge and hip caps.
- C. Field-Assembled, Lap-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint at location and spacing recommended by manufacturer.

1. Provide sealant tape at lapped joints of metal roof panels and between panels and protruding equipment, vents, and accessories.
  2. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps and on side laps of nesting-type metal panels; on side laps of ribbed or fluted metal panels; and elsewhere as needed to make metal panels weatherproof to driving rains.
  3. At metal panel splices, nest panels with minimum 6 IN end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.
- D. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Flash and seal metal panels with weather closures where fasciae meet soffits, along lower panel edges, and at perimeter of all openings.

### 3.04 METAL WALL PANEL INSTALLATION

- A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
1. When two rows of metal panels are required, lap panels 4 IN minimum.
  2. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
  3. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
  4. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
  5. Install screw fasteners in predrilled holes.
  6. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated, or if not indicated, as necessary for waterproofing.
  7. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws.
  8. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
- B. Field-Assembled, Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

### 3.05 METAL SOFFIT PANEL INSTALLATION

- A. Provide metal soffit panels full width of soffits. Install panels perpendicular to support framing.
- B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

### 3.06 THERMAL INSULATION INSTALLATION FOR FIELD-ASSEMBLED METAL PANELS

- A. General: Install insulation concurrently with metal wall panel installation, in thickness indicated to cover entire wall, according to manufacturer's written instructions.
  - 1. Set vapor-retarder-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.
  - 2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
  - 3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths with both sets of facing tabs sealed to provide a complete vapor retarder.
  - 4. Install blankets straight and true in one-piece lengths. Install vapor retarder over insulation with both sets of facing tabs sealed to provide a complete vapor retarder.
- B. Blanket Roof Insulation: Comply with the following installation method:
  - 1. Over-Framing Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Hold in place by metal roof panels fastened to secondary framing.
    - a. Between-Purlin Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder facing tabs up and over purlin, overlapping adjoining facing of next insulation course maintaining continuity of retarder. Hold in place with bands and crossbands below insulation.
  - 2. Over-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Install layer of filler insulation over first layer to fill space formed by metal roof panel standoffs. Hold in place by panels fastened to standoffs.
  - 3. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
- C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing members. Hold in place by metal wall panels fastened to secondary framing.
  - 1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.

### 3.07 DOOR AND FRAME INSTALLATION

- A. General: Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.
- B. Personnel Doors and Frames: Install doors and frames according to ANSI A250.8. Shim as necessary to comply with DHI A115.IG. Fit non-fire-rated doors accurately in their respective frames.



1. At fire-rated openings, install frames according to, and doors with clearances specified in, NFPA 80.

C. Field Glazing: Comply with installation requirements in Section 08 81 00 - Glazing.

### 3.08 WINDOW INSTALLATION

- A. Seal perimeter of each window frame with elastomeric sealant used for metal wall panels.
- B. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.
- C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.
- D. Field Glazing: Comply with installation requirements in Section 08 81 00 - Glazing.

### 3.09 ACCESSORY INSTALLATION

- A. General: 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 metal roof panel assembly including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
  2. Install components for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
- B. 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 as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
  1. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 FT with no joints allowed within 24 IN of corner or intersection.
- C. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 4 FT OC using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
- D. Downspouts: Join sections with 1-1/2 IN telescoping joints. Provide fasteners designed to hold downspouts securely 1 IN away from walls; locate fasteners at top and bottom and at approximately 60 IN OC in between.
  1. Provide elbows at base of downspouts to direct water away from building.
  2. Tie downspouts to underground drainage system indicated.

- E. Circular Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Mount ventilators on flat level base. Install preformed filler strips at base to seal ventilator to metal roof panels.
- F. Continuous Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Join sections with splice plates and end-cap skirt assemblies where required to achieve indicated length. Install preformed filler strips at base to seal ventilator to metal roof panels.
- G. Roof Curbs: Install curbs at locations indicated on Drawings. Install flashing around bases where they meet metal roof panels.
- H. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.
- I. Doors: After completing installation, test and adjust doors to operate easily, free of warp, twist, or distortion.
- J. Windows: Adjust operating sashes and ventilators, screens, hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.
- K. Roof Ventilators: After completing installation, including work by other trades, lubricate, test, and adjust units to operate easily, free of warp, twist, or distortion as needed to provide fully functioning units.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform the following tests and inspections and to submit reports.
- B. Special Inspector: Owner will engage a qualified special inspector to perform the following tests and inspections and to submit reports.
- C. Tests and Inspections:
  - 1. High-Strength, Field-Bolted Connections: Connections shall be inspected during installation according to RCSC's "Specification for Structural Joints Using ASTM A325 or A490 Bolts."
  - 2. Welded Connections: In addition to visual inspection, field-welded connections shall be tested and inspected according to AWS D1.1.
- D. Metal Building Roof Inspection: Engage a certified inspector to perform an examination of standing-seam roof panel assemblies, all roof penetrations and roof curbs for weather tightness and compliance with manufacturer's standards and details.
  - 1. Provide a written report to the Owner indicating satisfactory installation and condition, at a minimum, areas listed below:
    - a. Panel end laps
    - b. Ridge flashing
    - c. Rack trim
    - d. Eave trim

- e. Exterior gutter
- f. Valley gutter
- g. Hip flashing
- h. Penetrations
- i. Exhaust fan curbs
- j. Snow guard attachment

### 3.11 CLEANING AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780 and manufacturer's written instructions.
- B. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.
- C. Touchup Painting: After erection, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted structural framing, bearing plates, and accessories.
  - 1. Clean and prepare surfaces by SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning."
  - 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

### **END OF SECTION**

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## **SECTION 13 34 23 – PORTABLE AND MOBILE BUILDINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Prefabricated Modular Switch Crew Building
2. Prefabricated Modular Guard House building

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - UPRR General Requirements

#### **1.03 SUBMITTALS FOR REVIEW**

- A. Delegated-Design Submittal: For pre-fabricated building indicated to comply with performance requirements, including permit submittal signed and sealed by the qualified professional engineer responsible for their preparation.
- B. Design Calculations: Calculate requirements for seismic restraints.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- D. Certification: That prefabricated unit meets all California Code requirements for this type unit.
- E. Finish Samples: For each type of exposed finish in manufacturer's standards.
- F. Warranty: Sample of special warranty

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer who has specialized in installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer

#### **1.05 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace materials or workmanship that fail within specified warranty period.
- B. Warranty Period: Five years from date of Substantial Completion.

#### **1.06 PRE-INSTALLATION CONFERENCE**

- A. Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures related to installation of modular building including, but not limited to, the following:
- B. Inspect and discuss condition of foundations and other preparatory work performed by other trades including Utilities.

- C. Inspect site access and discuss installation and delivery plan.
- D. Review required testing, inspecting, and certifying procedures.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with requirements, manufacturers offering Prefabricated Modular units that may be incorporated in the Work include, but are not limited to, the following:
  - 1. Amtex
  - 2. William Scotsman.

### 2.02 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Prefabricated Modular Unit shall withstand loads and stresses within limits and under conditions indicated according to requirements of the State Code, where the unit will be installed and ASCE/SEI 7.
- B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
- 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. Regulatory Requirements: Comply with applicable provisions of the Federal and State Code for Accessibility for Persons with Disabilities and all other applicable Codes as stated on the drawings.

### 2.03 PREFABRICATED MODULAR BUILDING

- A. Basis-of-Design Product: Provide a complete, integrated set of mutually dependent components that form a completely assembled, prefabricated modular building, ready for installation on Project site.
  - 1. Prefabricated Modular Switch Crew Building
    - a. Subject to compliance with requirements, provide "William Scotsman Modular Office" or comparable. Size as indicated on the drawings.
    - b. Subject to compliance with requirements, provide a ramp and stair for access to the modular. Size as indicated on the drawings.
    - c. Provide a canopy over the entrance doors as indicated on the drawings.
    - d. See attached UPRR Prefabricated Modular Building Specification
  - 2. Prefabricated Modular Guard House building
    - a. Subject to compliance with requirements, provide "William Scotsman Modular Office" or comparable. Size as indicated on the drawings.
    - b. See attached UPRR Prefabricated Guard House Building Specification

## 2.04 FABRICATION, GENERAL

- A. Fabricate unit completely in factory.
- B. Preglaze windows and doors at factory.
- C. Prewire unit at factory, ready for connection to service at Project site.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install unit according to manufacturer's written instructions.
- B. Set unit plumb and aligned. Level baseplates true to plane with full bearing on concrete bases.
- C. Fasten unit securely to cast-in anchor bolts.
- D. Connect electrical power service to power distribution system according to requirements specified in Division 16 Sections.
- E. Connect plumbing according to requirements specified in Division 15 Sections.
- F. Perform startup-checks of all mechanical and electrical systems.
- G. Adjust doors, operable windows, and hardware to operate smoothly, easily, properly, and without binding. Confirm that locks engage accurately and securely without forcing or binding.
- H. Lubricate hardware and other moving parts.
- I. After completing installation, inspect exposed finishes and repair damaged finishes.

### **END OF SECTION**

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## SECTION 13 34 24 – PREFABRICATED MODULAR BUILDING

<b>UNION PACIFIC MODULAR BUILDING SPECIFICATIONS</b>	
<b>Revision: August 2016</b>	
<b>FOUNDATION</b>	
Design	Foundation design is site-specific based on soil conditions and local requirements
<b>STEEL FRAME</b>	
Type - Single Wide	Outrigger frame
Type - Double, Triple Wide	Perimeter frame
Size	Based on size of site-specific building
Base Pads	Concrete or ABS Pier Pads
<b>FLOOR SYSTEM</b>	
Bottom Board	Treated 3/8" plywood or 30 GA. metal belly pan R-30
Insulation	R-30, use two layers R-15 unfaced fiberglass batt
Decking (1st)	3/4" plywood T&G, or 1 1/8" T&G full width of module
Decking (2nd)	3/4" plywood T&G, or 1 1/8" T&G held back 6" from marriage line
Notes	12" high moisture barrier installed on perimeter at floor rim and end joists
Notes	Ship loose 12" 3/4" T&G plywood for filler strip at marriage line (standard)
Notes	Ship loose 24" 3/4" T&G plywood for filler strip at marriage line
<b>INTERIOR WALLS</b>	
Framing Typical	2x4 at 16" o/c, to above ceiling grid
Framing Restrooms	2x6 or 2x8 at 16" o/c, full height to rafters
Insulation	R-11 unfaced at restroom walls, full height
Plenum Walls	Full width of modules, lined with 5/8" sheetrock for sound attenuation
<b>INTERIOR FINISHES</b>	
Floor Covering (1) Standard - Non-Wet Areas	1/8" x 12" x 12" VCT, Off-set Layout, Hold back at marriage line.
Floor Covering (2) Standard - Wet Areas	Commercial Grade Sheet Vinyl, 0.080 in. minimum, Heat Welded Seams w/ Self Coved Wall Base (Restrooms, Locker Rooms, and Shower Areas)
Floor Covering (3) Alternate Option - Non-Wet Areas	Flexi-Tile Interlocking Floor Tiles: 20 x 20 x 7mm, Industrial Coin Pattern, Color: Black or Dark Grey
Floor Covering (4) Alternate Option - Non-Wet Areas	PROTECT-ALL Commercial Flooring as manufactured by Oscoda Plastics, Inc. Interlocking sheets 18" x 18" x 1/4" thickness, in color chosen from manufacturer's. Stainless Steel drain rings & Transition strips as provided by Oscoda Plastics.
Floor Covering (5) Alternate Option - Wet Areas	PROTECT-ALL Commercial Flooring as manufactured by Oscoda Plastics, Inc. Seam welded sheets 60" x 60" x 1/4" , in color chosen from manufacturer's. Stainless Steel drain rings & Transition strips as provided by Oscoda Plastics.

Wall Base (1) Typical	4" Rubber Base, Roppe
Wall Base (2) Wet Areas	Self Coved Sheet Vinyl
Interior Trim (1) Typical	Vinyl covered corner trim
Interior Wall Covering (1) Typical	3 5/8" Sound Batt Insulation, Vinyl wrapped Hard Board/Particle Board (Supply UPRR with colors)
Interior Wall Covering (2) Telecom	3/4" A-C plywood (A surface facing room interior), painted, fire retardant plywood wood full height on two walls
Interior Wall Covering (3) Wet Areas	Wainscot - Fiberglass reinforced panel per code, behind & beside mop sink to 48" AFF. Full height FRP on all plumbing walls with plumbing fixtures.
Adhesive	Low Volatile Organic Compound (VOC) Adhesive
<b>EXTERIOR WALLS</b>	
Framing	2x6 construction, 30# felt waterproofing membrane to extend up under the final 2x6 that caps the wall siding and/or the flat metal trim
Sheathing	7/16" OSB or 3/8" CDX plywood
Insulation	R-19
<b>ROOF STRUCTURE</b>	
Roof Insulation	R-30
Roof Treatment	60 mil. TPO or PVC Membrane , fully adhered to the decking (Color to be white), FM90 wind rating
Roof Decking	1/2" (15/32") Exterior Grade Plywood with H-clips
Gutters & Downspouts	Color matched aluminum gutters with downspouts each corner (4 total) to grade with splash blocks. .032" Thickness
<b>EXTERIOR FINISHES</b>	
Siding	(.0149) 26 GA R-Panel (Color - Ash Gray)
Trims/Fascia	(.0149) 26 GA R-Panel (Color - Ash Gray)
Skirting	(.0149) 26 GA R-Panel & Perforated R-Panel (Color - Ash Gray)
Entry Canopy	Install a "Mitchell Metals" (770) 431-7305, or UPRR approved equal canopy at each entry door the size of the platform (See photos "F" & "G"). Submit designs to UPRR for review and approval. Stamped drawings are required for permitting. Provide weatherproof lighting on photocell at each entry. Canopy gutter & downspout to be incorporated into the canopy. Canopy to be secured to pavement or concrete footing (See photo "O" attached).
Ramp and Stair Assembly	HC Accessible - Aluminum slip resistant platforms, stairs and ramps, guardrail and handrails. Ramp and stair designs to be submitted to to UPRR for review and approval. Stamped drawings are required for permitting. Platforms, stairs and ramps to be secured to pavement or concrete footings (See photos "D" & "E" attached).
Step Assembly	HC Accessible - Aluminum slip resistant platform and steps, guardrail and handrails (See photo "F" attached). Stair Assembly to be secured to pavement or concrete footings.
<b>DOORS</b>	

Exterior Door	Insulated Steel Door and Frame (18 Gauge Min) w/ Commercial Grade Hardware, Markar continuous Hinge 16 GA. Galvanneal.
Frame	Steelcraft 16 gauge steel frames with mitered corners, continuously welded construction
Hinges	Tell 4545 Stainless steel, ball bearing, non-removable pin or equivalent
Finish	Painted
Hardware Exterior Doors	Exterior - Kaba PowerPlex 2000 10 Key Push Button Lock, Satin Chrome Finish, Lever (ADA) Compliant. Interior - Compatable Panic Bar Exit Device . (See Photo "Q" attached)
Hardware Interior	Commercial grade.
Telecom Closet	Arrow ML Series: (1) Arrow Lockset Lever ML11-26D-ACY406N: Lock, Gr 2 MD Cyl Lever Lockset, Entry Fnct, ML11-26D-ACY406N Locking Systems, Protec Cylinder CY406N-3, No Keys, Telecom Only.
Closer - Exterior	Lcn4041 RW/PA AL Hydraulic door closer (See photo "A" attached).
Interior Door	Solid core with commercial grade hardware (See photo "B" attached).
Door Stops	Floor mounted (See photo "C" attached).
<b>WINDOWS</b>	
Exterior Window (1)	Mfr. Standard, 36" x 48", aluminum framed, dual glazed, Low E, horizontal slider
Exterior Window (2)	Mfr. Standard, 36" x 36", aluminum framed, dual glazed, Low E, horizontal slider
Notes	Window manufacturers vary by region, specify manufacturer standard
Window Covering	1" metal horizontal blinds, color to be selected.
Window Security	Security Shield Window Barriers, interior side hinged mount, Impact Level 1 (See photos "H" & "I" attached).
<b>PLUMBING</b>	
HC Toilet	Handicap height, elongated bowl, flush valve if adequate water pressure is available
Std. Toilet	Standard height, elongated bowl, flush valve if adequate water pressure is available
HC Urinal	Handicap height, wall mounted, flush valve operated
Urinal	Standard height, wall mounted, flush valve operated
Flush Valve	1 gallon flush cycle, handicap handle
Lavatory	Lavatory & Faucet: 22" x 19" Wall Hung; One Piece Wall Hanger; ADA (See photo "L" attached). (Kohler Hampton K-2703-EH Lav; Kohler K-8046-5A Sink Faucet w/ Grid Drain and Wristblade Handles)
Lavatory Faucet	Ceramic disc, hot limit stop, ADA lever handle
Wash-Up Sink (ADA) - Alternate Option	ADA Wash-Up Hand Sink, Stainless Steel w/ Electronic Faucets. Manufacturer: Best Sheet Metal, Inc. See design submittals for size and model number. (See Photo "P" Attached)
Sink - Crew Room	ADA compliant stainless steel, 18 GA, to install with garbage disposall. Additional information on bid detail sheet.
Sink Faucet - Crew Room	Kohler ADA single handle, swing spout with sprayer
Mop Sink	24" x 24" x 10" molded stone, floor mount, 2" drain
Mop Faucet	830-AA Faucet
HC Shower Stall	One piece, gel coat finish, grab bars and seat ADA approved (white)
Shower Valve	Ceramic disc, hot limit stop, ADA handle, P.B. Adjustable height
HC Hose Kit	Commercial Grade

UP General Specifications

PREFABRICATED MODULAR BUILDING

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12 48 13-3

Water Heater	Electric Water Heater - Size based on Occupancy w/ H.D. Fusible Disconnect
Floor Drains	PVC body, polished nickel ring & grate, set in webcrete; accessible trap primers
Trap Primer	Automatically activated at pressure drops
Ice Maker/ Ref Water Valve	Recessed in wall with valve 1/2 x 1/4
Floor Sink	Porcelain with 1/2 grate and dome strainer
Sewer Lines	PVC DWV Schedule 40 plastic
Water Lines	Type L Copper Only
Backflow Preventer	Conbraco Series 40-200, RPZ, Reduced Pressure Principle Backflow Preventer - Size to match Modular Water Lines. A discharge line to be piped from the air gap at the relief valve connection thru the floor to the modular building perimeter. Backflow Preventer to be located in the Janitor Closet.
Hose Bibs	Frost Free, Qnty. 2 min. per building (See Floor Plan for Location)
<b>ELECTRICAL</b>	
Shower Light	Provide a shower light. Fixtures: (Damp Location Listed - Area that encompasses 8 feet above shower curb and 3 ft horizontally on all sides) (Wet Location listed - Subject to shower spray)
Restroom Power at Lavatory	Provide GFI outlet, one for each wall mount lavatory. (No GFI Main panel breakers)
Pipe Heating System	Braided Frostex pipe freeze protection system with a 9800 FlexFit Plug Kit. Provide outlets under Modular.
Panelboard	All panelboards must use: bolt-on circuit breakers and manufactured by Square D; short circuit rating appropriate for available fault current; and 30% spare capacity and breaker space. When modular is furnished with 1 panelboard or 1 main breaker, provide a main circuit breaker panelboard (may feed sub-panelboard). When modular is furnished with multiple panelboards, provide main lug only panelboards.
Special Purpose Receptacle	Exterior must be GFCI type with weather proof while-in-use cover; individual circuit with 20A duplex receptacle for each of the following: photocopy machine, in communications room, for each vending machine, in restroom/changing area, for use with microwave or coffee pot. Individual 30A duplex receptacle GFCI receptacle for each ice machine. Exterior Ice machine receptacle to have metallic, weather proof while-in-use cover and GFCI receptacle for each ice machine. For each crew computer & printer need Individual 20A duplex receptacle with a counter height duplex receptacle and communication outlet.
Wiring	Minimum branch circuit wire no. 12 AWG copper. Pilot and control can be no. 14 AWG copper. Wire needs to be THW, THWN, or THWN insulation.
Raceways	Inside walls need electrical metallic tubing with compression couplings
Service Conduits/Conduits	Underground and exposed conduit must be rigid galvanized steel.
Communication/Sig naling Cable	Two (2) four-inch diameter conduit to room, terminating in insulating bushing. One (1) two-inch diameter conduit for TMGB grounding.
Communication Data Outlet	One (1) one-inch conduit (pull wire, communication outlet boxes, and grounding required by code)
Lighting (Electrical)	Dual level switching or motion sensor control when required by Federal, State, and Local requirements; heavy duty fusible disconnect switches for electric water heaters.

Fixtures	Linear fluorescent fixtures w/T-8, 32 Watt lamps, 10% THD electronic ballasts; exterior, cut off lighting fixtures controlled by photo electric cells for each exit; 2 level switch for all rooms; dimming lights only for conference rooms. Exit signs with self-contained, battery operated back up units; all lighting must comply with Illuminating Engineering Society (IES)
Electrical Note	See UPRR Modular Electrical Standards.pdf for further information on modular design requirements.
<b>HVAC</b>	
Combo Heat/AC	Bard Unit - wall hung air conditioners or heat pump-depending on region. Provide condensation hose, extend to exterior building surface or storm drain.
Size	Sized based on region. Minimum 2.5 ton with 10 kw heat strip. One per module.
Testing & Balancing	HVAC System to be test and balanced by a qualified third party agency. Report to be provide to UPRR for review.
Supply Ducting	Mfr. Standard overhead with insulated flex duct with flex duct sound isolation sleeves and flow controls at supply plenums.
Return Ducting	Overhead insulated flex duct
Diffusers	24" x 24" t-bar with manual dampers
Thermostat	7 Day programmable
Duct Detectors	Duct smoke detectors installed at return plenums
Return Air	Through return air grills in ceiling ducted back to plenum walls
Outside Air	At machines
HVAC Vibration	Provide boot at plenum/duct connections
Exhaust Fan (1)	180 CFM, switched with lights
Exhaust Fan (2)	400 CFM, switched with lights
Exhaust Fan (3)	180 CFM, on thermostat in telecom room
<b>SPECIALTIES</b>	
Restroom Accessories	Kimberly-Clark - Paper Towel Dispenser, Toilet Tissue Dispenser, Soap Dispenser, Toilet Seat Cover Dispenser (See Union Pacific Standard Dispenser Reference Information)
Mirror	Bobrick B-165, 18" x 36"
Waste Receptacle	Bobrick B-3645
Feminine Hygiene Products	Bobrick B-270 - Surface Mounted - Sanitary Napkin Disposal
Grab Bars	36" and 42" Horizontal, 18" Vertical
Shower Rod & Curtain	3' with PVC Curtain
Toilet Partitions	Metal, Floor Mounted, Standard Colors
ADA Dressing Table/Bench (If shown on drawing)	ADA dressing table to be 24"d by 48" w, wall mounted, folding with padded naugahyde seat located across or near the ADA shower (See photo "N" attached). ( <a href="http://www.wheelsunlimited.com/benches.html">http://www.wheelsunlimited.com/benches.html</a> )
Lockers	Installed metal lockers to be louvered with number plates, continuous sloped metal top, finished end panels, zee bases and recessed locks, see project floor plan for size and configuration. Lockers to be welded (not riveted or bolted) Republic Storage Systems or Equivalent.
Benches	10" maple tops with painted steel pedestals, see project floor plan for size and quantity. Republic Storage Systems or Equivalent.

<b>CABINETS</b>	
Coffee Bar	Base and Upper Cabinets (Wilsonart or Formica) plastic laminate finish, recessed hinges. Satin Nickel Arch Bar Cabinet Drawer Pulls.
Countertop	Countertop (Wilsonart or Formica) plastic laminate with plastic laminate backsplash and self edge
Key Storage Cabinet	Wall mounted metal cabinet, locking with Key Tags. Compact Locking Key Cabinet # 11-01155 or Equal Shipped Loose: Location to be determined by owner during turnover.
<b>TELECOM</b>	
Cable Tray	Provide and install 6" in-ceiling cable tray, see UP Telecom Specs for further detail and how to install.
Communications Conduit	1" conduit run from designated communications closet to all offices and computer locations with pull lines included 1" conduit from all communication wall j-boxes to cable tray above ceiling.
Telecommunication s Closet	1) Hardware: Arrow ML Series 2) One, (see print) or more, wall of the closet shall be lined with rigidly installed, wall-to-wall framing of Trade Size ¾ -inch A-C plywood, 8-ft. (2.4-m) high painted white. 3) The closet shall include dedicated 3-wire 120V AC – 20 ampere quad outlets on separate branch circuits. (see UPRR drawing for location and quantity) 4) The closet shall also include dedicated 20amp 110V female twist lock on 20amp circuits, Mounted at ceiling tile level, pendent mounted, supported from roof structure. (see UPRR drawing for location and quantity). 5) GND bar (TMGB) should have be connected to electrical MGB. Bonding conductor should be sized to UP Telecom Standards, a minimum 2awg.
Communications Closet Doors	Louvered doors with lockset
Communications Room Lighting	Flourescent - Lights should be positioned so that there is plenty of light behind and in front of racks. Lighting equivalent to 540 lux (50 foot-candles). Do not mount on rear wall.
Terminating Space	1) The terminating space for the service entrance shall have a ¾ -inch trade size (20 mm) A-C plywood backboard, 8-ft. (2.4-m) high. 2) The terminating space shall include a 120V, 20-amp. AC power outlet 1 m (3 ft.) above the floor. Do not center on back wall.
Office Outlets	1) Private offices should have a 1" telecom conduit in the two side walls as well as the back wall of enclosed offices. 2) Larger private offices for Supt.'s, Gen. Managers, etc should have a 1" telecom conduit on the front wall. 3) (If Noted on power plan) Conference Rooms will require one 1" conduits under the finished floor for telecom data and one 1.5" conduit for AV cables, to the center of the room, as well as the wall conduits. See telecom standards.
Grounding, Bonding, Electrical Protection	Multiple buss-bars placed in a building shall be directly bonded with, minimally, a 2-AWG copper conductor.
Pathways	1) Flex tray is recommend for overhead installation in office buildings. 2) Flex Trays-2"x12"x10', CF54/300-10 GS METALS 3) Flex tray hardware GS METALS 4) For in floor raceway systems recommend: (slab concrete floor) 5) Walkerdut DD22430 No. 2 Duct for power and D42430 No.4 Duct for voice and cabling. <a href="http://www.wiremold.com/product_catalog/walker/index.html">http://www.wiremold.com/product_catalog/walker/index.html</a>

Firestop Equipment	EX Path Firestop Equipment: (QTY. 1) EZP544W Mounting Plate, (QTY. 1) EZD44S Pathways and (QTY .1) EZRCM44S Module.(See photo "R" attached)
Telecom Note	See UPRR Telecom Standards_Rev K.pdf for further information on modular design requirements.
<b>OTHER</b>	
Payment Terms and Conditions	Supplier may invoice for 100% of project cost upon completion of site setup. UPRR will release 90% of payment, and hold 10% in retainage. Once modular has been delivered and walk through has been completed, Supplier must submit a retainage invoice (for the outstanding 10%) along with a notarized release of liens indicating that all subcontractors have been paid to the Railroad Architect.
Floor Cleaning and Sealing	Perform the following operations immediately after completion of unit: 1. Remove visible adhesive and other surface blemishes using cleaner recommended by tile manufacturers. 2. Sweep or vacuum floor thoroughly 3. Do not wash floor until after time period recommended by resilient floor tile manufacturer 4. Damp-mop tile to remove black marks and soil. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended by tile manufacturer 5. Apply protective floor polish to tile surfaces, no more than 4 days prior to inspection, that are free from soil, visible adhesive, and surface blemishes. Use commercially available, tile manufacturer approved protective floor polish and sealer after cleaning.
Turnover Meeting - General	Turnover meeting - onsite meeting will be held between the modular building company representative and the local customer to review all mechanical and electrical system operations, warranties and warranty service contacts with the customer. This includes fire alarm system operations if installed. The modular building company shall provide copies of all warranties, guarantees and O&M manuals for all equipment and building components installed. All building keys to be turned over to the customer.
Turnover Meeting - Testing & Cleaning	Testing and cleaning - upon completion of the work involved, the modular building company shall clean the interior and exterior of the modular building and surrounding grounds occupied in connection with the work and shall remove all rubbish (to a location off-site), excess materials, and equipment, leaving the location of the work clean to the satisfaction of the Railroad Project Manager. The exterior of the modular building to be power washed if the project engineer deems it necessary. All floors to be cleaned and sealed. HVAC system to be tested and balanced by qualified third party, report to be provided for UPRR for review.
Turnover Meeting - Operation & Maintenance (O&M) Manuals	Operation and Maintenance Manuals - The contractor shall provide two sets of O&M manuals w/ CD copies for all equipment provided in the work. One set to be given to the new occupant of the modular building and the other to be sent to the Railroad Project Manager.



Photo A



Photo B



Photo C



Photo D



Photo E





Photo F



Photo G



Photo H



Photo I



Photo J



Photo K



Photo L



Photo M



Photo N



Photo O



Photo P



Photo Q



Photo R

**END OF SECTION**

## **SECTION 13 47 13 - CATHODIC PROTECTION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Cathodic protection.
- B. Contractor shall design and install Cathodic protection system to conform to NACE SP0169 (formerly RP0169), Current Edition - Recommended Practice, Control of External Corrosion on Underground or Submerged Metallic Piping Systems. Design and installation shall be by individuals certified by NACE.

#### **1.02 RELATED SECTIONS**

- A. 40 46 50 Cathodic Protection-Impress Current
- B. 40 46 51 Cathodic Protection-Galvanic

#### **1.03 REFERENCED STANDARDS**

- A. National Association of Corrosion Engineers (NACE) International Standard Practice (SP) 0169.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data.
  - a. Provide submittal data for all products specified in this Specification Section.
  - b. See Specification Section 26 05 00 for additional requirements.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

## **END OF SECTION**

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## **SECTION 21 05 00 - FIRE PROTECTION AND ALARM SYSTEMS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

**A. Section Includes:**

1. Fire detection and alarm system, including all associated equipment, devices, and controls necessary for proper operation.

**B. Coordinate this Section with 21 13 13 -Sprinkler Systems.**

**C. The Contractor shall furnish all installation drawings, tools, equipment, materials, and supplies and shall perform all labor to complete the work as specified and in compliance with the codes, standards and regulations listed below.**

**D. The design of the system shall consist of, but not limited to:**

1. A determination of the applicable fire and safety codes.
2. Analysis of the various plant ambient temperatures, noise levels and environments (wet, dusty, oily, corrosive, hazardous, etc.).
3. Establishing the number of and type of detectors, alarm detectors, and manual stations required.
4. Identifying the proper wiring and mounting configurations.

#### **1.02 REFERENCED STANDARDS**

**A. Authority having jurisdiction's regulations for Safety to Life from Fire and Emergencies in Buildings and Structures, and General Fire Protection.**

**B. National Fire Protection Association, NFPA 71, 72, 90A, and 101.**

**C. National Electrical Code (NFPA 70)**

**D. The system shall be listed by Underwriters Laboratories and Factory Mutual.**

#### **1.03 GENERAL**

**A. Nameplates: Each component of equipment shall be identified with a permanently affixed nameplate bearing the manufacturer's name and address, and type or style and catalog number of the item.**

**B. Tags: Keys and locks shall be furnished with tags bearing stamped identification numbers. Cable and conduit runs, wiring circuits, and all spare parts supplied to maintain the system shall be furnished with hard phenolic or stainless steel tags.**

**C. Power Requirements:**

1. Power supply to the fire alarm control panel (FACP) will be 120 Volts, 60 Hz, Single phase.

2. The alarm system shall include an automatically recharged back-up power supply with sufficient battery capacity to operate the entire system in the normal supervisory mode for 24 HRS and then sound all alarms for five (5) minutes. In the event of power failure, the system shall automatically transfer to the standby batteries.
3. All external circuits requiring system operating power shall be suitable for 24 Volt DC service and shall be individually fused at the control panel.

D. Supplier's Qualifications:

1. The system design, equipment installation, and installation supervision furnished under this section shall be provided by a manufacturer who has been engaged in the production of this type of equipment for at least 10 years and has a fully-equipped service organization within fifty (50) miles of this installation.
2. All panels and peripheral devices shall be the standard products of a single manufacturer, and the manufacturer's name shall be displayed on each component. The system shall be manufactured by Cerberus Pyrotronics or Simplex Time Recorder Company.

E. Spare Parts: The following spare parts shall be supplied with the fire detection and alarm system. Spare parts shall be suitably packaged for shipment.

1. One each type of smoke detector and heat detector.
2. One each type of manual pull station and audiovisual alarm.

#### 1.04 SUBMITTALS

- A. Submit as specified in Section 01 33 00.
- B. Complete electrical wiring diagrams, assembly and installation drawings, detailed specifications, and data covering the materials used and the parts, devices, and other accessories forming a part of the equipment furnished shall be submitted in accordance with the Submittals Section.
- C. In addition to the submittals to the Engineer, the Contractor shall submit complete plans and information to the local fire department for review. The equipment submittals shall include the following:
  1. A complete description of all system components, including certification of listing by Underwriters Laboratories (UL) and Factory Mutual Insurance Company Global (FM).
  2. Complete sequence of operation for all functions of the system.
  3. Complete system wiring diagram for all components and interfaces to equipment supplied under other sections.
  4. Location drawings for all controls, alarm actuating devices, and audiovisual alarm signaling devices.
  5. A listing of the manufacturer's representatives responsible for installation and service.
  6. Operation and maintenance manuals.



## 1.05 SYSTEM DESCRIPTION

- A. The fire alarm system shall be operated and monitored by a fire alarm control panel (FACP) as indicated on the drawings located in the Planner's office (Room 110). The system shall automatically initiate fire alarm signals whenever any manual or automatic fire detection device is placed in an alarm mode. The system shall identify the devices and their locations and simultaneously transmit a signal to the municipal alarm connection and activate the building elevator control panel and FACP. The FACP shall annunciate and sound local alarms for detection device alarm conditions, system trouble, or circuit failure. Alarm signals shall be consistent throughout the building or site. The operation of any alarm initiating device shall cause audible and visual alarms to sound and to be displayed throughout the building as required. A key-accessible reset function shall reset the alarm system after alarm initiating conditions have been cleared.
- B. Fire Alarm System:
1. The system shall be composed of supervised multiplex data communications circuits, closed loop initiation circuits with individual zone supervision, and supervised individual notification circuits as required. The system shall monitor incoming power. In addition to the FACP, the system shall include heat detectors, smoke detectors, audio-visual alarm units, end of line devices, manual pull stations, alarm horns, water flow switches, sprinkler valve anti-tamper switches, wiring (including conduit), connections to devices, outlet boxes, junction boxes, and all other necessary equipment for a complete operating system.
  2. System trouble, including grounded or open supervised circuit, power failure, system battery low voltage, or system failure, shall cause the system to enter a trouble mode, and display visual and audible alarms. The visual alarm shall be displayed until the initiating trouble has been cleared.
  3. The alarm sequence initiated by the activation of any manual station, automatic detection device, or sprinkler flow shall be as follows:
    - a. Selected audible alarm initiating devices sound a march time code until silenced by the alarm silence switch at the FACP.
    - b. Selected visual alarm indicating devices display a continuous strobe pattern until the system is reset.
    - c. A supervised signal to notify the local fire department or the central processing unit is activated.

## 1.06 SYSTEM COMPONENTS

- A. All fire alarm equipment and materials, devices and assemblies shall be listed and/or labeled by UL or another accepted testing laboratory for the intended purpose. The equipment shall not be altered, installed, or modified in any way that would void the label or listing.
- B. All control equipment shall have transient voltage protection devices in compliance with UL 864.
- C. The system controls shall be UL listed for Power Limited Applications according to NEC 760. All circuits shall be marked in accordance with NEC 760-23.

- D. Peripheral components as specified shall be provided in sufficient number and located as required to meet all applicable codes.

## PART 2 - PRODUCTS

### 2.01 REMOTE SENSORS

#### A. Fire Alarm Pull Stations:

1. Addressable pull stations shall communicate the station's status (alarm, normal) over two (2) wires that also supply power the pull station. The address shall be set on each station. The stations shall be manufactured from high-impact red Lexan. Lettering shall be raised and painted white. When activated, the stations shall mechanically latch and remain latched until they are manually reset using a key common to all locks.
2. The location "address" of the pull stations shall be field programmable from the FACP over the signaling line circuit.

#### B. Smoke Detectors:

1. Analog addressable smoke detectors shall be of the photoelectric type and shall communicate actual smoke chamber values to the system control panel. The sensors shall be solid-state, containing no radioactive material, and shall be capable of detecting up to seven (7) sensitivity levels between 0.5 and 3.7 percent.
2. The sensors shall be plug-in units mounted on a twist-lock base. Smoke detector bases shall be common with the heat detector bases and shall be compatible with other addressable detectors and addressable manual stations on the same circuit. The detectors shall be suitable for both ceiling and wall mounting and shall have a 30-mesh insect screen. Detector bases shall contain a light emitting diode that will flash each time it is scanned by the control panel. When the sensor detects smoke or fails, the diode shall illuminate to indicate the abnormal condition. When required, detector bases shall be provided with a relay driver output that may be controlled either automatically or manually from the control panel.
3. Each detector shall contain a magnetically actuated test switch for alarm testing at the sensor location.
4. Smoke detectors for installations in ducts shall be as specified above, furnished and installed under the HVAC section and shall be provided with auxiliary DPDT (Double Pole, Double Throw) relays, remote LED (Light Emitting Diode) alarm indicators, and key-operated test stations.

#### C. Heat Detectors:

1. Addressable heat detectors shall be ambient compensated combination rate-of-rise and fixed temperature type. The fixed temperature operation of the sensor shall be selectable for either 117 or 135 DegF. Rate-of-rise operation shall be selectable for either 15 or 20 DegF per minute and shall be self-restoring.
2. The thermal type sensor shall be a plug-in unit that mounts on a twist-lock base. Bases shall be as described for smoke detectors.

D. Audiovisual Alarm Units:

1. Alarm units shall consist of horn and A Xenon flashtube installed in a surface or semi-flush wall or ceiling-mounted enclosure. The horn shall have polarized connections with separate leads for in/out wiring for each leg of the associated signal circuit. Sound levels shall be ninety decibels (90 dB) at 10 FT.
2. The visual unit shall operate on twenty-four volts direct current (24V DC) and shall have a white translucent pyramidal lens with the word "FIRE imprinted in red lettering. The flash rate shall be 1 to 1.5 times per second.

E. Auxiliary Relays: Auxiliary relays shall be supplied where required. The relays shall be of high quality and shall be fitted with dust-tight plastic covers. The contacts shall be at least 1/8 IN DIA, of gold-plated silver cadmium oxide, rated for 5 amperes at 115 volts alternating current (AC).

2.02 PANELS

A. Fire Alarm Control Panel:

1. The control panel shall be constructed from steel, in compliance with UL 864, with front access door, and shall be surface wall-mounted.
2. The control panel shall be of modular construction, with solid-state, microprocessor-based electronics, and shall display only the primary controls and functions essential to operation during a fire alarm condition. Keyboards or keypads shall not be required to operate the system during fire alarm conditions. The sound that identifies each condition shall be readily distinguishable without having to view the panel. The audible device shall also sound during each keypress to indicate that the key is pressed.
3. The following primary controls shall be visible through a front access panel:
  - a. Eighty-character liquid crystal display.
  - b. Red system alarm LED.
  - c. Yellow supervisory service LED.
  - d. Yellow trouble LED.
  - e. Green "Power On" LED.
  - f. Alarm acknowledge key.
  - g. Supervisory acknowledge key.
  - h. Trouble acknowledge key.
  - i. Alarm system key.
  - j. System reset key.
4. The following secondary control switches and LEDs shall be available behind an access door:
  - a. Autodialer disconnect switch.
  - b. Door holder release bypass.
  - c. Manual evacuation (drill).

- d. Future expansion.
- 5. The control panel shall include the following functions:
  - a. Setting of time and date.
  - b. LED testing.
  - c. Listing of alarm, trouble, and abnormal conditions.
  - d. Separate enabling and disabling of each monitor point.
  - e. Separate activation and deactivations of each control point.
  - f. Changing operator access levels.
  - g. Walk-test enable.
  - h. Running diagnostic functions.
  - i. Displaying software revision level.
  - j. Displaying historical logs.
  - k. Displaying card status.
  - l. Point listing.
- 6. The following lists from the points list menu shall be available for maintenance purposes:
  - a. All points by address.
  - b. Monitor points.
  - c. Auxiliary controls.
  - d. Feedback points.
  - e. Pseudo points.
  - f. LED/switch status.
- 7. Scrolling through menu options or lists shall proceed in a self-directing manner, guiding by prompting messages. The controls for the points list menu shall be located behind an access door.
- 8. The control panel shall contain a backlit two (2) line by forty (40) character liquid crystal display. To conserve standby battery power in the event of an AC power failure, the display shall be lit only during keypad activity.
- 9. The display shall consist of both upper and lower case letters. Lower case letters shall be used for softkey titles and for prompting the user. Upper case letters shall be used for system status information. A cursor shall be visible when information is being entered.
- 10. All wiring shall be brought to terminal strips for field connections.
- 11. Front Panel Operation and Capabilities:
  - a. Under normal conditions, the front panel shall display a "SYSTEM IS NORMAL" message and the current time and date.

- b. Should an abnormal condition be detected, the appropriate alarm, supervisory, or trouble LED shall flash. The audible signal shall pulse for alarm conditions sound steady for trouble or supervisory conditions.
  - c. The LCD shall display the following information pertaining to abnormal condition:
    - 1) Location label (40 characters available)
    - 2) Type of alarm device – smoke detector, pull station, water flow sensor.
    - 3) Point status – alarm, trouble.
  - d. Buttons shall be provided to acknowledge alarm conditions and to silence audible alarms in compliance with NFPA 72.
12. Alarm Silencing: When the “ALARM SILENCE” button is pressed, all alarm signals shall cease. Alarm signals shall not be silenced during “alarm silence inhibit” mode.
13. System Reset:
- a. Using the “SYSTEM RESET” button shall restore the system to its normal state after an alarm condition has been remedied.
  - b. The LCD display shall step the user through the resetting procedure with simple printed messages. “SYSTEM RESET IN PROGRESS”, will be displayed first, followed by, “SYSTEM RESET COMPLETED” and finally “SYSTEM IS NORMAL” after all alarm conditions are cleared.
  - c. If an alarm condition persists, “SYSTEM RESET IN PROGRESS” will be followed by, “SYSTEM RESET ABORTED” and the system will remain in the abnormal state. System control relays will not reset. The audible alarm and alarm LED will remain on. The display will indicate the total number of alarms and troubles in the system, along with a prompt to use the proper keys to review the alarm points. These points will not require acknowledgement if they are previously acknowledged.
  - d. Should the “ALARM SILENCE INHIBIT” function be active, the “SYSTEM RESET” key press will be ignored. The message, “SYSTEM RESET INHIBITED” will be briefly displayed to indicate the action was not taken. As feedback to the operator, “SYSTEM RESET NO LONGER INHIBITED” will be displayed when the “inhibit” function times out.
14. Function Keys:
- a. Additional function keys shall be provided to access status data for the following points:
    - 1) Initiating device circuits.
    - 2) Indicating appliance circuits.
    - 3) Auxiliary relays
    - 4) Feedback points.
    - 5) All other input/output points.

- b. The following status data shall be available.
  - 1) Primary state of point.
  - 2) Zone, PAD and card type.
  - 3) Class “A” status.
  - 4) Current priority of outputs.
  - 5) Disable/enable status.
  - 6) Verification tallies of initiating devices.
  - 7) Automatic/manual control status of output points.
  - 8) Acknowledge status.
  - 9) Relay status.

15. History Logging:

- a. The system shall be capable of logging and storing 300 events in an alarm log and 300 events in a trouble log. These events shall be stored in a battery-protected random access memory. Each recorded event shall include the time and date of the occurrence.
- b. The following historical alarm log events shall be stored:
  - 1) Alarms.
  - 2) Alarm acknowledgement.
  - 3) Alarm silence.
  - 4) System reset.
  - 5) Alarm verification tallies.
  - 6) Walk test results.
  - 7) Trouble historical log cleared.

16. Silent Walk Test with History Logging:

- a. The system shall be capable of being tested by one person. While in testing mode, the alarm activation of an initiating device circuit shall be silently logged as an alarm condition in the historical data file. After logging the alarm, the panel shall automatically reset.
- b. The momentary disconnection of an initiating or indicating device circuit shall be silently logged in the historical data file as a trouble condition. After logging the trouble condition, the panel shall automatically reset.
- c. Should the walk test feature be on for an inappropriate length of time, it shall automatically revert to the normal mode.
- d. The control panel shall be capable of supporting up to eight (8) separate testing groups, one of which may be in a testing mode while the other (non-testing) groups may be active and operating as normally programmed. After testing is completed, testing data may be retrieved from the system in chronological order to ensure device/circuit activation.

- e. Should an alarm condition occur from an active point that is not in walk mode, it shall initiate the normal alarm sequence.
- 17. LED Supervision: All LEDs shall be supervised for burnout or disarrangement. Should a problem occur, the LCD shall display the location numbers of the module and the LED to facilitate location of the affected LED.
- 18. System Trouble Reminders: In the event of a trouble condition within the system, with the audible signal silenced the trouble signal shall resound a 24 HR intervals as a reminder that the fire alarm system is not 100 percent operational. Both the time interval and the trouble reminder signal shall be programmable to adapt to the application.
- 19. Operational Access Levels:
  - a. Four access levels shall be provided, with level four (4) being the highest. Level one (1) actions shall not require a pass code. Pass codes shall consist of up to ten (10) digits.
  - b. The following keys/switches shall have access levels:
    - 1) Alarm Silence.
    - 2) System Reset.
    - 3) Set Time/Date.
    - 4) Manual Control.
    - 5) On/Off/Auto Control.
    - 6) Disable/Enable.
    - 7) Clear Historical Alarm Log.
    - 8) Clear Historical Trouble Log.
    - 9) Walk Test.
    - 10) Change Alarm Verification.
  - c. Acknowledge keys shall also require privileged access to acknowledge points. If the operator presses an acknowledge key with insufficient access, an error message will be displayed. The points shall scroll with acknowledge key presses to view the points on the list, but the points will not be acknowledged in the database.
- B. Enclosures: A cabinet of sufficient size shall be provided to accommodate all equipment required. The door of the cabinet shall be equipped with locks and a continuous hinge, providing protection from tampering, yet allowing full view of the various lights and controls. Indoor enclosures shall have a NEMA type designation as required by the location. Outdoor NEMA Type 4X enclosures shall be stainless steel.

## 2.03 WIRING

- A. Intermodule wiring for common system functions shall be installed in a supervised cable bus. Disarrangement of the bus shall cause a distinctive "Cable Supervisory" LED to be illuminated in addition to activating the common trouble indicators.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. All work shall be installed as indicated on the drawings and in accordance with the manufacturer's diagrams and recommendations except where otherwise indicated.
- B. Conduit and interconnecting wiring for system components shall be furnished and installed under this section.
- C. All junction boxes furnished hereunder shall be painted red and permanently labeled "FIRE ALARM". A consistent wiring color code shall be maintained throughout the installation.
- D. Installation of equipment and devices that connect to equipment furnished under other sections shall be closely coordinated with the suppliers of the equipment.
- E. After completion of the installation, the Contractor shall clean the inside and the outside of the fire alarm equipment and shall remove all dirt and debris from the site.

### 3.02 WIRING

- A. Above-grade wiring shall be installed in electrical metallic tubing as specified in the electrical section. The system conductors shall not be installed in conduits or junction boxes in common with conductors of other systems. Conduit fill shall conform to NEC.

### 3.03 TESTING

- A. The Contractor shall notify the Engineer at least thirty (30) days in advance of conducting the performance and acceptance tests. The tests shall be performed in the presence of the Engineer, the Owner, and the local fire marshal, or their representatives. The Contractor shall furnish all instruments and personnel required for tests. A complete test report and letter of completion shall be submitted to the Engineer. The tests shall be performed by, or under the supervision of, a qualified representative of the fire alarm manufacturer and shall include the following:
  - 1. Verify that the system is free of grounds or open circuits. The FACP shall indicate when a ground or an open circuit exists.
  - 2. Verify that all alarm signal devices, stations, transmitters, automatic detectors, and supervisory devices are functioning as specified.
  - 3. Test each fire alarm device and circuit. Individually activate each manual initiating station and verify correct alarm operation and control panel response. Individually test each automatic initiating device and verify correct alarm operation and control panel response. Individually test each automatic initiating device and verify correct alarm operation, control panel response, and remote equipment operation.
  - 4. Test battery backup systems for specified capacity.
  - 5. Reconduct test to verify correction of any defect found in initial testing.

## END OF SECTION



## **SECTION 21 11 10 - FIRE PROTECTION PIPING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Pipe.
2. Fittings.
3. Valves.
4. Hydrants.
5. Connections.

#### **1.02 SUBMITTALS**

- A. Submit under provisions of Division 01.
- B. Shop Drawings: Indicate installation, layout, weights, floor and wall penetrations, mounting and support details, and piping connections.
- C. Product Data: Provide manufacturers catalog data on pipe materials, pipe fittings, joining materials, valves, and accessories. Indicate valve data and ratings.

#### **1.03 PROJECT RECORD DRAWINGS**

- A. Submit under provisions of Division 01.
- B. Record actual locations of piping and valves.

#### **1.04 OPERATION AND MAINTENANCE DATA**

- A. Submit under provisions of Division.
- B. Maintenance Data: Include installation instructions, spare parts lists, procedures, and treatment programs.

#### **1.05 QUALITY ASSURANCE**

- A. Sprinkler Systems: Perform work to NFPA 13.
- B. Standpipe and Hose Systems: Perform to NFPA 14.
- C. Water Service for Fire Protection: Perform to NFPA 24.
- D. Welding Materials and Procedures: Perform to ASME Code and applicable state labor regulations.
- E. Valves, Hydrants, and Connections: Shall be UL listed and FM approved. Provide manufacturer's name and pressure rating marked on valve body. Pressure ratings shall be suitable for operating conditions.
- F. Maintain one copy of each document on site.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to site under provisions of Division 01.
- B. Deliver and store valves in shipping containers, with labelling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

## PART 2 - PRODUCTS

### 2.01 SPRINKLER AND STANDPIPE PIPING, BURIED

- A. Ductile Iron Pipe: AWWA C151, pressure class determined using AWWA C150, exterior bituminous coating, cement lined.
  - 1. Fittings: Ductile iron AWWA C110 or C153, exterior bituminous coating, cement lined.
  - 2. Joints: AWWA C111, mechanical joint ,or push joint.
  - 3. Mechanical Joint Restraint Device: In lieu of concrete blocking. Shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. Restraint device shall be ductile iron, minimum 250 psi with minimum safety factor of 2:1.
- B. Polyvinyl Chloride Pipe (PVC): AWWA C900, Class 150; Furnish in ductile iron pipe equivalent outside diameters.
  - 1. Fittings: Ductile iron AWWA C110 or C153, exterior bituminous coating, cement lined.
  - 2. Joints: AWWA C111, mechanical joint.

### 2.02 SPRINKLER AND STANDPIPE PIPING, ABOVE GROUND

- A. Wet Sprinkler Pipe and Fittings:
  - 1. Pipe: NFPA 13; Steel, or copper.
  - 2. Fittings: NFPA 13; Cast iron, malleable iron, steel, or copper.
- B. Standpipe Pipe and Fittings:
  - 1. Pipe: NFPA 13; Steel, or copper.
  - 2. Fittings: NFPA 13; Cast iron, malleable iron, steel, or copper.

### 2.03 GATE VALVES (BURIED)

- A. Iron body, 175 psi WOG, bronze trim, non-rising stem, 2 IN square wrench nut, AWWA style stuffing box, parallel seat, double disc, UL/FM approved.
  - 1. Valve Box: Heavy duty cast iron body, 2-piece screw type, flanged base, heavy duty cast iron drop lid with letters "WATER" cast into lid.

#### 2.04 GATE VALVES

- A. Up to and including 2 IN (50 mm): 150 psi SWP, bronze body, bronze trim, rising stem, handwheel, inside screw, single wedge or disc, threaded or solder ends.
- B. Over 2 IN (50 mm): 175 psi WOG, iron body, bronze trim, handwheel, OS&Y, double wedge disc, flanged ends, UL/FM approved.

#### 2.05 GLOBE (OR ANGLE) VALVES

- A. Up to 2 IN (50 mm): 150 psi SWP, bronze body, bronze trim, rising stem and handwheel, inside screw, renewable composition disc, threaded or solder ends, with backseating capacity, repackable under pressure.
- B. Over 2 IN (50 mm): 125 psi SWP, iron body, bronze trim, rising stem, handwheel, OS&Y, plug-type disc, flanged ends, renewable seat and disc.

#### 2.06 BALL VALVES

- A. Up to and including 2 IN (50 mm): 400 psi WOG, bronze two piece body, stainless steel ball, PTFE seats and stuffing box ring, lever handle, threaded or solder ends.
- B. Over 2 IN (50 mm): 125 psi SWP, cast iron body, stainless steel ball, PTFE seat and stuffing box seals, lever handle, or gear drive handwheel for sizes 10 IN (250 mm) and over, flanged, UL/FM approved.

#### 2.07 BUTTERFLY VALVES

- A. Bronze body, 174 psi WOG, stainless steel disc, resilient replaceable seat, threaded ends, extended neck, handwheel and gear drive and integral indicating device.
- B. Cast or ductile iron body, 175 psi WOG, chrome plated ductile iron disc, resilient replaceable EPDM seat, wafer or lug ends, extended neck, handwheel and gear drive and integral indicating device.

#### 2.08 CHECK VALVES

- A. Up to and including 2 IN (50 mm): 150 psi SWP, bronze swing disc, threaded or solder ends.
- B. Over 2 IN (50 mm): 175 psi WOG, iron body, bronze trim, rubber faced swing disc, renewable disc and seat, flanged ends.

#### 2.09 DRAIN VALVES

- A. Threaded bronze angle, globe, ball, or butterfly, 150 psi SWP, with hose thread nipple and cap.

#### 2.10 INDICATOR POST VALVE

- A. Iron body, 175 psi WOG, bronze trim, non-rising stem, 2 IN square wrench nut, AWWA style stuffing box, indicator post flange, parallel seat, double disc.
  - 1. Indicator Post: Adjustable type, cast iron flanged and drilled base, two height adjustment set screws, adjustable length steel stem with 2 IN square socket, cast iron L-type operating handle, clear plexiglass indicator window, aluminum sign plates.

## 2.11 WALL INDICATOR POST

- A. Iron body, one piece, flanged and drilled base, steel stem with 2 IN square socket, clear plexiglass indicator window, aluminum sign plates, cast iron handwheel.

## 2.12 FIRE HYDRANTS

- A. AWWA C502, 5.25 IN dry barrel type, equipped with two 2.5 IN hose connections and one 4.5 IN pumper connection, 6 IN mechanical joint inlet connection, 175 psig working pressure
- B. Style of hydrant to match existing City standard.
- C. Model Centurion manufactured by Mueller, or approved equal.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

### 3.02 INSTALLATION

- A. Install piping in accordance with NFPA 13 for sprinkler systems, NFPA 14 for standpipe and hose systems, NFPA 24 for service mains. Refer to Section 40 05 07 for hanger and support requirements for fire protection piping.
- B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- C. Install piping to conserve building space, and not interfere with use of space and other work. Coordinate installation with all other trades.
- D. Group piping whenever practical at common elevations.
- E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- F. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- G. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09 90 00.
- H. Do not penetrate building structural members unless indicated.
- I. Provide sleeves when penetrating footings floors and walls. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required. Refer to Section 40 05 07.
- J. Die cut screw joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

- K. Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to placing in service.
- L. Provide gate, ball or butterfly valves for shut-off or isolating service.
- M. Provide drain valves at main shut-off valves, low points of piping and apparatus.

**END OF SECTION**

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## **SECTION 21 13 13 - SPRINKLER SYSTEMS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. SECTION INCLUDES**

1. Wet-pipe sprinkler system.
2. System design, installation, and certification.
3. Fire department connections.

#### **1.02 SYSTEM DESCRIPTION**

- A. Provide hydraulically designed wet-pipe system to provide coverage for building areas noted on drawings. Provide all components necessary to provide a complete working system(s).
- B. Provide system to meet NFPA 13 hazard requirements as noted on drawings or as required by code.
- C. Water Supply: Contractor to field verify and incorporate into the design, as required, the existing water flow test data:
  1. Elevation of static and elevation of residual pressure test gauge.
  2. Static pressure: psig.
  3. Residual pressure: psig.
  4. Flow: gpm.
  5. Date:
  6. Location of hydrants and hydrant identification number(s):
  7. Hydraulic Calculations: No more than 90 percent of the available pressure at the connection to the standpipe and/or sprinkler riser shall be used.
- D. Interface system with building control system and building Fire Alarm.
- E. Provide fire department connections as indicated or as required by code.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of Division 01.
- B. Shop Drawings: Indicate hydraulic calculations, water flow test data, detailed pipe layout, hangers and supports, components and accessories. Indicate system controls.
- C. Product Data: Provide data on sprinkler heads, valves, air compressor, pumps, and all accessories and specialties, including manufacturers catalog information. Submit performance ratings, temperature ratings, rough-in details, weights, support requirements, and piping connections.
- D. Submit shop drawings, product data, and hydraulic calculations to authority having jurisdiction for approval. Submit proof of approval to Architect/Engineer.

- E. Certificate of Compliance: Certificate indicating system has been tested and meets or exceeds specified requirements and code requirements.
- 1.04 PROJECT RECORD DOCUMENTS
  - A. Submit under provisions of Division 01.
  - B. Record actual locations of sprinkler heads, piping, valves, and accessories on drawings. Indicate drain and test locations.
- 1.05 OPERATION AND MAINTENANCE DATA
  - A. Submit under provisions of Division 01.
  - B. Maintenance Data: Include all components of system, servicing requirements, Record Drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.
- 1.06 QUALITY ASSURANCE
  - A. The design, materials, equipment, installation, inspection, and testing of the automatic sprinkler system(s) and combination standpipe and sprinkler system shall be in strict accordance with the required and advisory provisions of NFPA 13.
  - B. Equipment and Components: All equipment and components shall be UL listed and FM approved for the appropriate service.
  - C. Maintain one copy of document on site.
- 1.07 QUALIFICATIONS
  - A. Installer: Company specializing in performing work of this Section with minimum three years experience.
  - B. Design sprinkler system under direct supervision of a Professional Engineer experienced in design of this work, and licensed in the State of Iowa.
- 1.08 REGULATORY REQUIREMENTS
  - A. Hydraulic Calculations, Product Data, and Shop Drawings: Bear stamp of approval of authority having jurisdiction and the local Fire Marshall.
- 1.09 DELIVERY, STORAGE, AND HANDLING
  - A. Deliver and store products to site, and protect under provisions of Division 01.
  - B. Store products in shipping containers and maintain in place until installation. Inspect for damage.
  - C. Provide temporary end caps and closures. Maintain caps in place until installation.
- 1.10 EXTRA MATERIALS
  - A. Furnish under provisions of Division 01.
  - B. Provide extra sprinkler heads under provisions of NFPA 13.
  - C. Provide one suitable wrench(s) for each head type.



- D. Provide metal storage cabinet in a janitor's closet.

## PART 2 - PRODUCTS

### 2.01 SPRINKLER HEADS

#### A. Suspended Ceiling:

1. Type: Recessed pendant type with matching push on escutcheon plate.
2. Head Finish: Chrome plated.
3. Escutcheon Plate Finish: Chrome plated.
4. Fusible Link: Glass bulb type, temperature rated for specific area hazard as indicated in Sprinkler System Schedule.
5. Model: M manufactured by Viking.

#### B. Exposed Area Type:

1. Type: Standard upright type or pendant type .
2. Head Finish: Brass.
3. Fusible Link: Glass bulb type temperature rated for specific area hazard.
4. Model: M manufactured by Viking.

### 2.02 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve (Single Zone Systems): Iron body, bronze seat, check type valve with divided seat ring, rubber faced clapper to automatically actuate electrically or hydraulically operated alarm(s), with pressure retard chamber, pressure gauges, and variable pressure trim. Provide pressure sensitive alarm switch to activate fire alarm system.
- B. Electric Alarm: Electrically operated red enamelled gong with pressure alarm switch.
- C. Optional Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy red enamelled gong and motor housing, nylon bearings, and inlet strainer.
- D. Water Flow Switch: (Multi-zone Systems):
  1. Integral, vane type, non-accumulative retard type, for horizontal or vertical mounting, with two sets of SPDT auxiliary contacts and adjustable from 0 to 60 seconds. Set flow switches at an initial setting between 20 and 30 seconds.
  2. Provide with two contacts rated 10 amps at 125 volt AC.
- E. Valve Supervisory Switches:
  1. Switch shall be contained in a weatherproof housing, which shall provide a 3/4 IN tapped conduit entrance and incorporate the necessary facilities for attachment to the valves.

2. Provide two sets of SPDT contacts, tamperproof, and arranged to cause a switch operation if the housing cover is removed, or if the unit is removed from its mounting.
  3. Switch housing to be finished in red enamel.
  4. Supervisory switches for ball and butterfly valves may be integral with the valve.
- F. Pressure Switches:
1. Provide with 1/2 IN NPT male pressure connection. Switch shall be activated by any flow of water equal to or in excess of the discharge from one sprinkler.
  2. Maximum service rating of 175 psig, factory adjusted to operate at a pressure of 4 to 8 psi. Provide unit with two sets of SPDT contacts.
  3. Furnish switch in red baked enamel, weatherproof, oil resistant housing with tamper resistant screws.
- G. Automatic Ball Drips: Cast brass 3/4 IN in-line automatic ball drip with both ends threaded with iron pipe threads.
- H. Fire Department Connection:
1. Type: Flush mounted wall type with brass finish.
  2. Fire Department connection: One 5 IN Storz hydrant port with coupling size to suit fire department hardware; dust cap and chain of matching material and finish.
  3. Drain: 3/4 IN (19 mm) automatic drip, connected to drain.
  4. Label: Provide escutcheon with integral raised letters "Auto-sprinkler" connection.
- I. Identification Signs: Provide control valves, drain valves, test and drain connections, and alarm devices with identification signs (enamel on metal) in accordance.
- J. Self-Contained Test and Drain Assembly:
1. Bronze body, with chrome plated bronze ball, brass stem, steel handle, PTFE seat, and site glass. Provide valve with three position indicator plate (off, test, drain), 1/4 IN tapping for pressure gauge and various sized orifice inserts to simulate flow through each size diameter sprinkler heads.

## 2.03 DOUBLE CHECK BACKFLOW PREVENTION ASSEMBLY

- A. ASSE 1015, epoxy coated cast iron check valve bodies with bronze seats. Provide two independent check valves with shut off valves and ball type test cocks. Maximum friction loss through assembly shall not exceed 5 psig at design flow.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Coordinate work of this Section with other affected work.

### 3.02 INSTALLATION

- A. Install equipment in accordance with manufacturer's instructions.
- B. Install buried shut-off valves in valve box. Provide post indicator.
- C. Provide double check valve assembly at sprinkler system water source connection. Install above a floor drain.
- D. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- E. Locate outside alarm gong on building wall as directed by the owner.
- F. Place pipe runs to minimize obstruction to other work.
- G. Place piping in concealed spaces above finished ceilings. Locate piping in stairways as near ceiling as possible to prevent tampering by unauthorized personnel, and to provide a minimum of 7 FT of headroom.
- H. Center heads one direction only in ceiling tile with location in other direction variable, dependent upon spacing and coordination with ceiling elements.
- I. Apply masking tape or paper cover to ensure concealed sprinkler head cover plates do not receive field paint finish.
- J. Flush entire piping system of foreign matter.
- K. Hydrostatically test entire system.
- L. Require test be witnessed by authority having jurisdiction.
- M. Mount valve supervisory switches so as not to interfere with normal operation of the valve and adjust to operate within two revolutions toward the closed position of the valve control, or when the stem has moved no more than one-fifth of the distance from its normal position.
- N. Do not use quick response sprinklers in the same sprinkler zone with other sprinkler types. If quick response sprinklers are required in renovated areas, change existing sprinklers to match new.
- O. Cutout disks, which are created by cutting holes in the walls of pipe for flow switches and non-threaded pipe connections, shall be wired next to the point of removal.
- P. For each sprinkler zone provide a control valve, flow switch, and a self contained test and drain assemble with pressure gauge.
- Q. For control valves at each indicating sprinkler system riser, sprinkler zone, standpipe system riser, main entrance service, and PIV (post indicator valve), provide a supervisory switch that is connected to the fire alarm system. Standpipe hose valves and test and drain valves shall not be provided with supervisory switches.
- R. Provide a waterflow switch for each sprinkler zone and where indicated on drawings. Install waterflow switch and adjacent valves in easily accessible locations.
- S. Each sprinkler zone shall coincide with each fire alarm zone.

- T. Provide a drain at base of risers, drain connection on valved sections, and drains at other locations for complete drainage of system. Provide valve in drain lines and connect to the central drain riser. Discharge riser outside over splash block, indirectly over standpipe drain connected to storm sewer, or as indicated. The main drain shall be capable of full discharge test without allowing water to flow onto the floor.
  - U. Provide test pipes in accordance with NFPA 13. Test pipes shall be valved and piped to discharge through proper orifice as specified above for drains.
  - V. Provide pressure gauge at each waterflow switch location, at the top of each standpipe, and at each main drain connection.
- 3.03 TEST
- A. Automatic Sprinkler System - NFPA 13
- 3.04 INSTRUCTIONS
- A. Furnish the services of a competent instructor for not less than two four-hour periods for instructing facility personnel in the operation and maintenance of the system(s), on the dates requested by the Owner.

**END OF SECTION**

## **SECTION 21 22 00 –CLEAN AGENT FIRE SUPPRESSION SYSTEM**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Design and installation of Clean Agent Fire Suppression System with an addressable detection and control system for the following areas:
  - a. Communications Room

#### **1.02 SCOPE**

- A. This specification outlines the requirements for a Total Flood Ecaro-25 clean agent fire suppression system utilizing HFC-125 as the extinguishing agent, and with an addressable detection and control system. The work includes all engineering, labor, materials, equipment, and services necessary, and required, to complete and test the suppression and detection system
- B. Exclusions: The work listed below shall be provided by other, or under different section of this specification:
  1. Power supply to the system control panel.
  2. Interlock wiring and conduit for shutdown of HVAC system components and electric power supply.
  3. Connection to fire alarm system

#### **1.03 RELATED REQUIREMENTS (SECTIONS)**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  1. Section 07 84 13 - Through-Penetration Firestop Systems" for fire-stopping sealants.
  2. Division 23 - Mechanical HVAC actuators and system operation controlled shutdown.
  3. Division 26 - Electrical Power wiring interlock and connection to fire alarm system.

#### **1.04 SUBMITTALS**

- A. Product Data: Submit drawings, calculations and system data sheets for approval prior to starting work:
  1. Field installation layout drawings at 1/8" = 1'-0" detailing the location of all agent storage tanks, pipe runs and pipe sizes, detector locations, control devices, pull stations, audible and visual alarms.

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2. Auxiliary details and information pertaining to the system and components.
  3. Electrical layout drawings.
  4. Internal control wiring diagrams.
  5. Hydraulic flow calculations.
  6. Sequence of operation.
- B. Maintenance Data: For fire-protection components to include in maintenance manuals

#### 1.05 QUALITY ASSURANCE

- A. The design, equipment, installation, testing, and maintenance of the system shall be in conformance with the following standards.
1. NFPA No. 2001 - Clean Agent Fire Extinguishing System
  2. NFPA No. 70 - National Electric Code.
  3. NFPA No. 72 - National Fire Alarm Code
  4. Factory Mutual and Underwriters Laboratory.
  5. Requirements of the Authority Having Jurisdiction (AHJ)
- B. NFPA Compliance: Fabricate and label components to comply with NFPA 2001 PRODUCTS

#### 1.06 INSTALLER QUALIFICATIONS

- A. Installing Contractor shall be trained by the supplier to design, install, test and maintain a clean agent system.
- B. Installing Contractor shall be an experienced firm regularly engaged in the installation of automatic clean agent, or similar, fire suppression systems.
- C. Installing Contractor shall maintain or have access to a clean agent recharging station, and be an authorized stocking distributor of clean agent equipment.

#### 1.07 WARRANTY

- A. Special Warranty: Manufacturer's Standard Form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
1. Warranty period. Five years from date of substantial completion.

#### 1.08 INSPECTIONS AND MAINTENANCE

- A. Provide (2) Inspections during the first year of service to insure system is operating correctly and to provide maintenance service to system and all components.
1. Inspections shall be made at 6 month intervals.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. System shall be a Fike Ecaro-25 clean agent system as manufactured by Fike Fire Protection Systems, Blue Springs, MO

### 2.02 SYSTEM DESCRIPTION

- A. Total flooding ECARO-25 fire extinguishing system. The system shall include the necessary mechanical and electrical installation, required detection and control equipment, agent storage containers, agent, system actuation equipment, discharge nozzles, pipe and fittings, manual release and abort stations, audible and visual alarm devices, auxiliary devices and controls, shutdowns, functional checkout and testing, training and other operations necessary for a fully functional UL Listed and/or FM Approved clean agent system.

### 2.03 SYSTEM DESIGN REQUIREMENTS

- A. Extinguishing Agent: System shall a Clean Agent System utilizing HFC-125.
- B. Design Criteria: System shall provide a minimum design concentration of 8.0%, by volume, in all areas or protected spaces, at the minimum anticipated temperature. Per NFPA 2001, the system design shall not exceed a maximum exposure limit concentration level of 11.5% by volume.
  - 1. System will be designed in accordance with manufacturer's guidelines.
  - 2. Locate clean agent storage tank within the same space it is to service.
  - 3. Coordinate location of piping and discharge devices with other trades including HVAC and Electrical devices.
- C. Components: The system shall be complete in all ways. It shall include all mechanical and electrical installation, all detection and control equipment, agent storage containers, ENCARO-25 agent, system actuation equipment, discharge nozzles, pipes and fittings, manual release and abort stations, and alarm interface devices.
  - 1. The Encaro-25 clean agent system materials and equipment shall be standard products of the supplier's latest design and suitable to perform the functions intended. Components which perform similar function shall be provided by one manufacturer.
  - 2. Clean Agent shall be stored in Fike P/N 70-XXX Series Agent Storage Containers. Containers shall be super-pressurized, with dry Nitrogen, to an operating pressure of 360 psi @ 70 degrees F. Containers shall be of high-strength allow steel construction and shall conform to NFPA 2001.
  - 3. Containers shall be actuated by parallel wired Gas Cartridge Actuators through a Fike P/N 10-1832 Agent Release Module (ARM), located at each agent storage container.

4. Each container shall have a pressure gauge and low pressure switch to provide visual and electrical supervision of the container pressure. The low pressure switch shall be wired to the control panel to provide an audible and visual "Trouble" alarm in the event the container pressure drops below 288 psi. Pressure gauge shall be color coded to provide an easy visual indication of container pressure.
  5. Each container shall have a pressure relief provision automatically actuated if the internal temperature exceeds 150 degree F.
  6. Discharge nozzles shall be Fike P/N 80-XXX in NPT sizes 3/8" - 2". Each size shall be available in 180 and 360 degree distribution patterns.
  7. Distribution piping shall be reamed, blown clear and swabbed to remove burrs, mill varnish and cutting oils prior to assembly.
  8. All pipe threads shall be sealed with Teflon tape pipe sealant.
  - 9.
- D. Control Panel: Control Panel shall be Cheetah Xi 50 as manufactured by Fike Fire Protections Systems, Blue Springs, MO
1. Provide battery stand-by power supply to power complete discharge in the absence of building power, taking into considerations the power requirements of alarms, initiating devices and auxiliary components under full load conditions.
  2. Accessible Devices
- E. Sensors, Releasing Module, Releasing Module, Control Module, Relay monitors, Manual Release and Discharge Abort devices shall be manufactured by Fike Corporation.
- F. Audible and Visual Alarms:
1. Provide Audible and Visual Signal Devices operated by Cheetah Control Panel.
  2. Alarm bell, horn and horn/strobe devices shall be Fike P/N's 20-XXX, or equal.
  3. A strobe device shall be placed outside and above each exit door from the protected space. Provide advisory signage at each light location.
- G. Dual Action - Manual Release
1. Locate (1) Manual Release Switch adjacent to each exit door of the protected area.
  2. Manual Release Switch shall be Fike P/N 10-1638.
  3. Shall be dual action requiring two distinct operations to initiate a system actuation.
  4. Manual actuation shall bypass the time delay and abort functions, shall cause the system to discharge in and shall cause all release and shutdown devices to operate in the same manner as if the system had operated automatically.
- H. Abort Station:
1. Abort station shall be Fike P/N-10-1639.



2. Abort station shall be supervised and shall indicate a trouble condition at the Control Panel if depressed, and no alarm condition exists.
  3. Abort station shall be located adjacent to the manual discharge switch at the room exit.
  4. Locate digital countdown timer above Abort Station.
- I. Advisory Signage:
1. Provide signage as required to comply with NFPA 2001.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine areas where system will be installed. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.02 INSTALLATION

- A. General: Install clean agent fire suppression system components including control panel, piping, discharge devices, and alarm devices in locations as indicated on the system design drawings and per manufacturer's recommendations.
1. All wiring shall be installed in a neat and workmanlike manner and shall conformance with the National Electric Code. Wiring shall meet all applicable local and state codes.

#### 3.03 SYSTEM ACTUATION

- A. System Actuation: System shall be actuated by a combination of ionization and/or photoelectric detectors installed at a maximum spacing of 250 square feet per detector. There shall be a minimum of 2 detectors per individual enclosed space. Detectors shall be wired in sequential detection method of operation. Automatic operation shall be as follows:
1. Actuation of one (1) detector within the system shall:
    - a. Illuminate "Alarm" lamp on the control panel face.
    - b. Energize alarm bell and visual indicator.
    - c. Transmit a signal to the fire alarm panel.
    - d. Shut down HVAC system for Communications Room.
  2. Actuation of a second (2nd) detector within the system shall:
    - a. Illuminate the "Pre Discharge" lamp on the control panel face.
    - b. Energize a re-energize horn and strobe devices.
    - c. Start time delay sequence of 60 seconds.
    - d. System abort sequence is enabled.

3. System Abort Procedure: System discharge may be aborted by depressing the "Dead Man" mushroom switch located adjacent to the manual discharge switch at room exit point. Depressing the abort switch shall re-set the discharge delay to 30 seconds each time it is depressed.
4. After completion of the time-delay sequence, system shall activate and the following shall occur:
  - a. Illuminate "System Fired" lamp on the control panel face.
  - b. Energize a visual indicator outside the hazard area in which the discharge has occurred.
  - c. Clean agent is discharged.

#### 3.04 INSPECTION

- A. After the system installation has been completed, the entire system shall be inspected and functionally tested by qualified, trained personnel in accordance with NFPA and manufacturer standards

#### 3.05 TESTING

- A. Testing and Training: Contractor shall provide testing, training and all other operations for a fully functional and approved system.
  1. Seal and secure protected spaces against agent loss and/or leakage during the 10 minute "hold" period

#### 1.1 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.
- B. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.
- C. Replace fire-protection items that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

### **END OF SECTION**

## **SECTION 22 05 19 - METERS AND GAGES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Meters, gages, switches and accessories used by the Railroad in mechanical systems.
2. Meters and gages furnished as part of factory fabricated equipment are specified with specific equipment.

#### **1.02 SUBMITTALS**

##### **A. Submit as specified in Section 01 33 00.**

##### **B. Product Data:** Submit manufacturer's technical product data, including installation instructions for each type of meter and gage. Product shall be suitable for intended service.

##### **C. Shop drawings required by this Section include, but are not limited by, the following:**

1. Manufacturer's product data for all components, drawings, operation and maintenance manuals and testing results if required.
2. Piping diagrams for new or modified control valves.

#### **1.03 REFERENCED STANDARDS**

##### **A. American National Standards Institute (ANSI).**

##### **B. Instrument Society of America (ISA).**

##### **C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS).**

#### **1.04 QUALITY ASSURANCE**

##### **A. UL Compliance:** Comply with applicable UL standards pertaining to meters and gages.

##### **B. ANSI and ISA Compliance:** Comply with applicable portions of ANSI and Instrument Society of America (ISA) standards pertaining to construction and installation of meters and gages.

### **PART 2 - PRODUCTS**

#### **2.01 TURBINE FLOW METERS**

##### **A. Provide Smith Guardsman Series model K2B or equal meter for Fuel Management System. Meter shall have the following minimum specifications:**

1. 150# RF flanges with upstream flow straightening device as recommended by manufacturer.
2. Fuel flow range: 40 gpm to 600 gpm.

UP General Specifications

METERS AND GAGES

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3. Unidirectional flow with stainless steel blades.
  4. One pickup coil and preamplifier.
  5.  $\pm 0.25$  percent linearity and  $\pm 0.02$  percent repeatability.
- B. Meter electronics shall be taped and protected for future connection by others.

## 2.02 PRESSURE GAGES

- A. Provide pressure gages of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
- B. Type: General use, 1 percent accuracy, ANSI B40.1 grade A, phosphor bronze bourdon type, bottom connection.
- C. Range: Conform to the following:
1. Potable (Domestic) Water: 0-100 psig.
  2. Diesel Fuel dispense: 0-100 psig.
  3. Lube oil recirculation: 0-75 psig.
  4. All others not specifically listed here shall be determined by engineer on shop drawings.
- D. Manufacturer: Subject to compliance with service requirements, provide pressure gages of one of the following:
1. Ametek/U.S. Gauge.
  2. Ashcroft.
  3. Marsh Instrument Co.; Unit of General Signal.
  4. Marshalltown Instruments, Inc.
  5. Weiss Instruments, Inc.

## 2.03 PRESSURE GAGE COCKS

- A. General: Provide pressure gage cocks between pressure gages and gage tees on piping systems. Construct gage cock of brass with 1/4 IN female NPT on each end, and "T" handle brass plug.
- B. Syphon: 1/4 IN straight coil constructed of brass tubing with 1/4 IN male NPT on each end.
- C. Snubber: 1/4 IN brass bushing with corrosion resistant porous metal disc, through which pressure fluid is filtered. Select disc material for fluid served and pressure rating.
- D. Manufacturer: Same as for pressure gages.

## 2.04 PRESSURE SWITCHES

- A. Provide Square D type GDW-4 pressure switch, SPDT, NEMA 4, 0 - 75 psig range, with 1/4 IN isolating gage cock or equal.
- B. Initial switch settings per Engineer.

## PART 3 - EXECUTION

### 3.01 INSTALLATION OF GAGES AND SWITCHES

- A. General: Install pressure gages in piping tee with pressure gage cock, located on pipe at most readable position.
- B. Install switches as required in Division 16 and as recommended by manufacturer.

### 3.02 ADJUSTING AND CLEANING

- A. Adjusting: Adjust faces of gages to proper angle for best visibility.
- B. Cleaning: Clean windows of gages and factory-finished surfaces. Replace cracked or broken windows, repair any scratched or marred surfaces with manufacturer's touch-up paint.

**END OF SECTION**

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## **SECTION 22 05 28 - HOSE REELS AND ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Locomotive and rail car servicing hose reels, oxygen and acetylene manifold systems, accessories, and associated equipment.
- B. The Contractor shall perform all labor and services necessary for proper installation and operation of the systems and work described in this section of the specifications and/or indicated on the drawings, or reasonably implied.
- C. The Contractor shall include the necessary equipment, specialties, tests, electrical, etc., for the complete installation of the locomotive servicing hose reels.

#### **1.02 REFERENCED STANDARDS**

##### **A. American National Standards Institute (ANSI):**

1. B1.20.1 – General Purpose Pipe Threads.

##### **B. Society of Automotive Engineers (SAE):**

#### **1.03 SUBMITTALS**

##### **A. Submit as specified in Section 01 33 00.**

##### **B. Provide shop drawings and manufacturers literature information for the following:**

1. Hose reels, hose, and end equipment.

### **PART 2 - PRODUCTS**

#### **2.01 ACCEPTABLE MANUFACTURERS**

##### **A. Spring-driven Hose Reels for servicing fluids:**

1. Hannay.
2. Reelcraft Series 9000 (Series TW-7000 for oxy/acetylene).
3. Approved equal.

##### **B. Electric Cord Reels:**

1. Reelcraft Series 4000.
2. Approved equal.

##### **C. Oil Dispensing Reels**

1. Snyder 445-23-K1 Hose Reel Assembly, LH or RH, complete
2. Approved equal

## 2.02 HOSE REELS

- A. The hose reels shall be located as shown on the Drawings for dispensing maintenance fluids from a number of permanent delivery points located throughout the facility. The hose reels will supply the following services:
  - 1. Lube Oil (LO).
  - 2. Untreated Water (CW).
- B. The hose reels shall be the open type and spring-driven, complete with the following:
  - 1. Ratchet locking assemblies to maintain the service hose at the operator-selected extension.
  - 2. Roller guide assemblies for the hoses.
  - 3. Adjustable ball stop or bumper devices to maintain the stated pendant length of hose outside the hose reel.
  - 4. Stainless steel or plastic tags affixed to the hose reel unit by stainless steel wire or rivets identifying the reel type as listed in the hose reel schedule. Also provide identification tags at control handles.
  - 5. Permanently lubricated bearing assemblies.
  - 6. Containerized spring motor with weatherproof gasketing.
  - 7. Steel construction with heavy-duty brackets.
  - 8. Factory-applied paint or coating systems.
  - 9. Flexible inlet hose assemblies at least 2 FT long for connecting the hose reels to the fixed supply piping.
  - 10. All components (swivels, O-rings, etc.) compatible with the fluid handled and rated for the fluid pressures and temperatures stated.
- C. The hose supplied for use with the hose reels shall be SAE rated for the stated service. Fabric reinforced hoses 1/2 IN inside diameter and smaller shall have at least one reinforcing braid. Fabric reinforced hoses larger than 1/2 IN inside diameter shall have two reinforcing braids. The outside hose cover shall be abrasion resistant. One end of the hose shall have a hose fitting compatible with the connection on the hose reel. The other (service) end of the hose shall have a fitting with pipe threads in accordance with ANSI B1.20.1. The nominal pipe size of the service end hose fitting shall be the same size as the inside diameter of the hose and shall be a male fitting.
- D. Electric cord reels shall be complete with an incandescent lamp.

## 2.03 HOSE REEL ACCESSORIES

- A. The Contractor shall install a nondripping (when fully closed) ball valve at the end of the pendant length of hose outside each hose reel housing. These ball valves shall be "Clincher Type 2000", manufactured by Jamesbury Corporation. Valves shall have brass bodies with stainless steel trim and TFE seats



- B. The Contractor shall install nozzles for the lube oil hose reels downstream of the ball valves. The nozzles shall be right angle type, permitting at least four positions of the hold-open clip. Each nozzle shall have a 1 IN DIA spout and shall be OPW "190" or equal.

#### 2.04 OXYGEN-ACETYLENE MANIFOLD SYSTEM

- A. An oxygen-acetylene welding manifold system shall be provided, installed, and placed in proper working order to provide an uninterrupted service supply with no downtime. The manifold system shall be semi-automatic type, so that as the primary supply is depleted, a reserve supply is available to automatically begin service.
- B. The manifold system shall be suitably sized for 8 cylinders of oxygen and 8 cylinders of acetylene. The manifold system shall be complete and include, but not be limited to, the following items: Single stage regulators, adjustable line regulator, master shutoff valves, flash arresters, pressure switch port, single outlet connection, and wall mounting brackets. All valving and pressure regulation shall be provided such that, through pressure differential, the switch- over from the primary bank takes place without interruption of service. Once depleted, the primary bank can be replaced and becomes the new reserve bank.
  - 1. Line pressure regulators (included with automatic manifold system) connected between the cylinders and the piping system shall be set at the following pressures:
    - a. Oxygen system pressure: 35 PSIG (maximum).
    - b. Acetylene system pressure: 15 PSIG (maximum).
- C. The manifold system shall be Victor "Automatic - VM" or equal.
- D. A suitably sized metal storage frame with safety chains shall be provided for storing the cylinders on the outside of the building, as indicated on the drawings.
- E. Suitable medium-heavy flow station regulators shall be provided on each oxygen and acetylene line at each hose reel as indicated on the drawings.

#### 2.05 QUICK COUPLINGS

- A. Quick couplings shall be provided on the journal oil and drain oil connections as indicated on the drawings. The journal oil couplings shall be brass, 3/4 IN size, and shall include the socket, plug, and dust cap. The quick couplings shall be Hanson "Series 6-HK", with socket number B6-HP31 and plug number B6-KT31 or equal.
- B. The drain oil couplings shall be steel, 1-1/2 IN size, and shall include the socket, plug, and dust cap, Hanson "Series 12-HK", with socket number 12-H46 and plug number 12-K46 or equal.
- C. Compressed Air: The service end of the hose shall have a 1/2 IN quick disconnect fitting for air operated tools.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. The Contractor shall install equipment and accessories in accordance with equipment manufacturer's recommendations and applicable codes and standards, using accepted industry methods and materials. Installation of servicing system pipe, pipe fittings, and piping accessories is specified in the piping sections.

### 3.02 SYSTEM SEQUENCE OF OPERATIONS

- A. Locomotive servicing system sequences shall be provided to establish brief system descriptions and control sequences for the specific location as applicable.
- B. Non-Potable Water Systems. Non-potable water (NPW) will be distributed from a process water supply line, which originates in the office building basement, to various hose reel service points located in the maintenance shop. In addition, the non-potable water system is the supply source for the treated water system.
- C. Journal Oil System. Journal oil (JO) will be unloaded from tanker trucks at the fill box location on the south side of the pumphouse. Positive displacement rotary vane pump shall pump the journal oil to the 10,000 GAL storage tank. The journal oil will be distributed from the storage tank to various hose reels and trackside service points located in the locomotive shop and on the service platform, by a rotary vane positive displacement pump. The dispensing pumps will be operated by a HAND-OFF-AUTO (HOA) switch located at the motor control center. With the switch set to the AUTO position, the pump will be energized when the discharge line pressure drops below the set point. With the switch in the HAND position, the pump will run continuously until manually shut off. The pump will be de-energized with the switch in the OFF position.
- D. Compressor Oil System. Compressor oil (CO) will be unloaded from tanker trucks at the fill box location on the south side of the pumphouse. Positive displacement rotary vane pumps will transfer the compressor oil to the 10,000 GAL storage tank. The compressor oil will be distributed from the storage tank to various hose reels located in the locomotive shop, by a rotary vane positive displacement pump. The dispensing pumps will be operated by a HAND-OFF-AUTO (HOA) switch located at the motor control center. With the switch set to the AUTO position, the pump will be energized when the discharge line pressure drops below the set point. With the switch in the HAND position, the pump will run continuously until manually shut off. The pump will be de-energized with the switch in the OFF position.
- E. Lube Oil System. Lube oil (LO) shall be unloaded from tanker trucks at the fill box location on the south side of the pumphouse. Positive displacement rotary vane pumps will transfer the lube oil to the 20,000 GAL storage tank. The lube oil will be distributed from the storage tank to various hose reels located in the locomotive shop and on the service platform, by a rotary vane positive displacement pump (P-11 or P-12). The pumps will be operated by a HAND-OFF-AUTO (HOA) switch located at the motor control center. With the switch set to the AUTO position, the pump will be energized when the discharge line pressure drops below the set point. With the switch in the HAND position, the pump will run continuously until manually shut off. The pump will be de-energized with the switch in the OFF position.

- F. Drain Oil (Used Lube) System. Drain oil (DO) is removed from the locomotives at various trackside locations in the locomotive shop and on the service platform. The oil will be drawn from the locomotives by air powered diaphragm pumps (P-22, P-23, P-24) located in the west end of the locomotive shop, and transferred to the 20,000 GAL storage tank. The pumps will be operated using HAND-OFF (HO) switches at various trackside locations. (See description in Phase 1 for service platform waste oil system operation.) An air powered diaphragm pump located in the pumphouse will be used for unloading trucks or barrels of waste oil. This is not expected to occur frequently; therefore, no fill box will be provided. A rotary vane positive displacement pump (P-17 or P-18) will be used to transfer the waste oil from the storage tank to a tanker truck. A HAND-OFF switch will be located at the motor control center. With the switch in the HAND position, a remote switch located on the fill box control panel will be energized. With the switch in the OFF position, the remote switch will be de-energized. The pumps will be energized only when both the switch at the motor control panel and the remote switch are in the HAND position.
- G. Radiator Water System. City water will be conditioned with a water softener. A metering pump, provided by the Owner, shall be installed down- stream of the water softener. The metering pump will inject sodium borate solution from one of two available 330 GAL totes located adjacent to the pump. Piping and valving from the totes to the pump will be such that an empty tote can be replaced without interruption to the distribution system. The treated water will be distributed to various hose reel stations in the locomotive shop and on the service platform. The treated water metering pump will be operated by an ON-OFF switch located at the motor. When the switch is set to the ON position, metering pump start/stop functions will be controlled by a water flowmeter provided by the Owner. When the switch is in the OFF position, the metering pump will be de-energized.
- H. Toilet Chemical System. Toilet chemical (TC) will be unloaded from tanker trucks at the fill box location on the south side of the pumphouse. Centrifugal pumps will transfer the toilet chemical to the 10,000 GAL storage tank. The toilet chemical will be distributed from the storage tank to the service platform by a horizontal, single stage turbine pump (P-15 or P-16). The dispensing pumps will be operated by a HAND-OFF-AUTO (HOA) switch located at the motor control center. With the switch set to the AUTO position, the pump will be energized when the discharge line pressure drops below the set point. With the switch in the HAND position, the pump will run continuously until manually shut off. The pump will be de-energized with the switch in the OFF position.
- I. Soap System. A pre-mixed soap solution (SP) will be unloaded from tanker trucks at the fill box location on the south side of the pumphouse. Centrifugal pumps will transfer the soap solution to the 10,000 GAL storage tank. The soap solution will be distributed from the storage tank to various hose reels located in the locomotive shop and on the service platform, as well as the automatic wash facility, by a horizontal, single stage turbine pump (P-14). The pump will be operated by a HAND-OFF-AUTO (HOA) switch located at the motor control center. With the switch set to the AUTO position, the pump will be energized when the discharge line pressure drops below the set point. With the switch in the HAND position, the pump will run continuously until manually shut off. The pump will be de-energized with the switch in the OFF position.

- J. Diesel Fuel System. Diesel fuel will be pumped from the storage tank to the fueling booms located on the service platform. Diesel fuel dispensing skill will be purchased by Union Pacific Railroad. Contract shall install skid and connect required piping and utilities.

### 3.03 HOSE REEL SCHEDULE

- A. For each project location, provide a Hose Reel Schedule to identify the requirements and parameters of the hose reels to be installed for the project. A typical schedule should include the information as shown in the following example:

#### EXAMPLE – HOSE REEL SCHEDULE – EXAMPLE

<u>Application</u>	<u>Temp.</u> <u>°F</u>	<u>Pressure,</u> <u>psig</u>	<u>Hose ID</u> <u>Inches</u>	<u>Hose Length - Feet</u>			<u>Mounting</u> <u>Position</u>	<u>Roller</u> <u>Position</u>	<u>No.</u> <u>Req'd</u>
				<u>On</u> <u>Reel</u>	<u>As</u> <u>Pendant</u>	<u>Total</u> <u>Length</u>			
Journal Oil	100	100	1/2	60	2	62	Wall	C	9
Lube Oil	100	100	1	50	2	52	Wall	C	10
Compressor Oil	100	100	1/2	60	2	62	Wall	C	10
Non Potable Water	60	50	3/4	60	2	62	Wall	C	19
Soap/Water Mix	60	100	3/4	60	2	62	Wall	C	19
Compressed Air	60	100	1/2	60	2	62	Wall	C	19
Radiator Water	60	50	3/4	60	2	62	Wall	C	10
Oxygen/Acetylene	60	100	1/2 dual	60	2	62	Wall	C	19
Trouble Light	NA	NA	NA	NA	NA	NA	Wall	C	19

**END OF SECTION**

## **SECTION 22 10 00 - PLUMBING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

**A. Section Includes:**

1. Furnishing and installation of materials, appliances, fixtures, equipment, and appurtenances associated with the plumbing systems as indicated herein and on the drawings. Suitable connections shall be provided for each fixture, piece of equipment, and appurtenance as required.
- B. Requirements for plumbing systems, including, but not limited to, pipe materials, valves, thermal insulation, and pipe supports which are not an integral part of the fixture or piece of equipment and are not specified herein, are covered in other sections.
- C. Refer to Section 01 61 02 for additional requirements.

#### **1.02 GENERAL**

- A. Coordination: Appliances, fixtures, equipment, and appurtenances furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations furnished by the manufacturer unless exceptions are approved by the Owner.
- B. The Contractor shall verify that each component of the plumbing system is compatible with all other parts of the system; that all piping, fixtures, and appurtenances are appropriate for the intended function; and that all devices necessary for a properly functioning system have been provided.
- C. Appliances, fixtures, equipment, and appurtenances furnished under this section shall be the standard product of the manufacturer. Where two or more units of the same class of equipment are required, they shall be the product of a single manufacturer; however, all the component parts of the system need not be the products of one manufacturer.
- D. The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall notify the Owner of any discrepancy before performing the work.
- E. Where several manufacturers' names have been listed as possible suppliers, only the products of the first manufacturer listed have been checked for size, functions, and features.
- F. Metal Gages: Metal thicknesses and gages specified herein are minimum requirements. Gages refer to US Standard gage.

### 1.03 GOVERNING STANDARDS

- A. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with the applicable national, state, and local codes and ordinances, laws, and regulations which pertain to such work. In case of a conflict between these specifications and any applicable national, state, or local code, ordinance, law, or regulation, the latter shall govern.
- B. The plumbing work shall conform to the latest edition Plumbing Code of the Authority having jurisdiction.
- C. All work shall comply with American Gas Association (AGA), American Society for Testing and Materials (ASTM), National Fire Protection Association (NFPA), Uniform Building Code (UBC) and Underwriters' Laboratories (UL) safety requirements.

### 1.04 SUBMITTALS

- A. Submit as specified in Section 01 61 02 and Section 01 33 00.
- B. Drawings and Data: Complete assembly and installation drawings, wiring and schematic diagrams, together with detailed specifications and data covering materials used, parts, devices and other accessories forming a part of the fixtures and equipment furnished, shall be submitted in accordance with the submittals section. Device tag numbers indicated on the contract drawings shall be referenced on the submittals where applicable. The data and specifications for each unit shall include, but shall not be limited to, the following:
  - 1. Equipment, Piping Accessories, and Appurtenances:
    - a. Name of manufacturer.
    - b. Type and model.
    - c. Construction materials, thicknesses, and finishes.
    - d. Capacities.
    - e. Pressure and temperature ratings.
    - f. Overall dimensions.
    - g. Piping connection size and location.
    - h. Net weight.
    - i. Wiring diagrams.
  - 2. Plumbing Fixtures:
    - a. Name of manufacturer.
    - b. Type and model.
    - c. Construction materials, thicknesses, and finishes.
    - d. Water consumption data.
    - e. Overall dimensions
    - f. Rough-in dimensions.



## PART 2 - PRODUCTS

### 2.01 PERFORMANCE AND DESIGN REQUIREMENTS

- A. All fixtures and equipment shall be designed to meet the performance and design conditions as specified herein and on the drawings.

### 2.02 MATERIALS

- A. Anchor Bolts and Expansion Anchors: All anchor bolts, expansion anchors, nuts, and washers shall comply with the requirements of the anchor bolts and expansion anchors section.
- B. Piping Systems: Unless otherwise specified herein, piping system materials shall conform to the miscellaneous piping and ductile iron pipe sections.
- C. Valves: Unless otherwise specified herein, valves indicated to be a part of the plumbing systems shall conform to the miscellaneous valves section.

### 2.03 PLUMBING EQUIPMENT

- A. General: Plumbing equipment shall be provided with all required supports, fasteners, fittings, and escutcheons required for a complete installation.
- B. Automatic Water Softener: The water softener shall have a capacity and dimensions as indicated on the drawings. The system shall consist of two softener tanks, one brine tank, a metered recycle controller with alternator mechanism, motor-driven regeneration valve, and automatic brine control system. Brine tank shall be polyester. Softener tanks shall be fiberglass reinforced polyester. System size, manufacturer, and model number shall be as indicated on the drawings. Softener system shall be manufactured by Culligan, Bruner, or Rainsoft.

### 2.04 CONSTRUCTION

- A. Shop Painting: Unless otherwise indicated, shop painting shall be as specified in the General Equipment Stipulations. Surface finish damaged during installation shall be repaired to the satisfaction of the Owner. Field painting shall conform to the requirements of the painting section.
- B. Color: The color of vitreous china, cast iron, enameled steel, and acrylic plumbing fixtures shall be white unless otherwise indicated. The color of other plumbing fixtures shall be the manufacturers' standard. The finish and color of plumbing equipment shall be the manufacturers' standard unless otherwise indicated.

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. The Contractor shall field verify all existing conditions prior to submitting a bid proposal.



### 3.02 INSTALLATION

- A. Piping, fixtures, equipment, and materials furnished under this section shall be installed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are approved by the Owner.
- B. Water Supply Piping and Accessories: Water supply piping shall not be routed over or in front of electrical switchboards or panels unless acceptable to the Owner.
  - 1. Water hammer arresters shall be provided in the hot and cold water supply piping at all quick-closing valves, solenoid valves, and plumbing fixtures. Arresters shall be located and sized as indicated on the drawings. Water hammer arresters shall be installed in an accessible location when possible.
- C. Drainage and Vent Piping and Accessories: Drainage and vent piping shall not be routed over or in front of electrical switchboards or panels unless acceptable to the Owner.
  - 1. Unless otherwise indicated or required by code, horizontal sanitary drainage piping 3 IN or less in diameter shall be installed at a uniform slope of 1/4 IN/FT (2 percent); horizontal sanitary drainage piping larger than 3 IN in diameter shall be installed at a uniform slope of 1/8 IN/FT (1 percent); horizontal storm drainage piping shall be installed at a uniform slope of 1/8 IN/FT (1 percent).
  - 2. All sanitary and storm drainage piping which is required to be buried beneath floors shall be cast iron.
  - 3. Drainage fittings shall be installed to guide sewage, wastewater, and storm water in the intended direction of flow. Change in direction shall be made by sweep type fittings whenever possible. Quarter bends and sanitary tee fittings shall not be installed for vertical to horizontal or horizontal to horizontal change of direction.
  - 4. Plumbing vents passing through roofs shall be located at least 12 IN from a parapet or the intersection of a cant with the roof deck, and shall be adequately flashed watertight. Plumbing vents shall not be located closer to operable windows or outside air intakes than is allowed by the applicable code.
  - 5. Floor drains shall be carefully adjusted to the correct elevation for proper drainage. Floor cleanouts shall be installed flush with the finished floor. Heads of fastening screws shall not project above the cover or grate surface.
  - 6. Unless otherwise indicated, floor cleanouts shall be line size for 4 IN and smaller drainage piping, and shall be 4 IN for drains larger than 4 IN. Proper clearance shall be provided for access to cleanouts.
  - 7. Floor drains, trench drains, floor sinks, and bell-up drains indicated to be trapped shall be provided with a deep seal "P" trap located as close to the drain as possible.

- D. Plumbing Fixtures and Accessories: Plumbing fixtures shall be set level and plumb, and shall be securely attached to the floor or wall as appropriate. Unless a fixture height is indicated on the drawings, each fixture shall be mounted at the manufacturer's recommended height. Where indicated to be ADA compliant, fixtures shall be mounted at the heights established by the Federal Government.
1. Fixtures shall be sealed to the floor or wall with a sealant as specified in the caulking section. The color of caulking shall match the fixture.
  2. Fixture traps shall be installed to be easily removed for servicing and cleaning. Escutcheons shall be provided at all locations where fixture supply or drain piping penetrates walls, floors, or ceilings.
  3. Water piping at stop valves, shower heads, and flush valves shall be rigidly secured to blocking. Drop-ear elbows shall be used whenever possible. All water supply piping shall be cleaned and flushed prior to installing the plumbing fixtures.
- E. Plumbing Equipment: Plumbing equipment shall be installed in accordance with manufacturer's recommendations. Adequate clearance shall be provided for access to all components which may require adjustment, servicing, or replacement.
1. Water heaters shall be installed in accordance with AGA, NSF, NFPA, and UL requirements. Storage type water heaters shall be cleaned and flushed prior to connection to the potable water system. Water heater relief valves shall be piped to the nearest floor drain or bell-up drain, and shall terminate the appropriate air gap distance above the drain within 6 IN of the floor.
  2. Fuel gas pressure regulator vents and fuel train vent valves shall be piped to the exterior of the building.

### 3.03 FIELD TESTING

- A. Field testing of the plumbing systems shall conform to the requirements of the miscellaneous piping section and the pipeline pressure and leakage testing section.

### 3.04 ADJUSTING

- A. All flush valves and other devices shall be adjusted for proper flow and quiet operation. Faucet and supply assemblies shall be adjusted or repaired to prevent leaks. All drains shall be checked for proper operation.

### 3.05 PROTECTION

- A. Plumbing fixtures, equipment, and appurtenances shall be adequately protected from damage immediately after installation. Plumbing fixtures shall not be used during the construction period.

### 3.06 CLEANING

- A. Immediately prior to the final inspection, plumbing fixtures, equipment, piping, and appurtenances shall be thoroughly cleaned. Cleaning solutions and cleaning method shall be as recommended by the manufacturer. All faucet aerators shall be removed, cleaned, and replaced.

3.07 SCHEDULES

A. Schedules relating to the plumbing work are indicated on the drawings.

**END OF SECTION**

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## **SECTION 22 11 13 - WATER DISTRIBUTION PIPING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Water distribution piping system, including potable cold and hot water piping, fittings, and specialties within the building.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- ##### **A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.**

#### **1.03 SUBMITTALS**

- ##### **A. Submit as specified in Section 01 33 00.**
- ##### **B. Product data for each piping specialty, and valve specified.**
- ##### **C. Test reports as specified in Part 3 of this Section.**

#### **1.04 QUALITY ASSURANCE**

- ##### **A. Regulatory Requirements: Comply with the provisions of the following:**
1. ASME B 31.9: "Building Services Piping" for materials, products and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- ##### **A. Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:**
1. Relief Valves:
    - a. Cash (A.W.) Valve Mfg. Corp.
    - b. Watts Regulator Co.
    - c. Conbraco Industries Inc.
    - d. Zurn Industries, Inc.; Wilkins-Regulator Div.
  2. Y-Pattern Strainers:
    - a. Armstrong Machine Works.
    - b. Trane Co.
    - c. Hoffman Specialty ITT; Fluid Handling Div.
    - d. Victaulic Co. of America (low pressure applications only).

- e. Metraflex Co.
- f. Watts Regulator Co.
- g. Spirax Sarco.
- 3. Dielectric Waterway Fittings:
  - a. Victaulic Company of America.
- 4. Dielectric Unions:
  - a. Perfection Corp.
  - b. Watts Regulator Co.

## 2.02 PIPE AND TUBE MATERIALS

- A. General: Refer to Part 3, Article "PIPE APPLICATIONS" for identification of systems where the below materials are used.
- B. Drawn Temper Copper Tubing: ASTM B88, Type L.

## 2.03 FITTINGS

- A. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.

## 2.04 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, 95-5 tin-antimony.

## 2.05 GENERAL DUTY VALVES

- A. General Duty Valves (i.e., grate, globe, check, ball, and butterfly valves) are specified in Division 15 Section "General Duty Valves." Special duty valves are specified below by their generic name; refer to Part 3 Article "VALVE APPLICATION" for specific uses and applications for each valve specified.

## 2.06 PIPING SPECIALTIES

- A. Unions: ANSI B16.39, malleable iron, Class 150, hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends. Threads shall conform to ANSI B1.20.1.
- B. Dielectric Unions: Threaded or soldered end connections as required to suit application; constructed to isolate dissimilar metals, prevent galvanic action, and prevent corrosion.
- C. Relief Valves: Provide proper size for relief valve, in accordance with ASME Boiler and Pressure Vessel Codes, for indicated capacity of the appliance for which installed.
- D. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Provide temperature relief at 210 DEG F, and pressure relief at 150 psi.

## PART 3 - EXECUTION

### 3.01 PIPE APPLICATIONS

- A. Install Type L, drawn copper tubing with wrought copper fittings, above ground, within building.
- B. Install Type K, seamless copper tubing with no joints below ground or within slabs.

### 3.02 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, and other design considerations. So far as practical, install piping as indicated.

### 3.03 HANGERS AND SUPPORTS

- A. Hanger, supports, and anchor devices are specified in Division 15 Section "SUPPORTS AND ANCHORS." Conform to the table below for maximum spacing of supports.
- B. Install hangers with the following minimum rod sizes and maximum spacing:

<u>Nom. Pipe Size</u>	<u>Max. Span-Ft.</u>	<u>Min. Rod Size-Inches</u>
1/2 to 1-1/4	7	3/8
1-1/2 to 2	10	3/8
2-1/2 to 3	10	1/2

### 3.04 FIELD QUALITY CONTROL

- A. Test water distribution piping as follows:
  - 1. Test for leaks and defects all new distribution piping systems.
  - 2. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for a period of 4 HRS. Leaks and loss in test pressure constitute defects which must be repaired.
  - 3. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained. Operate all plumbing to the satisfaction of the Owner.
  - 4. Prepare reports for all tests and required corrective action.

### 3.05 ADJUSTING AND CLEANING

- A. Clean and Disinfect water distribution piping as follows:
  - 1. Purge all new water distribution piping systems and parts of existing systems, which have been altered, extended, or repaired prior to use.

2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction, or in case a method is not prescribed by that authority, the procedure described in either AWWA C601, or AWWA D105, or as described below:
  3. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
  4. Fill the system or part thereof, with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system, or part thereof, and allow to stand for 24 HRS.
  5. Drain the system, or part thereof, of the previous solution, and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 HRS.
  6. Following the allowed standing time, flush the system with clean potable water until chlorine does not remain in the water coming from the system.
  7. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.
- B. Prepare reports for all purging and disinfecting activities.

**END OF SECTION**



## **SECTION 22 11 23 - DOMESTIC WATER CIRCULATING PUMPS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Pumps for domestic hot water circulating systems applications.

#### **1.02 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 22 10 00 - Plumbing.
- C. Section 22 42 00 - Plumbing Fixtures.
- D. Section 23 07 19 - Piping Insulation.
- E. Section 22 10 00 "Plumbing Equipment"

#### **1.03 SUBMITTALS**

- A. Product data including certified performance curves and rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories. Indicate pump's operating point on curves.
- B. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating between manufacturer-installed wiring and field-installed wiring.
- C. Maintenance data for pumps to include in the operation and maintenance manual specified in Division.
  1. Include startup instructions.

#### **1.04 REFERENCED STANDARDS**

- A. Regulatory Requirements: Comply with provisions of the following:
  1. ASME B31.9 "Building Services Piping" for piping materials and installation.
  2. Hydraulic Institute's "Standards for Centrifugal, Rotary & Reciprocating Pumps" for pump design, manufacture, testing, and installation.
  3. UL 778 "Standard for Motor Operated Water Pumps" for construction requirements. Include UL listing and labeling.
  4. NEMA MG 1 "Standard for Motors and Generators" for electric motors. Include NEMA listing and labeling.
  5. NFPA 70 "National Electrical Code" for electrical components and installation.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Vertical In-Line Pumps:

- a. Allis-Chalmers Fluid Products Co.; Industrial Pump Div.
- b. Armstrong Pumps, Inc.
- c. Dunham-Bush, Inc.
- d. General Signal; Aurora Pump.
- e. ITT Fluid Technology Corp.; Bell & Gossett Div.
- f. Patterson Pump Co.
- g. Peerless Pump Co.
- h. Taco, Inc.
- i. PACO.

### 2.02 GENERAL

A. System circulating pump shall be centrifugal type, close-coupled single stage; with a cast bronze enclosed dynamically balanced impeller, internally flushed mechanical seal suitable for continuous operation up to 225 DegF, minimum working pressure of 125 psi, cast iron case with gauge tappings and vent and drain ports, and a single speed continuous duty NEMA MG 1 motor. Pumps shall be factory tested, cleaned and painted prior to shipping.

### 2.03 HORIZONTAL IN-LINE PUMPS

A. Description: Horizontal, in-line, centrifugal, flexible-coupled, single-stage, radially split case design. Include vertical-mounting, bronze-fitted design and mechanical seals rated for 125 psig (860-kPa) minimum working pressure and a continuous water temperature of 225 DegF (107 DegC).

1. Casing: Cast iron, with threaded companion flanges for piping connections. Pump motor, coupling and impeller shall be removable from casing without removing the casing from the piping.
2. Impeller: ASTM B584, cast bronze, statically and dynamically balanced, closed, single suction, and keyed to shaft.
3. Wear Rings: Replaceable, bronze casing ring.
4. Shaft and Sleeve: Ground and polished stainless-steel shaft with bronze sleeve.
5. Shaft: Ground and polished stainless-steel shaft with axially split spacer coupling.
6. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
7. Motor: Directly mounted to pump casing.

UP General Specifications

DOMESTIC WATER CIRCULATING PUMPS

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## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install pumps according to manufacturer's written installation and alignment instructions.
- B. Install pumps in locations indicated and arranged to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

### 3.02 CONNECTIONS

- A. General: Install shutoff valve and strainer on pump suction and check valve and balancing valve with memory stop on pump discharge.
- B. Connect piping to pumps as indicated. Install reducers at the pump flange and install valves that are the same size as piping connecting to pumps.
- C. Install temperature and pressure gage test in suction and discharge piping around each pump.
- D. Install electrical connections for power, controls, and devices.
- E. Electrical power and control wiring and connections are specified in Division 26 Sections.

### 3.03 FIELD QUALITY CONTROL

- A. Check suction piping connections for tightness to avoid drawing air into pumps.
- B. Clean strainers.
- C. Set pump controls.

### 3.04 COMMISSIONING

- A. Final Checks Before Startup: Perform the following preventive maintenance operations and checks before startup:
  - 1. Lubricate bearings.
  - 2. Check motor for proper rotation that matches direction marked on pump casing.
  - 3. Check that pumps are free to rotate by hand. Pumps for handling hot liquids shall be free to rotate with pump hot and cold. Do not operate pump if it is bound or even drags slightly until cause of trouble is determined and corrected.
  - 4. Check that pump controls are correct for required application.

### 3.05 PUMP CONTROLS

- A. Pump shall be scheduled through the DDC system. When the pump is scheduled to be operation through the DDC system, the pump shall be turned on/off through a line voltage adjusted to maintain heating water piping at 118 DegF (adj.).
- B. Pump shall run continuously.

## END OF SECTION

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## **SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Sanitary drainage and vent piping, inside building and to outdoor locations indicated.

#### **1.02 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 22 42 00 - Plumbing Fixtures.
- C. Section 22 48 00 - Plumbing Specialties.
- D. Section 31 23 10 - Excavation and Fill.
- E. Division 33 - Utilities.
- F. Section 40 50 02 - Basic Mechanical Materials and Methods.
- G. Section 40 05 07 - Hangers and Supports.

#### **1.03 SUBMITTALS**

- A. Test Results and Reports: Specified in "Field Quality Control" Article.
- B. Provide submittals for all sanitary sewer materials including manufacturer data for piping, fittings, and joining materials.

#### **1.04 QUALITY ASSURANCE**

- A. Provide stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

### **PART 2 - PRODUCTS**

#### **2.01 PIPES AND TUBES**

- A. Hub-and-Spigot, Cast-Iron Soil Pipe: ASTM A74, Service class. Include ASTM C564 rubber gasket, with dimensions required for pipe class, for each hub.
- B. Hubless, Cast-Iron Soil Pipe: ASTM A888 or CISPI 301.

#### **2.02 PIPE AND TUBE FITTINGS**

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.

- B. Threaded-Fitting, End Connections: ASME B1.20.1.
- C. Hub-and-Spigot, Cast-Iron, Soil-Pipe Fittings: ASTM A 74, Service and Extra Heavy classes, hub and spigot. Include ASTM C 564 rubber gasket, with dimensions required for pipe class, for each hub.
- D. Hubless, Cast-Iron, Soil-Pipe Fittings: CISPI 301.
- E. Cast-Iron Solvent Fittings: ASME B16.45 drainage-pattern aerator and deaerator.
- F. Cast-Iron, Threaded Fittings: ASME B16.4, Class 125, galvanized, standard pattern.
- G. Cast-Iron, Threaded Drainage Fittings: ASME B16.12, galvanized, drainage pattern.
- H. Cast-Iron, Threaded Flanges: ASME B16.1, Class 125.
- I. Ductile-Iron, Push-on-Joint Fittings: AWWA C110, ductile- or gray-iron standard pattern; or AWWA C153, ductile-iron compact pattern. Include AWWA C111 ductile- or gray-iron glands, rubber gaskets, and steel bolts with mechanical-joint fittings. Include AWWA C111 rubber gaskets with push-on joint fittings.

## 2.03 JOINING MATERIALS

- A. Refer to Section 40 50 02 "Basic Mechanical Materials and Methods" for commonly used joining materials.
- B. Solder: ASTM B32, Alloy Sn95, Sn94, or E; lead free.
- C. Hubless, Cast-Iron, Soil-Piping Couplings: ASTM C1277 assembly of metal housing, corrosion resistant fasteners, and ASTM C564 rubber sleeve or gasket with integral, center pipe stop. Include the following:
  - 1. Heavy-Duty, Stainless-Steel Couplings: ASTM A666, Type 304, stainless-steel housing or shield; and stainless-steel clamps. Include gasket.
    - a. Clamp Width: 3 IN (75 mm) wide with 4 clamps.

## PART 3 - EXECUTION

### 3.01 EXCAVATION

- A. Refer to Section 31 00 00 "Earthwork" and Section 31 23 10 "Excavation and Fill" for excavating, trenching, and backfilling.

### 3.02 PIPING APPLICATIONS

- A. Aboveground, Soil, Waste, and Vent Piping: Use the following:
  - 1. 1-1/2 IN NPS (DN40): Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and heavy duty Type 304 stainless steel soil pipe couplings.
  - 2. 2 through 6 IN NPS (DN50 to DN100): Hubless, cast-iron soil pipe; hubless, cast-iron, soil-pipe fittings; and soil-pipe couplings. Heavy duty Type 304 stainless steel.
- B. Underground, Soil, Waste, and Vent Piping: Use the following below floor slabs:

- a. 2 through 6 IN NPS (DN50 to DN100): Hub-and-spigot, cast-iron soil pipe, Service class; hub-and-spigot, cast-iron, soil-pipe fittings, Service class; and push joints.

### 3.03 PIPING INSTALLATION, GENERAL

- A. Refer to Section 40 50 02 "Basic Mechanical Materials and Methods" for basic piping installation.

### 3.04 SERVICE ENTRANCE PIPING INSTALLATION

- A. Extend building sanitary drain piping and connect to sanitary sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections to the building sanitary sewers.
- B. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Section 40 50 02 "Basic Mechanical Materials and Methods" for wall penetration systems.

### 3.05 DRAINAGE AND VENT PIPING INSTALLATION

- A. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- B. Make changes in direction for drainage and vent piping using appropriate branches, bends, and long sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not make change in direction of flow greater than 90 degrees. Use proper size of standard increasers and reducers if different sizes of piping are connected. Reducing size of drainage piping in direction of flow is prohibited.
- C. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- D. Install drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Sanitary Building Drain: 2 percent downward in direction of flow for piping 4 IN and smaller.
  - 2. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- E. Sleeves are not required for cast-iron soil piping passing through concrete slab on grade if slab is without membrane waterproofing.

### 3.06 JOINT CONSTRUCTION

- A. Refer to Section 40 50 02 "Basic Mechanical Materials and Methods" for basic piping joint construction.

- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Compression (Push) Joints: Rubber gasket matching class of pipe and fittings.
  - 2. Hubless Joints: Rubber gasket and sleeve or clamp.

### 3.07 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section 40 05 07 "Hangers and Supports" for pipe hanger and support devices. Install the following:
  - 1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
  - 2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs 100 FT (30 m) and less.
- B. Install supports according to Section 40 05 07 "Hangers and Supports."
- C. Support vertical piping at base and at ceiling.
- D. Rod diameter may be reduced one size for double-rod hangers, with 3/8 IN (10-mm) minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum spacing and minimum rod diameters:
  - 1. 1-1/2 and 2 IN NPS (DN40 and DN50): Maximum horizontal spacing, 60 IN (1500 mm) with 3/8 IN (10-mm) minimum rod diameter; maximum vertical spacing, 15 FT (4.5 m).
  - 2. 3 IN NPS (DN80): Maximum horizontal spacing, 60 IN (1500 mm) with 1/2 IN (13-mm) minimum rod diameter; maximum vertical spacing, 15 FT (4.5 m).
  - 3. 4 IN NPS (DN100 and DN125): Maximum horizontal spacing, 60 IN (1500 mm) with 5/8 IN (16-mm) minimum rod diameter; maximum vertical spacing, 15 FT (4.5 m).
- F. Install hangers for ductile-iron piping with the following maximum spacing and minimum rod diameters:
  - 1. 1-1/4 IN NPS (DN32): Maximum horizontal spacing, 84 IN (2100 mm); 3/8 IN (10-mm) minimum rod diameter; maximum vertical spacing, 15 FT (4.5 m).
  - 2. 1-1/2 IN NPS (DN40): Maximum horizontal spacing, 108 IN (2700 mm) with 3/8 IN (10-mm) minimum rod diameter; maximum vertical spacing, 15 FT (4.5 m).
  - 3. 2 IN NPS (DN50): Maximum horizontal spacing, 10 FT (3 m) with 3/8 IN (10-mm) minimum rod diameter; maximum vertical spacing, 15 FT (4.5 m).
  - 4. 2-1/2 IN NPS (DN65): Maximum horizontal spacing, 11 FT (3.4 m) with 1/2 IN (13-mm) minimum rod diameter; maximum vertical spacing, 15 FT (4.5 m).
  - 5. 3 IN NPS (DN80): Maximum horizontal spacing, 12 FT (3.7 m) with 1/2 IN (13-mm) minimum rod diameter; maximum vertical spacing, 15 FT (4.5 m).
- G. Support piping not listed above according to MSS SP-69 and manufacturer's written instructions.



### 3.08 CONNECTIONS

- A. Connect service entrance piping to exterior sewerage and drainage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage piping to service entrance piping, and extend to and connect to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer Section 22 48 00 - "Plumbing Specialties."

### 3.09 FIELD QUALITY CONTROL

- A. Inspect drainage and vent piping as follows:
  - 1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
  - 2. During installation, notify authorities having jurisdiction at least 24 HRS before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
    - a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  - 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
  - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
  - 3. Roughing-In Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10 FT of head (30 kPa). Water level must not drop from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.

4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1 IN WG (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

### 3.10 CLEANING AND PROTECTING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

### **END OF SECTION**

## **SECTION 22 14 29 - SUMP PUMPS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes:
  - 1. Sump pumps.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

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

#### **1.03 REFERENCED STANDARDS**

- A. UL and NEMA Compliance – Provide electric motors and components which are listed and labeled by Underwriters Laboratories and comply with NEMA Standards.

#### **1.04 SYSTEM DESCRIPTION**

- A. Provide single source coordination responsibility through the pump manufacturer for the entire system including but not limited to the following:
  - 1. Pumps.
  - 2. Motors.
  - 3. Float switches.
  - 4. Control panel.
  - 5. Guiderails.

#### **1.05 SUBMITTALS**

- A. Submit as specified in Section 01 61 02 and Section 01 33 00.
- B. Product Data – Submit manufacturer's pump specifications, installation and start-up instructions, and current accurate pump characteristic performance curves with selection points clearly indicated.
- C. Wiring Diagrams – Submit manufacturer's electrical requirements for power supply wiring to pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field installed.
- D. Maintenance Data – Submit maintenance data and parts lists of each type of pump, control and accessory; including "trouble-shooting" maintenance guide. Include this data, product data, and wiring diagrams in maintenance manual; in accordance with the requirements of Division 01.

## PART 2 - PRODUCTS

### 2.01 SUBMERSABLE SUMP PUMPS

- A. General – Provide complete equipment and incidentals required for a non-clog submersible centrifugal sump pump(s) specified herein.
- B. Operating Conditions – The pumps(s) shall be rated at 2HP, 460V, 3 PH, 60Hz, running at 1750 RPM. The units shall produce 100 GPM at 35 FT TDH. The pump shall be capable of handling a 2-1/2 IN spherical solid. The pump shall be non-overloading throughout the entire range of operation without employing service factor. The pump shall reserve a minimum service factor of 1.20.
- C. Construction – The pump shall be centrifugal, non-clog, submersible, waste water type. The pump volute, motor, and seal housing shall be a high quality gray cast iron, ASTM A48, Class 30. All external mating parts shall be machined and Buna N Rubber square-rings sealed. All fasteners exposed to the pumped liquids shall be 300 series stainless steel.
- D. Electrical Power Cord – The motor power cord shall be SJTW/SJTW-A type. The cord shall have a molded compression grommet to insulate electrical connections. The grommet shall be threaded into the motor housing to provide a positive seal and to prevent leaking of liquid into the motor housing. The sealing grommet shall provide strain relief for the power cord.
- E. Motor – The stator, motor, and bearings shall be mounted in a sealed submersible type housing. The stator windings shall have Class F insulation, 311 DegF and a dielectric oil filled motor, NEMA B design. Further protection shall be provided by on-winding thermal sensors. Heat sensors shall be low resistance, bi-metal disc that is temperature sensitive. It shall be mounted directly on the stator windings and sized to open at 120 DegF and automatically reset at 30 DegF to 35 DegF differential. The pump and motor shall be specifically designed so that they may be operated partially or completely submerged in the liquid being pumped.
- F. Bearings and Shaft – An upper radial bearing and lower thrust bearing shall be required. These shall be heavy-duty bearings which are permanently lubricated by the dielectric oil which fills the motor housing. The shaft shall be machined from a solid 303 stainless steel forging of a large diameter to reduce shaft deflection.
- G. Seals – The pump shall have two (2) mechanical seals, mounted in tandem, with an oil chamber between the seals. The seals shall have carbon and ceramic faces. Replacement seals shall be readily available.
- H. Impeller – The impeller shall be of the enclosed non-clogging design and have pump-out vanes on the front and backside to prevent grit and other materials from collecting in the seal area. The impeller shall be dynamically balanced.
- I. Casing – The casing shall be of the end suction volute type having sufficient strength and thickness to withstand all stress and from service at full operating pressure and load.
- J. Painting – The pump shall be painted after assembly with a zinc chromate base enamel.

- K. Control Panel – Furnish and install on complete pump control panel in a NEMA 3R rated enclosure. The panel to provide short circuit protection and line disconnect. The panel shall incorporate circuit breakers with through inner door operating handles, tamper proof door, inner door, run lights, start relays and magnetic starters with ambient compensated quick trip overloads, alternator and HOA selector switches, and high level alarm light and alarm bell with silencer.
- L. Available Manufacturers – Subject to compliance with requirements, manufacturers offering submersible type sump pumps which may be incorporated in the work include, but are not limited to, the following:
  - 1. ABS, Inc.
  - 2. Barnes Pump, Inc.
  - 3. Myers Pumps, Inc.
  - 4. Weil Pump Co.
  - 5. Weinman Pump LFE Corp.; Fluids Control Division.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION OF PUMPS

- A. General – Install pumps which are indicated on drawings, in accordance with the manufacturer's published installation instructions, complying with recognized industry practices to ensure pumps comply with requirements and serve intended purposes.
- B. Electrical Wiring – Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagrams submittal to Electrical Installer.

**END OF SECTION**

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## SECTION 22 15 10 - COMPRESSED AIR STATION

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Section Includes:

1. Standard Union Pacific Railroad compressed air stations. All of the air supply stations shall be similar in design, but actual CFM requirements may vary by location.
- B. These Packages must be completely assembled, wired and plumbed stations designated to operate in ambient conditions between –20 DegF to +110 DegF without experiencing freezing and overheating problems.
- C. This entire system will be designed for, and installed in a standard ICC container or an UPRR approved container sizes as listed below. All modifications to the container that will be required for the appropriate air flows, ambient temperatures, heat rejection, lighting, flooring, equipment spacing, maintenance access, etc., will be the responsibility of the vendor.

COMPRESSOR	CONTAINER SIZE
All singles	8 FT-6 IN (Nominal)W x 7 FT-0 IN H x 20'LG
Duals (up to 40hp)	8 FT-6 IN (Nominal)W x 7 FT-0 IN H x 20'LG
Duals (over 40hp)	8 FT-6 IN (Nominal)W x 7 FT-0 IN H x 40'LG

#### 1.02 REFERENCED STANDARDS

- A. ANSI/CAGI B19.1 Safety Standards for Compressors for Processor Industry
- B. American Petroleum Institute (API):
  1. 5L, Line Piping
- C. ASTM International (ASTM):
  1. A234, Specification for Piping Fittings of Wrought Carbon Steel for Moderated and Elevated Temperatures
- D. American National Standards Institute (ANSI):
  1. B16.9, Factory Made Wrought Steel Buttwelding Fittings
- E. American Society of Mechanical Engineers – Boiler and Pressure Vessel Code.
- F. National Electrical Code (NEC) – Latest Published Edition.
- G. Uniform Building Code and applicable local building codes.

### 1.03 SUBMITTALS

- A. Provide detailed literature describing the furnished equipment with bid. This information includes dimensional information concerning the overall dimensions, proposed container modifications inclusive to inlets, outlets, venting, personnel egress, anchor bolts and electrical connection of the assembled package unit. Failure to provide a complete description will result in rejection of the bid.
- B. Vendor shall provide accurate layout drawings in electronic format for approval, prior to construction.
- C. Vendor shall provide copies of each installation, operation, and maintenance manuals and repair parts list for all equipment with each compressed air station in electronic format. One hard copy is to be stored in a metal holder securely fastened to the building interior structure.
- D. Supply submittals as listed in the project specifications.

### 1.04 QUALITY ASSURANCE

- A. Vendor shall have a minimum of 5 years experience in design and construction of compressed air stations of similar size and components.

## PART 2 - PRODUCTS

### 2.01 COMPRESSED AIR STATION

- A. The compressed air station shall be one complete unit. The complete Compressed Air Station shall consist of, but not limited to, the following components:
  - 1. Air Compressor.
  - 2. Air Dryer.
  - 3. Inline Filter.
  - 4. Oil / Water Separator.
  - 5. Demand Controller.
  - 6. Dry Air Receiver (if applicable).
  - 7. Piping as needed.
  - 8. Valves – 5 gph, no air loss. Valves shall be “Manual” or “On-Demand” depending on location, as needed if not supplied:
    - a. Examples, but not limited to, compressor moisture separator, receiver tank, and inline filter.
  - 9. Heating/Ventilation (as needed per region).
- B. Electrical Supply: Two (2) 7.5 HP Air Compressors (120/240V, 1 Phase, 3 Wire).



1. Compressed air station shall have Square D heavy duty fusible, pad-lockable, NEMA 3R, 600V switch, for a 3-wire system. This disconnect shall be 200A rated with a 200A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.
  2. Inside the container, provide a Square D NQ MLO 225A main panel with separate breakers for each air compressor (100A, 240V, 2 pole), lighting (20A, 120V, 1 pole), receptacles (20A, 120V, 1 pole) and appropriately sized breakers per the National Electrical Code (NEC) for any additional loads (ie. heater, air conditioner, etc.).
  3. All conductors for interior wiring shall be 98 percent conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #12 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/240V, 1P, 3W).
- C. Electrical Supply: Two (2) 7.5hp Air Compressors (**277/480V, 3 Phase, 4 Wire**).
1. Compressed air station shall have a Square D, heavy duty, fusible, pad-lockable, NEMA 3R, 600V switch, for a 4-wire system. This disconnect shall be 100A rated with a 100A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.
  2. Inside the container, provide 125A Square D NF, MLO, 480Y/277V panelboard with 30 spaces, with separate circuit breakers for each air compressor (30A, 480V, 3 pole) and Mini-Power Zone (25A, 480V, 2 pole). Provide appropriately sized breakers per the National Electrical Code (NEC) for any other loads (ie. heater, air conditioner, etc.). Balance load across phases. Also provide a 5kVA Square D Mini-Power Zone, 480V input to 120/240 volt, with separate breakers to service lighting (20A, 120V, 1 pole) and receptacles (20A, 120V, 1 pole).

3. All conductors for interior wiring shall be 98% conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #10 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/240V, 1P, 3W).

D. Electrical Supply: Two (2) **10hp** Air Compressors (120/**208V**, 3 Phase, 4 Wire).

1. Compressed air station shall have a Square D, heavy duty, fusible, pad-lockable, NEMA 3R, 600V switch, for a 4-wire system. This disconnect shall be 200A rated with a 200A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.
2. Inside the container, provide 225A Square D NQ, MLO, 120/208V panelboard with 30 spaces, with separate circuit breakers for each air compressor (70A, 208V, 3 pole), lighting (20A, 120V, 1 pole), and receptacles (20A, 120V, 1 pole). Provide appropriately sized breakers per the National Electrical Code (NEC) for any other loads (ie. heater, air conditioner, etc.).
3. All conductors for interior wiring shall be 98 percent conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #10 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/208V, 3P, 4W).

**E. Electrical Supply: Two (2) 15hp Air Compressors (120/208V, 3 Phase, 4 Wire).**

1. Compressed air station shall have a Square D, heavy duty, fusible, pad-lockable, NEMA 3R, 600V switch, for a 4-wire system. This disconnect shall be 200A rated with a 200A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.
2. Inside the container, provide 225A Square D NQ, MLO, 120/208V panelboard with 30 spaces, with separate circuit breakers for each air compressor (100A, 208V, 3 pole), lighting (20A, 120V, 1 pole), and receptacles (20A, 120V, 1 pole). Provide appropriately sized breakers per the National Electrical Code (NEC) for any other loads (i.e. heater, air conditioner, etc.).
3. All conductors for interior wiring shall be 98 percent conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #10 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/208V, 3P, 4W).

**F. Electrical Supply: Two (2) 10hp Air Compressors (120/240V, 3 Phase, 4 Wire).**

1. Compressed air station shall have a Square D, heavy duty, fusible, pad-lockable, NEMA 3R, 600V switch, for a 4-wire system. This disconnect shall be 200A rated with a 200A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.
2. Inside the container, provide 225A Square D NQ, MLO, 120/240V panelboard with 30 spaces, with separate circuit breakers for each air compressor (70A, 240V, 3 pole), lighting (20A, 120V, 1 pole), receptacles (20A, 120V, 1 pole). Provide appropriately sized breakers per the National Electrical Code (NEC) for any other loads (ie. heater, air conditioner, etc.). Balance load across phases.

3. All conductors for interior wiring shall be 98 percent conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #10 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/208V, 3P, 4W).

G. Electrical Supply: Two (2) **15hp** Air Compressors (120/**240V**, 3 Phase, 4 Wire).

1. Compressed air station shall have a Square D, heavy duty, fusible, pad-lockable, NEMA 3R, 600V switch, for a 4-wire system. This disconnect shall be 400A rated with a 225A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.
2. Inside the container, provide 225A Square D NQ, MLO, 120/240V panelboard with 30 spaces, with separate circuit breakers for each air compressor (100A, 240V, 3 pole), lighting (20A, 120V, 1 pole), receptacles (20A, 120V, 1 pole). Provide appropriately sized breakers per the National Electrical Code (NEC) for any other loads (ie. heater, air conditioner, etc.). Balance load across phases.
3. All conductors for interior wiring shall be 98 percent conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #10 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/208V, 3P, 4W).

- H. Electrical Supply: Two (2) **10hp** Air Compressors (**277/480V**, 3 Phase, 4 Wire).
1. Compressed air station shall have a Square D, heavy duty, fusible, pad-lockable, NEMA 3R, 600V switch, for a 4-wire system. This disconnect shall be 200A rated with a 125A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.
  2. Inside the container, provide 125A Square D NF, MLO, 480Y/277V panelboard with 30 spaces, with separate circuit breakers for each air compressor (35A, 480V, 3 pole) and Mini-Power Zone (25A, 480V, 2 pole). Provide appropriately sized breakers per the National Electrical Code (NEC) for any other loads (ie. heater, air conditioner, etc.). Balance load across phases. Also provide a 5kVA Square D Mini-Power Zone, 480V input to 120/240 volt, with separate breakers to service lighting (20A, 120V, 1 pole) and receptacles (20A, 120V, 1 pole).
  3. All conductors for interior wiring shall be 98 percent conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #10 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/208V, 3P, 4W).
- I. Electrical Supply: Two (2) **15hp** Air Compressors (**277/480V**, 3 Phase, 4 Wire).
1. Compressed air station shall have a Square D, heavy duty, fusible, pad-lockable, NEMA 3R, 600V switch, for a 4-wire system. This disconnect shall be 200A rated with a 125A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.
  2. Inside the container, provide 125A Square D NF, MLO, 480Y/277V panelboard with 30 spaces, with separate circuit breakers for each air compressor (50A, 480V, 3 pole) and Mini-Power Zone (25A, 480V, 2 pole). Provide appropriately sized breakers per the National Electrical Code (NEC) for any other loads (ie. heater, air conditioner, etc.). Balance load across phases. Also provide a 5kVA Square D Mini-Power Zone, 480V input to 120/240 volt, with separate breakers to service lighting (20A, 120V, 1 pole) and receptacles (20A, 120V, 1 pole).

3. All conductors for interior wiring shall be 98 percent conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #10 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/208V, 3P, 4W).
- J. Electrical Supply: Two (2) **25hp** Air Compressors (**277/480V**, 3 Phase, 4 Wire).
1. Compressed air station shall have a Square D, heavy duty, fusible, pad-lockable, NEMA 3R, 600V switch, for a 4-wire system. This disconnect shall be 200A rated with a 125A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.
  2. Inside the container, provide 125A Square D NF, MLO, 480Y/277V panelboard with 30 spaces, with separate circuit breakers for each air compressor (80A, 480V, 3 pole) and Mini-Power Zone (25A, 480V, 2 pole). Provide appropriately sized breakers per the National Electrical Code (NEC) for any other loads (ie. heater, air conditioner, etc.). Balance load across phases. Also provide a 5kVA Square D Mini-Power Zone, 480V input to 120/240 volt, with separate breakers to service lighting (20A, 120V, 1 pole) and receptacles (20A, 120V, 1 pole).
  3. All conductors for interior wiring shall be 98 percent conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #10 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/208V, 3P, 4W).

- K. Electrical Supply: Two (2) **30hp** Air Compressors (**277/480V**, 3 Phase, 4 Wire).
1. Compressed air station shall have a Square D, heavy duty, fusible, pad-lockable, NEMA 3R, 600V switch, for a 4-wire system. This disconnect shall be 400A rated with a 250A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.
  2. Inside the container, provide 250A Square D NF, MLO, 480Y/277V panelboard with 30 spaces, with separate circuit breakers for each air compressor (100A, 480V, 3 pole) and Mini-Power Zone (25A, 480V, 2 pole). Provide appropriately sized breakers per the National Electrical Code (NEC) for any other loads (ie. heater, air conditioner, etc.). Balance load across phases. Also provide a 5kVA Square D Mini-Power Zone, 480V input to 120/240 volt, with separate breakers to service lighting (20A, 120V, 1 pole) and receptacles (20A, 120V, 1 pole).
  3. All conductors for interior wiring shall be 98 percent conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #10 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/208V, 3P, 4W).
- L. Electrical Supply: Two (2) **40hp** Air Compressors (**277/480V**, 3 Phase, 4 Wire).
1. Compressed air station shall have a Square D, heavy duty, fusible, pad-lockable, NEMA 3R, 600V switch, for a 4-wire system. This disconnect shall be 400A rated with a 400A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.
  2. Inside the container, provide 400A Square D NF, MLO, 480Y/277V panelboard with 30 spaces, with separate circuit breakers for each air compressor (125A, 480V, 3 pole) and Mini-Power Zone (25A, 480V, 2 pole). Provide appropriately sized breakers per the National Electrical Code (NEC) for any other loads (ie. heater, air conditioner, etc.). Balance load across phases. Also provide a 5kVA Square D Mini-Power Zone, 480V input to 120/240 volt, with separate breakers to service lighting (20A, 120V, 1 pole) and receptacles (20A, 120V, 1 pole).

3. All conductors for interior wiring shall be 98 percent conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #10 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/208V, 3P, 4W).

M. Electrical Supply: Two (2) **50hp** Air Compressors (**277/480V**, 3 Phase, 4 Wire).

1. Compressed air station shall have a Square D, heavy duty, fusible, pad-lockable, NEMA 3R, 600V switch, for a 4-wire system. This disconnect shall be 400A rated with a 400A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.
2. Inside the container, provide 400A Square D I-Line HCM, MLO, 480Y/277V panelboard with 27 spaces, with separate circuit breakers for each air compressor (150A, 480V, 3 pole) and Mini-Power Zone (25A, 480V, 2 pole). Provide appropriately sized breakers per the National Electrical Code (NEC) for any other loads (ie. heater, air conditioner, etc.). Balance load across phases. Also provide a 5kVA Square D Mini-Power Zone, 480V input to 120/240 volt, with separate breakers to service lighting (20A, 120V, 1 pole) and receptacles (20A, 120V, 1 pole).
3. All conductors for interior wiring shall be 98 percent conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #10 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/208V, 3P, 4W).



N. Electrical Supply: Two (2) **60hp** Air Compressors (**277/480V**, 3 Phase, 4 Wire).

1. Compressed air station shall have a Square D, heavy duty, fusible, pad-lockable, NEMA 3R, 600V switch, for a 4-wire system. This disconnect shall be 400A rated with a 400A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.
2. Inside the container, provide 400A Square D I-Line HCM, MLO, 480Y/277V panelboard with 27 spaces, with separate circuit breakers for each air compressor (175A, 480V, 3 pole) and Mini-Power Zone (25A, 480V, 2 pole). Provide appropriately sized breakers per the National Electrical Code (NEC) for any other loads (ie. heater, air conditioner, etc.). Balance load across phases. Also provide a 5kVA Square D Mini-Power Zone, 480V input to 120/240 volt, with separate breakers to service lighting (20A, 120V, 1 pole) and receptacles (20A, 120V, 1 pole).
3. All conductors for interior wiring shall be 98 percent conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #10 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/208V, 3P, 4W).

O. Electrical Supply: Two (2) **75hp** Air Compressors (**277/480V**, 3 Phase, 4 Wire).

1. Compressed air station shall have a Square D, heavy duty, fusible, pad-lockable, NEMA 3R, 600V switch, for a 4-wire system. This disconnect shall be 400A rated with a 400A Class R fuse for single point electrical connection located outside the container, approved and labeled for service entry to feed all equipment and lighting. All fuses shall be Class "R" Bussman Fusetrons, unless otherwise noted. Provide three spare fuses for each size used. All necessary accessories to make a complete electrical system are required. This includes equipment grounding kit, rainproof bolt-on hub, neutral assembly kit, and the lock off guard kit.

2. Inside the container, provide 400A Square D I-Line HCM, MLO, 480Y/277V panelboard with 27 spaces, with separate circuit breakers for each air compressor (225A, 480V, 3 pole) and Mini-Power Zone (25A, 480V, 2 pole). Provide appropriately sized breakers per the National Electrical Code (NEC) for any other loads (ie. heater, air conditioner, etc.). Balance load across phases. Also provide a 5kVA Square D Mini-Power Zone, 480V input to 120/240 volt, with separate breakers to service lighting (20A, 120V, 1 pole) and receptacles (20A, 120V, 1 pole).
  3. All conductors for interior wiring shall be 98 percent conductivity copper. Insulation shall be 600V THW or THWN thermoplastic, unless otherwise specified. No wire shall be smaller than #10 unless otherwise noted. Conductors shall be continuous from outlet to outlet. No splices shall be made except within outlet or junction boxes. All exposed interior raceways shall be galvanized rigid steel (RGS). Minimum size conduit shall be 3/4 IN nominal trade size. All panels, wire and conduit shall comply with NEC. All panels shall provide at least 25 percent spare breaker capacity. Panelboards and disconnects shall be marked with permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8 IN in height. Indicate panel name, or designation and voltage, phase, and wire characteristics (ie, 120/208V, 3P, 4W).
- P. Station shall have a 2 IN flanged compressed air outlet pipe located outside the container and clearly labeled.

## 2.02 COMPRESSOR BUILDING

- A. The standard container sizes are listed on the project drawings and shall meet ICC specifications or UPRR approval for a container of similar dimensions. It is to be free of dents, punctures, bulges, and any damage which detracts from its general function and appearance.
- B. The compressor building shall be provided with thermostat controlled electric heaters and ventilation system to protect from freezing, overheating, or premature shutdown under all ambient conditions. The internal temperature is to be maintained to ensure maximum compressor efficiency.
- C. Flooring shall be appropriate for ease of cleaning and resistance to contaminants and/or oils.
- D. Lighting inside container shall be comprised of Lithonia Lighting Model MSL LED style fixtures, providing a minimum of twenty (20) foot-candles.
- E. Install equipment to maximize service clearance around compressors and dryer for ease of maintenance.
- F. All clearances required by the latest published edition of the NEC shall be observed.
- G. A minimum of two (2) 120-volt duplex outlets shall be provided. One (1) is to be located by the Control Panel and one (1) by the Compressor. If the control panel and compressor are next to each other, place the outlets opposite each other at either end of the container. If heat tracing is required, a third outlet is to be furnished in proximity to the condensate lines or equipment to be traced.

- H. A lockable, wall mounted metal cabinet shall be provided for all lists of daily, weekly, and monthly maintenance procedures, as well as manuals and keys.
- I. An adequate drain system for all condensates shall be installed and directed to an Oil / Water Separator. All condensate lines shall be heat traced when regional temperatures dictate such precautions, or as required on the design drawings (refer to outlet requirements – previous).
- J. Weather-tight metal double doors shall be provided to provide ease of installation and removal of the compressor(s). Dual compressors require double doors for each compressor.
- K. All doors shall be fitted with industrial grade locking devices to prohibit unauthorized access.
- L. Appropriate duct work for demand air and heated exhaust air shall be provided. Compressor exhaust air shall not be vented directly into the container.
- M. Appropriate duct work for demand air and heated exhaust air shall be provided. Compressor exhaust air may be vented directly into the container provided the ventilation system is sized adequately to handle additional air flow.
- N. Compressor building penetrations (piping, vents, etc.) shall be made water-tight by installing flashing, sealed, and caulked.
- O. Air intake openings are to have filters installed.
- P. Completed package shall be transported to installation sites via truck without special handling, disassembly, etc. (e.g. 13 FT-6 IN transport height).

### 2.03 COMPRESSOR

- A. The compressor(s) shall be single stage, air cooled, oil flooded rotary screw type. The compressor is to meet stated cfm requirements and the manufacturer is to submit the CAGI performance sheet. The Compressor package is to take into account compressor performance results.
- B. Compressor shall include, but not limited by, the following:
  - 1. Multi-stage, 3-micron dust inlet filter and differential pressure indicator (dirty filter).
  - 2. Air inlet / unload valve assembly.
  - 3. Integral gear drive – Belt drive systems shall not be used (except for small horsepower compressors at the discretion of the engineer).
  - 4. High efficiency, ODP motor (voltage, phase, and hp as required per application; performance specifications to be provided to UPRR).
  - 5. TEFC cooling fan motor (for oil cooler and after-cooler).
  - 6. Wye/Delta starter or other “soft start” on main motor.
  - 7. NEMA 12 enclosure.
  - 8. ASME coded air/oil separator tank.
  - 9. High efficiency air/oil separator element.
  - 10. Differential pressure oil circulation system.

11. Integrated after-cooler and high efficiency moisture separator with manual and No-Loss demand drain valve.
12. Oil stop valve and thermostatic oil cooler by-pass valve.
13. Spin-on type oil filter and oil level indicator.
14. Minimum pressure check valve.
15. Air check valve.
16. Factory fill of 8000 HR synthetic lubricant.
17. Full six (6) sided enclosure (85 max. dB, per CAGI standards).
18. Start-Stop controls, without modulation.

#### 2.04 COMPRESSOR CONTROL SYSTEM

- A. Microprocessor control system (120-volt) which utilizes an energy efficient “load/no-load” control. During periods of prolonged operation in the unload mode, the unit will automatically shut off stay in an auto restart mode which will automatically start the unit when demand increases.
- B. Controller program and operating parameters shall not be lost by power failure. Air compressor shall restart automatically with restoration of power.
- C. In the case of dual compressors, logic is to be configured to allow for alternate start/stop operation. Controller Logic shall allow one (1) compressor to be taken off line while the other compressor continues to run.
- D. System will include a minimum of the following:
  1. LED Indicators:
    - a. Automatic Operation.
    - b. Voltage On.
    - c. General Alarm.
  2. Push Buttons:
    - a. Start/Stop and Emergency Stop.
    - b. Function Keys.
    - c. Scroll Keys.
    - d. Tabulator Keys.
  3. Data Display:
    - a. Discharge Outlet Temperature.
    - b. Delivery Air Pressure.
    - c. Motor Overload Status.
    - d. Running Hours and Loaded Hours.
  4. Service Indicators:
    - a. Air and Oil Filter.

- b. Oil Separator and Oil Level.
- 5. Remote Exterior LED Indicator Lights:
  - a. Green = Ready/Operating.
  - b. Red = General Alarm.

#### 2.05 AIR DRYER

- A. The air dryer shall be designed as a refrigerated cycling type (or desiccant type when specified by UPRR) and built to ASME code standards. Design Dew point shall be 35-39 pdp.
- B. Air dryer may be incorporated within the compressor system.
- C. Dryer system shall be approximately sized for the combined air flow of all compressors.

#### 2.06 INLINE FILTER

- A. The filter shall remove any remaining water, mist, oil, particulates, etc. up to one (1.0) micron from the air entering the air receiver.
- B. The filter shall be deep bed media design, with a maximum range of 2 psid indicating when the element is due to be changed.
- C. The filter vessel shall be ASME coded.
- D. A three (3) valve filter bypass system shall be installed.

#### 2.07 AFTER FILTER

- A. The filter shall remove any remaining water, mist, oil, particulates, etc. up to one-tenth (0.01) micron from the air entering the air receiver.

#### 2.08 OIL/WATER SEPARATOR

- A. The oil/water separator is to collect drainage from the air receiver, inline filter and air dryer.
- B. The separated water is to be piped to the outside of the building for drainage.
- C. The oil collection system shall be designed for removal of the oil on an annual basis concurring with the compressor oil change.

#### 2.09 DEMAND CONTROLLER

- A. Sized for maximum flow of compressed air system.
- B. Field adjustable range from 60 - 120 psig. Initially set at 90 psig discharge pressure. Include 0 - 200 psig pressure gauges to read inlet & discharge pressures.
- C. Maximum allowable pressure drop through the demand controller shall not exceed 3 psid at maximum flow of compressed air system.
- D. The demand controller shall keep the system pressure  $\pm 1.5$  psig at all flow conditions within the turndown range of the valve.
- E. The demand controller shall have a turn down of 30 percent minimum.

- F. Demand controller to be located on wall near air outlet pipe. Demand controller shall remain inside container and piping from the external air receiver tank will be piped back into container, through demand controller and back out. Compressor provider will provide all internal piping to and from demand controller. The connections from the demand controller to the outside of the container will be 2 IN.

#### 2.10 AIR RECEIVER

- A. An internal air receiver may be installed if compressor stations do not have air tanks.
- B. Internal air receivers to have automatic no loss air drains tied to Oil/Water separator.
- C. Receivers to be of steel construction, ASME National Board coded for 150 psi minimum working pressure.

#### 2.11 PIPING

- A. Air line piping shall be ASTM A53 Grade B or API-5L Grade, schedule 40, seamless or ERW. Condensate lines shall be type M copper.
- B. Fittings:
  - 1. Threaded pipe fittings shall be 3000 #, forged steel conforming to ANSI B16.11.
  - 2. Piping is not to present a tripping hazard, a maintenance obstacle, or violate NEC required clearances.
- C. Pipe dope to be used on all threaded connections, no Teflon tape shall be used.

#### 2.12 VALVES

- A. Valves shall be ANSI Class 600 ball valve with lever handle, carbon steel body, Teflon seats, stainless steel trim and NPS ends.
- B. Drain valves shall be low loss type air drains, tied to Oil/Water separator.

#### 2.13 HEATER/ VENTILATION

- A. Heater shall be electric type.
- B. More than one heating element may be installed to allow for appropriate heating of container.
- C. Ventilation to be sized to allow for required compressor air demand.
- D. Ventilation Inlet to have air filters installed to minimize dust build-up.

### PART 3 - EXECUTION

#### 3.01 PAINTING

- A. All pipe, couplings, equipment and pipe fittings shall be prepared and painted per Specification Section 09 90 00.
- B. Container exterior shall be painted light gray with a minimum 3 mils DFT alkyd enamel with appropriate primer pre-applied to bare metal or modification areas.

### 3.02 START-UP SERVICES

- A. Services of a factory trained start-up engineer for the Owner's on-site installation shall be included in total cost of the equipment.
- B. The Start-up Engineer shall certify that all assembled equipment and components in this specification have been pre-tested, installed, and in good working order prior to any acceptance for shipment by the Railroad. Upon receipt of the system to the installation site, the Start-up Engineer shall ensure that the owner's representatives responsible for future system operation have been fully instructed as to proper maintenance and operation parameters as required or specified by the vendor.
- C. The Start-up Engineer shall examine field installation and make any recommendation he deems fit to ensure proper operation under all conditions.

### 3.03 GUARANTEE

- A. The vendor shall guarantee all materials and workmanship furnished will replace or make any satisfactory adjustments for any part shown to be defective within twelve (12) months after the acceptance by the Railroad.

### 3.04 MAINTENANCE

- A. To prevent nullification Original Equipment Manufacturer's warranties container manufacturer shall provide maintenance for the period of one (1) year.
  - 1. Quarterly operational checks shall be performed which will include a complete system analysis.

## **END OF SECTION**

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## **SECTION 22 15 11 - HUMP COMPRESSED AIR SYSTEM**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Compressed air systems including:
  - a. Rotary screw air compressors and controls.
  - b. Air filters.
  - c. Air dryer.
  - d. Air receivers.
  - e. Flow controller
  - f. Flow meter.
  - g. Pressure transmitter.

##### **B. Section does not include:**

1. Compressed Air Stations to supply yard air systems. See Section 22 15 10.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Division 1 - General Requirements.**

#### **1.03 REFERENCED STANDARDS**

##### **A. American Society of Mechanical Engineers (ASME):**

1. Section VIII, Construction of Pressure Vessels Division 1.

##### **B. National Electrical Manufacturers Association (NEMA):**

1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

##### **C. Underwriters Laboratories, Inc. (UL).**

##### **D. Compressed Air and Gas Industries (CAGI) ADF-100.**

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Sections 01 61 02 and 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Detailed literature describing the equipment. This information includes dimensional information concerning the overall dimensions, power / control requirements, operating characteristics, options included, etc.
3. Fabrication Drawings:
  - a. Air receiver fabrication Drawing showing all tap locations and ASME data plate information.

- b. Show location of all control equipment.
  - c. Show location and dimension of air compressors top and end exhaust duct connections.
- 4. Controller and related equipment system description and diagrams.
- 5. A complete I/O points list for control system that describes all analog and discrete I/O points and their description.
- 6. A detailed control panel layout drawing with a complete Bill of Material (BOM) that lists each panel mounted component including part numbers, description and quantity.
- 7. Manufacturer's installation instruction.
- 8. Manufacturer's statement of proper installation and start-up.
- B. Operation and Maintenance Manuals:
  - 1. See Section 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.
  - 2. Electronic copies of the manuals are sufficient for initial submittal to Railroad. One hard copy print should be provided to Railroad at completion of the project.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Air compressor:
    - a. Ingersoll-Rand.
    - b. Atlas-Copco.
    - c. Kaeser.
    - d. Or approved equal.
  - 2. Air Compressor Controller:
    - a. Ingersoll-Rand.
    - b. Or approved equal.
  - 3. Air Filtration:
    - a. Ingersoll-Rand.
    - b. Zeks.
    - c. Atlas-Copco.
    - d. Kaeser.
    - e. Or approved equal.

4. Air dryer:
  - a. Ingersoll-Rand.
  - b. Zeks.
  - c. Or approved equal.
5. Automatic pneumatic no-loss drain valves:
  - a. Ingersoll-Rand.
  - b. Zeks.
  - c. Or approved equal.
6. Flow Controller:
  - a. Ingersoll-Rand.
  - b. Or approved equal.
7. Flow Meter:
  - a. Rosemount.
  - b. Or approved equal.
8. Pressure Transmitter:
  - a. Rosemount.
  - b. Or approved equal.

## 2.02 COMPRESSED AIR SYSTEM

### A. General:

1. Provide an air compressor system with the following components:
  - a. Rotary screw air compressors: Four (4) each.
  - b. Wet air receiver: Two (2) each.
  - c. Dry air receiver: Two (2) each.
  - d. Supplemental dry air receivers: Six (6) each.
  - e. Controls: As specified.
    - 1) Pressure transducer: Two (2) each.
    - 2) Pressure dew point instrument: One (1) each.
  - f. Desiccant Air Dryer: Two (2) each.
  - g. Air dryer pre-filter and after filter package: Two (2) each.
  - h. No loss drains: As needed.
  - i. Flow controller: One (1) each.
  - j. Flow meter: One (1) each.
  - k. Pressure transmitter: Two (2) each.
2. Equipment shall be factory assembled piped and wired requiring only field

connection of air piping, and electrical power, and condensate piping.

## 2.03 ROTARY SCREW AIR COMPRESSOR

A. Each compressor shall have the following performance and configuration:

1. Capacity: 1,440 scfm at 135 psig.
2. Maximum pressure: 145 psig.
3. Horsepower: 300 (Main Motor).
4. Air Cooled.
5. Two stage.
6. Oil Flooded.
7. Variable Speed Drive (VSD).
8. Power outage restart.
9. Each compressor shall be configured to include the standard top (of unit) exhaust, and will be modified to include an end mounted exhaust. See Drawings for configuration.

B. Compressor features:

1. Multiple unit control system with display.
2. Coolant filter with replaceable element.
3. 1- micron dust inlet filter and differential pressure indicator.
4. ODP 460 V, 3 PH, 60 Cycle, high efficiency motors.
5. TEFC cooling fan motor (for oil cooler & after cooler)
6. Inerter controlled cooling fan motor.
7. ASME coded air/oil separator tank.
8. Two stage air/oil separator element, oil carry over shall be less than 3 ppm.
9. Aftercooler and high efficiency moisture separator with manual and automatic electric demand drain.
10. Air Check valve.
11. Oil stop valve and thermostatic oil cooler by-pass valve.
12. Spin-on type oil filter and oil level indicator.
13. Differential pressure oil circulation system.
14. Minimum pressure valve.
15. Control system with display.
16. Integrated VFD.
17. Factory fill of 8000 HR synthetic lubricant.
18. Full (6) sided acoustical sound attenuating enclosure (79 Max DB per CAGI).

C. Controls:

1. Microprocessor control system (120-volt control voltage).
2. Variable frequency drive.
3. Controller program and operating parameters shall not be lost by power failure. System shall restart automatically with restoration of power.
  - a. Provide Power Outage Restart Option (PORO) module.
4. Modbus communication.
5. Provide events log capability.
  - a. Provide continuous monitoring with logging of abnormal conditions and display of relevant messages.
6. Built in sequence compressor control.
7. System will include a minimum of the following:
  - a. LED Indicators:
    - 1) Automatic Operation.
    - 2) Power On.
    - 3) General Alarm.
  - b. Push Buttons:
    - 1) Start/Stop and Emergency Stop.
    - 2) Function Keys.
    - 3) Scroll Keys.
    - 4) Tabulator Keys.
  - c. Data display:
    - 1) Compressed air discharge temperature.
    - 2) Delivery air pressure.
    - 3) Motor overload fault alarm.
    - 4) Running hours and loaded hours.
    - 5) Performance analysis.
  - d. Service Indicators:
    - 1) Air & oil filter.
    - 2) Oil Separator & oil level.

#### 2.04 COMPRESSOR MASTER CONTROL PANEL

- A. Furnish an Allen Bradley CompactLogix PLC compressor controller / sequencer suitable for minimum of five (5) units and flow controller.
  1. Controls shall be housed in a NEMA 4X stainless steel enclosure.

2. Provide a managed Ethernet switch with 8 copper ports and 2 fiber ports. Managed Ethernet switch shall be Allen Bradley Stratix 5700 switch or approved equal.
3. PLC shall be supplied with sufficient digital and analog I/O points to enable the compressor sequencing, monitoring and control as called out in this specification. Provide at least 20 percent spare I/O points of each type. Provide at least 30 percent spare terminal blocks. All PLC I/O points, including spares, shall be wired to terminal blocks. Terminal blocks shall be Phoenix Contact UT4 or UT5 feed through type.
4. Provide a mushroom type (red colored) padlockable E-Stop pushbutton for emergency stop of all compressors. E-Stop pushbutton shall be hardwired to each compressor motor starter. Sufficient contact blocks shall be provided for this purpose.
5. All pushbuttons, selector switches and pilot lights shall be Allen Bradley Bulletin 800T/H 30.5mm devices. All pushbuttons shall be black colored with 1 NO and 1NC contact. Pilot lights shall be LED push-to-test (PTT) type. Selector switches shall be black colored.
6. Compressor vendor shall provide the PLC code in both native and pdf format to the Owner, Contractor and Union Pacific PLC Contractor for coordination. Each step of the PLC code shall be explained in simple English language on the side for easy understanding by others.
7. Provide an Allen Bradley PanelView Plus 6 1000 10.4 IN touchscreen OIT on the Compressor Master Control Panel. OIT shall have a main screen that displays status and alarms for the five compressors and two dryers and associated instruments/components. There shall be a separate alarms screen that shall display all active alarms in red background. A graphic pushbutton shall be available on each screen to enable the operator to go to the alarms screen. A separate graphics screen shall be provided for each compressor and dryer.
8. Coordinate with the Owner and Contractor prior to commencement of development of OIT graphics to obtain the Owner HMI graphics standards (colors and symbols). Vendor shall try to mimic the Owners HMI graphics as closely as possible. Submit a set of OIT graphics in color to the Owner and Engineer for approval prior to finalizing the graphics. Vendor shall address any comments arising out of this submittal prior to factory testing and final shipment.
9. Provide a redundant 24VDC power supply in the Master Control Panel to provide 24VDC power to the Ethernet switch and OIT and any other components that require 24VDC power. Power supply shall be manufactured by SolaHD or approved equal. Power supply shall be provided with a redundancy module that shall monitor the active 24VDC power supply and upon failure of the active module it shall automatically switch over to the standby module without loss of 24VDC power to the associated components.
10. Submit a complete I/O points list that describes all analog and discrete I/O points and their description.
11. Submit a detailed control panel layout drawing with a complete Bill of Material (BOM) that lists each panel mounted component including part numbers, description and quantity.

- B. The Automation system should monitor and trend supply pressure, each compressor amperage, system pressure, system flow, pressure dew point, as well as, valve position the flow controller. The flow controller should be controlled by the compressor master control PLC.
- C. The following will be required from the PLC as a minimum:
  - 1. Utilize different pressure setpoints and permissive times during trim mode and active mode.
  - 2. Utilize different PID loops for flow controller during active and trim modes.
  - 3. Rotate compressors based on running hours or programmed sequence.
  - 4. Start, load, unload, and stop compressors as required.
  - 5. Delay starting and loading of a compressor when the rate of pressure change is positive or zero.
- D. Provide package to allow monitoring of compressed air system through Modbus TCP or Ethernet/IP.
  - 1. PLC in Compressor Master Control Panel will communicate with UP provided Hump Air Supervisory Control Panel via Modbus TCP or Ethernet/IP. Compressor vendor shall coordinate with UP's Hump Air Supervisory Control Panel supplier to establish communication with the Supervisory PLC. Compressor vendor shall provide PLC I/O Register Map to UP PLC Contractor. UP PLC Contractor, CSE Services, Tony Schmitz (Phone: 402-733-2100 x2102) shall provide the Supervisory Control Panel.
  - 2. Package to provide user with the following items (not limited to):
    - a. System status & control.
    - b. System performance monitoring.
    - c. Equipment status monitoring.
    - d. Equipment maintenance scheduler.
    - e. Graphing and trending tools for flow (from flow meter), pressure, pressure dew point, compressor amperage, flow controller valve position.
    - f. Reporting tools.
    - g. Warning and alarm monitoring.
- E. Low pressure alarm: 110 psi.
- F. Pressure Transducer
  - 1. Provide two (2) total, one (1) on each air receiver as located on Drawings, 0 – 150 PSIG pressure transducers. One (1) active and one (1) back-up.
  - 2. Pressure transducers shall provide 4-20 mA output to Compressor Master Control Panel.
  - 3. See plans for location and schedule.
  - 4. Manufacturer:
    - a. Dwyer, Model 628.

- b. Or approved equal.
- 5. Pressure range (gage):
  - a. 0 – 150 PSIG.
- 6. Pressure transducer shall include:
  - a. Conduit housing.
    - 1) 1/2 IN FNPT conduit connection.
  - b. 1/4 IN MNPT process connection.
  - c. Include isolation valve.
  - d. NEMA 4X enclosure.
  - e. Stainless steel wetted parts.
- G. Pressure Dew Point Instrument:
  - 1. Provide pressure dew point instrument.
  - 2. Pressure dew point instrument shall provide 4-20 mA output to Compressor Master Control Panel.
  - 3. Instrument sensor shall be compatible with dry compressed air from desiccant air dryer (Vaisala DRYCAP 180M or equal).
  - 4. See plans for location and schedule.
  - 5. Manufacturer:
    - a. Vaisala, DMT242.
    - b. Or approved equal.
  - 6. Pressure range (gage):
    - a. 0 – 150 PSIG.
  - 7. Dew point range:
    - a. -100 DegF to +80 DegF
  - 8. Pressure dew point instrument shall include:
    - a. 1/2 IN MNPT connection.
    - b. Include isolation valve.
    - c. NEMA 4 enclosure.
    - d. Stainless steel probe.
- H. New compressors shall be equipped with Variable Frequency Drives (VFD).
- I. Provide control scheme to respond to air consumption demands.
  - 1. Air flow shall be monitored downstream of the flow controller (by flow meter) as located on plans.
  - 2. Air pressure shall be monitored downstream of the dryer near the main air receivers as located on plans.



3. The master compressor controller will use the (4) 300 HP compressors to maintain a target pressure. The controller shall utilize flow rate of change and pressure drop to determine compressor operations.
  - a. Normal Compressor Master Control system operation:
    - 1) Maintain a target pressure of 130 psig (adjustable) at the main air receiver tanks.
    - 2) Compressors shall be cycled on/off as necessary to maintain the target pressure. Controller shall utilize flow rate of change and pressure drop to determine/predict compressor operations.
  - b. Back-up control system operation (local controls):
    - 1) In the event of a Compressor Master Control Panel failure, system shall default into local control operation. Operation sequence shall default to the following:
      - a) The first compressor that is brought on will be a “trim” compressor. This compressor will throttle between 30 percent - 100 percent of capacity to try to maintain 135 psig. If the pressure drops to the “Add” pressure (132 psig), the controller will begin the process of turning on another compressor. The next compressor brought on-line would be a “base” compressor. This compressor will be able to throttle between 70 percent - 100 percent. Both the trim and base compressors will be able to throttle together to prevent rapid cycling of the system. If the pressure drops to the next “Add” pressure setting (129 psig), the controller will begin the process of turning on the third compressor. It would only be able to run at 100 percent capacity. If the pressure drops to the next “Add” pressure setting (126 psig), the controller will begin the process of turning on the last compressor. It would only be able to run at 100 percent capacity. As the pressure rises to the “Remove” pressure, compressors would then be taken off-line.
      - b) System will be set up to rotate operation of compressors from “trim”, “base”, “third” or “last” compressor.

## 2.05 AIR RECEIVERS

- A. See Section 23 05 99 for inspection and testing requirements.
- B. Provide wet air receivers at locations as shown on plans.
  1. Size:
    - a. Provide two (2) vertical wet air receivers with capacity as scheduled on Drawings. Condensate from wet receiver shall be routed to condensate management system installed within compressor building. Condensate piping shall be insulated.
  2. Receivers to be of steel construction, ASME National Board coded for 165 psi minimum working pressure.

- C. Provide dry air receivers at locations as shown on plans.
  - 1. Size:
    - a. Provide two (2) horizontal dry receiver tanks with capacity as scheduled on Drawings, dry air for primary air storage.
  - 2. Receivers to be of steel construction, ASME National Board coded for 150 psi minimum working pressure.
- D. Provide supplemental air receivers at locations as shown on plans.
  - 1. Size:
    - a. Provide four (4) horizontal dry receiver tanks with capacity as scheduled on Drawings, dry air for supplemental air storage.
    - b. Provide two (2) vertical dry receiver tanks with capacity as scheduled on Drawings, dry air for supplemental air storage.
  - 2. Receivers to be of steel construction, ASME National Board coded for 150 psi minimum working pressure.
- E. Receiver shall have following accessories:
  - 1. Pressure gage, 4-1/2 IN, 0-300 psi.
  - 2. Vent valve.
  - 3. Safety relief valve.
    - a. Manufacturer:
      - 1) Kunkle Series 6000.
      - 2) Or equal.
    - b. Safety relief valves shall be set to pressure rating of tank.
    - c. Wet air receivers and primary dry air receiver tank safety relief valves shall be capable of exhausting combined flow capacity of compressors.
    - d. Safety valve quantity and sizing shall meet state and/or local requirements.
- F. Horizontal air receivers are to be provided with saddles.
- G. Air receivers shall be mounted on concrete slabs.

## 2.06 COMPRESSOR INLET AIR FILTER

- A. Compressor Inlet Particulate Filters:
  - 1. Provide inlet particle filter.
  - 2. Filter shall remove 99.9 percent of particles down to 3.0 micron rating.
  - 3. Provide with replaceable filter element.

## 2.07 IN LINE OIL / PARTICULATE FILTERS

- A. In Line Filters:
  - 1. Ingersoll Rand – NL Module.

2. Or approved equal.
- B. Filters shall remove oil and water liquid/mists, and solid particulates from compressed air. Filter must be capable of removing oil and water liquid/mist down to 0.5 ppm by weight.
- C. Filters shall use both mechanical and centrifugal action to remove up to 99 percent of all solid particles and droplets of water or oil before it reaches the filter element.
- D. Filter elements to provide 99.98 percent efficiency at 0.1 micron retention.
- E. The filters shall have the following features:
  1. Replaceable cartridge type filter elements.
  2. Differential pressure gauges.
  3. Housing to be cast aluminum, 250 LB working pressure.

## 2.08 AIR DRYERS

- A. Desiccant Air Dryer:
  1. Provide heated desiccant type air dryer size for compressor flow and corrected for operational temperature and pressure factors.
    - a. Flow Rating (not corrected): 6000 SCFM (minimum).
  2. Dried air shall have a pressure dewpoint of -40 DegF.
  3. Dryer capacity shall be based upon inlet air at 145 psig, 100 percent relative humidity, 100 DegF ambient temperature with a maximum of 5 psi maximum pressure loss across the unit.
  4. Automatic cycling shall be controlled by included PLC controller.
  5. Twin drying towers comprised of pressure vessels that are UL approved or ASME coded for 200 psi operating pressure.
    - a. Provide safety relief valve on each tower.
  6. Construct with corrosion resistant materials with heat exchanger being aluminum, stainless steel or epoxy coated copper.
  7. All copper components exposed to ambient air to be epoxy coated.
  8. Provide following unit mounted indicators:
    - a. Temperature indicators:
      - 1) Inlet air.
      - 2) Outlet air.
      - 3) Purge heater outlet.
      - 4) Purge exhaust.
    - b. Pressure indication:
      - 1) Air outlet.
      - 2) Each tower.

- 3) Purge pressure.
- c. Indicator lights:
  - 1) Power on.
  - 2) Compressor on.
  - 3) High temperature.
  - 4) Dryer cycle status.
- 9. Provide digital controls to automatically start, stop, and control compressor with safety shut down interlocks for thermal overloads.
- 10. Unit enclosure to be NEMA 4.
- 11. Power supply to be 460 V, 3 PH, 60 HZ.
- 12. Provide filter package with 3-way valved bypass including:
  - a. Pre-filter.
    - 1) Filter to remove oil and liquid water to 0.01 PPM (by weight) and capable to remove solid particles as small as 0.01 micron.
    - 2) Employ a replaceable element for coalescing oil mists.
    - 3) Provide no-loss drains.
    - 4) Provide differential pressure gauge.
  - b. After-filter.
    - 1) Filter to remove particulate matter with minimum efficiency of 99.95 percent of particles larger than 1 micron.
    - 2) Provide differential pressure gauge.
- 13. Provide a purge adjustment valve.
- 14. Provide noise reducing mufflers of depressurization exhaust.
- 15. Provide purge exhaust discharge sensor. Sensor shall shut down purge air heater when purge exhaust has reached regeneration temperature.
- 16. Dryer to be equipped with an Energy Management System / Dewpoint Control (EMS).
  - a. Include;
    - 1) Digital dew point display.
    - 2) Dew point control of the dryer cycle.
- 17. Purge exhaust to be piped outside of building.
  - a. Provide two (2) each 4 IN MNPT purge mufflers.
- 18. Desiccant type: Activated alumina.

## 2.09 FLOW CONTROLLER

### A. Provide automatic rotary control valves.

1. Flow controller with PID (Proportional – Integral – Derivative) controller for the hump air supply shall be provided.
  - a. The PID controller shall maintain a setpoint by adjusting the control output to meet changing air demand.
  - b. Controller to have two-line display that displays both target and actual pressures.
2. Control valve to default to open on loss of control signal.
3. Demand controller shall be controlled through Master Control Panel. Provide pressure transducers located as shown on plans, pressure transducers shall be integrated into control system.
4. Valve body type:
  - a. Butterfly or Ball flanged.
5. Characteristic:
  - a. Modified equal percentage.
6. Actuator type:
  - a. Spring and diaphragm.
7. Positioner type:
  - a. I/P.
  - b. 4 – 20 mA dc input signal.
  - c. Enclosure: NEAM 4.
8. Modbus communication port.

### B. Manufacturer:

1. Ingersoll-Rand, Intelliflow.
2. Or approved equal.

### C. Flow requirements:

1. 200 scfm to 7,200 scfm.

### D. Pressure requirements:

1. Inlet: 135 psig.
2. Outlet: 130 psig.
3. Provide controller to +/- 0.75 psi throughout rated flow range.
4. Provide ability to control downstream pressure for full range of compressor flow rate.

### E. Electrical:

1. 110 VAC, 1 PH

F. Accessories

1. Mounted pressure transducer and 3-valve bypass.
2. NEMA 4 enclosure.
3. Drain port
4. Filter / regulator on pneumatic control line.

2.10 PRESSURE GAGES.FLOW METER

A. Provide flow meter for hump air supply.

B. Manufacturer:

1. Rosemount, 3051SFA Annubar.
2. Or approved equal.

C. Flow requirements:

1. 7,200 SCFM (maximum).

D. Pressure requirements:

1. 125 PSIG.

2.11 PRESSURE TRANSMITTER

A. Provide two (2) pressure transmitters as located on plans to provide system pressure.

B. Pressure transmitters shall provide 4-20 mA HART output to Hump Air Supervisory Control Panel.

C. Manufacturer:

1. Rosemount, 2088.
2. Or approved equal.

D. Pressure range (gage):

1. 0 – 150 PSIG.

E. Pressure transmitter shall include:

1. Pipe mounting bracket.
2. LCD display configured for engineering units.
3. Integral manifold, block and bleed 2 valve configuration.
  - a. Rosemount, 306 Manifold or similar.

2.12 ACCESSORIES

A. Automatic pneumatic no-loss drain valves:

1. Provide automatic drain valve for condensate.
2. Provide No Loss Drains on compressors, package filters, oil / particulate filter, and wet air receivers.

## 2.13 FABRICATION

- A. Complete all brackets or connections and openings for air receiver and vessels prior to testing in manufacturer's plant.
  - 1. No field welding or drilling permitted.

## 2.14 SOURCE QUALITY CONTROL

- A. Dryers:
  - 1. Performance test in accordance with ISO Guidelines CAGI ADF-100.

## 2.15 MAINTENANCE MATERIALS

- A. Filter Element:
  - 1. Provide a minimum of three (3) filter replacement elements for each filter.
- B. Coolant: Provide 1 GAL container.

# PART 3 - EXECUTION

## 3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Air receivers shall be painted in accordance with Section 09 90 00.

## 3.02 FIELD QUALITY CONTROL

- A. Employ and pay for services of compressor, dryer, and control system manufacturer's representatives to:
  - 1. Supervise shop installation and shop startup.
  - 2. Inspect final installation.
  - 3. Supervise field startup and perform final adjustments.
  - 4. Provide final programming and adjustments for control system.
  - 5. Coordinate controls system tie-in with UP Controls Contractor (Hump Air Supervisory Control Panel).
  - 6. Initial testing to verify equipment and controls (as a whole) operate as specified prior to railroad operations. Correct / adjust system as necessary to meet operational requirements.
  - 7. Operational testing shall be conducted during actual hump operations. System shall be monitored during actual hump operations for a minimum of 16 HRS and as necessary for a fully functioning system as specified.
    - a. Include follow-up operational monitoring/testing for six (6) months and twelve (12) months after initial operational testing for a minimum of 8 HRS on-site each visit. Follow-up operational monitoring/testing to verify operational performance, compliance with this specification, instrumentation calibration, equipment condition/servicing & maintenance recommendations, and overall condition and operation of the system.

8. Provide training for a minimum of 12 HRS on operation and maintenance procedures.
9. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

**END OF SECTION**



## **SECTION 22 20 00 - PLUMBING FIXTURES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes: Plumbing fixtures and trim.
- B. Related Specification Sections include but are not necessarily limited to:
  - 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
  - 2. Division 01 - General Requirements.
  - 3. Section 01 61 02 - Basic Mechanical Requirements.
  - 4. Section 01 61 03 - Equipment: Basic Requirements.
  - 5. Section 22 10 00 - Plumbing.
  - 6. Section 40 05 07 - Hangers and Support.
  - 7. Section 40 50 02 - Basic Mechanical Material and Methods.

#### **1.02 REFERENCED STANDARDS**

- A. Americans with Disabilities Act (ADA):
  - 1. Accessibility Guidelines for Buildings and Facilities (ADAAG).
- B. American National Standards Institute (ANSI):
  - 1. Z358.1, Emergency Eyewash and Shower Equipment.
- C. American Society of Mechanical Engineers (ASME):
  - 1. A112.19.3, Stainless Steel Plumbing Fixtures (Designed for Residential Use).
- D. American Society of Sanitation Engineers (ASSE):
  - 1. 1011, Performance Requirements for Hose Connection Vacuum Breaker.
- E. Canadian Standards Association (CSA).
- F. NSF International (NSF).
- G. Underwriters Laboratories, Inc. (UL).
- H. Building Code:
  - 1. International Code Council (ICC):
    - a. International Building Code and associated standards, 2012 Edition including all amendments, referred to herein as Building Code.

#### **1.03 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

2. See Specification Section 01 61 03
  3. Color selection charts for Owner color selection.
  4. Fabrication and/or layout Drawings:
    - a. Layout plan(s) showing dimensions, elevations, etc.
    - b. Details showing connections, installation, rough-in locations, etc.
  5. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
    - c. Chemical-resistance data.
- B. Operation and Maintenance Manuals:
1. See Division 1 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- B. Catalog numbers shall not be considered complete. These are given as an aid to the contractor and to indicate the quality required. The contractor is responsible for the complete description of material before ordering. The material description takes precedence over the catalog number.
1. Plumbing Fixtures (Vitreous China):
    - a. American Standard.
    - b. Crane.
    - c. Kohler.
    - d. Eljer.
  2. Water Closet and Urinal Trim:
    - a. Zurn.
    - b. Sloan.
    - c. American Standard.
    - d. Kohler.
  3. Water Closet Seats:
    - a. Same as water closet manufacturer.
    - b. Church.

- c. Beneke
- 4. Lavatory Trim:
  - a. American Standard.
  - b. Chicago Faucets.
  - c. Kohler.
  - d. Sloan.
- 5. Stainless Steel Sinks:
  - a. Just Manufacturing.
  - b. Elkay.
- 6. Sink Trim:
  - a. American Standard.
  - b. Chicago Faucets.
  - c. Kohler.
  - d. Just.
  - e. Zurn.
- 7. Wash Fountains:
  - a. Best Sheet Metal, Inc.
  - b. Engineer/Owner approved equal.
- 8. Mop Sinks:
  - a. Fiat.
  - b. Standard - Elsmere Granite Co.
  - c. Williams.
  - d. Florestone.
- 9. Mop Sink Trim:
  - a. American Standard.
  - b. Chicago Faucets.
  - c. Kohler.
- 10. Shower Trim:
  - a. Symmons.
  - b. Leonard.
  - c. American Standard.
- 11. Electric Water Coolers:
  - a. Halsey-Taylor.
  - b. Elkay.

- c. Haws.
  - d. Oasis.
  - e. Sunroc.
12. Floor Drains and Floor Sinks:
- a. Wade.
  - b. Josam.
  - c. Zurn.
  - d. Smith.
13. Trap Primers:
- a. Mifab.
  - b. PPP.
14. Cleanouts:
- a. Wade.
  - b. Josam.
  - c. Zurn.
  - d. Smith.
15. Wall Hydrants and Hose Bibbs:
- a. Nibco.
  - b. Wade.
  - c. Woodford.
  - d. Smith.
16. Domestic Electric/Gas Water Heaters:
- a. A.O. Smith.
  - b. Rudd.
  - c. Rheem.
  - d. State.
17. Electric Instantaneous Water Heaters:
- a. Eemax.
  - b. Engineer/Owner approved equal.
18. Reduced Pressure Backflow Preventers:
- a. Watts.
  - b. Febco.
  - c. Clayton.

19. Double Check Backflow Preventers:
  - a. Watts.
  - b. Febco.
  - c. Clayton.
20. Expansion Tanks:
  - a. Amtrol.
  - b. Taco.
  - c. Wessels.
  - d. Elbi.
21. Remote Mixing Valves:
  - a. Watts.
  - b. Apollo.
  - c. Powers.
  - d. Leonard.
22. Emergency Mixing Valves:
  - a. Leonard.
  - b. Bradley.
  - c. Lawler.
  - d. Powers.
23. Emergency Eye/Face Washes:
  - a. Bradley.
  - b. Acorn Safety.
  - c. Encon.
  - d. Guardian.
  - e. Haws.
24. Ice Machine Valve Boxes:
  - a. Guy Gray.
  - b. Water-Tite.
  - c. Oatey.
25. Yard Office Drug Testing Valve Cabinet:
  - a. Acorn.
  - b. Engineer/Owner approved equal.
26. Water Hammer Arrestors:
  - a. Zurn.

- b. Smith.
- c. Wade.
- d. Josam.
- e. Watts.
- f. Mifab.

27. Water Pressure Reducing Valves:

- a. Fisher.
- b. Masoneilan.
- c. Trerice.
- d. Watts.

28. Water Filters:

- a. Aqua-Pure.
- b. Campbell.

C. Submit request for substitution in accordance with Division 1.

## 2.02 MANUFACTURED UNITS

### A. Plumbing Fixtures (Vitreous China):

1. Water closet (WC-1, WC-2, and WC-3):

- a. White.
- b. 1.28 gallons per flush
- c. Siphon jet.
- d. Elongated bowl.
- e. 1-1/2 IN top spud.
- f. Bolt caps.
- g. Mount water clo
- h. Type:
  - 1) WC-1 (wall hung) American Standard Model 3351.101.
  - 2) WC-2 and WC-3 (handicapped wall hung) American Standard Model 3351.101.

2. Sensor Operated Flushometer Type (For WC-1 and WC-2):

- a. Diaphragm type.
- b. Plug-in AC powered with universal input voltage of 100-240 Vac, 60Hz. Provide with transformer.
- c. Chrome plated.
- d. Permex synthetic rubber diaphragm.

- e. Self-adaptive infrared sensor with indicator light.
  - f. Courtesy flush override button.
  - g. Non-hold open integral solenoid operator.
  - h. Two (2) chrome plated wall covers.
  - i. Screw driver Bak-Chek angle stop.
  - j. Wall and spud flanges.
  - k. Spud size as required.
  - l. Type:
    - 1) American Standard Selectronic, Model 6067.121.002 (top spud).
3. Sensor Operated Flushometer Type (For WC-3):
- a. Diaphragm type.
  - b. Plug-in AC powered with universal input voltage of 100-240 Vac, 60Hz. Provide with transformer.
  - c. Chrome plated.
  - d. Permex synthetic rubber diaphragm.
  - e. Screw driver Bak-Chek angle stop.
  - f. Wall and spud flanges.
  - g. Spud size as required.
  - h. Remote electric push button.
    - 1) ADA compliant non-hold-open feature type actuator, large diameter, spring loaded, operates on 120 VAC or 24 VAC, mounted on a standard 4"x4" 2-gang electrical box, includes wall plate with four vandal resistant screws. Provide with transformer.
  - i. Type:
    - 1) Sloan, Model 111-ES-S (top spud) with remote electric push button Sloan Model EL-172-A.
4. Water closet seat:
- 1) Molded plastic, anti-microbial, open front, no cover, self-sustaining, stainless steel hinge with check, and designed for an elongated bowl.
5. Urinal (UR-1 and UR-2):
- a. White.
  - b. Top spud.
  - c. 0.125 gallons per flush.
  - d. Type:
    - 1) UR-1 (wall hung) American Standard "Washbrook FlowWise", Model 6590.530.

- 2) UR-2 (handicapped wall hung) American Standard "Washbrook FlowWise", Model 65590.530.
6. Sensor Operated Flushometer Type (For UR-1 and UR-2):
  - a. Diaphragm type.
  - b. Plug-in AC powered with universal input voltage of 100-240 Vac, 60Hz. Provide with transformer.
  - c. Chrome plated.
  - d. Permex synthetic rubber diaphragm.
  - e. Self-adaptive infrared sensor with indicator light.
  - f. Courtesy flush override button.
  - g. Non-hold open integral solenoid operator.
  - h. Two (2) chrome plated wall covers.
  - i. Screw driver Bak-Chek angle stop.
  - j. Wall and spud flanges.
  - k. Spud size as required.
  - l. 0.125 gallons per flush.
  - m. Type:
    - 1) American Standard Selectronic, Model 6062.301.007 (back spud).
7. Lavatory (LAV-1 and LAV-2):
  - a. White.
  - b. Front overflow.
  - c. Wall mounted with single center faucet hole.
  - d. Drilled for concealed arm carriers.
  - e. Provide quarter turn 3/8" chrome plated heavy brass angle supply loose key stops, chrome plated soft copper supply lines, offset drain and tailpiece, 1-1/4" 20 gauge cast brass p-trap, and support carrier.
  - f. LAV-1: Overall size: 20 IN x 18 IN
  - g. LAV-2: Overall size: 27 IN x 20 IN
  - h. Type:
    - 1) LAV-1 American Standard "Lucerne" Model 0356.421.
    - 2) LAV-2 American Standard Model 9140.047
8. Lavatory Electronic Hand Washing Faucet (For LAV-1 and LAV-2):
  - a. ADA compliant.
  - b. 0.5 gpm.
  - c. Sensor range adjustment screw.



- d. LED indicator lights.
  - e. Filtered solenoid valve with serviceable "Y" strainer filter.
  - f. Bak-chek tee.
  - g. Trim plate (4 IN center) with anti-rotation pin.
  - h. Plug-in AC powered with universal input voltage of 100-240 Vac, 60Hz. Provide with transformer.
  - i. Vandal resistant spray head.
  - j. Below deck mixing valve.
  - k. Type:
    - 1) Sloan Optima Model ETF-80.
9. Sink (S-1):
- a. White.
  - b. Front overflow.
  - c. Overall size: Oval 20 IN x17 IN.
  - d. Countertop mounted with holes on 8 IN centers.
  - e. Self-rimming.
  - f. Provide quarter turn 3/8" chrome plated heavy brass angle supply loose key stops, chrome plated soft copper supply lines, offset drain and tailpiece, and 1-1/4" 20 gauge cast brass p-trap.
  - g. Type:
    - 1) American Standard Model 0475.020.
10. Sink Faucet (For S-1):
- a. Polished chrome-plated 11" tall rigid gooseneck faucet with 2.5 IN lever handles.
  - b. 8 IN centers.
  - c. Quarter turn ceramic disc cartridges.
  - d. Vandal resistant 1.5 GPM aerator.
  - e. Install MV-1 in accessible location below S-1.
  - f. Type:
    - 1) Zurn, Model Z831B1-XL
- B. Wash Fountain (WF-1 and WF-2):
- 1. Wall mounted, type 304, 14 gage stainless steel.
  - 2. WF-1 Overall size: 72IN side to side and 20 IN front to back with 10 IN high backsplash.
  - 3. WF-1Bowl Size: 69 IN side to side, 16 IN front to back, and 16 IN deep.

4. WF-2 Overall size: 72IN side to side and 20 IN front to back with 6 IN high backsplash.
5. WF-2 Bowl Size: 69 IN side to side, 16 IN front to back, and 6 IN deep.
6. Three separate faucets. Each faucet provided with a thermostatic mixing valve
7. Two liquid soap dispensers located on either side of center faucet.
8. Single drain centered in bowl with strainer.
9. Stainless steel 14 gauge brackets for wall hanging.
10. Hard-wired 115V electronic infrared sensor, single hole faucets, gooseneck, backsplash-mounted, aerator with maximum of 2.2 gpm @ 60 psi, and integral thermostat mixing valve. Provide with transformer.
11. Provide quarter turn 3/8" chrome plated heavy brass angle supply loose key stops, chrome plated soft copper supply lines, offset drain and tailpiece, 1-1/4" 20 gauge cast brass p-trap, and support carrier.
12. Mixing valve shall be accessible from faucet.
13. Type:
  - a. WF-1 (Non-ADA): Best Sheet Metal Model 084WS72208BS.
  - b. WF-2 (ADA): Best Sheet Metal Model ADA-032E722066B
  - c. WF-1 and WF-2 Trim: Best Sheet Metal Model BSM045.

C. Sink (S-2):

1. Self-rimming, double compartment with faucet deck, type 304, 18 gauge stainless steel, completely undercoated.
2. Overall size: 33IN side to side and 21 IN front to back.
3. Each bowl: 13 IN side to side, 16 IN front to back, and 6.5 IN deep.
4. Removable stainless steel basket strainer with neoprene stoppers.
5. Provide quarter turn 3/8" chrome plated heavy brass angle supply loose key stops, chrome plated soft copper supply lines, offset drain and tailpiece, and 1-1/4" 20 gauge cast brass p-trap.
  - a. Type:
    - 1) Just Model DL.

D. Sink Faucet (For S-2):

1. Polished chrome-plated 9" tall swing gooseneck faucet with 4 IN wrist blade handles.
2. Quarter turn ceramic disc cartridges.
3. Vandal resistant 1.5 GPM aerator.
4. 8 IN centers.
5. Spray hose with lever control.
6. Install MV-1 in accessible location below S-2.

7. Type:
  - a. Zurn, Model Z871J4-XL
- E. Insulation kit for all lavatories, sinks, and wash fountains:
  1. Provide for all lavatory, sink, or wash fountain ADA applications where the p-trap, stop valves, and supply lines are visible without opening up a cabinet to the rest of the room.
  2. Pre-manufactured insulation kit for p-trap, stop valves, and supply lines.
  3. Provide an insulation kits for each p-trap, stop valve, and supply line per lavatory, sink, and wash fountain. Contractor shall determine the exact quantity required.
  4. Type:
    - a. Truebro Model Lav-Guard
- F. Mop Sink (MS-1):
  - a. Precast terrazzo, one piece.
  - b. Overall size: 24 IN x 24 IN x 12 IN
  - c. Stainless steel integral drain with removable strainer.
  - d. 3" outlet.
  - e. Continuous stainless steel cap on all edges.
  - f. Lowered front wall for access.
  - g. Type:
    - 1) Fiat Model SB-2424.
- G. Mop Sink Fittings (For MS-1):
  1. Exposed, two handle mixing faucet, brass construction, chrome plated finish, single wing handles, wall mounted, 3/4 IN hose thread spout with integral vacuum breaker, wall brace, pail hook, and check stops.
  2. Mop hanger, hose, and hose bracket.
  3. Caulk between mop sink and wall with silicone based caulk.
  4. Type:
    - a. Chicago Model 897-CP.
- H. Showers (SH-1):
  1. SH-1 enclosure by others. Refer to Architectural plans for shower enclosure requirements.
  2. Shower Fittings (For SH-1):
    - a. Single handle pressure balanced mixing faucet, brass or bronze construction, washerless design, off-cold-hot temperature range indicator dial, polished chrome cast metal lever handle, integral check stops, adjustable temperature limit stop.

- b. Adjustable spray hand held shower, chrome plated 24" mounting rail, chrome plated brass swivel connector, 60" chrome plated metal hose and quick disconnect.
- c. Chrome plated brass supply elbow with flange, chrome plated elevated vacuum breaker with chrome plated piping and flanges.
- d. ADA compliant.
- e. 2.5 gpm.
- f. ASSE 1016 listed.
- g. Type:
  - 1) Symmons 1-117-FS

I. Electric Water Cooler (EWC-1):

- 1. Wall hung, bi-level, high-efficiency electric refrigerated water cooler and bottle filling station.
- 2. ADA compliant.
- 3. Exact finish to be determined by Architect/Owner.
- 4. Shall deliver a minimum 8 gph of 50°F drinking water at 90°F ambient and 80°F inlet water temperature.
- 5. Front and side electronic pushbars for activation for the bubbler.
- 6. Electronic sensor for touchless activation with auto 20 second shutoff timer for the bottle filling unit.
- 7. Bottle filler shall provide 1.1 gpm flow rate with laminar flow to minimize splashing.
- 8. Provide 3,000 gallon capacity filter, certified to NSF/ANSI 42 and 53 with visual monitor to indicate replacement is necessary.
- 9. Stainless steel fountain top.
- 10. Hermetically sealed, air-cooled condensing unit.
- 11. Bubbler to be shielded for protection with an anti-squirt, anti-sweat and abrasion resistant design.
- 12. 115V-1P
- 13. Type:
  - a. Elkay Model LZSTLG8WS

J. Carriers:

- 1. All carriers shall be compatible with the specified fixtures.
- 2. Closets (wall hung):
  - a. Wade W-330 or 340 for vertical stacks.
  - b. Wade W-310, 4 IN for horizontal lines.
- 3. Urinals: Wade W-400 series.

4. Lavatories: Wade W-520 series.
5. Drinking fountains (electric water coolers): Wade W-400 series.

K. Drains:

1. Floor drain (FD-1):
  - a. Cast iron body, nickel bronze adjustable top.
  - b. 6" round with bottom outlet. Refer to plans for exact outlet size.
  - c. Flashing collar, deep seal trap.
  - d. Provide trap primer connection for all floor drains not serving ice machines.
  - e. Type:
    - 1) Wade 1100
2. Floor Sink (FS-1):
  - a. Bottom outlet.
  - b. Clamping seepage flange.
  - c. Seepage openings.
  - d. 8 IN x 8 IN with 6 IN sump.
  - e. Refer to plans for outlet size.
  - f. Cast iron body.
  - g. White porcelain coated interior.
  - h. 1/2 IN nickel bronze top.
  - i. Plastic dome bottom strainer.
  - j. Provide trap primer connection for all floor sinks not serving ice machines.
  - k. Type:
    - 1) Wade Model 9110.

L. Traps:

1. Floor and equipment drains:
  - a. Same material and coating as the piping system.
  - b. 3 IN minimum seal.
2. Fixture drains:
  - a. 2 IN minimum seal.
  - b. Cast brass.
  - c. Chrome plated.
  - d. Size as required.

M. Trap Primers (TP-1):

1. Pressure drop activated, 1/2" male NPT inlet and 1/2" female NPT outlet, built-in air gap, and removable filter screen.
2. No adjustments or pre-charge requirements.
3. ASSE 1018 listed.

4. Distribution system
  - a. Provide trap primer distribution unit when two or more traps are served by a single trap primer. Refer to plans for locations.
5. Provide for all floor drains/sinks not serving ice machines.

N. Cleanouts:

1. Floor Cleanouts (FCO)
  - a. Adjustable, cast iron housing, anchor flange, tapered thread plug, round secured stainless steel top.
  - b. Top style shall match floor finish as follows:
    - 1) Unfinished floor – Round solid scoriated top.
    - 2) Tile or terrazzo – Round recessed top.
    - 3) Carpet – Round top with carpet flange.
  - c. Type:
    - 1) Zurn Model Z1400
2. Yard Cleanout (YCO)
  - a. 2-way round, dura-coated cast iron, size as listed on plans.
  - b. Double flanged heavy duty secured scoriated dura-coated cast iron cover.
  - c. Lifting device.
  - d. Bronze cleanout plug with gas/water tight seal.
  - e. Type:
    - 1) Zurn
3. Wall Cleanout (WCO)
  - a. End cap, cast iron access body, gas and water tight bronze or brass threaded plug, round stainless steel access cover, extended machine screw.
  - b. Type
    - 1) Zurn Model Z-1441
4. Additional cleanout requirements:
  - a. Provide cleanouts of same size as pipe up to 4 IN and not less than 4 IN for larger pipes.
  - b. Close access openings for concealed cleanouts with flush floor plates.
  - c. Provide screws which match cover plate material.
  - d. 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.
  - e. Cleanouts installed in exposed piping shall consist of a ferrule or threaded adapter and a cast-brass or bronze cleanout plug installed in a T-pattern, 90 degree drainage fitting.

- f. Close access openings for concealed cleanouts with flush floor or flush wall cover plates or flush ceiling access panels.
- g. Provide screws which match cover plate material.
- h. Cleanouts installed in completely accessible pipe chases or where piping is exposed do not require special covers.

O. Wall Hydrant (WH-1):

- 1. Freezeless, brass valve body and seat, standard finish.
- 2. Non-ferrous metal stem, automatic draining, vacuum breaker, 3/4" male hose thread.
- 3. Wall clamp, concealed in flush wall mounted lockable wall box, key operated.
- 4. ASSE 1019 approved and listed.
- 5. Verify number of key operators to be provided with Owner. Box cover and hydrant shall use a common key.
- 6. Length as recommended by manufacturer for wall thickness.
- 7. Type:
  - a. Woodford Model B67.

P. Hose Bibb (HB-1):

- 1. Brass construction, standard finish, vacuum breaker, 3/4 IN hose thread, metal wheel handle, loose tee key.
- 2. Type:
  - a. Woodford Model 24.

Q. Domestic Water Heater (EWH):

- 1. Electric tank type:
  - a. Size and capacity as scheduled.
  - b. UL listed and compliant to NAECA, ASHRAE 90.1 and ASHRAE 90A.
  - c. Vertical, metal cabinet, baked enamel finish, glass-lined welded steel tank, 150 PSI working pressure, fiberglass or foam insulation.
  - d. Brass water connections and drain valve.
  - e. ASME approved T&P relief valve, anode rod.

R. Instantaneous Water heater (IWH)

- 1. Size and capacity as scheduled.
- 2. High strength reinforced plastic body, thermostatically controlled, enclosed controls, fully adjustable thermostat (100-140°F), high temperature limit switch, 150 psi working pressure, replaceable element, and capable of operating down to 0.3 gpm.

S. Domestic Water Heater (GWH):

- 1. Gas-fired tank type:

- a. Size and capacity as scheduled.
- b. Certified by CSA and bear NSF approval.
- c. Internal surfaces:
  - 1) Glass-lined with alkaline borosilicate composition fused-to-steel.
  - 2) Provide magnesium rods rigidly supported for cathodic protection.
- d. Equip heaters with safety shutoff in case of pilot failure, gas pressure regulator, certified draft diverter and pressure and temperature relief valve.
- e. Insulate tank with vermin-proof glass fiber insulation or equal.
- f. Heavy gage steel jacket with baked enamel finish over bonderized undercoating.
- g. Warranty against corrosion for three (3) year period.
- h. Provide water heaters meeting ASHRAE/IESNA 90.1 IP for energy efficiencies.
- i. Sealed combustion. Exact size, termination, and routing of flue/combustion air shall be per manufacturer requirements.

T. Reduced Pressure Backflow Preventer (BFP-1):

- 1. Bronze or FDA approved epoxy coated cast iron construction, size shall be same as pipe, non-corrosive internal parts, stainless steel springs, differential pressure relief valve between spring-loaded check valves, shutoff valves on inlet and outlet of unit, and air gap drain fitting.
- 2. Test ports with shutoff valves, factory tested.
- 3. Rated for 175 PSI at 33°F to 140°F, 13 PSI maximum pressure drop at 10 FPS.
- 4. All parts to be serviceable without removing unit from line.
- 5. Approved by USC FCCC and HR, AWWA C511-92, ASSE 1013, and IAPMO listed.
- 6. Mount a maximum of 60" above finished floor.
- 7. Provide and install bronze or epoxy coated strainer upstream of each unit. Install additional valve upstream from each strainer for servicing strainer.
- 8. Flow pressure drop curves shall be submitted.
- 9. Type:
  - a. Watts Series 909

U. Double Check Backflow Preventer (BFP-2):

- 1. Bronze or FDA approved epoxy coated cast iron construction, size shall be same as pipe, non-corrosive internal parts, stainless steel springs, spring-loaded check valves, shutoff valves on inlet and outlet of unit, and air gap drain fitting.
- 2. Test ports with shutoff valves, factory tested.
- 3. Rated for 175 PSI at 33°F to 140°F, 13 PSI maximum pressure drop at 10 FPS.
- 4. All parts to be serviceable without removing unit from line.



5. Approved by USC FCCC and HR, AWWA C511-92, ASSE 1013, and IAPMO listed.
6. Mount a maximum of 60" above finished floor.
7. Provide and install bronze or epoxy coated strainer upstream of each unit. Install additional valve upstream from each strainer for servicing strainer.
8. Flow pressure drop curves shall be submitted.
9. Type:
  - a. Watts Series 007/709

V. 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 IN drain valve spilling over floor drain.
2. Install full sized bypass line around meter with a sealed valve approved by Water Department.
  - a. Meters 2 IN and less: Threaded fittings.
  - b. Meters 2-1/2 IN and larger: Flanged connections.

W. Expansion Tank (ET)

1. Size and capacity as scheduled on plans.
2. Welded black steel construction.
3. ASME stamped.
4. Guaranteed airtight and leakproof.
5. Stainless steel system connection.
6. Heavy butyl diaphragm and rigid polypropylene liner mechanically bonded to tank to provide a 100% non-corrosive water reservoir.
7. Diaphragm and liner shall be approved for use in potable water systems.
8. All wetted components shall be made of FDA approved materials.
9. Provide standard Schrader air valve for field charging.

X. Remote Mixing Valve (MV-1)

1. Remote anti Remote anti-scald thermostatic mixing valve for tempered water control.
2. All bronze/brass construction with rough finish, threaded inlets and tamper resistant setpoint.
3. ASSE 1070 approved.
4. Install below SK-1 and SK-2 in accessible location.

5. Type:

- a. Watts USG-B

Y. Emergency Mixing Valve (MV-2)

1. Thermostatic mixing valve for emergency eyewash or combination eyewash/facewash fixture, bronze body construction, cold water bypass, inlet and outlet thermometers, integral checkstops, outlet and inlet isolation valves, and mounting bracket.
2. Provide with recessed mounted cabinet 18 gauge stainless steel with 16 gauge locking door to enclose mixing valve, inlet stops, outlet thermometer, and inlet/outlet isolation valves.
3. Thermostatic mixing and pressure regulating valves to deliver 3 gpm of tempered water (65-90°F) with 10 psi pressure differential.
4. Shall meet ANSI Standard Z358.1.
5. Type:
  - a. Bradley Model S19.

Z. Emergency Eye/Face Wash (EEW-1)

1. Accessible, wall mounted, stainless steel bowl, twin chrome plated spray heads with caps and retaining chains/straps, brass supply arms, integral flow control fitting, brass piping and fittings with brass/bronze stay open ball valve, and 1-1/4 IN drain outlet with chrome plated brass tailpiece and trap.
2. Universal identification sign, ANSI Z358.1 compliant.
3. Minimum flow rate of 3.0 gpm at 30 psi. Activation time shall be 1 second or less. Brass/bronze piping, fittings, and valves shall be chrome plated or chemical resistant powder coated.
4. Install MV-2 in recessed cabinet beside EEW. Coordinate exact location of cabinet with Architect/Owner.
5. ADA Compliant.
6. Install flow switch on cold water branch line serving EEW. Flow switch shall send an alarm to the DDC system when flow is detected. The exact location of the EEW where flow is detected shall be shown on the DDC system.
  - a. Flow Switch shall be rated for 125/250 V, 5 A.
  - b. Single pole, double throw.
  - c. UL listed.
7. Type:
  - a. Bradley Model S19-220.

AA. Emergency Eye/Face Wash (EEW-2)

1. Accessible, wall mounted, stainless steel bowl, twin chrome plated spray heads with caps and retaining chains/straps, brass supply arms, integral flow control fitting, brass piping and fittings with brass/bronze stay open ball valve, and 1-1/4 IN drain outlet with chrome plated brass tailpiece and trap.

2. Universal identification sign, ANSI Z358.1 compliant.
3. Minimum flow rate of 3.0 gpm at 30 psi. Activation time shall be 1 second or less. Brass/bronze piping, fittings, and valves shall be chrome plated or chemical resistant powder coated.
4. Install MV-2 in surface mounted cabinet beside EEW. Coordinate exact location of cabinet with Architect/Owner.
5. ADA Compliant.
6. Provide heat trace for all piping located outside.
7. Hinged stainless steel dust cover.
8. Anti-freeze valve.
9. Install flow switch on cold water branch line serving EEW. Flow switch shall send an alarm to the DDC system when flow is detected. The exact location of the EEW where flow is detected shall be shown on the DDC system.
  - a. Flow Switch shall be rated for 125/250 V, 5 A.
  - b. Single pole, double throw.
  - c. UL listed.
10. Type:
  - a. Bradley Model S19224.

BB. Ice Machine Valve Box (VB-1)

1. Galvanized steel enclosure, angle valve with 1/4 IN compression outlet.
2. Type:
  - a. Guy Gray Model BIM675.

CC. Yard Office Drug Testing Valve Cabinet (VC-1)

1. One piece, 18 gauge, stainless steel recessed box with all seams continuously welded with door and wall flange. Contractor shall ensure valve cabinet is large enough to enclose 1" pipe and associated shutoff valve serving the Yard Office Drug Testing Restroom water closet.
2. Door shall include cam and cylinder lock with two keys. Concealed hinges shall be mounted in heavy reinforcing channels and allow door to fully open 150 degrees. Door shall be easily removable if needed.
3. Provide with adjustable, wide beveled flange to cover irregularities in the wall opening.
4. Type:
  - a. Acorn.

DD. Water Hammer Arrestor (WHA-1, WHA-2, and WHA-3)

1. Bellows type.
2. Pre-charged.
3. All stainless steel construction.

4. ASSE 1010 approved.
5. PDI Certified.
6. WHA-1: Rated for 1-11 fixture units.
7. WHA-2: Rated for 12-32 fixture units.
8. WHA-3: Rated for 33-60 fixture units.
9. Type:
  - a. Zurn Model Z1700

EE. Water Pressure Reducing Valves:

1. Up to 2-1/2 IN line size.
  - a. Self-contained type, diaphragm actuated, with cast iron body, stainless steel springs, diaphragm, trim and seats for maximum operating pressure of 150 psig gauge and maximum pressure drop of 100 psi.
2. 2-1/2 IN through 6 IN line size,
  - a. Single seated plug valve, with cast iron body, stainless steel seat, maximum 125 psig gauge inlet, 20 - 100 psi differential.

FF. Water Filter (F-1)

1. Cast brass or stainless steel head, stainless steel sump, 5 micron filter cartridge, FDA approved.
2. Install in accessible location on cold water lines serving ice machines.

GG. Vent flashings: Plumbing vent flashings shall be furnished and installed as indicated on the plans.

## PART 3 - EXECUTION

### 3.01 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.
  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. Floor drains installed in floors that include a waterproofing membrane shall be provided with a flashing flange and membrane clamp.
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.

D. Wall Hydrants:

1. Refer to plans for mounting height requirements.
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 calk 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. Refer to plans for mounting height requirements.

F. Water Hammer Arrestors:

1. Install on hot and cold water lines adjacent to each battery of fixtures or other equipment where indicated on Drawings.

G. Cleanouts:

1. Cleanouts installed in floors that include a waterproofing membrane shall be provided with a flashing flange and membrane clamp.
2. 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. Trap primers: Provide shutoff valve in cold water line to each trap primer. Install per manufacturer's requirements.

I. Wall Plates and Escutcheons: Install as specified in Specification Section 22 10 00 or this Specification Section.

J. Water Heater:

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. When required, connect gas piping as detailed in accordance with Specification Section 23 11 23 and located so as not to interfere with the unit service where applicable.
6. Start up the unit and adjust all controls for proper temperature control and maximum efficiency.

K. Reduce Pressure Backflow Preventer: Install on water lines as required by Code.

### 3.02 FIELD QUALITY CONTROL

- A. Test piping and fixtures for leaks per Specification Section 40 05 03.

**END OF SECTION**

## **SECTION 22 42 00 - PLUMBING FIXTURES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Water closets.
2. Urinals.
3. Lavatories.
4. Sinks.
5. Showers.
6. Electric water coolers.
7. Wash fountains.
8. Mop sinks.

#### **1.02 REFERENCED STANDARDS**

- A. ANSI/ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
- B. ANSI/ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
- C. ANSI/ASME A112.19.1 - Enameled Cast Iron Plumbing Fixtures.
- D. ANSI/ASME A112.19.2 - Vitreous China Plumbing Fixtures.
- E. ANSI/ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
- F. IAPMO/ANSI Z124.1 - Plastic Bathtub Units.
- G. IAPMO/ANSI Z124.2 - Plastic Shower Receptors and Shower Stalls.
- H. ANSI Z358.1 - Emergency Eyewash and Shower Equipment.
- I. ANSI/ARI 1010 - Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of Division 01, for all Products specified in this Section.
- B. Product Data: Provide catalog illustrations of fixtures and trim, indicating manufacturer, sizes, rough-in dimensions, utility sizes, and finishes.
- C. Submit Manufacturer's installation instructions under provisions of Division 1.

#### **1.04 OPERATION AND MAINTENANCE DATA**

- A. Submit under provisions of Division 01, for all Products specified in this Section.
- B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

UP General Specifications

PLUMBING FIXTURES

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#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01.
- B. Accept fixtures on site in factory packaging. Inspect for damage.
- C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

#### 1.06 FIELD MEASUREMENTS

- A. Verify that field installation measurements are as indicated on shop drawings.
- B. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories and sinks.

#### 1.07 EXTRA MATERIALS

- A. Furnish under provisions of Division 01.
- B. Provide two sets of faucet, valve, and flush valve service kits.

### PART 2 - PRODUCTS

#### 2.01 WATER CLOSET

##### A. WC-1 (1.6 GAL Flush):

- 1. Bowl: ANSI/ASME A112.19.2; wall mounted, siphon jet, white vitreous china, elongated bowl, 1-1/2 IN (38 mm) top spud, bolt caps, designed to flush efficiently on 1.6 gallons of water. Model Kingston manufactured by Kohler, or approved equal.
- 2. Flush Valve: ASME A112.18.1; exposed chrome plated, diaphragm type, escutcheon, integral screwdriver stop, vacuum breaker, electric solenoid operated actuated by infra-red sensor, chrome plated wall cover plate with tamper proof screws, control circuit transformer, maximum 1.5 GAL flush volume. Model Royal 111ES-S manufactured by Sloan, or approved equal.
- 3. Seat: Solid white plastic, open front, external check and self-sustaining hinge, stainless steel posts, brass bolts, without cover. Model 255 manufactured by Church, or approved equal.

##### B. HWC-1 (1.6 GAL Flush):

- 1. Bowl: ANSI/ASME A112.19.2; wall mounted, siphon jet, white vitreous china, elongated bowl, 1-1/2 IN (38 mm) top spud, bolt caps, designed to flush efficiently on 1.6 GAL of water, top of seat 18 IN (450 mm) above finish floor. Model Kingston manufactured by Kohler.
- 2. Flush Valve: ASME A112.18.1; exposed chrome plated, diaphragm type, escutcheon, integral screwdriver stop, vacuum breaker, electric solenoid operated actuated by infra-red sensor, chrome plated wall cover plate with tamper proof screws, control circuit transformer, maximum 1.5 GAL flush volume. Model Royal 111ES-S manufactured by Sloan, or approved equal.



3. Seat: Solid white plastic, open front, external check and self-sustaining hinge, stainless steel posts, brass bolts, without cover. Model 255 manufactured by Church, or approved equal.

C. HWC-2 (1.6 GAL Flush):

1. Bowl: ANSI/ASME A112.19.2; wall mounted, siphon jet, white vitreous china, elongated bowl, 1-1/2 IN (38 mm) top spud, bolt caps, designed to flush efficiently on 1.6 GAL of water, top of seat 18 IN (450 mm) above finish floor. Model Kingston manufactured by Kohler.
2. Flush Valve: ASME A112.18.1; exposed chrome plated, diaphragm type, escutcheon, integral screwdriver stop, vacuum breaker, electric solenoid operated actuated by infra-red sensor, chrome plated wall cover plate with tamper proof screws, control circuit transformer, maximum 1.5 GAL flush volume. Model Royal 111-1.6 manufactured by Sloan, or approved equal.
3. Seat: Solid white plastic, open front, external check and self-sustaining hinge, stainless steel posts, brass bolts, without cover. Model 255 manufactured by Church, or approved equal.

2.02 URINAL

A. UR-1/HUR-1:

1. ANSI/ASME A112.19.2; white vitreous china, no water wall hung urinal with integral housing and drain insert. For handicap installation, mount rim 17 IN (425 mm) above finished floor. Model FloWise Flush-Free Waterless Urinal model number 6150 or 6154 manufactured by American Standard, or approved equal.
2. Wall Mounted Carrier: ANSI/ASME A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs.

2.03 LAVATORY

A. LAV-1 Basin: Integral in the countertop.

- B. Trim: Sloan Optma ESP-20 infra-red sensor operated electrical solenoid, off-set drain, strainer/tailpiece, P-trap and waste to wall. Wheel handle supply pipes. All trim below the sink to be insulated.

2.04 SINK

A. SK-1:

1. Bowl: ANSI/ASME A112.19.3; Type 304 stainless steel, double compartment 33 x 22 x 7.5 IN (8.4 x 5.6 x 1.9 cm), 18 gauge (1.37 mm) thick, self-rimming with heavy duty undercoating, 3-1/2 IN (90mm) diameter stainless steel sink drain with crumb cup, ledge back drilled for trim, 4 hole. Model LRAD3319 manufactured by Elkay, or approved equal.

2. Trim: ASME A112.18.1; chrome plated brass supply with gooseneck swing spout, water economy aerator, spray fitting, 2.2 GPM maximum flow, lever handles and retractable spray; chrome plated 17 gauge (1.3mm) brass P-trap with clean-out plug and arm with escutcheon. Supply pipes with wheel handles. Model LKD2443 faucet as manufactured by Elkay, or approved equal.

## 2.05 SHOWER

### A. SH-1:

1. Shower: IAMPO/ANSI Z124.2: Heavy duty, reinforce glass fiber shower, gel-coated, 45-5/8 x 51-3/8 x 78-1/4 IN (11.6 x 13.1 x 20.0 cm) high one piece, soap dish, shower curtain, chrome plated brass drain with perforated strainer, fold-up seat, beige color. Model 1423-BFS, base unit, horizontal L-shape grab bar as manufactured by LASCO or approved equal.
2. Trim: ANSI/ASME A112.18.1: Concealed cast brass shower supply, non-scald, lever handle, wall-hand shower with 5 FT metal flexible hose, wall connection and flange, in-line vacuum breaker and 30 IN slide bar. Model S-96-300X-B30-6-V as manufactured by Simmons or approved equal.

## 2.06 ELECTRIC WATER COOLER

### A. EWC-1 (Wall Mounted):

1. Fountain: ANSI/ARI 1010; wall mounted two level electric water cooler with stainless steel top, stainless steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, mounting bracket, refrigerated with integral air cooled condenser, UL listed and labeled. Model EBFATL-8 manufactured by Elkay or approved equal.
2. Capacity: 8 GPH (30.3 L/h) of 50 DegF (10 DegC) water with inlet at 80 DegF (27 DegC) and room temperature of 90 DegF (32 DegC).
3. Electrical: Hardwired for connection to 120 volt 60 Hz electric wiring system including grounding connector.

## 2.07 WASH FOUNTAINS

### A. WF-1:

1. Bowl: Semi-circular, 80 IN (203 cm) diameter, precast stone, 16 gauge stainless steel bowl and base, 3 stations, vandal resistant spray nozzles, 0.4 GPM flow restrictor, soap tray, cast brass P-trap. Model SS-3N manufactured by Bradley, or approved equal.
2. Accessories: Automatic solenoid valve operated by infra-red sensor, control transformer, automatic shut-off delay, thermostatic mixing valve, combination stop, strainer, and check valves, liquid soap dispenser.

## 2.08 MOP SINKS

### A. MS-1 (Floor Mounted):

1. ASME A112.61M mopsink: Florestone MSR-2424, one piece molded mop receptor, integral drain, strainer, 2 IN IPS.

2. Trim: MR-371 faucet, MR-370 hose, MR-372 mop hanger, MR-373 rim guards and two 24 IN x 24 IN stainless steel wall plates.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

#### **3.02 PREPARATION**

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

#### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install each fixture with trap, easily removable for servicing and cleaning.
- C. Provide chrome plated supplies and [lock-shield, loose key] stops, reducers, and escutcheons for each fixture. Provide all necessary mounting hardware for complete installation.
- D. Install components level and plumb.
- E. Install and secure fixtures in place with [wall supports] [wall carriers] and bolts.
- F. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 92 00, color to match fixture.
- G. Solidly attach water closet flanges to floor with lag screws.

#### **3.04 INTERFACE WITH OTHER PRODUCTS**

- A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

#### **3.05 ADJUSTING**

- A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

#### **3.06 CLEANING**

- A. At completion, clean plumbing fixtures and equipment.

#### **3.07 PROTECTION OF FINISHED WORK**

- A. Protect finished Work and fixtures with adequate covers.
- B. Use of fixtures during construction is not permitted.

### **END OF SECTION**

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## **SECTION 22 48 00 - PLUMBING SPECIALTIES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Cleanouts.
2. Hose bibs.
3. Hydrants.
4. Back water valves.
5. Backflow preventers.
6. Water hammer arrestors.
7. Water Pressure Reducing Valves.
8. Relief Valves.
9. Trap seal primer valve.
10. Floor drains and Area Drains.
11. Floor sinks.
12. Trench Drains.
13. Garbage Disposal.

#### **1.02 SUBMITTALS**

- A. Submit under provisions of Division 01.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
- C. Product Data: Provide component sizes, rough-in requirements, service sizes, materials of construction, and finishes.
- D. Manufacturer's Installation Instructions: Indicate assembly and support requirements.

#### **1.03 PROJECT RECORD DOCUMENTS**

- A. Submit under provisions of Division 01.
- B. Record actual locations of equipment, cleanouts, backflow preventers

#### **1.04 OPERATION AND MAINTENANCE DATA**

- A. Submit under provisions of Division 01.
- B. Operation Data: Indicate frequency of treatment required for interceptors and testing procedures for backflow preventers.
- C. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products under provisions of Division 01.
- B. Accept specialties on site in original factory packaging. Inspect for damage.

1.06 EXTRA MATERIALS

- A. Furnish under provisions of Division 01.
- B. Provide two loose keys, one hose end vacuum breaker, and service kits for hose bibs.

PART 2 - PRODUCTS

2.01 FLOOR DRAINS AND AREA DRAINS

- A. FD-1: ANSI A112.21.1; painted cast iron two piece body with flange, weep holes, reversible clamping collar, and round vandal proof, adjustable nickel-bronze strainer. Provide 1/2 IN IPS trap primer.
  - 1. Model: W-1100 series manufactured by Wade; Z-415 manufactured by Zurn; or approved equal.
    - a. FD-2: ANSI A112.21.1; painted cast iron two piece body with flange, weep holes, reversible clamping collar, and square vandal proof, adjustable bronze strainer. 1/2 IN IPS trap primer.
  - 2. Model: W-1100 series manufactured by Wade; Z-415 manufactured by Zurn; or approved equal.
    - a. AD-1: ANSI a112.21.1; ANSI Load Class – Special Duty, Cast iron 16 IN square drain with sediment bucket and ductile iron tractor grate. Grate free area = 76.4 SQ IN Wade 2360 series.

2.02 FLOOR SINKS

- A. FS-1, square: 8 IN deep acid resisting enameled cast iron body, aluminum dome strainer 8 x 8 IN top with cast iron 3/4 grate, 1/2 IN IPS trap primer.
  - 1. Model: W-9100 series manufactured by Wade; Z-1900 Series manufactured by Zurn; or approved equal.

2.03 CLEANOUTS

- A. Exterior Surfaced Areas (GCO): Round cast iron access frame and heavy duty non-skid cover, cast iron ferrule with brass plug.
  - 1. Model: W-7000 Series manufactured by Wade; Z-1402 manufactured by Zurn; or approved equal.
- B. Interior Finished Floor Areas (FCO): Painted cast iron, two piece adjustable body, PVC plug, round top with scoriated nickel-bronze cover in service areas and square with depressed cover to accept floor finish in finished floor areas.
  - 1. Model: W-6000 Series manufactured by Wade; Z-1400 manufactured by Zurn; or approved equal.

- C. Interior Finished Wall Areas (WCO): Line type with cast iron body and PVC countersunk plug, and round stainless steel access cover secured with machine screw.
    - 1. Model: W-8460 manufactured by Wade; Z-1446 manufactured by Zurn; or approved equal.
  - D. Interior Unfinished Accessible Areas (UCO): Line type with cast iron body and PVC raised head plug.
    - 1. Model: Z-1445 manufactured by Zurn; W-8560 manufactured by Wade; or approved equal.
- 2.04 HOSE BIBBS
- A. Interior: 125 psi WOG, bronze or brass with integral mounting flange, replaceable seal disc, 3/4 IN hose thread spout, with handwheel, vacuum breaker in conformance with ANSI/ASSE 1011.
    - 1. Model: 102-304 VB manufactured by B & K Industries; or approved equal.
- 2.05 HYDRANTS
- A. Wall Hydrant: ANSI/ASSE 1019; non-freeze, self-draining type with polished bronze wall plate, 3/4 IN hose thread spout, 3/4 IN inlet, handwheel, and vacuum breaker.
    - 1. Model: W-8620 manufactured by Wade; Z-1310 manufactured by Zurn; or approved equal.
  - B. Post Hydrant: ANSI/ASSE 1019; Non-freeze, self-draining type, cast aluminum housing, bronze casing, 3/4 IN hose thread vacuum breaker outlet, 3/4 IN inlet, 4 FT minimum depth of bury, lever handle.
    - 1. Model: W-8610 manufactured by Wade; Z-1385/Z-1390 manufactured by Zurn; or approved equal.
- 2.06 BACKFLOW PREVENTERS
- A. Reduced Pressure Principle Backflow Preventers 2 IN and smaller: ANSI/ASSE 1013; bronze body with bronze internal parts and stainless steel springs; two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; non-threaded vent outlet, air gap drain fitting; assembled with two ball valves, bronze strainer, and four test cocks; Suitable for water temperature range of 33 - 180 DegF (1 - 82 DegC) at a working pressure of 150 psi (1034 kPa).
    - 1. Model: 990 or 909 manufactured by Watts Regulator; Model 825Y manufactured by Febco; Series 40-200 manufactured by Conbraco; or approved equal.

- B. Reduced Pressure Principle Backflow Preventers, Larger than 2 IN: ANSI/ASSE 1013; Epoxy coated ductile iron body; two independently operating check valves with replaceable bronze seats, elastomeric disks, and stainless steel springs; Removable bronze or epoxy coated cast iron body differential pressure relief valve; air gap drain fitting; assembled with two non-rising stem gate valves, epoxy coated cast iron strainer, and four test cocks; Suitable for water temperature range of 33 - 180 DegF (1 - 82 DegC) at a working pressure of 150 psi (1034 kPa).
  - 1. Model: 990 or 909 manufactured by Watts Regulator; Model 825YD manufactured by Febco; Series 40-200 manufactured by Conbraco; or approved equal.
- C. Backflow Preventer Test Kit: Provide complete test kit including pressure gauge, test valves, high pressure hoses, adaptor fittings, mounting strap, and instructions; All test equipment shall be contained in a corrosion resistant carrying case.
  - 1. Provide one test kit for each type of backflow preventer specified.

#### 2.07 WATER HAMMER ARRESTORS

- A. ANSI A112.26.1M; stainless steel construction, sized in accordance with PDI WH-201, precharged suitable for operation in temperature range -100 to 300 DegF (-73 to 149 DegC) and maximum 125 psig (860 kPa) working pressure.
  - 1. Model: Shokstop manufactured by Wade; Z-1700 manufactured by Zurn; or approved equal.

#### 2.08 WATER PRESSURE REDUCING VALVES

- A. Up to and including 3 IN: Bronze body, rated for maximum inlet pressure of 300 psig (2064 kPa), stainless steel seat, integral stainless steel strainer, sealed spring cage, outlet pressure adjustment, built-in thermal expansion by-pass, gage tapping.
  - 1. Model: U5B manufactured by Watts Regulator; or approved equal.

#### 2.09 RELIEF VALVES

- A. Bronze body, Teflon seat, steel stem and springs, testing lever, automatic, direct pressure actuated, capacities ASME certified and labeled, rated for working pressure suitable for system installation.

#### 2.10 TRAP SEAL PRIMER VALVES

- A. Trap Seal Primer Valves: ASSE 1018. water-supply-fed type, with the following characteristics:
  - 1. 125 psig (860 kPa) minimum working pressure.
  - 2. Bronze body with atmospheric – vented drain chamber.
  - 3. Inlet and Outlet connections: 1/2 IN NPS (DN15) threaded, union or solder joint.
  - 4. Gravity Drain Outlet Connection: 1/2 IN NPS (DN15) threaded or solder joint.
  - 5. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.



B. Trap Seal Primer System: Factory-fabricate, automatic-operation assembly for wall mounting with the following:

1. Piping: 1/2 IN NPS, ASTM B88, Type K; copper, water tubing inlet and manifold with number of 1/2 IN NPS (DN15) outlets as required.
2. Cabinet: Steel box and stainless-steel cover.
3. Electric Controls: 24 HR timer, solenoid valve and manual switch for 120 V ac power.
4. Vacuum Breaker: ASSE 1001.

## 2.11 TRENCH DRAINS

A. Polydrain trench drains, Type Series 021 through 191, as manufactured by ABT, Inc. Components:

1. Drain trench: Fabricated of polyester polymer concrete, 155 mm (6.1 IN) wide, 100 mm (4 IN) ID with radiused bottom, having following attributes:
  - a. Lengths: Nominal 0.5 meter (19.6 IN) and 1.0 meter (39.19 IN).
  - b. Bottoms: Sloped to provide 0.6 percent slope.
  - c. Anchoring ribs: Full length.
  - d. Grate locking slots: Blind, vibration damping, thermoplastic.
  - e. Interlocking ends.
2. Grates:
  - a. Slotted ductile iron.
  - b. Ductile iron anchor frames.
  - c. Modle 503, severe point loads.
3. Accessories:
  - a. End plates.
  - b. Outlet plates.
  - c. Strainer.
  - d. Locking devices.
  - e. Sealant.
  - f. Polywall sidewall extensions.
  - g. Installation devices.
  - h. Catch basins, 900 series.

## 2.12 GARBAGE DISPOSAL

- A. Housing, cast metal, insininsinkeratorerator.
- B. Motor overload with manual reset.
- C. Feed – continuous.

- D. Positive seal stopper.
- E. Sink flange – stainless steel.
- F. Motor – permanent magnet.
- G. Waste elbow – ABS.
- H. Impellers – stainless steel.
- I. Bearings – permanently lubricated, sleeve type.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install plumbing specialties in accordance with manufacturer's instructions.
- B. Extend cleanouts to finished floor or wall surface. Ensure clearance at cleanout for rodding of drainage system.
- C. Encase exterior cleanouts in concrete flush with grade.
- D. Pipe relief from backflow preventer to nearest drain.
- E. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to lavatories, sinks, and wash fountains.
- F. Extend the trap seal primer piping from the manifold to each floor drain.

#### 3.02 INSTALLATION OF TRENCH DRAINS

- A. In accord with manufacturer's instructions.
- B. Utilize manufacturer's approved installation device to assure proper joints, drawn tightly together by device.
- C. The trench drain and its encapsulating concrete should be isolated from the expansion and contraction stress of the adjacent slabs.

**END OF SECTION**

## **SECTION 23 05 48 - VIBRATION CONTROL**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Vibration control.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.
- B. Product Data: Submit manufacturer's technical product data and installation instructions for each type of vibration control product. Submit schedule showing size, type, deflection, and location for each product furnished.

### **PART 2 - PRODUCTS**

#### **2.01 BASIC CONSTRUCTION AND REQUIREMENTS**

- A. Vibration isolators shall have either known undeflected heights or other markings so deflection under load can be verified.
- B. All isolators shall operate in the linear portion of their load versus deflection curve. The linear portion of the deflection curve of all spring isolators shall extend 50 percent beyond the calculated operating deflection (e.g., 3 IN for 2 IN calculated deflection). The point of 50 percent additional deflection shall not exceed the recommended load rating of the isolator.
- C. The lateral to vertical stiffness ratio ( $K_x/K_y$ ) of spring isolators shall be between 0.8 and 2.0.
- D. All neoprene shall have UV resistance sufficient for 20 years of outdoor service.
- E. All isolators shall be designed or treated for corrosion resistance. Steel bases shall be cleaned of welding slag and primed for interior use, and hot dip galvanized after fabrication for exterior use. All bolts and washers over 3/8 IN diameter located outdoors shall be hot dip galvanized per ASTM A153. All other bolts, nuts and washers shall be zinc electroplated. All ferrous portions of isolators, other than springs, for exterior use shall be hot dip galvanized after fabrication. Outdoor springs shall be neoprene dipped or hot dip galvanized. All damage to coatings shall be field repaired with two coats of zinc rich coating.
- F. Equip all mountings used with structural steel bases with height-saving brackets. Bottoms of the brackets shall be 1-1/2 IN to 2-1/2 IN above the floor or housekeeping pad, unless shown otherwise on the drawings. Steel bases shall have at least four points of support.

- G. Provide motor slide rails for belt-driven equipment.
- H. All isolators, except M1, shall have provision for leveling.

## 2.02 MOUNTINGS

### A. Type M1:

1. 0.75 IN thick waffled neoprene pad with minimum static deflection of 0.07 IN at calculated load and 0.11 IN at maximum load.
2. Units need not be bolted down unless called for or needed to prevent movement. If bolted down, prevent short circuiting with neoprene bushings and washers between bolts and isolators.
3. Acceptable Manufacturers: Mason "Super W", Kinetics Amber/Booth Vibration Eliminator Co.

## 2.03 HANGERS

### A. Type H1:

1. Vibration hangers shall consist of a double-deflection neoprene element with a projecting bushing or oversized opening to prevent steel-to-steel contact.
2. Static deflection shall be at least 0.15 IN at calculated load and 0.35 IN at maximum rated load.
3. Provide hangers with end connections as required for hanging ductwork or piping.
4. Acceptable Manufacturers: Mason "HD" or "WHD", Kinetics, Aeroflex, Vibration Eliminator Co.

### B. Type H2:

1. Vibration hangers shall contain a steel spring in a neoprene cup with a grommet to prevent short circuiting the hanger rod.
2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.
3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the grommet and short circuiting the spring.
4. Provide end connections for hanging ductwork or piping.
5. Acceptable Manufacturers: Mason "30" or "W30", Kinetics, Amber/Booth, Aeroflex, Vibration Eliminator Co.

### C. Type H3:

1. Vibration hangers shall have a steel spring in a neoprene cup with a grommet to prevent short circuiting of the hanger rod.
2. The cup shall have a steel washer to distribute load on the neoprene and prevent its extrusion.

3. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the grommet and short circuiting the spring.
4. Provide end connections for hanging ductwork or piping.
5. Hangers shall be capable of holding the load at a fixed elevation during installation. They shall have a secondary adjustment to transfer the load to the spring and maintain the same position.
6. Deflection shall be indicated by a pointer and scale.
7. Acceptable Manufacturer: Mason "PC30", Kinetics, Amber/Booth , Vibration Eliminator Co.

### PART 3 - EXECUTION

#### 3.01 PERFORMANCE OF ISOLATORS

- A. General: Comply with minimum static deflections recommended by ASHRAE, for selection and application of vibration isolation materials and units as indicated.
- B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units.

#### 3.02 GENERAL INSTALLATION

- A. Comply with manufacturer's instructions for installation and load application to vibration control materials and units.
- B. Provide vibration isolation as indicated on the drawings and as described herein.
- C. Clean the surface below all mountings that are not bolted down and apply adhesive cement equal to Mason Type WG between mounting and floor. If movement occurs, bolt mountings down. Isolate bolts from baseplates with neoprene washers and bushings.
- D. All static deflections listed in the drawings and specifications are the minimum acceptable actual deflection of the isolator under the weight of the installed equipment - not the maximum rated deflection of the isolator.
- E. Where a specific quantity of hangers is noted in these specifications, it shall mean hanger pairs for support points that require multiple hangers, such as rectangular ducts or pipes supported on a strut rack.

#### 3.03 PIPE ISOLATION

- A. The first three hangers from vibration-isolated equipment shall be type H1.
- B. Install flexible connectors in all piping connected to vibration producing equipment. This includes all fans, compressors, etc. Absence of flexible connectors on piping diagrams does not imply that they are not required.
- C. Provide sufficient piping flexibility for vibrating refrigerant equipment, or furnish flexible connectors with appropriate temperature and pressure ratings.

- D. Vibration isolators shall not cause any change in position of piping that will result in stresses in connections or misalignment of shafts or bearings. Equipment and piping shall be maintained in a rigid position during installation. Do not transfer load to the isolators until the installation is complete and under full operational load. Hanger H3 and Mounting M4 may be used instead of other products for this purpose.
- E. Support piping to prevent extension of flexible connectors.

#### 3.04 DUCTWORK ISOLATION

- A. The first three hangers on all fan systems shall be Type H1 with at least 0.20" minimum static deflection.
- B. Provide flexible duct connections at all fan inlets and outlets and on the mechanical room side of all locations where ducts penetrate mechanical room walls. Refer to Specification Section 23 33 00 for specific requirements.

#### 3.05 ADJUSTING AND CLEANING

- A. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short-circuit unit isolation.

#### 3.06 VIBRATION CONTROL PRODUCT SCHEDULE

TYPE OF EQUIPMENT	ISOLATOR TYPE	STATIC DEFLECTION	FLEXIBLE CONNECTIONS
In-Line Supply Fans/Exhaust Fans	H2 or H3	0.75"	Ductwork per Section 23 33 00.
Fan Coil Units	N/A	N/A	Piping per this section
Computer Room Units	H2 or H3	0.75"	Ductwork per Section 23 33 00 and piping per this section.
Unit Heaters	H2 or H3	0.75"	N/A
Energy Recovery Units/Air Handling Units (Note 1)	M1	N/A	Ductwork per Section 23 33 00 and piping per this section
Condensing Units	M1	N/A	Piping per this section.
In-line pumps	H2 or H3	0.75"	N/A

Note 1: Internal fan isolation shall be determined by the energy recovery unit/air handling unit manufacturer. Isolation selected shall be a minimum of 98% efficient at the scheduled CFM and static pressure.

**END OF SECTION**

## **SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Testing, adjustment and balancing of HVAC systems.
2. Testing, adjustment and balancing of hydronic systems.
3. Measurement of final operating condition of HVAC systems.
4. Sound measurement of equipment operating conditions.
5. Vibration measurement of equipment operating conditions.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 00 - Submittals and Substitutions.
- B. Section 01 45 00 - Quality Assurance and Control.
- C. Section 23 05 48 - Vibration Control.
- D. Section 22 11 23 - Domestic Water Circulating Pumps.
- E. Section 22 14 29 - Sump Pumps.
- F. Section 23 12 20 - Chemical and Petroleum Pumps.
- G. Section 23 31 10 - Ductwork.
- H. Section 23 33 00 - Ductwork Accessories.
- I. Section 23 37 00 - Air Outlets and Inlets.

#### **1.03 REFERENCED STANDARDS**

- A. ASHRAE Systems Handbook: Chapter 37, Testing, Adjusting and Balancing, latest edition

#### **1.04 SUBMITTALS**

- A. Submit name of adjusting and balancing agency for approval within 30 days after award of contract.
- B. Submit test reports as a submittal under provisions of Section 01 33 00.
- C. Submit test reports under provisions of Section 01 45 00.
- D. Prior to commencing work, submit draft reports indicating adjusting, balancing and equipment data required.
- E. Submit draft copies of report for review prior to final acceptance of work. Provide final copies for Buyer and for inclusion in operating and maintenance manuals.

- F. Provide reports in electronic format, and indexed. Include electronic copies of drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- G. Include detailed procedures, agenda, sample report forms, prior to commencing system balance.

#### 1.05 REPORT FORMS

- A. Submit reports on forms.
- B. Forms shall include the following information:
  - 1. Title Page:
    - a. Company name.
    - b. Company address.
    - c. Company telephone number.
    - d. Project name.
    - e. Project location.
    - f. Project Engineer.
    - g. Project Buyer.
    - h. Project altitude.
  - 2. Instrument List:
    - a. Instrument.
    - b. Supplier.
    - c. Model.
    - d. Serial number.
    - e. Range.
    - f. Calibration date.
  - 3. Test conditions for fans and pump performance forms, including the following:
    - a. Settings for outside, return, and exhaust dampers.
    - b. Condition of filters.
    - c. Cooling coil wet and dry bulb conditions.
    - d. Fan drive settings including settings and percentage of maximum pitch diameter.
    - e. Other system operating conditions that affect performance.
  - 4. System Diagrams including schematic layouts of air distribution systems. Present with single line diagrams and include the following:
    - a. Quantities of outside, supply, return, and exhaust airflows.
    - b. Duct outlet and inlet sizes.



- c. Terminal units.
- d. Locations of duct traverse of duct layout.
- 5. Air Moving Equipment:
  - a. Location.
  - b. Supplier.
  - c. Model.
  - d. Unit Identification.
  - e. Supply air flow, specified and actual.
  - f. Return air flow, specified and actual.
  - g. Outside air flow, specified and actual.
  - h. Total static pressure (total external), specified and actual.
  - i. Inlet pressure.
  - j. Discharge pressure.
  - k. Fan RPM.
- 6. Exhaust/Supply Fan Data:
  - a. Location.
  - b. Manufacturer.
  - c. Model.
  - d. Air flow, specified and actual.
  - e. Total static pressure (total external), specified and actual.
  - f. Inlet pressure.
  - g. Discharge pressure.
  - h. Fan RPM.
- 7. Return Air/Outside Air Data:
  - a. Identification/location.
  - b. Design air flow.
  - c. Actual air flow.
  - d. Design return air flow.
  - e. Actual return air flow.
  - f. Design outside air flow.
  - g. Actual outside air flow.
  - h. Return air temperature.
  - i. Outside air temperature.
  - j. Required mixed air temperature.

- k. Actual mixed air temperature.
  - l. Design outside/return air ratio.
  - m. Actual outside/return air ratio.
8. Electric Motors:
- a. Manufacturer.
  - b. HP/BHP.
  - c. Phase, voltage, amperage; nameplate, actual, no load.
  - d. RPM.
  - e. Service factor.
  - f. Starter size, rating, heater elements.
9. V-Belt Drive:
- a. Identification/location.
  - b. Required driven RPM.
  - c. Driven sheave, diameter and RPM.
  - d. Belt, size and quantity.
  - e. Motor sheave, diameter and RPM.
  - f. Center to center distance, maximum, minimum, and actual.
10. Duct Traverse: Provide directly at the relief air inlet, supply air outlet, outside air inlet, and relief air outlet for each energy recovery unit and air handling unit.
- a. Associated Energy Recovery Unit or Air Handling Unit identification.
  - b. System zone/branch.
  - c. Duct size.
  - d. Area.
  - e. Design velocity.
  - f. Design air flow.
  - g. Test velocity.
  - h. Test air flow.
  - i. Duct static pressure.
  - j. Air temperature.
  - k. Air correction factor.
11. Air Distribution Test Sheet:
- a. Air terminal number.
  - b. Room number/location.
  - c. Terminal type.

- d. Terminal size.
- e. Area factor.
- f. Design velocity.
- g. Design air flow.
- h. Test (final) velocity.
- i. Test (final) air flow.
- j. Percent of design air flow.

12. Heating/Cooling Coils:

- a. System Identification.
- b. Location.
- c. Coil type.
- d. Airflow rate.
- e. Average face velocity.
- f. Air pressure drop.
- g. Outside air, wet and dry bulb temperatures.
- h. Return air, wet and dry bulb temperatures.
- i. Entering air, wet and dry bulb temperatures.
- j. Leaving air, wet and dry bulb temperatures.

13. Terminal Heat Transfer Units (Unit Heaters):

- a. Drawing symbol.
- b. Location.
- c. Manufacturer and model.
- d. Flow rate (cfm): specified and actual.
- e. Entering air temperature: specified and actual.
- f. Leaving air temperature: specified and actual.
- g. Air Btuh (cfm) x temperature rise x 1.09.

14. Energy Recovery Wheel:

- a. Drawing Symbol.
- b. Location.
- c. Primary Entering Air Temperature.
- d. Primary Leaving Air Temperature.
- e. Primary Air Pressure Drop.
- f. Primary Air Flow Rate .
- g. Secondary Entering Air Temperature.

- h. Secondary Leaving Air Temperature.
- i. Secondary Air Pressure Drop.
- j. Secondary Air Flow Rate .
- k. Wheel RPM.

15. Duct Leakage Test:

- a. Air system and fan.
- b. Leakage class.
- c. Test pressure.
- d. Construction pressure.
- e. Flow rate: specified and actual.
- f. Leakage: specified and actual.
- g. Statement that fire dampers, reheat coils and other accessories were included in the test.
- h. Pass or Fail.
- i. Test performed by.
- j. Test witnessed by.

16. Air Flow Measuring Station:

- a. Drawing symbol.
- b. Service.
- c. Location.
- d. Manufacturer and model.
- e. Size.
- f. Flow rate: specified and actual.
- g. Pressure drop: specified and actual.

17. Fire Dampers:

- a. Damper and access door location.
- b. System identification.
- c. Type.
- d. Size.
- e. UL assembly number.
- f. Fusible link temperature rating.
- g. Manufacturer and model.
- h. Operation pass/fail/reset.

18. Balancing Valves:

- a. Drawing symbol.
- b. Service.
- c. Location.
- d. Size.
- e. Manufacturer and model.
- f. Flow rate: specified and actual.
- g. Pressure drop: specified and actual.

19. Hot Water Recirculating Pump:

- a. Drawing symbol.
- b. Service.
- c. Manufacturer, size, and model.
- d. Impeller size: specified and actual.
- e. Flow Rate: specified and actual.
- f. Pump Head: specified, operating and shut-off.
- g. Suction Pressure: operating and shut-off.
- h. Discharge Pressure: operating and shut-off.

20. Water Heater:

- a. Drawing symbol.
- b. Service.
- c. Location.
- d. Manufacturer and model.
- e. Capacity: specified, nameplate, and actual.
- f. Control Setting: specified and actual.
- g. Pressure drop: specified and actual.
- h. Entering water temperature: specified and actual.
- i. Leaving water temperature: specified and actual.

1.06 RECORD DOCUMENTS

- A. Submit record documents.

1.07 QUALITY ASSURANCE

- A. Agency shall be company specializing in the adjusting and balancing of systems specified in this Section with minimum 3 years documented experience.
- B. Total system balance shall be performed in accordance with ASHRAE Systems Handbook, latest edition.

## 1.08 SEQUENCING AND SCHEDULING

- A. Sequence work to commence after completion of systems and schedule completion of work before substantial completion of project.

## PART 2 - PRODUCTS

### 2.01 TESTING AND BALANCING EQUIPMENT

- A. Testing and balancing equipment will not be turned over to the owner.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Before commencing work, verify that systems are complete and operable. Ensure the following:
  - 1. Equipment is operable and in a safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - 5. Duct systems are clean of debris.
  - 6. Correct fan rotation.
  - 7. Fire and volume dampers are in place and open.
  - 8. Coil fins have been cleaned and combed.
  - 9. Access doors are closed and duct end caps are in place.
  - 10. Air outlets are installed and connected.
  - 11. Duct system leakage has been eliminated.
- B. Report to Buyer any defects or deficiencies noted during performance of services.
- C. Promptly report abnormal conditions in mechanical systems or conditions which prevent system balance.
- D. If, for design reasons, system cannot be properly balanced, report as soon as observed.
- E. Beginning of work indicates acceptance of existing conditions.

### 3.02 PREPARATION

- A. Provide instruments required for testing, adjusting and balancing operations. Make instruments available to Engineer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

### 3.03 INSTALLATION TOLERANCES

- A. Adjust air handling systems to plus or minus 5 percent for supply systems and plus or minus 10% for return and exhaust systems from figures indicated.

### 3.04 TEMPERATURE CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Verify free travel and proper operation of control devices such as damper and valve operators.
- F. Verify sequence of operation of control devices. Note the speed of response to input changes.
- G. Confirm interaction of electrically operated switch transducers.
- H. Confirm interaction of interlock and lockout systems.
- I. Record voltages of power supply and controller output. Determine if the system operates on a grounded or nongrounded power supply.
- J. Note operation of electric actuators using spring return for proper fail-safe operations.

### 3.05 ADJUSTING

- A. Recorded data shall represent actually measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Engineer.

### 3.06 AIR SYSTEM PROCEDURE - GENERAL

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.

- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 IN positive static pressure near the building entrances.

### 3.07 CONSTANT-VOLUME AIR SYSTEMS' BALANCING PROCEDURES

- A. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer.
  - 1. Measure fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure at least 24 IN downstream from the fan and upstream from fittings in ducts such as elbows and transitions.
    - b. Measure inlet static pressure of single-inlet fans at least 18 IN upstream from flexible connection and downstream from duct fittings.
  - 2. Adjust fan speed higher or lower than design to achieve scheduled air flow. Make required adjustments to pulley sizes, to accommodate fan- speed changes.
  - 3. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating and economizer modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts and major branch ducts to design airflows within specified tolerances.
  - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.



2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submains and branch ducts to design airflows within specified tolerances.
- C. Adjust terminal outlets and inlets for each space to design airflows within specified tolerances of design values.
1. Adjust each outlet in the same room or space to within specified tolerances of design quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  2. Adjust patterns of adjustable outlets for proper distribution without drafts.

**END OF SECTION**

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## **SECTION 23 05 99 - INSPECTION AND TESTING OF AIR RECEIVERS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Responsibilities and procedures for inspecting and testing of air receivers and unfired pressure vessels. These vessels include equipment with an operating pressure that exceeds 15 LBS/psig and have a capacity of 30 GAL or more. These may include but are not limited to:
  - a. Fixed air receivers in shops and yards of 30 GAL (4 CU FT) or more.
  - b. Portable air tanks of 30 GAL (4 CU FT) or more.

##### **B. Tanks that ARE NOT covered include:**

1. Air and Vacuum chambers that are part of motor vehicle controls or air brake systems.
2. Hydraulic pump systems on jacks or arms.
3. Cylinders on hydraulic systems
4. Air tanks for air brake systems
5. Bulk oxygen storage tanks. (These are to be inspected annually by the Company providing the bulk service).

#### **1.02 REFERENCED STANDARDS**

##### **A. Applicable Codes and Regulations shall be as follows:**

1. American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.
2. National Board Inspection Code ANSI / NB-23.
3. The original UPRR Chief Engineering Bulletin 127.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Submittals shall include the company who will be performing the inspection.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION**

#### **3.01 CERTIFIED INSPECTOR**

##### **A. The Inspector must:**

1. Hold a valid National Board Commission License.

2. Be qualified by written examination or other requirement under the applicable State laws and regulations. This information may be found at the respective States Department of Boiler Inspections.

### 3.02 INSPECTING AND TESTING OF PRESSURE VESSELS

- A. Unfired pressure vessels must be inspected both internally and externally and tested before being placed in service and after any alteration or major repair. Where State regulations differ, observe the more stringent Inspection Interval (Contact your State Board for Boiler Inspections to determine the State requirements for unfired pressure vessels).

### 3.03 THICKNESS TESTS

- A. The inspector will perform an ultrasonic thickness test or other type of non-destructive thickness test that will be accurate within  $\pm 1$  percent or .001 IN or better.
- B. For horizontal tanks there must be two (2) tests at the bottom and two (2) tests at the top of the shell and (2) tests in each head. For vertical tanks, perform two (2) tests in each head and four (4) tests at random areas of the shell.
- C. At the time of the first testing they will need to permanently mark the test zones. Future tests should be conducted in those areas. To mark the zones they will need to:
  1. Paint a red circle 3 IN DIA around each of the eight (8) test zones.
  2. Label each zone one (1) through (8) for future testing reference.
  3. On future tests note any reduction in the wall thickness in the Remarks / Comments section.

### 3.04 TESTING OF SAFETY AND RELIEF VALVES

- A. The tests should be bench tests with the following requirements:
  1. Perform the tests at a pressure not exceeding 110 percent of the valve's normal operating pressure.
  2. Conduct at least 3 tests and record the highest activating pressure.
  3. Record the re-seating pressure.
  4. When the tests are complete, securely attach to the valve a tag that will show:
    - a. The date the tests were completed.
    - b. The highest activating pressure result.
    - c. The lowest re-seating pressure.
    - d. The initials of the person doing the tests.

### 3.05 TESTING OF GAUGES

- A. Pressure gauges should register pressure up to double the intended working pressure of the equipment. All gauges should be removed for testing and service. The tests should be a bench tests with the following requirements.
  1. Check all gauges against a dead-weight tester or a calibrated master gauge.

2. Test the gauge at three pressure levels with one being the expected operating pressure.
3. Re-calibrate gauges at any time they are in error.
4. Securely attached to the gauges a tag showing the test dates and the initials of the person doing the tests.
5. All gauges that cannot be calibrated shall be removed from service and disposed of.

**END OF SECTION**

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## **SECTION 23 07 13 - DUCTWORK INSULATION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Ductwork insulation.
2. Duct Liner.
3. Insulation jackets.

#### **1.02 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.
- B. Product Data: Provide product description, including conductivity, density, temperature ratings, and fire resistance ratings.
- C. Manufacturer's Installation Instructions: Indicate procedures that ensure acceptable workmanship and installation standards will be achieved.
- D. Submit list of insulation and jacket materials and thickness for each service, and locations.

#### **1.03 QUALITY ASSURANCE**

- A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255, or UL 723; unless otherwise indicated.

#### **1.04 QUALIFICATIONS**

- A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect, and handle products to site under provisions of section 01 65 50.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

#### **1.06 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 HRS.

## PART 2 - PRODUCTS

### 2.01 GLASS FIBER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, noncombustible blanket.
  - 1. 'K' ('Ksi') value : ASTM C518, 0.34 at 75 DegF ( 0.049 at 24 DegC).
  - 2. Maximum service temperature: 250 DegF (121 DegC).
  - 3. Maximum moisture absorption: ASTM C553, 3.0-percent by weight.
  - 4. Density: 0.75 LB/CU FT ( 12 kg/cu m).
  - 5. Standard Fiber Glass Duct Wrap manufactured by Certainteed; Fiberglas All-Service Duct wrap manufactured by Owens-Corning Fiberglas Corp.; or approved equal.
- B. Vapor Barrier Jacket:
  - 1. Foil-Scrim-Kraft jacket, glass scrim reinforced laminate of aluminum foil facing bonded to kraft paper 0.0032 IN (0.081 mm ) white vinyl.
  - 2. Moisture vapor transmission: ASTM E96; 0.02 perm.
  - 3. Secure with pressure sensitive vapor barrier tape; Kraft paper reinforced with glass fiber yarn and bonded to aluminized film to match jacket, with pressure sensitive rubber based adhesive.
- C. Fabrication Adhesive: Non-flammable, quick setting; Spark-Fas 85-20 or Quick-Tack 85-60 manufactured by Foster Products Corp.; Type J-545-F manufactured by Vimasco Corp.; or approved equal.

### 2.02 GLASS FIBER DUCT LINER, FLEXIBLE

- A. Insulation: ASTM C1071, Type I; flexible, noncombustible blanket with surface coating.
  - 1. 'K' ('Ksi') value: ASTM C518, 0.28 at 75 DegF (0.040 at 24 DegC).
  - 2. Maximum service temperature: 250 DegF (121 DegC).
  - 3. Maximum Moisture Absorption: ASTM C553, 1.0 percent by weight.
  - 4. Maximum Velocity on Coated Air Side: 5,000 FT/min (25.4 m/sec).
  - 5. Ultralite manufactured by Certainteed; PermaCote Linacoustic manufactured by Manville; or approved equal.



- B. Acoustical Performance; minimum sound absorption coefficient, ASTM C423 Type "A" mounting:

<b>Octave</b>	<b>Liner Thickness, IN</b>		
<b>Frequency</b>	<b>1</b>	<b>1-1/2</b>	<b>2</b>
12 0.04	0.16	0.22	
250	0.25	0.46	0.67
500	0.57	0.82	0.99
1000	0.78	0.94	1.02
2000	0.87	0.95	0.96
4000	0.89	0.91	0.92

- C. Adhesive: Waterproof, quick setting; Spark-Fas 85-20 or Quick-Tack 85-60 manufactured by Foster Products Corp.; Type J-545-F manufactured by Vimasco Corp.; or approved equal.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Verify that ductwork has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed and dry.

#### 3.02 INSTALLATION

- A. Insulation type and thickness, vapor barrier type, and jacket type: As scheduled on Drawings.
- B. Install materials in accordance with manufacturer's instructions.
- C. Insulated ductwork conveying air below ambient temperature and dual temperature ducts:
  - 1. Provide insulation and vapor barrier.
  - 2. Provide finish coating as specified, and where indicated.
  - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- D. Insulated ductwork conveying air above ambient temperature:
  - 1. Provide with [or without] standard vapor barrier jacket.
  - 2. Provide finish coating as specified, and where indicated.
  - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
  - 4. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

- E. For ductwork exposed in mechanical equipment rooms and in finished spaces below 10 FT (3 meters) above finished floor and where otherwise indicated, finish with canvas jacket sized for finish painting.
- F. External Duct Insulation Application:
  - 1. Secure insulation and vapor barrier with adhesive and seal joints with vapor barrier adhesive or tape to match jacket.
  - 2. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
  - 3. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
  - 4. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- G. Duct Liner Application:
  - 1. Install in accordance with SMACNA Standards.
  - 2. Adhere insulation with 90 percent adhesive coverage.
  - 3. Secure insulation with mechanical liner fasteners.
  - 4. Seal and smooth joints.
  - 5. Seal liner surface penetrations with adhesive.
  - 6. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

### 3.03 DUCT INSULATION SCHEDULE

- A. All rectangular supply air ductwork: 1-1/2 IN duct liner.
- B. All round supply air ductwork: 2 IN, 1-1/2 LB density glass fiber flexible insulation.
- C. All relief air ductwork: 1-1/2 IN duct liner.
- D. All outdoor air ductwork: 2 IN duct liner.

**END OF SECTION**

## **SECTION 23 07 19 - PIPING INSULATION**

### **PART 1 - GENERAL**

#### **1.01 SECTION INCLUDES**

- A. Piping insulation.
- B. Jackets and accessories.

#### **1.02 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Product Data: Provide product description, including conductivity, density, temperature ratings, and fire resistance ratings.
- C. Manufacturer's Installation Instructions: Indicate procedures that ensure acceptable workmanship and installation standards will be achieved.
- D. Submit list of insulation and jacket materials and thickness for each service, and locations.

#### **1.03 QUALITY ASSURANCE**

- A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with ASTM E84, NFPA 255, or UL 723; unless otherwise indicated.

#### **1.04 QUALIFICATIONS**

- A. Applicator: Company specializing in performing the work of this section with minimum three years experience.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, protect, and handle products to site under provisions of section 01 65 50.
- B. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Store insulation in original wrapping and protect from weather and construction traffic.
- D. Protect insulation against dirt, water, chemical, and mechanical damage.

#### **1.06 ENVIRONMENTAL REQUIREMENTS**

- A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- B. Maintain temperature during and after installation for minimum period of 24 HRS.

## PART 2 - PRODUCTS

### 2.01 GLASS FIBER

- A. Insulation: ASTM C547; rigid molded, noncombustible.
  - 1. 'K' ('ksi') value: ASTM C335, 0.23 at 75 DegF (0.035 at 24 DegC).
  - 2. Minimum Service Temperature: -20 DegF (-28.9 DegC).
  - 3. Maximum Service Temperature: 300 DegF (150 DegC).
  - 4. Maximum Moisture Absorption: ASTM C553; 0.2 percent by volume maximum.
  - 5. MicroLok manufactured by Manville, or approved equal.
- B. All Service Vapor Barrier Jacket:
  - 1. ASTM C921, White 35 LB kraft paper reinforced with glass fiber yarn and bonded to aluminized film with flame resistant adhesive.
  - 2. Moisture Vapor Transmission: ASTM E96; 0.02 perm.
  - 3. Secure with self sealing longitudinal laps and butt strips.
- C. Fabrication Adhesive: Non-flammable, quick setting; Spark-Fas 85-20 manufactured by Foster Products Corp.; Drion 85-75 manufactured by Foster Products Corp.; or approved equal.
- D. Reinforcing Membrane:
  - 1. Woven synthetic fiber, PVA finish, 30 percent minimum embedded elongation; Mast-A-Fab manufactured by Foster Products Corp.; Elastafab 894 manufactured by Vimasco Corp. or approved equal.
  - 2. Fibrous Glass Cloth: Untreated; 9 OZ/SQ YD (305 g/sq m) weight.
- E. Vapor Barrier Mastic Finish:
  - 1. Piping Service at or below ambient temperature: Single component, elastomeric coating containing Hypalon, white color, maximum 0.02 perm; Monolar 60-95 manufactured by Foster Products Corp.; or approved equal.
  - 2. Piping Service above ambient temperature: Water based mastic, white color, minimum 3.0 perm; SealFas G-P-M 35-00 manufactured by Foster Products Corp.; WC-5 manufactured by Vimasco Corp.; or approved equal.

### 2.02 FLEXIBLE ELASTOMERIC THERMAL INSULATION

- A. Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type I for tubular materials and Type II for sheet material.
  - 1. Adhesive: As recommended by insulation material manufacturer.
  - 2. Ultra-violet-Protective Coating: As recommended by insulation manufacturer.

### 2.03 MOLDED RIGID CELLULAR GLASS INSULATION

- A. ANSI/ASTM C552; 0.35 maximum 'K' value at 75 DegF, moisture resistant, non-combustible; suitable for -100 DegF to 900 DegF.

- B. For below grade installations, use asphaltic mastic paper vapor barrier jacket.
- C. For above grade installations, use self-seal all-purpose white kraft jacket.

#### 2.04 HYDROUS CALCIUM SILICATE INSULATION

- A. ASTM C533; rigid modded pipe insulation; asbestos free; 0.40 'K' vale at 300 DegF; 1200 DegF maximum service temperature; 16 gauge stainless steel tie wires on maximum 12 IN centers.

#### 2.05 JACKETS

- A. PVC Plastic Jacket: ASTM C921, One-piece molded type fitting covers and sheet material, white color, UV resistant.

1. Minimum Service Temperature: 0 DegF (-18 DegC).
2. Maximum Service Temperature: 150 DegF ( 66 DegC).
3. Moisture Vapor Transmission: ASTM E96; 0.05 perm.
4. Maximum Flame Spread: ASTM E84; 25.
5. Maximum Smoke Developed: ASTM E84; 50.
6. Thickness: 30 mil (0.76 mm).
7. Connections: Brush on welding adhesive or Pressure sensitive color matching vinyl tape .
8. 550 PVC manufactured by Ceel-Co, LoSmoke manufactured by Proto Corp., or approved equal.

- B. Aluminum Insulation Jackets:

1. Insulation jackets shall be furnished and installed piping systems as indicated herein and on the drawings.
2. Fittings in insulated piping systems and piping or equipment where indicated shall be provided with an aluminum jacket. Piping systems where indicated to have aluminum jackets shall be insulated with the same aluminum jacketing material.
3. Factory prefabricated weatherproof aluminum jacket system consisting of preformed 0.020 IN thick aluminum sections fabricated with a continuous modified Pittsburg Z-Lock on the longitudinal seam and each butted section of jacketing is to be sealed with a butt strap, weather-tight system for butt joints. Special factory made jacket fittings shall be provided at all fittings, wherever possible. All jacketing shall have an integrally bonded polysurlyn moisture retarder over the entire surface in contact with the insulation. All joints shall be sealed with bead of silicon caulking. Aluminum jacket system shall be Lock-On or Z-Lock as manufactured by ITW or equivalent."

#### 2.06 TANK AND EQUIPMENT INSULATION

- A. Tank and equipment insulation shall be closed cell, flexible foamed plastic in sheet form. Insulation shall have a K factor of 0.28, maximum, at 75 DegF mean temperature and shall have a built-in vapor barrier."

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify that piping has been tested before applying insulation materials.
- B. Verify that surfaces are clean, foreign material removed, and dry.

### 3.02 INSTALLATION

- A. Insulation type and thickness, vapor barrier type, and jacket type: As scheduled on Drawings.
- B. Install materials in accordance with manufacturer's instructions.
- C. On exposed piping, locate insulation and cover seams in least visible locations.
- D. Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:
  - 1. Provide vapor barrier, factory applied or field applied.
  - 2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe.
  - 3. Provide finish coating of type specified for insulation used.
  - 4. PVC fitting covers may be used with all service insulation jacket.
  - 5. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.
  - 6. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
  - 7. Insulate and vapor seal hangers, supports, anchors, and other equipment attached directly to cold surfaces to prevent condensation.
- E. For insulated pipes conveying fluids above ambient temperature:
  - 1. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
  - 2. Provide finish coating of type specified for insulation used.
  - 3. PVC fitting covers may be used with all service insulation jacket.
  - 4. For hot piping conveying fluids 140 DegF (60 DegC) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
  - 5. For hot piping conveying fluids over 140 DegF (60 DegC), insulate flanges and unions at equipment.
- F. Inserts and Shields:
  - 1. Application: Piping 1-1/2-IN (40 mm) diameter or larger.
  - 2. Shields: MSS SP69; Factory coated galvanized between pipe hangers or pipe hanger rolls and inserts, ribbed with rolled edges for use with pipe hangers.
  - 3. Insert Location: Between support shield and piping and under the finish jacket.

4. Insert Configuration: Same thickness and contour as adjoining insulation; length:

Nom. Pipe Size (IN)	Insert Length (IN)
1/2 to 2-1/2	6
3 to 6	99
8 to 10	12
12 and over	18

- G. Finish insulation at supports, protrusions, and interruptions.
- H. For pipe exposed in mechanical equipment rooms, in the maintenance shop and in finished spaces below 10 FT (3 meters) above finished floor and where otherwise indicated, finish with PVC jacket and fitting covers.
- I. For exterior applications, provide vapor barrier and aluminum jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with reinforced vapor barrier cement. Cover with aluminum jacket and fitting covers with seams located on bottom side of horizontal piping.
- J. For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket and fitting covers with seams located on bottom side of horizontal piping.

### 3.03 INSULATION SCHEDULE

- A. Domestic Cold Water (Potable and Non-Potable): 1 IN premolded fiberglass insulation with an all service vapor barrier jacket.
- B. Domestic Hot Water and Circulating up to 140 DegF (Potable and Non-Potable):
- Up to 1-1/2 IN Pipe Size: 1 IN premolded fiberglass insulation with an all service jacket.
  - Above 1-1/2 IN Pipe Size: 1 1/2 IN premolded fiberglass insulation with an all service jacket.
- C. Plumbing Vents within 10 FT from Roof Penetration: 1/2 IN premolded fiberglass insulation with an all service jacket.
- D. Cooling Coil Condensate Drains and Dedicated Floor Drain Branch Piping, Sanitary and Indirect Waste Piping Conveying Fluids 55 DegF such as drains serving Ice Machines: 1/2 IN flexible elastomeric insulation.
- E. Underground Domestic Hot Water and Circulating Lines: 1IN molded rigid cellular glass.
- F. Insulation Inserts at Hangers: Match pipe insulation thickness - molded rigid cellular glass or hydrous calcium silicate insulation.
- G. Refrigerant Liquid, Suction, and Hot Gas Piping:
- Up to 1-1/2 IN Pipe Size: 1 IN flexible elastomeric insulation.
  - Above 1-1/2 IN Pipe Size: 1-1/2 IN flexible elastomeric insulation.

- H. Lube Oil, Compressor Oil, Journal Oil, Nonpotable Water, Soap, Soap/Water, Recovered Oil, Locomotive Retention Fluid, Drain Oil Piping, and Level Control Valve Pilot Piping: 1 IN flexible elastomeric thermal insulation.
- I. All piping installed outdoors and/or with the potential of exposure to sunlight under normal operating conditions shall include aluminum jacket.

**END OF SECTION**



## **SECTION 23 09 00 - HVAC INSTRUMENTATION AND CONTROLS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Instrumentation and control for HVAC systems.
2. Temperature control.
3. Ventilation control.
4. Heating control.
5. Cooling control.
6. Control wiring.
7. Panels and accessories.
8. Miscellaneous.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Union Pacific Railroad (UPRR) Contract Section.
- B. Division 01 - UPRR General Conditions.
- C. Section 01 61 03 - Equipment: Basic Requirements.
- D. Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC).
- E. Section 23 05 53 - Mechanical Identification.
- F. Section 23 09 00 - HVAC Instrumentation and Controls.
- G. Section 23 09 93 - Sequence of Operation.
- H. Section 23 31 10 -Ductwork.
- I. Division 26 - Electrical.

#### **1.03 REFERENCED STANDARDS**

- A. American Society of Heating Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
  1. 62-1989, Ventilation for Acceptable Indoor Air Quality.
- B. ASTM International (ASTM):
  1. D1693, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
- C. The Instrumentation, Systems, and Automation Society (ISA):
  1. S5.1, Instrumentation Symbols and Identification.
  2. S5.4, Standard Instrument Loop Diagrams.

D. Scientific Apparatus Makers Association (SAMA):

1. PM C20.1, Process Measurement and Control Terminology.

1.04 QUALITY ASSURANCE

A. See Section 01 61 03.

B. Miscellaneous:

1. Controls to be in compliance with Section 26 05 00 for NEMA and NEC 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.
3. Express control device performance requirements in terminology in accordance with SAMA PM C20.1. Process measurement and control terminology.

1.05 SYSTEM DESCRIPTION

- A. Work shall be provided as an integrated operating system. HVAC control system shall use non-proprietary BACnet IP protocol.
- B. Provide a complete system of automatic temperature control, thermostats, relays, valves, dampers operators and other associated controls and appurtenances required to maintain minimum conditions described in detail herein and on the drawings, together with thermometers, gauges, and other accessory equipment.
  1. HVAC systems shall be controlled with direct digital controls (DDC) according to sequence contained in this section.
    - a. Additional points or software programming not listed but which are required to meet following sequences of operation shall be provided.
  2. Assemble control system with complete system of wiring and accessory equipment 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 Operations" are designed to illustrate operating functions only.
  1. Control sequence shall be considered supplementary to sequence of operation.
  2. 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 the Owner and to make a complete system.
- E. Sequence of Operations – General:
  1. Sequence of operations indicated basic operating functions only. Contractor shall review drawings and submit manufacturer's recommendations subject to Engineer's approval. Refer to Section 23 09 93 for sequence of operations.
    - a. Airflow Measuring Stations:

- 1) Duct Mounted Airflow Measuring Stations (AFMS) - Thermal Dispersion
  - a) Provide airflow/temperature measurement devices where indicated on the plans.
  - b) Each AFMS shall consist of one or more sensor probes and a single, remotely mounted, microprocessor-based transmitter capable of independently processing up to 16 independently wired sensor assemblies.
    - (1) Each sensor assembly shall contain two individually wired, hermetically sealed bead-in-glass thermistors.
    - (2) Thermistors shall be mounted in the sensor assembly using a marine-grade, waterproof epoxy. Thermistor leads shall be protected and not exposed to the environment.
    - (3) Devices using chip-in-glass or diode-case chip thermistors are not acceptable.
    - (4) Devices using less than two thermistors in each sensor assembly are not acceptable.
    - (5) Devices using platinum wire RTDs are not acceptable.
    - (6) Devices having electronic circuitry mounted in or at the sensor probe are not acceptable.
    - (7) Pitot tubes and arrays are not acceptable.
    - (8) Vortex shedding devices are not acceptable.
  - c) All Sensor Probes:
    - (1) Each sensor assembly shall independently determine the velocity and temperature at its measurement point.
    - (2) Each sensor assembly shall be calibrated at a minimum of 16 airflow rates and 3 temperatures to standards that are traceable to the National Institute of Standards and Technology (NIST).
    - (3) Airflow measuring station assembly accuracy shall be  $\pm 2$  percent of Reading over the entire operating airflow range. Temperature accuracy shall be  $\pm 0.15$  DegF  $0.07$  DegC between  $-20$  DegF- $29$  DegC and  $160$  DegF  $71$  DegC.
    - (4) The operating humidity range for each sensor probe shall be 0 - 99 percent RH (non-condensing).
    - (5) Each sensor probe shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to the remotely mounted transmitter. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter for each measurement location.
    - (6) The number of probes shall be as recommended by the manufacturer to achieve the specified accuracy.

d) Duct and Plenum Probes:

- (1) Probes shall be constructed of extruded, gold anodized, 6063 aluminum tube. All wires within the aluminum tube shall be Kynar coated.
- (2) Probe assembly mounting brackets shall be constructed of 304 stainless steel.
- (3) The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated on the plans.

e) Sensor Density:

<u>Area (SQ FT m<sup>2</sup>)</u>	<u>Total # of Sensors Required</u>
< 20.2	4
20.2 to < 40.4	6
40.4 to < 80.75	8
80.75 to < 161.5	12
≥ 161.5	16

f) Transmitters:

- (1) The transmitter shall have an integral 16 character alphanumeric LCD display capable of simultaneously displaying individual airflow and temperature.
- (2) The transmitter shall be capable of field configuration and diagnostics using an on-board interface and LCD display.
- (3) The operating temperature range for the transmitter shall be -20 DegF to 120 DegF.

g) The transmitter shall be capable of communicating with other devices using one of the following interface options:

- (1) Linear analog output signals for airflow and temperature: Field selectable, fuse protected and isolated, 0 - 10 VDC/4-20mA (4-wire)
- (2) RS-485: Field selectable BACnet-ARCNET, BACnet-MS/TP, Modbus-RTU or Johnson Controls N2-Bus. BACnet devices shall provide analog variables for airflow and temperature containing individual sensor airflow rate and temperature data.
- (3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, Modbus-TCP and TCP/IP. Provide dynamic link libraries and VBA functions to interface Ethernet devices to Microsoft Excel for remote monitoring of airflow and temperature using a Windows 2000 or Windows XP based PC.
- (4) LonWorks Free Topology.

2. Current Measuring Devices:
  - a. Current Switches for Constant Speed Motors:
  - b. Digital device rated for amperage load of motor or device with split core design, adjustable high and low trip points, 600 VAC rms isolation, induced power from the monitored load, LED indicator lamps for output status and sensor power. The device shall sense overloading, belt-loss, and power failure with a single signal.
3. Current Switches for Motors Controlled by VFD:
  - a. Digital device rated for amperage load of motor or device with split core design, factory programmed to detect motor undercurrent conditions on variable or constant volume loads, self-calibrating, positive status indication, LED indicator lamps, 600 VAC rms isolation, induced power from the monitored load with N.O. output. The current sensor shall store the motor current operating parameters in non-volatile memory and have a pushbutton reset to clear the memory if the operating parameters change or the sensor is moved to another load. The device shall sense overloading, belt-loss, and power failure with a single signal. The sensor shall be mounted on the load side of variable frequency drives.
4. Hydrogen Sensors:
  - a. Solid-state gas sensor/transmitter, NEMA 1 gasketed enclosure, normal operating temperature 0 - 120 DegF, normal relative humidity operation 5-95 percent,  $\pm 5$  percent accuracy, and detection range of 0 - 4.4 percent in air.
  - b. Provide 4-20 mA output from the sensor to the DDC system.
  - c. Provide local alarm whenever hydrogen level exceeds 1 percent.
  - d. Install in accordance with OSHA requirements.
  - e. Unit shall be factory calibrated and shall be re-calibrated after installation per manufacturer's recommendations.
5. Miscellaneous Devices:
  - a. Control Relays:
    - 1) Form "C" contacts rated for the application with "push-to-test" contact transfer feature and an integral LED to indicate coil energization.
    - 2) Mount all relays and power supplies in a NEMA 1 enclosure beside the FMCS panel or controlled device and clearly label their functions.
6. Thermostat and Sensor Enclosures:
  - a. Clear plastic guard with lock. Wire guard with tamperproof screws. Setpoint shall be adjustable with cover in place. Fasten to wall separately from thermostat. Provide guards in all corridors, gymnasiums, locker rooms, toilet rooms, assembly halls and as noted on the drawings.
  - b. Heavy Duty Enclosure:

- 1) Perforated steel, tamperproof locking thermostat and control device enclosure.
  - 2) Box shall be nominally 8 IN x 6 IN x 2 IN 200 x 150x50 mm deep or sized as required to fit devices to be enclosed.
  - 3) Perforated cover shall be 16 gauge (1.52 mm) steel with maximum 3/16 IN 5 mm perforations on maximum 1/4 IN 6 mm staggered centers for a 55 percent free area.
  - 4) Secure to wall from inside of box. Cover shall be secured by tamperproof screws to frame.
  - 5) Color shall match electrical devices. Verify color with the Electrical Contractor.
- c. Combination temperature and CO2 room/zone sensors:
- 1) Wall mounted combination sensors shall contain a space temperature sensor and carbon dioxide (CO2) sensors in a single, decorative housing. The CO2 sensor shall use single-beam absorption infrared diffusion technology (non-dispersive infrared), and shall have integral programming to perform automatic baseline calibration without user interface. The recommended manual recalibration period shall not be less than five years. Other features of wall-mounted combination sensors shall include:
    - a) Operating conditions: 60 to 90 DegF (15 to 32 DegC) and 0 to 95 percent RH, non condensing.
    - b) Power supply: 18-30 VAC, 50/60 Hz (18-42 VDC polarity protected).
    - c) CO2 sampling method: Diffusion.
    - d) CO2 sensor output: 4 to 20 mA or 0 to 10 V signal.
    - e) CO2 measurement range: 0-2000 ppm.
    - f) Sensitivity  $\pm 20$  ppm.
    - g) Accuracy  $\pm 100$  ppm at 60 to 90 DegF (15 to 32 DegC) and 760mm Hg.
    - h) CO2 sensor calibration: Single point calibration via pushbutton and LED.
  - 2) Space temperature sensor: 10K ohm  $\pm 2$  percent at 77 DegF (25 DegC) thermistor with pushbutton override (and a temperature setpoint adjustment potentiometer).
  - 3) Combination sensors shall be provided with the manufacturer's recommended carbon dioxide calibration kit. The quantity shall be suitable to initially calibrate each sensor provided for the project.
- d. Demand control ventilation:

- 1) Each variable-air-volume zone controller (terminal unit) shall monitor primary air flow, space temperature, air handler status and mode, supply air temperature (as applicable) and shall position its terminal damper based on its proportional-integral-derivative (PID) temperature control algorithm to maintain the desired zone temperature setpoint of 75 DegF (adjustable). Each zone controller shall include the inherent ability to override the temperature control loop and modulate the terminal's damper with a proportional-integral (PI) loop, based on a CO<sub>2</sub> sensor with its associated setpoint schedule, in conjunction with the normal temperature control loop. The zone controller shall be capable of maintaining a ventilation setpoint through a demand-controlled ventilation (DCV) algorithm in conjunction with the air-handling unit to fulfill the requirements of ASHRAE standard, 62-1989 "Ventilation for Acceptable Indoor Air Quality" (including Addendum 62a-1990).
- 2) The DCV control function shall determine the zone ventilation airflow based on the CO<sub>2</sub> zone sensor input signal. When the DCV function is enabled, the zone controller shall override (increase) the primary airflow in order to provide additional ventilation if the airflow in order to prevent the CO<sub>2</sub> sensor reading from exceeding the desired zone setpoint. The control algorithm shall use a proportional-integral (PI) algorithm to determine the required airflow in order to prevent the CO<sub>2</sub> sensor from exceeding the desired zone setpoint.
- 3) Whenever the system air-handling unit (RTU-501) is operating, the system controller shall maintain the base ventilation rate (minimum ventilation rate) unless overridden by a pre-occupancy purge sequence or the DCV function.
- 4) All zone controllers shall be polled and the highest CO<sub>2</sub> sensor reading shall be sent to the system controller. This CO<sub>2</sub> reading shall be compared to the system CO<sub>2</sub> setpoint. If the reading is below the system CO<sub>2</sub> setpoint, the rooftop unit shall maintain the base ventilation rate. If the reading is above the setpoint, the rooftop unit damper controller shall modulate the outdoor air dampers open using a rooftop unit damper controller shall modulate the outside air dampers open using a proportional-integral (PI) loop to maintain the zone CO<sub>2</sub> at the zone setpoint.
- 5) The system controller shall modulate the rooftop's gas preheat control to maintain the discharge air temperature setpoint if the mixed air temperature falls below the discharge air temperature setpoint. The outside air damper position shall close decreasing CO<sub>2</sub> sensor signal down to the base ventilation rate. The zone controller (terminal unit) shall contain a provision to operate modulating type heat to maintain the space temperature at the midpoint between the heating and cooling setpoints during DCV operation. The zone controller shall have the capability to define a maximum primary airflow limit (ventilation) to protect the zone from overcooling for those units that do not include local heating. DCV control shall be automatically suspended if the overall space temperature falls below the heating setpoint and the outdoor air damper shall return to the base ventilation position.

- 6) If RTU-501's economizer control determines that it is beneficial to use outdoor air for cooling, the economizer shall override the DCV algorithm to modulate the dampers to open to maximum position.
- e. Operation shall be dependent upon the equipment mode of operation, so that the DCV function using the input signal from a CO2 sensor located in the conditioned space. Control functions shall include outdoor air damper modulation, monitoring, and alarm generation. The unit controller shall maintain an adjustable CO2 setpoint by overriding the mixed-air damper position and modulating the damper further open to provide the required ventilation. The DCV algorithm shall automatically limit the amount of outdoor air to prevent the mixed-air temperature from falling below 50 DegF. The unit controller shall also have the ability to limit the maximum amount of outdoor air during DCV operation. If heating is available during DCV operation, the gas heating section shall modulate to maintain a minimum supply air temperature of 65 DegF. The unit controller shall also have the ability to limit the maximum amount of outdoor air during DCV operation. If heating is available during DCV operation, the gas heating section shall modulate to maintain a minimum supply air temperature of 65 DegF, if neither heating or cooling is required by the space. If the space temperature exceeds an adjustable high limit value or falls below an adjustable low limit value, or if the space humidity exceeds the humidity setpoint, the algorithm shall disable any DCV damper override and maintain the normal minimum ventilation setpoint or to the combined mixed-air temperature setpoint until the space temperature and/or space relative humidity returns to normal.
7. Administration Building exhaust fan (EF-506). Fan shall be constant speed and run continuously.

#### 1.06 SYSTEM PERFORMANCE

- A. Performance Standards: System shall conform to the following minimum standards over network connections:
  1. Graphic Display: A graphic with 20 dynamic points shall display with current data within 10 seconds.
  2. Graphic Refresh: A graphic with 20 dynamic points shall update with current data within 8 seconds.
  3. Object Command: Devices shall react to command of a binary object within 2 seconds. Devices shall begin reacting to command of an analog object within 2 seconds.
  4. Object Scan: Data used or displayed at a controller or workstation shall have been current within the previous 6 seconds.
  5. Alarm Response Time: An object that goes into alarm shall be annunciated at the workstation within 45 seconds.
  6. Program Execution Frequency: Custom and standard applications shall be capable of running as often as once every 5 seconds. Select execution times consistent with the mechanical process under control.



7. Performance: Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per second. Select execution times consistent with the mechanical process under control.
8. Multiple Alarm Annunciations: Each workstation on the network shall receive alarms within 5 seconds of other workstations.
9. Reporting Accuracy: System shall report values with minimum end-to-end accuracy listed in Table 1.
10. Control Stability and Accuracy: Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

<b>TABLE 1 Reporting Accuracy</b>	
1) <b>Measured Variable</b>	2) <b>Reported Accuracy</b>
3) Space temperature	4) $\pm 1$ DegF ( $\pm 0.5^{\circ}\text{C}$ )
5) Ducted air	6) $\pm 1$ DegF ( $\pm 0.5^{\circ}\text{C}$ )
7) Outside air	8) $\pm 2$ DegF ( $\pm 1.0^{\circ}\text{C}$ )
Dew point	$\pm 3$ DegF ( $\pm 1.5^{\circ}\text{C}$ )
9) Water temperature	10) $\pm 1$ DegF ( $\pm 0.5^{\circ}\text{C}$ )
11) Delta-T	12) $\pm 0.25$ DegF ( $\pm 0.15^{\circ}\text{C}$ )
13) Relative humidity	14) $\pm 5\%$ RH
15) Water flow	16) $\pm 2\%$ of full scale
Airflow (terminal)	$\pm 10\%$ of full scale (see Note 1)
Airflow (measuring stations)	$\pm 5\%$ of full scale
Airflow (pressurized spaces)	$\pm 3\%$ of full scale
17) Air pressure (ducts)	18) $\pm 25$ Pa ( $\pm 0.1$ IN w.g.)
19) Air pressure (space)	20) $\pm 3$ Pa ( $\pm 0.01$ IN w.g.)
21) Water pressure	22) $\pm 2\%$ of full scale (see Note 2)
23) Electrical (A, V, W, power factor)	24) $\pm 1\%$ of reading (see Note 3)
Carbon monoxide (CO)	$\pm 5\%$ of reading
Carbon dioxide (CO <sub>2</sub> )	$\pm 50$ ppm
<b>Note 1: Accuracy applies to 10%–100% of scale</b>	
<b>Note 2: For both absolute and differential pressure</b>	

**Note 3: Not including utility-supplied meters**

<b>TABLE 2 Control Stability and Accuracy</b>			
<b>Controlled Variable</b>	<b>Control Accuracy</b>	<b>Range of Medium</b>	
Air pressure	±0.2 IN w.g. (±50 Pa )	0–6 IN w.g. (0–1.5 kPa)	
	±0.01 IN w.g.( ±3 Pa)	–0.1 to 0.1 IN w.g. (–25 to 25 Pa)	
Airflow	±10% of full scale		
Space temperature	±2.0 DegF (±1.0°C)		
Duct temperature	±3 DegF (±1.5°C)		
Humidity	±5% RH		
Fluid pressure	±1.5 psi (±10 kPa)	1–150 psi (0–1 MPa)	
	±1.0 IN w.g. (±250 Pa)	(0–50 IN w.g.) differential	

**1.07 WARRANTY**

- A. Warrant work as required in the General Conditions.

**1.08 MAINTENANCE SERVICE AGREEMENT**

- A. A written proposal for a maintenance contract shall be provided to the Owner for on-site preventive maintenance services related to the Instrumentation and Control system. The cost of this maintenance contract shall not be included in the Contract Price.
- B. This proposal shall be provided within 30 days after final acceptance for the purpose of entering a contract for annual maintenance subsequent to the first year of maintenance. Standard per diem rates for providing breakdown service shall be set forth in the contract. Such rates shall be fair and reasonable and reflect the lowest rates offered to most favored customers. The fee quoted shall be firm for a minimum of 90 days from date of issue.
- C. This maintenance contract shall include all labor, parts, and emergency calls providing on-site response within 24 HRS, to provide complete system maintenance for a period of one year after the date of Substantial Completion of the system for all equipment and software provided as part of the scope of work.
- D. Provide software updates throughout the maintenance contract period. Provide latest official released version for all software provided under this Contract. Owner shall have the latest software releases at the end of the maintenance contract period.
- E. The maintenance contract shall also include a minimum of 4 preventive maintenance visits by qualified service personnel of the Supplier who is familiar with the type of equipment provided for this project. Each preventive maintenance visit shall include routine adjustment, calibration, cleaning and lubrication of system equipment and verification of correct operation.

- F. Visits to the sites to correct deficiencies under warranty shall not be included in this preventive maintenance service contract.
- G. Emergency maintenance procedures or plant visits may coincide with a preventive maintenance visit, however, they shall not replace the work intended to be performed during a preventive maintenance visit. The Supplier shall have full responsibility for the system hardware preventive and corrective maintenance.
- H. During the one-year maintenance period, observation of maintenance tasks performed under this agreement by plant personnel and the instruction of said personnel in the details of the maintenance work being performed, shall be provided.

#### 1.09 MANUFACTURER SUPPORT

- A. Provide a written proposal for a manufacturer support agreement for products specified herein for a minimum of 12 months starting at final completion of the project. The cost of this manufacturer support agreement shall not be included in the Contract Price unless part of the manufacturer's standard terms of sale. The support agreement shall be executed in the name of, and for the benefit of, the Owner. At a minimum, this agreement shall provide the Owner with:
  - 1. 8 AM to 5 PM, 5 day per week manufacturer telephone support.
  - 2. Access to the manufacturer's technical support website.
  - 3. Software and firmware updates.

#### 1.10 OWNERSHIP OF PROPRIETARY MATERIAL

- A. All software provided under this Contract shall be licensed to the Owner at the time of purchase.
- B. Project-specific software and documentation shall become the Owner's property. This includes, but is not limited to:
  - 1. Graphics.
  - 2. Record drawings.
  - 3. Database.
  - 4. Application programming source code.
  - 5. Documentation.
- C. All software programs and documentation developed under this Contract shall be turned over to the Owner in format so programs can be adjusted, reconfigured, or re-programmed by the Owner or their representatives.
- D. Turn over all keys and passwords to the system. Any passwords shall be turned over to the Owner and the Owner shall have full access to modify the system after final completion. Any changes made during or after testing, start-up, and commissioning shall be incorporated and provided to the Owner.
  - 1. Change Administrator Level Control of system software to the Owner following start up to allow the Owner the ability to grant or restrict access to any user, including the system supplier and the installing contractor.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**

## **SECTION 23 09 93 - SEQUENCE OF OPERATION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Sequence of system operations.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to work of this Section.
- B. Division 23 - Mechanical Sections apply to this Section.
- C. Division 26 - Electrical Sections apply to this Section.

#### **1.03 REFERENCED STANDARDS**

- A. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilation Systems" where applicable to controls and control sequences.

#### **1.04 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.

### **PART 2 - PRODUCTS**

#### **2.01 TEMPERATURE CONTROLS**

- A. Provide a complete temperature control system including programmable logic controllers (PLC's). HVAC temperature controls shall be compatible with PLC equipment provided for process and equipment controls installed by process control contractors.

### **PART 3 - EXECUTION**

#### **3.01 DOMESTIC HOT WATER CIRCULATING PUMP**

- A. All circulating pumps shall be scheduled through the DDC system. When a particular circulating pump is scheduled to operate through the DDC system, it shall operate as needed through its associated aquastat. Refer to plans and Specification Section 22 11 23 for additional information.

#### **3.02 ELECTRIC AND GAS FIRED DOMESTIC WATER HEATERS**

- A. Water heaters shall be provided with integral thermostats.

3.03 COMPRESSED AIR SYSTEM

- A. Air compressor shall be provided with an integral pressure switch.

**END OF SECTION**

## **SECTION 23 11 23 - NATURAL GAS SYSTEMS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Natural gas piping, accessories, and installation.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

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

#### **1.03 REFERENCED STANDARDS**

1. NFPA - 54 - National Fuel Gas Code, for gas piping materials and components, gas piping installations, and inspection, testing, and purging of gas piping systems.

#### **1.04 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.
- B. Product data for each gas piping specialty and special duty valve. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Subject to compliance with requirements, manufacturers offering gas piping system products which may be incorporated in the work include, but are not limited to, the following:
  1. Gas Cocks:
    - a. Jenkins Bros.
    - b. Lunkenheimer Co.
    - c. Powell Co.
    - d. Stockham.

#### **2.02 PIPE MATERIALS**

- A. Conform to NFPA 54 and with requirements specified herein. Supply piping to appliances or equipment shall be at least as large as the inlets thereof..

#### **2.03 PIPE AND FITTINGS**

- A. Aboveground and Within Buildings and Vaults

UP General Specifications  
NATURAL GAS SYSTEMS

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1. Pipe: Black steel in accordance with ASTM A53, Schedule 80, threaded ends for sizes 2 inches and smaller; otherwise, plain end beveled for butt welding.
  2. Threaded Fittings: ASME B16.3, black malleable iron.
    - a. Pipe thread tape: antiseize and sealant tape of polytetrafluoroethylene (PTFE).
  3. Socket-Welding Fittings: ASME B16.11, forged steel.
  4. Butt-Welding Fittings: ASME B16.9, with backing rings of compatible material.
  5. Flanges and Flanged Fittings: ASME B16.5 steel flanges or convoluted steel flanges conforming to ASME BPVC SEC VIII D1. Flange faces shall have integral grooves of rectangular cross sections which afford containment for self-energizing gasket material.
    - a. Bolts and Nuts: Stainless steel bolting; ASTM A193, Grade B8M or B8MA, Type 316, for bolts; and ASTM A194, Grade 8M, Type 316, for nuts. Dimensions of bolts, studs, and nuts shall conform with ASME B18.2.1 and ASME B18.2.2 with coarse threads conforming to ASME B1.1, with Class 2A fit for bolts and studs and Class 2B fit for nuts. Bolts or bolt-studs shall extend through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Bolts shall have American Standard regular square or heavy hexagon heads; nuts shall be American Standard heavy semi finished hexagonal.
    - b. Gaskets: Fluorinated elastomer, compatible with flange faces.
- B. Underground Polyethylene (PE) PE pipe and fittings are as follows:
1. Pipe: ASTM D2513, 100 psig working pressure, Standard Dimension Ratio (SDR), the ratio of pipe diameter to wall thickness, 11.5 maximum.
  2. Socket Fittings: ASTM D2683.
  3. Butt-Fusion Fittings: ASTM D2513, molded.
  4. Provide detectable aluminum-foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inch minimum width, color-coded yellow for natural gas, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be "CAUTION BURIED GAS PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

## 2.04 PIPING SPECIALTIES

- A. Unions: ANSI B16.39, Class 150 black malleable iron; female pattern; brass to iron seat; ground joint.
- B. Dielectric Unions: ANSI B16.39, Class 250; malleable iron and cast bronze; with threaded or soldered end connections suitable for pipe to be joined; designed to isolate galvanic and stray current corrosion.



- C. Pressure Regulator, self-contained with spring-loaded diaphragm pressure regulator, psig to inches water reduction, pressure operating range as required for the pressure reduction indicated, volume capacity not less than indicated, and threaded ends for sizes 2 inches and smaller, otherwise flanged.
- D. Earthquake Automatic Gas Shutoff Valve, ASCE 25-16 and UL listed or AGA listed or International Association of Plumbing and Mechanical Officials (IAPMO) listed. The valve may be either pendulum or ball construction with actuator.
- E. Risers shall be manufacturer's standard riser, transition from plastic to steel pipe with 7 to 12 mil thick epoxy coating. Use swaged gas-tight construction with O-ring seals, metal insert, and protective sleeve. Provide remote bolt-on or bracket or wall-mounted riser supports.
- F. Transition Fittings
  - 1. Steel to Plastic (PE): As specified for "riser" except designed for steel-to-plastic with tapping tee or sleeve. Coat or wrap exposed steel pipe with heavy plastic coating.
  - 2. Plastic to Plastic: Manufacturer's standard bolt-on (PVC to PE) plastic tapping saddle tee, UL listed for gas service, rated for 100 psig, and O-ring seals; Manufacturer's standard slip-on PE mechanical coupling, molded, with stainless-steel ring support, O-ring seals, and rated for 150 psig gas service; Manufacturer's standard fused tapping (PE-to-PE) tee assembly with shut-off feature.
- G. Gas Equipment Connectors
  - 1. Flexible Connectors: ANSI Z21.45.
  - 2. Quick Disconnect Couplings: ANSI Z21.41/CSA 6.9.
  - 3. Semi-Rigid Tubing and Fittings: ANSI Z21.69/CSA 6.16.
- H. Valve Box: Provide street valve box with cast-iron cover and two-piece 5 1/4 inch shaft-slip valve box extension. Cast the word "Gas" into the box cover. Use valve box for areas as follows:
  - 1. Roads and Traffic Areas: Heavy duty, cast iron cover.
  - 2. Other Areas: Standard duty, concrete cover.

## 2.05 VALVES

- A. Aboveground:
  - 1. Gas Cocks 2 IN and Smaller: 150 psi WOG, bronze body, straightaway pattern, square head, threaded ends.
  - 2. Gas Cocks 2-1/2 IN and Larger: MSS SP-78; 175 psi, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends.
- B. Belowground
  - 1. Metallic Ball Valves ASME B16.33 or ASME B16.38 corrosion-resisting steel, with threaded or flanged ends. Provide polytetrafluoroethylene (PTFE) seats.

2. PE Ball or Plug Valves ASME B16.40 and ASTM D2513, Class C materials (PE 2306 or PE 3406), strength rating and SDR matching PE pipe dimensions and working pressure.

#### 2.06 HANGERS AND SUPPORTS

- A. MSS SP-58, as required by MSS SP-69.

### PART 3 - EXECUTION

#### 3.01 PIPE APPLICATIONS

- A. Install steel pipe with threaded joints and fittings for 2 IN and smaller, and with welded joints for 2-1/2 IN and larger.

#### 3.02 PIPING INSTALLATIONS

- A. General: Conform to the requirements of NFPA 54 - National Fuel Gas Code.

#### 3.03 FIELD QUALITY CONTROL

- A. Pump shall be scheduled through the DDC system. When the pump is scheduled to be operation through the DDC system, the pump shall be turned on/off through a line voltage aquastat to maintain heating water piping at 118 DegF (adj.).

**END OF SECTION**

## **SECTION 23 23 00 - REFRIGERANT PIPING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Refrigerant piping used for air conditioning applications.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

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

#### **1.03 SUBMITTALS**

- ##### **A. Submit under provisions of section 01 33 00.**

##### **B. Product data for the following products:**

1. Each type valve specified.
2. Each type refrigerant piping specialty specified.

- ##### **C. Shop Drawings showing layout of refrigerant piping, specialties, and fittings including, but not necessarily limited to, pipe and tube sizes, valve arrangements and locations and risers with oil traps.**

#### **1.04 QUALITY ASSURANCE**

- ##### **A. Regulatory Requirements: Comply with provisions of the following codes:**

1. ANSI B31.5: ASME Code for Pressure Piping - Refrigerant Piping.
2. ANSI/ASHRAE Standard 15: Safety Code for Mechanical Refrigeration.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- ##### **A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:**

1. Refrigerant Valves and Specialties:
  - a. Alco Controls Div, Emerson Electric.
  - b. Danfoss Electronics, Inc.
  - c. EATON Corporation, Control Div.
  - d. Henry Valve Company.
  - e. Sporlan Valve Company.

## 2.02 PIPE AND TUBING MATERIALS

- A. Copper Tubing: ASTM B 88, Type L, hard-drawn straight lengths.

## 2.03 FITTINGS

- A. Wrought-Copper Fittings: ANSI B16.22, streamlined pattern.

## 2.04 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).

## 2.05 VALVES

- A. General: Isolation valve assemblies shall be UL-listed and designed to conform to ARI 760.

## 2.06 REFRIGERANT PIPING SPECIALTIES

- A. General: Complete refrigerant piping specialty assembly shall be UL-listed and designed to conform to ARI 760.
- B. Strainers: 500 psig maximum working pressure; forged brass body with monel 80-mesh screen, and screwed cleanout plug; Y-pattern, with solder end connections.
- C. Moisture/liquid Indicators: 500 psig maximum operation pressure, 200 DegF maximum operating temperature; forged brass body, with replaceable polished optical viewing window, and solder end connections.
- D. Filter-driers: 500 psig maximum operation pressure; steel shell, flange ring, and spring, ductile iron cover plate with steel capscrews, and wrought copper fittings for solder end connections. Furnish complete with replaceable filter-drier core kit.

# PART 3 - EXECUTION

## 3.01 PIPE APPLICATIONS

- A. Use Type L or Type ACR hard drawn copper tubing with wrought copper fittings and brazed joints above ground, within building.

## 3.02 PIPING INSTALLATIONS

- A. General: Install refrigerant piping in accordance with ASHRAE Standard 15 "The Safety Code for Mechanical Refrigeration."
- B. Install piping in as short and direct arrangement as possible to minimize pressure drop.
- C. Install piping for minimum number of joints using as few elbows and other fitting as possible.
- D. Insulate hot gas lines. Liquid lines are not required to be insulated.
- E. Install horizontal hot gas lines with 1/8 IN per 10 FT downward slope to the condenser.
- F. Use fittings for all changes in direction and all branch connections. Install piping at right angles or parallel to building walls.

- G. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- H. Install strainers immediately ahead of each expansion valve.
- I. Install moisture/liquid indicators in liquid lines between filter/driers and thermostatic expansion valves and in liquid line to receiver.
- J. Install unions to allow removal of solenoid valves, pressure regulating valves, expansion valves, and at connections to condensers and evaporators.

### 3.03 HANGERS AND SUPPORTS

- A. General: Hanger, supports, and anchors are specified in Section 40 05 07 "Hangers and Support" Conform to the table below for maximum spacing of supports:
- B. Install hangers with the following minimum rod sizes and maximum spacing:

NOM. PIPE SIZE - IN	MAX. SPAN - FT	MIN. ROD SIZE - IN
1 and smaller	7	3/8
1-1/8 thru 1-7/8	9	3/8
2 and larger	10	3/8

### 3.04 PIPE JOINT CONSTRUCTION

- A. Brazed Joints: Comply with the procedures contained in the AWS "Brazeing Manual."

### 3.05 VALVE INSTALLATIONS

- A. General: Install refrigerant valves in accordance with manufacturer's instructions.
- B. Thermostatic expansion valves shall be integral with the chillers.
- C. Install pressure regulating and relieving valves and piping as required by ASHRAE Standard 15.

### 3.06 CLEANING

- A. Before installation of copper tubing, clean the tubing and fittings.

### 3.07 ADJUSTING AND CLEANING

- A. Verify actual evaporator applications and operating conditions, and adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.
- B. Clean and inspect refrigerant piping systems in accordance with requirements of Section 40 05 03 - Piping Materials and Methods.
- C. Adjust controls and safeties. Replace damaged or malfunctioning controls and equipment with new materials and products.

## END OF SECTION

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## **SECTION 23 31 10 - DUCTWORK**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes:
  - 1. Sheet metal ductwork.
  - 2. Flexible ducts.
  - 3. Duct cleaning.

#### **1.02 REFERENCED STANDARDS**

- A. ADC - Flexible Duct Performance & Installation Standards.
- B. ASHRAE - Handbook 1989 Fundamentals; Chapter 32 - Duct Design.
- C. ASHRAE - Handbook 1992 Systems and Equipment; Chapter 16 - Duct Construction.
- D. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- E. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- F. ASTM A527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- G. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- H. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- I. SMACNA - Round Industrial Duct Construction Standards.
- J. UL 181 - Factory-Made Air Ducts and Connectors.

#### **1.03 DEFINITIONS**

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.
- B. SMACNA Pressure Class: All ducts are 2 IN WG pressure class, unless otherwise indicated on Drawings.
- C. Seal Class: Seal class 'C' for all ducts of pressure class 2 IN WG and less.

#### **1.04 REGULATORY REQUIREMENTS**

- A. Construct ductwork to NFPA 90A standards.

#### **1.05 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Indicate duct fittings, particulars such as materials, gauges, sizes, welds, hangers, and configuration prior to start of work for all duct systems.

## 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and protect products under provisions of Section 01 65 50.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. General: Non-combustible or conforming to UL 181 requirements for Class 0 air duct materials, unless otherwise indicated.
- B. Steel ducts: ASTM A527 galvanized steel sheet, lock-forming quality, having G90 (Z 275) zinc coating on each side in conformance with ASTM A525.
- C. Flexible ducts, nonmetallic, insulated: UL 181 Class 1 air duct, chlorinated polyethylene core, galvanized steel wire helix, 1-1/2 IN (40 mm) thick fiberglass insulation, reinforced metalized polyester vapor barrier, rated working pressure 6 IN WG (1500 Pa) positive and 1 IN WG (250 Pa) negative, rated velocity 4000 fpm (20 m/s) minimum.
  - 1. Model: UPC#037 manufactured by Atco Rubber Products; M-KE manufactured by Flexible Technologies; or approved equal.
- D. Fasteners: Rivets, bolts, or sheet metal screws, compatible with duct material.
- E. Sealant - One part joint sealers shall be water-based mastic systems that meet the following requirements: maximum 48-hour cure time, service temperature of -20 DegF to +175 DegF, resistant to mold, mildew and water, flame spread rating below 25 and smoke-developed rating below 50 when tested in accordance with ASTM E84, suitable for all SMACNA seal classes and pressure classes. Mastic used to seal flexible ductwork shall be marked UL 181B-M. All other mastics shall be marked UL 181A-M.
  - 1. Pressure sensitive tape used for sealing ductwork shall be minimum 2.5-wide, listed and marked UL 181A-P having minimum 60 OZ/IN peel adhesion to steel and service temperature range from -20 DegF to 250 DegF.
  - 2. Joint sealers shall meet the volatile organic compound (VOC) limits of US Green Building Council LEED credit EQ 4.1 Low-Emitting Materials – Adhesives & Sealants (follow latest edition at the time of bidding) regardless of whether the project is trying to achieve LEED status or not.
- F. Hangers and hanger rod: Select hanging system in accordance with SMACNA HVAC Duct Construction Standards; select hanger materials with corrosion resistance equal to or greater than the duct material.

### 2.02 SHEET METAL DUCTWORK- GENERAL

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
  - 1. Factory fabricated duct joining system: As manufactured by Ductmate Industries; or approved equal.
- B. No variation of duct configuration or sizes permitted except by written permission.



- C. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where there is insufficient space for radius elbows and where rectangular elbows are shown, provide rectangular fittings with single thickness air foil turning vanes.
- D. Increase duct sizes gradually, not exceeding 15 degrees divergence where possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- E. Branch connections and take-offs: Rectangular with 45 degree entry, or 45 degree diverging wye.
- F. Connect flexible ducts to metal ducts using sheet metal collars and tape plus draw bands. Seal collars to main duct with duct sealant.
- G. Use crimp joints with or without bead for joining round duct sizes 12 IN (300 mm) and smaller with crimp in direction of air flow.
- H. Use double nuts and lock washers on threaded rod supports.
- I. Sizes shown on plans are inside clear dimensions.

#### 2.03 LOW PRESSURE DUCTWORK

- A. Fabricated and support in accordance with SMACNA Low Pressure Duct Construction Standards and ASHRAE handbooks. Provide duct material, gages, reinforcing and sealing for operating pressures indicated.
- B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission from Engineer.
- C. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.

#### 2.04 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.
- B. Apply a coat of adhesive to liner facing in direction of airflow not receiving metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.
- E. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.
  - 1. Apply an adhesive coating on longitudinal seam sin ducts exceeding 2,500 FPM air velocity.

- F. Secure liner with mechanical fasteners 4 IN from corners and at intervals not exceeding 12 IN transversely around perimeter; at 3 IN from transverse joints and at intervals not exceeding 18 IN longitudinally.

## 2.05 ROUND DUCT FABRICATION

- A. Round Ducts: Fabricate round supply ducts with spiral lockseam construction. Comply with SMACNA: "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gages.

## 2.06 ROUND DUCT FITTINGS FABRICATION

- A. Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figures 3-4 and 3-5 and with metal thicknesses specified.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.
- C. Elbows: Fabricate in die-formed, gored, or pleated construction. Fabricate the bend radius of die-formed, gored and pleated elbows 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:
  - 1. Mitered Elbows: Mitered elbows shall not be used.
  - 2. Round Elbows – 8 IN and Smaller: Die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60 and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2 IN DIA (e.g. 3-1/2 and 4-1/2 IN) elbows with gored construction.
  - 3. Round Elbows – 9 through 14 IN: Gored or pleated elbows for 30, 45, 60 and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or 1/2 IN DIA (e.g. 9-1/2- and 10-1/2 IN) elbows with gored construction.
  - 4. Round Elbows – Larger than 14 IN: Gored elbows, except where space restrictions require a mitered elbow.
  - 5. Die-Formed Elbows for Sizes through 8 IN and All Pressures: 20 gauge with 2-piece welded construction.

## 2.07 FLEXIBLE DUCTS

- A. Install and support in accordance with SMACNA Duct Construction Standards or ADC Standards.
- B. Connections and joints: Use sheet metal collars or sleeves and tape plus stainless steel drawbands.

# PART 3 - EXECUTION

## 3.01 INSTALLATION

- A. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where indicated and where required for testing of systems.

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- B. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- C. Diffusers to ducts with 5 FT (1.5 m) maximum length of flexible duct.
- D. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

### 3.02 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints according to pressure classification and in accordance with SMACNA installation requirements.
- B. Pressure Classifications Greater than 2 IN Water Gage: All transverse joints, longitudinal seams and duct penetrations with joint sealing materials.
- C. Pressure Classification Through 2 IN Water Gage: All transverse joints and longitudinal seams with duct tape.
- D. Seal externally insulated ducts prior to insulation installation.

### 3.03 HANGING AND SUPPORTING

- A. Install rigid, rectangular metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-4 and Figures 4-6 through 4-9.
- B. Support horizontal ducts within 2 FT of each elbow and within 4 FT of each branch intersection.
- C. Support vertical ducts at a maximum interval of 16 FT and at each floor.
- D. Upper attachments to structures shall have an allowable load not to exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.
- E. Install concrete insert prior to placing concrete.
- F. Install powder actuated concrete fasteners after concrete is placed and completely cured.

### 3.04 CONNECTIONS

- A. Equipment Connections: Connect equipment with flexible connectors in accordance with Section 23 33 00 - "Ductwork Accessories."
- B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figure 2-8, 45 degree entry and conical type and as detailed.
- C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figure 2-16 through 2-18 and as detailed.
- D. Flexible Connections: Comply with SMACNA "HVAC Duct Construction Standards, Figure 2- 19 and as detailed.

### 3.05 FIELD QUALITY CONTROL

- A. Disassemble, reassemble and seal segments of the supply air systems as required to accommodate leakage testing, and as required for compliance with test requirements.

- B. Conduct tests, at static pressures equal to the maximum design pressure of the system or the section being tested. If pressure classifications are not indicated, test entire system at the maximum system design pressure. Do not pressurize systems above the maximum design operating pressure Give seven (7) days advanced notice for testing.
- C. Test and determine leakage from entire supply air rectangular duct system or section of the system by relating leakage to the surface area of the test section.
- D. Maximum Allowable Leakage: As described in ASHRAE 1989 Handbook, "Fundamentals" Volume, Chapter 32, Table 6 and Figure 10. Comply with requirements for leakage classification 6 for pressure classifications greater than 2 IN water gauge and less than and equal to 10 IN of water gauge.
- E. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.

### 3.06 ADJUSTING

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Section 23 05 93 - "Testing, Adjusting, and Balancing" for requirements and procedures for adjusting and balancing air systems.
- B. Vacuum duct systems prior to final acceptance to remove dust and debris.

### 3.07 ADJUSTING AND CLEANING

- A. Clean duct system and force air at high velocity through duct to remove accumulated dust. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

### 3.08 ACOUSTICAL LINER SCHEDULE

- A. Duct System              Material              Thickness in IN
- B. All rectangular supply air ducts Liner 1-1/2 IN.

## END OF SECTION

## **SECTION 23 33 00 - DUCTWORK ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Volume dampers.
2. Control dampers.
3. Damper operators.
4. Backdraft dampers.
5. Fire dampers.
6. Smoke dampers.
7. Flexible duct connections.
8. Duct access doors.
9. Duct test holes.

#### **1.02 REFERENCED STANDARDS**

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- C. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- D. UL 33 - Heat Responsive Links for Fire-Protection Service.
- E. UL 555 - Fire Dampers and Ceiling Dampers.
- F. UL 555S - Leakage Rated Dampers for use in Smoke Control Systems.

#### **1.03 SUBMITTALS**

- A. Submit shop drawings and product data under provisions of Section 01 33 00.
- B. Provide product data for factory fabricated products or shop drawings for shop fabricated assemblies, including dampers and operators, fire and smoke dampers, and duct access doors.
- C. Submit manufacturer's installation instructions under provisions of Section 01 33 00, for fire dampers, combination fire and smoke dampers, smoke dampers, and ceiling radiation dampers.

## PART 2 - PRODUCTS

### 2.01 VOLUME DAMPERS

- A. Rectangular, low leakage type: 16 gage galvanized steel hat channel frame, 16 gage galvanized steel blades maximum 6 IN (150 mm) wide, parallel blade action. Synthetic bearings, 1/2 IN plated steel axles, elastomeric blade edge seals, flexible stainless steel or aluminum jamb seals, maximum leakage 12 cfm/SQ FT at 4 IN WG differential pressure in accordance with AMCA Standard 500, mill galvanized finish, suitable for velocity to 1500 fpm (7.6 m/s) and pressure to 2.5 IN WG (600 Pa).
  - 1. Provide locking, indicating quadrant regulators. On insulated ducts mount quadrant regulators on stand-off brackets, bases or adaptors.
  - 2. Model: CD 60 manufactured by Ruskin; 500 Series manufactured by Swartwout; VCD-3000 Series manufactured by Greenheck; AC-500 Series manufactured by Air Balance Inc.; or approved equal.
- B. Round: Minimum 22 gage galvanized steel frame with rolled beads, minimum 22 gage galvanized steel blade, minimum 3/8 IN plated steel axle, swaged steel or nylon bearings, suitable for velocity to 1500 fpm (7.6 m/s) and pressure to 1 IN WG (250 Pa).
  - 1. Provide locking, indicating quadrant regulators. On insulated ducts mount quadrant regulators on stand-off brackets, bases, or adapters.
  - 2. Model: MDRS25 manufactured by Ruskin; Type 200 VCRD manufactured by Arrow United Industries; AC-112 manufactured by Air Balance Inc.; or approved equal.

### 2.02 CONTROL DAMPERS

- A. Rectangular, aluminum: Extruded aluminum hat channel frame 0.125 IN (3 mm) thick, extruded aluminum airfoil blades maximum 6 IN (150 mm) wide, 1/2 IN plated steel axles, synthetic bearings, parallel blade action. Inflatable elastomeric blade edge seals, flexible metal jamb seals, anodized finish, maximum leakage 12 cfm/SQ FT at 4 IN WG differential pressure in accordance with AMCA Standard 500.
  - 1. Provide damper operator as indicated on Drawings.
  - 2. Model: CD-50 manufactured by Ruskin; 501 manufactured by Swartwout; AC-526 manufactured by Air Balance Inc.; VCD-3000 series manufactured by Greenheck; or approved equal.
- B. Round, steel: Minimum 22 gage galvanized steel frame with rolled beads, double thickness galvanized steel blade, elastomeric blade edge seal, 1/2 IN DIA plated steel axle, stainless steel sleeve or oil-impregnated bronze bearings, suitable for pressure to 6 IN WG (1500 Pa), maximum leakage 0.15 scfm per inch of blade circumference at a pressure differential of 4 IN WG in accordance with AMCA Standard 500.
  - 1. Provide damper operator as indicated on Drawings. On insulated ducts mount quadrant regulators on stand-off brackets, bases, or adapters.
  - 2. Model: CDRS25 manufactured by Ruskin; AC-530 manufactured by Air Balance Inc.; Type 250 SRD manufactured by Arrow United Industries; or approved equal.

### 2.03 DAMPER OPERATORS

- A. Manual: Locking, indicating quadrant regulator. On insulated ducts mount quadrant regulators on stand-off brackets, bases, or adapters.
- B. Electric, two-position: 120 or 24 volt, 60 Hz electric motor operator with integral spring to return damper to normal position, cast aluminum weatherproof housing, oil immersed gear train, UL listed, SPDT adjustable auxiliary limit switch.
  - 1. Model: M445 M845 manufactured by Honeywell; MA-418 MA-318 manufactured by Siebe (Barber Colman); or approved equal.
  - 2. Provided by temperature control.
- C. Electric, modulating: 120 24 volt, 60 Hz modulating electric motor operator with integral spring to return damper to normal position, cast aluminum weatherproof housing, oil immersed gear train, internal transformer, UL listed, two adjustable auxiliary limit switches, minimum position potentiometer.
  - 1. Model: M945 manufactured by Honeywell; or approved equal.
  - 2. Provided by temperature control.

### 2.04 BACKDRAFT DAMPERS

- A. Backdraft dampers, size 18 x 18 IN (450 x 450 mm) or smaller, furnished with air moving equipment, may be air moving equipment manufacturers standard construction, unless otherwise indicated in equipment specification.
- B. Gravity dampers: Designed for vertical or horizontal (air flow up) mounting, minimum 0.081 IN (2 mm) thick extruded aluminum channel frame, minimum 0.05 IN (1.2 mm) thick extruded aluminum blades, synthetic elastomeric blade edge seals, synthetic bearings, concealed linkage, rear mounted screen, suitable for velocity to 1500 fpm (7.6 m/s).
  - 1. Model: BD2/A2 manufactured by Ruskin; 402 manufactured by Swartwout; Type 655 manufactured by Arrow United Industries; or approved equal.

### 2.05 FIRE DAMPERS

- A. Fabricate in accordance with NFPA 90A and UL 555, and as indicated. Provide dampers UL rated and labeled at 1-1/2 HRS at openings in walls and floors with less than a three hour fire rating. Provide dampers UL rated and labeled at 3 hours at openings in walls and floors with a fire rating of three hours or more.
- B. Fabricate curtain type dampers of galvanized steel with interlocking blades; Provide stainless steel closure springs and latches for horizontal installations; Type B or C configuration with blades out of air stream , except for ducts less than 12 IN (300 mm) in height.
- C. Fabricate multiple blade fire dampers with galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings, plated steel axles, plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.
- D. Fusible links: UL 33, shall separate at 165 DegF (74 DegC), unless otherwise indicated on Drawings.

- E. Where indicated, provide fire dampers UL-approved and Labeled as dynamic fire dampers.
- F. Manufacturer: Ruskin; Greenheck; Air Balance Inc.; Phillips Aire; or approved equal.

#### 2.06 SMOKE DAMPERS

- A. Provide combination dampers rated and labeled to Leakage Class I and qualified to 250 DegF (121 DegC) elevated temperature in accordance with UL 555S.
- B. Fabricate multiple blade dampers with galvanized steel or extruded aluminum frame and blades, oil-impregnated bronze or stainless steel sleeve bearings, plated steel axles, plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2 IN DIA actuator shaft, silicone blade edge seals and flexible metal compression type jamb seals where required to meet Leakage Class specified.
- C. Operators: Factory installed and approved in accordance with UL 555 and UL 555S. Two- position, normally closed action, electric type suitable to operate on 120 volt, 60 Hz.
- D. Manufacturer: Ruskin; Air Balance Inc.; Greenheck; or approved equal.

#### 2.07 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.
- B. Indoor: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 OZ/SQ YD (1.0 kg/sq m), minimum 4 IN ( 100 mm) wide, crimped into 3 IN wide metal edging strip.
  - 1. Model: Neoflex manufactured by Cain Manufacturing Co.; Ventglas manufactured by Ventfabrics; or approved equal.

#### 2.08 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards, and as indicated.
- B. Review locations prior to fabrication.
- C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum 1 IN (25 mm) thick insulation with sheet metal cover.
- D. Access doors smaller than 12 IN (300 mm) longest dimension may be removable type, secured with sash locks.
- E. Provide two hinges and two sash locks for sizes up to 18 IN (450 mm) longest dimension, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 48 IN (600 x 1200 mm). Provide an additional hinge for larger sizes. Full length piano type hinges are acceptable for doors with hinged side dimension up to 24 IN (600 mm).
- F. Access doors with sheet metal screw fasteners are not acceptable.



- G. Provide transparent window of plexiglass, wireglass, or laminated safety glass where indicated on Drawings.
- H. Manufacturer: Ruskin; Ventfabrics; CE Sparrow Co.; or approved equal.

## 2.09 DUCT TEST HOLES

- A. Cut or drill temporary test holes in ducts as required. Cap with neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- B. Permanent test holes shall be factory fabricated, air tight gasketed flanged fittings with screw cap. Provide extended neck fittings to clear insulation.
  - 1. Model: 699 manufactured by Ventfabrics; or approved equal.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions.
- B. Provide volume dampers at points on supply, return, and exhaust systems where indicated and where branches are taken from larger ducts and as required for air balancing.
- C. Provide fire dampers and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by authorities having jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.
- D. Demonstrate re-setting of fire dampers to authorities having jurisdiction and Owner's representative.
- E. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment.
- F. Provide 14 IN x14 IN duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, and elsewhere as indicated.
- G. Provide duct test holes where indicated and where required for testing and balancing purposes.

### **END OF SECTION**

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## **SECTION 23 34 00 - HVAC FANS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Heating, ventilating, and cooling equipment.

#### **1.02 RELATED REQUIREMENTS**

- A. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - General Requirements.
- C. Section 01 61 03 - Equipment: Basic Requirements.
- D. Section 23 05 93 - Testing, Adjusting, and Balancing.
- E. Section 23 09 00 - HVAC Instrumentation and Controls .
- F. Section 23 31 10 - Ductwork.

#### **1.03 REFERENCED STANDARDS**

- A. American Iron and Steel Institute (AISI):
  1. Steel Products Manual.
- B. Air Movement and Control Association (AMCA).
- C. Air Conditioning and Refrigeration Institute (ARI).
- D. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
  1. HVAC Applications Handbook, Chapter entitled "Sound and Vibration Control."
- E. Canadian Standards Association (CSA).
- F. FM Global (FM).
- G. National Electrical Manufacturers Association (NEMA):
  1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- H. National Fire Protection Association (NFPA):
  1. 70, National Electrical Code (NEC).
- I. National Roofing Contractors Association (NRCA).
- J. Underwriters Laboratories, Inc. (UL):
  1. 507, Standard for Electric Fans.
- K. Building code:
  1. International Code Council (ICC):

- a. International Building Code and associated standards, 2012 Edition including all amendments, referred to herein as Building Code.

#### 1.04 SUBMITTALS

##### A. Shop Drawings:

1. Submit under provisions of section 01 33 00.
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. Performance data on all equipment.
3. Certifications:
  - a. Provide certification of thickness of corrosion-protection coating.

##### B. Operation and Maintenance Manuals:

1. See Specification Sections 01 61 02 and 01 33 00 for requirements for:
  - a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.

#### 1.05 QUALITY ASSURANCE

##### A. 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.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

##### A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Inline fans:
  - a. Loren Cook.

- b. Aerovent.
    - c. Greenheck.
    - d. Twin City.
  - 2. Industrial Ceiling fans:
    - a. Big Ass Fans.
    - b. MacroAir Fans.
  - 3. Wall-mounted and ducted propeller-type fans:
    - a. Loren Cook.
    - b. Aerovent.
    - c. PennBarry Ventilator Co., Inc.
    - d. Greenheck.
    - e. Twin City/
  - 4. Toilet room exhaust fans:
    - a. PennBarry Ventilator Co., Inc.
    - b. Loren Cook.
    - c. Greenheck.
    - d. Twin City.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

## 2.02 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 ASHRAE HVAC Applications Handbook.

## 2.03 MANUFACTURED UNITS

- A. In-Line Centrifugal Fans :
- 1. AMCA certified Class I, II, or III.
  - 2. Non-overloading horsepower capability.
  - 3. Materials:
    - a. Wheel, impeller hub and blades: Aluminum or stainless steel.
    - b. Housing, innertube and belt well: Aluminum or stainless steel.
    - c. Inlet cone: Aluminum or stainless steel.

- d. Driver shaft: Solid stainless steel.
- 4. Airfoil design blades.
  - a. All welded construction.
- 5. All welded housing, innertube and belt well.
- 6. Innertube construction:
  - a. Isolates bearings and drive from airstream.
  - b. Removable end covers.
- 7. Bearings:
  - a. Cast iron pillow blocks.
  - b. Concentric bearing locking collar for drive shafts 1 IN and larger.
    - 1) SKF "ConCentra."
    - 2) Dodge "D Lock."
  - c. Regreaseable.
  - d. 200,000 HR average life.
- 8. Motor:
  - a. See Specification Section 01 61 03.
  - b. 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 percent motor horsepower.
- 9. Adjustable motor base.
- 10. Automatic drive belt tensioner.
- 11. Flanged inlet and outlet.
- 12. Accessories:
  - a. Weatherproof, louvered motor enclosure for exterior installation.
  - b. Internal inlet damper with external control linkage.
  - c. Stack hood.
  - d. Cam type access door.
  - e. Ceramic felt shaft seal.
  - f. Extended grease links and fittings.
- 13. Size and capacity as scheduled on Drawings.

14. Section 01 61 03.

B. Wall-Mounted and duct-mounted Propeller-Type Fans:

1. AMCA certified.
2. Industrial quality.
3. Materials:
  - a. Propeller: Cast aluminum or aluminum.
  - b. Venturi: Spun aluminum.
  - c. Panel and supports: Aluminum or stainless steel.
  - d. Drive shaft: Solid stainless steel.
  - e. Sheaves: Cast iron.
4. Propellers:
  - a. Statically and dynamically balanced.
  - b. Airfoil design.
  - c. Minimum four (4) blades.
5. Bearings:
  - a. Cast iron pillow blocks.
  - b. Concentric bearing locking collar for drive shafts 1 IN and larger.
    - 1) SKF "ConCentra."
    - 2) Dodge "D Lock."
  - c. Regreaseable.
  - d. 200,000 HR average life.
6. Welded reinforced motor base plate.
7. Adjustable motor base.
8. Motor:
  - a. See Specification Section 01 61 03.
  - b. 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 percent motor horsepower.
9. Automatic drive belt tensioner.
10. Accessories:

- a. Inlet guard.
- b. Outlet guard.
- c. Heavy-duty automatic shutter.
- d. Mounting adapter.
- e. Bird screen.
- f. Extended grease lines and fittings.

11. Size and capacity as scheduled on Drawings.

C. Industrial Ceiling Fan:

- 1. UL listed.
- 2. High volume, low speed.
- 3. Materials: .
  - a. Steel Motor frame and mount with powder coated paint.
  - b. Sprayproof and corrosion resistant .
- 4. Blades:
  - a. Extruded aluminum alloy.
  - b. Airfoil..
  - c. Rolled edges.
  - d. Weight balanced.
- 5. Bearing:
  - a. Neoprene sealed ball bearings, upper and lower.
- 6. Motor:
  - a. See Specification Section 01 61 03.
  - b. UL 507, waterproof tested.
  - c. Internal thermal overload protection.
  - d. Totally enclosed.
  - e. Direct drive or gear driven.
  - f. Induction type inverter rated if fan provided with VFD.
- 7. Secondary cable support assembly.
- 8. Accessories:
  - a. Solid state motor speed controller or VFD controller.
  - b. Downrod and support as recommended by manufacturer.

D. Toilet Room Exhaust Fans:

- 1. AMCA certified.
- 2. UL listed.



3. Materials: Galvanized steel.
4. Centrifugal wheels.
5. Permanently lubricated motor.
6. Acoustically insulated housing.
7. Resilient rubber-in-shear vibration isolation.
8. Fan, motor, and wheel assembly removable from housing.
9. Duct flanged outlet.
10. Integral backdraft damper.
11. Minimum 85-percent free open area face grill.
12. Accessories:
  - a. Integral exhaust grille.
  - b. Wall cap.
13. Size and capacity as scheduled on Drawings.

### PART 3 - EXECUTION

#### 3.01 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.

#### 3.02 FIELD QUALITY CONTROL

- A. Comply with Specification Section 23 05 93.

#### 3.03 ADJUSTING

- A. Install new filters on units which have been running prior to acceptance of Project.

**END OF SECTION**

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## **SECTION 23 34 23 - POWER VENTILATORS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes:
  - 1. Centrifugal roof exhausters.
  - 2. Ceiling exhaust fans.

#### **1.02 REFERENCED STANDARDS**

- A. AMCA 99 - Standards Handbook.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Rating Purposes.
- C. AMCA 261 - Directory of Products Licensed to Bear the AMCA Certified Ratings Seal.
- D. AMCA 300 - Test Code for Sound Rating Air Moving Devices.
- E. AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- F. NEMA MG1 - Motors and Generators.
- G. NFPA 70 - National Electrical Code.
- H. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease Vapors from Commercial cooking Equipment.
- I. UL 705 - Power Ventilators.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.
- B. Product Data: Provide data on fans and accessories, including fan curves with specified operating point clearly plotted, sound power levels at rated capacity, materials of construction, dimensions, and electrical characteristics and connection requirements.
- C. Manufacturer's Installation Instructions.

#### **1.04 OPERATION AND MAINTENANCE DATA**

- A. Submit under provisions of Section 01 61 02.
- B. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

#### **1.05 EXTRA MATERIALS**

- A. Provide two sets of belts for each belt drive fan.

## PART 2 - PRODUCTS

### 2.01 PRODUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Exhaust Fans:
  - a. Carnes Company, Inc.
  - b. Greenheck Fan Corp.
  - c. ACME.
  - d. PENN Ventilator Co.
  - e. Cook Co.
  - f. I.L.G. Industries, Inc.

### 2.02 CENTRIFUGAL ROOF EXHAUSTERS

A. Performance: As scheduled on Drawings.

B. Product Requirements:

1. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
2. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
3. Fabrication: Conform to AMCA 99.
4. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

C. Fan Unit: V-belt or direct driven as indicated, backward inclined wheel, with upblast spun aluminum housing; resilient mounted motor; 1/2 IN (13 mm) mesh, wire birdscreen; square base to suit roof curb with continuous curb gaskets.

D. Roof Curb: 12 IN (200 mm) high self flashing of galvanized steel or [aluminum with continuously welded seams, built in cant strips interior baffle with minimum 1 IN (25 mm) acoustic insulation, curb bottom, and factory installed nailer strip.

E. Electrical Characteristics and Components:

1. Electrical Characteristics as indicated on Drawings.
2. Motor: NEMA MG1, ODP.
3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
4. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.

F. Backdraft Damper: Aluminum multiple blade construction, felt or vinyl edge seals, with nylon bearings; [Gravity] operated.

- G. Sheaves: For V-belt drives, provide cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self aligning pre-lubricated ball bearings.

## 2.03 CEILING EXHAUST FANS

- A. Performance as scheduled on Drawings.
- B. Centrifugal Fan Unit: Direct driven with galvanized steel housing lined with 1/2 IN (13 mm) acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
- C. Electrical Characteristics and Components:
  - 1. Electrical Characteristics as indicated on Drawings.
  - 2. Motor: NEMA MG1, [ODP], permanently lubricated.
  - 3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70.
- D. Grille: Molded white plastic or aluminum with baked white enamel finish.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure roof exhausters with cadmium plated steel or stainless steel lag screws to roof curb.
- C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.
- D. Provide sheaves required for final air balance.
- E. Install backdraft dampers on inlet to roof exhaust fans.
- F. Provide backdraft dampers on outlet from ceiling exhaust fans and in the wall/roof cap.
- G. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan have been test run under observation.

### 3.02 CONNECTIONS

- A. Duct installations and connections are specified in other Division 23 sections. Make final duct connections with flexible connections.
- B. Electrical Connections: The following requirements apply:
  - 1. Electrical power wiring and grounding is specified in Division 26.

### 3.03 ADJUSTING, CLEANING AND PROTECTING

- A. Adjust damper counterbalance for proper damper operation.

- B. Clean unit cabinet interiors to remove foreign material and construction dirt and dust.  
Vacuum clean fan wheel and cabinet.

**END OF SECTION**

## **SECTION 23 37 00 - AIR OUTLETS AND INLETS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Diffusers.
2. Registers/grilles.
3. Door grilles.
4. Louvers.
5. Roof penthouses.

#### **1.02 REFERENCED STANDARDS**

- A. ADC 1062 - Certification, Rating and Test Manual.
- B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
- C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- D. ARI 650 - Air Outlets and Inlets.
- E. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- F. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

#### **1.03 QUALITY ASSURANCE**

- A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.
- B. Test and rate performance of louvers in accordance with AMCA 500.

#### **1.04 REGULATORY REQUIREMENTS**

- A. Conform to ANSI/NFPA 90A.

#### **1.05 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Provide product data for items required for this project.
- C. Submit schedule of outlets and inlets indicating type, size, location, application, materials of construction, pressure loss, and noise level. Submit pressure loss and water penetration data for louvers.
- D. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.
- E. Submit manufacturer's installation instructions under provisions of Section 01 33 00.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Diffusers/Grilles:

- a. Titus.
- b. Price.
- c. Nailor.
- d. Carnes.
- e. Krueger.

2. Louvers:

- a. Ruskin.
- b. Air Balance.
- c. Greenheck.
- d. Air Flow.
- e. Louvers & Dampers, Inc.
- f. Arrow.

### 2.02 RECTANGULAR CEILING DIFFUSERS

- A. Rectangular, adjustable pattern, stamped, multicore type diffuser to discharge air in pattern indicated on Drawings with sectorizing baffles where indicated.
- B. Provide border or frame type indicated on Drawings.
- C. Fabricate of steel with baked enamel off-white finish.
- D. Where indicated, provide duct mounted butterfly with wrench locking quadrants.

### 2.03 PERFORATED FACE CEILING RETURN GRILLES

- A. Perforated face with fully adjustable pattern and removable face.
- B. Provide border or frame type indicated on Drawings.
- C. Fabricate of steel with steel frame and baked enamel off-white finish.
- D. Where indicated, provide grille mounted OBD damper.

### 2.04 CEILING EXHAUST GRILLES

- A. Streamlined blades, minimum depth 3/4 IN, maximum 3/4 IN (19 mm) spacing, with spring or other device to set blades, horizontal face.
- B. Provide border or frame type indicated on Drawings with concealed mounting.
- C. Fabricate of steel with 20 gauge (0.90 mm) minimum frames and 22 gauge (0.80 mm) minimum blades, with factory baked enamel, off white finish.



- D. Where indicated, provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.

#### 2.05 WALL REGISTERS

- A. Streamlined and individually adjustable double deflection blades, minimum depth 3/4 IN, 3/4 IN (19 mm) maximum spacing vertical and horizontal and face.
- B. Provide border or frame type indicated on Drawings concealed mounting and gasket.
- C. Fabricate of steel with 20 gauge (0.90 mm) minimum frames and 22 gauge (0.80 mm) minimum blades, with factory baked enamel off-white finish.
- D. Where indicated, provide integral, gang-operated opposed blade dampers with removable key operator, operable from face.

#### 2.06 DOOR GRILLES

- A. V-shaped louvers of 20 gauge (0.90 mm) steel, 1 IN (25 mm) deep on 1/2 IN (13 mm) centers.
- B. Provide 20 gauge (0.90 mm) steel frame with auxiliary frame to give finished appearance on both sides of door, with factory prime coat finish.

#### 2.07 LOUVERS

- A. Provide storm proof louvers with vertical blades with built-in rain hooks, heavy channel frame with integral caulking slot, birdscreen with 1/2 IN (13 mm) square mesh for exhaust and 3/4 IN (19 mm) for intake, stainless steel anchors; louver depth as indicated on Drawings.
- B. Fabricate 0.125 IN (3.1 mm) extruded aluminum, welded assembly, with factory finish of prime coat. Paint to match same color of the building.
- C. Parallel blade damper, frame and blades of 0.08 IN thick aluminum, low leakage type with blade edge seals of vinyl or EPDM, air leakage less than 12 cfm/SQ FT at 4 IN WC differential pressure, tested in accordance with AMCA Standard 500.
- D. Damper operators, electric two position with spring to fail closed. Operators suitable for 120 or 24 volt 60 Hz power supply. Operators provided by temperature control.
- E. Furnish with flat flange for installation.

#### 2.08 ROOF PENTHOUSES

- A. Fabricate roof penthouses in accordance with SMACNA HVAC Duct Construction Standards.
- B. Fabricate of galvanized steel, minimum 16 gage (1.50 mm) base and 20 gage (0.90 mm) hood minimum 0.0625 IN (1.50 mm) thick base and 0.050 IN (1.20 mm) thick hood; suitably reinforced welded construction; with removable hood; birdscreen with 1/2 IN (13 mm) square mesh for exhaust and factory baked enamel finish; color to be selected.
- C. Mount unit on minimum 12 IN (300 mm) high curb base with insulation between duct and curb.
- D. Make hood outlet area minimum of twice throat area.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install items in accordance with manufacturers' instructions.
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- C. Install diffusers to flexible ductwork with airtight connection.
- D. Provide balancing dampers on duct take-off to diffusers.
- E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 90 00.

**END OF SECTION**

## **SECTION 23 40 10 - AIR CLEANING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Disposable panel filters.
2. Filter frames.

#### **1.02 REFERENCED STANDARDS**

- A. ANSI/UL 900 - Test Performance of Air Filter Units.
- B. ASHRAE 52 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.
- B. Filter media, filter performance data, filter assembly and filter frames.

#### **1.04 QUALITY ASSURANCE**

- A. Filter media shall be ANSI/UL 900 listed, Class 1 or Class 2, as approved by local authorities.
- B. Provide all filters as product of one manufacturer.
- C. Assemble filter components to form filter banks from products of one manufacturer.

#### **1.05 OPERATION AND MAINTENANCE DATA**

- A. Submit under provisions of Section 01 61 02.

#### **1.06 EXTRA STOCK**

- A. Provide clean filters in all units at time of installation.
- B. Provide clean filters in all units at project final completion after all interior finishes are complete.
- C. Provide one additional set of replacement filters for all units. Deliver to Owner at job site.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Store and protect products under provisions Section 01 61 02.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS:**

- A. Subject to compliance with requirements, provide products by one of the following:

UP General Specifications

AIR CLEANING

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1. Air Filters:
  - a. American Air Filter Co.
  - b. Cambridge Filter Corp.
  - c. Continental Air Filters.
  - d. Farr Co.

## 2.02 DISPOSABLE PANEL FILTERS

- A. Media: Thick fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive, nominal size as required 2 IN (50 mm) thick.
- B. Rating: 400 fpm (2.03 m/sec) face velocity, 0.30 IN WG (80 Pa)
- C. Casing: Cardboard frame with perforated metal retainer.

## 2.03 FILTER FRAMES

- A. General: Fabricate filter frames and supporting structures of 16 gauge (1.50 mm) galvanized steel or extruded aluminum T-section construction with necessary gasketing between frames and walls.
- B. Standard Sizes: Provide for interchangeability of filter media of other manufacturers; for panel filters, size as required filter media, minimum 2 IN (50 mm) thick.
- C. Side Servicing Housings: Flanged for insertion into ductwork, of reinforced 16 gauge (1.5 mm) galvanized steel; access doors with continuous gasketing and positive locking devices on both sides; extruded aluminum tracks or channels for filters with positive sealing gaskets.

# PART 3 - EXECUTION

## 3.01 INSTALLATION

- A. Install air cleaning devices in accordance with manufacturer's instructions.
- B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.
- C. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction.
- D. Install filter gauge static pressure taps upstream and downstream of filters. Mount filter gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.

## END OF SECTION

## **SECTION 23 54 10 - FORCED AIR FURNACES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Forced air furnaces.
2. Refrigerant cooling coil.
3. Humidifier.
4. Filter.
5. Controls.
6. Economizer.

#### **1.02 REFERENCED STANDARDS**

- A. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- B. ANSI/ASHRAE - 90A - Energy Conservation in New Building Design.
- C. ANSI/ASHRAE - 103 - Heating Seasonal Efficiency of Central Furnaces and Boilers, Methods of Testing.
- D. ANSI/NEMA MG 1 - Motors and Generators.
- E. ANSI/NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
- F. ANSI/UL 207 - Refrigerant - Containing Components and Accessories, Non-Electrical.
- G. ANSI/Z223.1 (NFPA 54) - National Fuel Gas Code.
- H. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- I. ARI 520 - Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units.
- J. ASHRAE 52 - Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- K. FS F-F 310A - Filter, Air Conditioning: Viscous Impingement and Dry Types, Replaceable.
- L. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.
- B. Submit shop drawings indicating assembly, required clearances, and location and size of field connections.
- C. Product Data: Provide rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

- D. Design data: Indicate refrigerant pipe sizing.
- E. Manufacturer's Installation Instructions: Indicate rigging, assembly, and installation instructions.
- 1.04 OPERATION AND MAINTENANCE DATA
  - A. Submit operation data under provisions of section 01 33 04.
  - B. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.
- 1.05 QUALITY ASSURANCE
  - A. Perform Work in accordance with ANSI/ASHRAE 15.
  - B. Maintain one copy of each document on site.
- 1.06 WARRANTY
  - A. Provide five year warranty under provisions of section 07 78 34.
  - B. Warranty: Include coverage for heat exchangers and compressors.
- 1.07 EXTRA MATERIALS
  - A. Submit maintenance materials under provisions of Division 01.
  - B. Provide two of each filter under provisions of Division 01.

## PART 2 - PRODUCTS

- 2.01 MANUFACTURERS
  - A. Bryant.
  - B. Lennox.
  - C. Carrier.
  - D. York.
- 2.02 MANUFACTURED :UNITS
  - A. Configuration: Upflow type with natural gas burner and electric refrigeration.
  - B. Units: MIL-F-17104E; Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger, gas burner or heater, controls, air filter, humidifier , refrigerant cooling coil with an extended plenum.
  - C. Construction and Ratings: In accordance with ARI 210/240. Testing: ASHRAE 14.
  - D. Performance Ratings: Energy Efficiency Rating (EER) not less than requirements of ANSI/ASHRAE 90A; seasonal efficiency to ANSI/ASHRAE 103.
  - E. Refer to Furnace Schedule. Heating capacities are sea level ratings. Cooling performance is based on ARI 210/240 test conditions.

### 2.03 FABRICATION

- A. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors, glass fiber insulation and reflective liner .
- B. Heat Exchanger: Aluminized welded construction.
- C. Combustion Chamber: ANSI/UL 727; or ANSI/UL 729; welded stainless steel. secondary chamber.
- D. Supply Fan: Centrifugal type rubber mounted with direct or belt drive.
- E. Motor: ANSI/NEMA MG 1; 1750 rpm rubber multi-speed isolated hinge mounted.
- F. Air Filters: FS F-F-300A; or FS F-F-310A; pleated glass fiber, disposable type in a filter housing. Refer to specification section "Air Cleaning."

### 2.04 BURNER

- A. Natural Gas Burner: High efficiency (95 percent) atmospheric type with 2 IN PVC combustion air supply pipe, combination gas valve and pressure regulator incorporation manual shut- off, pilot valve, automatic 100 percent shut-off and thermo-couple pilot safety device, electronic pilot ignition, and 2 IN PVC Exhaust Pipe.
- B. Burner Safety Controls: Thermocouple sensor prevents opening of solenoid gas valve until pilot flame is proven and stops gas flow on ignition failure.

### 2.05 BURNER OPERATING CONTROLS

- A. Room Thermostat: Cycles burner to maintain room temperature setting.
- B. High Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature and re-energizes when temperature drops to lower safe value.
- C. Control Supply Fan: Bonnet temperatures and independent of burner controls, manual switch for continuous fan operation.

### 2.06 HUMIDIFIER

- A. Type: ARI 610; wetted plate, pan or drum, power type with float controlled water supply mounted on furnace return air plenum.
- B. Accessories: Low voltage motor, transformer, bypass duct and damper, and replaceable evaporator media.
- C. Room Humidistat: Electric, adjustable, to energize humidifier when fan operating, to maintain setting.

### 2.07 EVAPORATOR COIL

- A. Coil: Copper tube aluminum fin assembly, galvanized drain pan, drain connection, refrigerant piping connections and factory installed thermostatic expansion valve.

### 2.08 ECONOMIZER

- A. Mixing Damper Economizer box: Multi-Position Damper Box with modulating dampers and actuator. Damper blades edged with polyurethane or neoprene strips.

- B. Air Temperature Controlled Thermostat, Outdoor Air Thermostat, Transformer, relays, and night set-back controls to close outdoor air damper.
- C. Cabinet: Heavy Gauge Steel with baked on enamel. Flanges for duct connections. Removable end panels for servicing.
- D. Manufacturer, make and model: Lennox EMD-14-65 or approved equal.

## 2.09 REFRIGERATION OPERATING CONTROLS

- A. Room Thermostat: Cycles compressor, condenser fan and supply fan to maintain room temperature setting.
- B. Refrigerant Pressure Switch: Cycles condenser fan on when condenser refrigerant pressure is above 285 psig (1965 kPa) and off when pressure drops below 140 psig (965 kPa).

## 2.10 OPERATING CONTROLS

- A. Electric solid state microcomputer based room thermostat with remote sensor.
- B. Room thermostat to incorporate:
  - 1. Automatic switching from heating to cooling.
  - 2. Preferential rate control to minimize overshoot and deviation from set point.
  - 3. Set-up for four separate temperatures per day.
  - 4. Instant override of setpoint for continuous or timed period from one hour to 31 days.
  - 5. Short cycle protection.
  - 6. Programming based on weekdays, Saturday and Sunday.
  - 7. Switch selection features including imperial or metric display, 12 or 24 HR clock, keyboard disable, remote sensor, fan on-auto.
  - 8. Battery Back-up.
- C. Room thermostat display to include:
  - 1. Time of day.
  - 2. Actual room Temperature.
  - 3. Programmed temperature.
  - 4. Programmed time.
  - 5. Duration of timed override.
  - 6. Day of week.
  - 7. System model indication: heating, cooling, auto, off, fan auto, fan on.
  - 8. State (heating or cooling) operation.



## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify that floors are ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available for furnace. and condenser package.  
Verify that proper fuel supply is available for connection.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install to NFPA 90A and ANSI/NFPA 90B.
- C. Install gas fired furnaces to ANSI Z223.1 and (NFPA 54).
- D. Provide PVC combustion air and exhaust connections.
- E. Install humidifiers to ARI 630.
- F. Mount furnaces installed on concrete bases.

**END OF SECTION**

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## **SECTION 23 55 33 - FUEL FIRED SPACE HEATERS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Gas fired unit heaters.
2. Controls.

#### **1.02 REFERENCED STANDARDS**

- A. ANSI/ASHRAE 103 - Heating Seasonal Efficiency of Central Furnaces and Boilers, Methods of Testing.
- B. ANSI/NEMA MG 1 - Motors and Generators.
- C. ANSI/NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
- D. ANSI/Z223.1 (NFPA 54) - National Fuel Gas Code.
- E. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.
- B. Shop Drawings: Indicate assembly, required clearances, and location and size of field connections.
- C. Product Data: Provide manufacturer's literature and data indicating rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.
- D. Manufacturer's Installation Instructions: Indicate rigging, assembly, and installation instructions.

#### **1.04 OPERATION AND MAINTENANCE DATA**

- A. Submit under provisions of section 01 33 04.
- B. Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listing.

#### **1.05 WARRANTY**

- A. Provide warranty under provisions of section 01 78 34.

#### **1.06 EXTRA MATERIALS**

- A. Submit maintenance materials under provisions of Division 01.

## PART 2 - PRODUCTS

### 2.01 UNIT HEATERS

- A. Units: Self-contained, packaged, factory assembled, pre-wired unit consisting of cabinet, supply fan, heat exchanger and controls.
- B. Heating Capacity: As scheduled on Drawings. Gas heating capacity is sea level rating.
- C. Air Handling:
  - 1. Fan: Capacity as scheduled on Drawings.
  - 2. Motor: ANSI/NEMA MG 1;
- D. Cabinet: Galvanized steel with baked enamel finish, easily removed and secured access doors, glass fiber insulation and reflective liner.
- E. Heat Exchanger: Aluminized welded construction.
- F. Supply Fan: Propeller type with direct drive.
- G. Gravity Draft Burner:
  - 1. Gas Burner: Atmospheric type with adjustable combustion air supply, combination gas valve and pressure regulator incorporating manual shut-off, pilot valve, automatic 100 percent shut-off and thermocouple pilot safety device, electronic pilot ignition, vent damper, and draft diverter.
  - 2. Burner Safety Controls: Thermocouple sensor prevents opening of solenoid gas valve until pilot flame is proven and stops gas flow on ignition failure.
- H. Burner Operating Controls:
  - 1. Room thermostat: Cycles fan and burner to maintain room temperature setting.
  - 2. High Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on high bonnet temperature and re-energizes when temperature drops to lower value.
  - 3. Fan Control: Thermostat cycles supply fan, with sub-base with fan auto-off-on switch.
- I. Operating Controls:
  - 1. Room Thermostat: 24 or 115 volt, to control burner operation, to maintain temperature setting. Include fan control switch (auto-on) include factory wired control power transformer for 24 volt controls.
- J. Accessories:
  - 1. Discharge Louvers: Individually adjustable horizontal louvers to match cabinet finish.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify that space is ready for installation of units and openings are as indicated on shop drawings.
- B. Verify that proper power supply is available.
- C. Verify that proper fuel supply is available for connection.

### 3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install to NFPA 90A and ANSI/NFPA 90B.
- C. Install gas fired units to ANSI Z223.1 (NFPA 54).
- D. Provide vent connections to ANSI/NFPA 211.

### 3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of equipment, including piping and electrical connections.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### 3.04 COMMISSIONING

- A. Perform the following final checks before startup:
  - 1. Verify that specified tests of piping systems are completed.
  - 2. Check for lubricating oil in lubricated-type equipment.
  - 3. Check safety valves for correct settings. Ensure settings are as specified.
- B. Starting Procedures: Follow manufacturer's written instructions. If no instructions are prescribed by manufacturer, proceed as follows:
  - 1. Energize circuits.
  - 2. Start and run equipment through complete sequence of operations.
  - 3. Check for excessive vibration and noise. Correct problems.
  - 4. Check gas pressure.
  - 5. Manually operate safety valves.
  - 6. Adjust operating controls, including pressure settings.
- C. Operate and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment discovered by service representative.

### 3.05 DEMONSTRATION

- A. Startup Services: Engage a factory-authorized service representative to perform startup services and to demonstrate and train Owner's maintenance personnel as specified below.
  - 1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventative maintenance.
  - 2. Review data in the operation and maintenance manuals. Refer to section 01 33 04.
  - 3. Schedule a 2 HR training session with Owner with at least 7 days' advance notice.

**END OF SECTION**

## **SECTION 23 62 13 - AIR COOLED CONDENSING UNITS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Condensing unit package. (Part of computer room system).
2. Charge of refrigerant and oil.
3. Controls and control connections.
4. Refrigerant piping connections.

#### **1.02 REFERENCED STANDARDS**

- A. ARI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- B. ARI 270 - Sound Rating of Outdoor Unitary Equipment.
- C. ARI 365 - Commercial and Industrial Unitary Air Conditioning Condensing Units.
- D. ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- E. NEMA MG-1 - Motors and Generators.
- F. NFPA 70 - National Electrical Code.
- G. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- H. UL 207 - Refrigerant-Containing Components and Accessories, Non-Electrical.
- I. UL 303 - Refrigeration and Air-Conditioning Condensing, and Air-Source Heat Pump Equipment.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.
- B. Submit shop drawings indicating components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.
- C. Submit product data under provisions of Division 01.
- D. Submit product data indicating rated capacities, weights, materials of construction, finishes, specialties and accessories, electrical nameplate data, and wiring diagrams.
- E. Submit design data under provisions of Division 01.
- F. Submit design data indicating pipe and equipment sizing.
- G. Submit manufacturer's installation instructions under provisions of Division 01.

#### **1.04 OPERATION AND MAINTENANCE DATA**

- A. Submit under provisions of section 01 33 04.

- B. Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site under provisions of section 01 65 50.
- B. Store and protect products under provisions of section 01 65 50.
- C. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- D. Protect units on site from physical damage. Protect coils.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURED UNITS

- A. Units: Self-contained, packaged, factory assembled and prewired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, and screens.
- B. Construction and Ratings: In accordance with ARI 210/240, UL 207 and UL 303.
- C. Performance Ratings: Energy Efficiency Ratio (EER) tested and certified in accordance with ARI 210/240 and ARI 365.
- D. Performance: As scheduled on Drawings.

#### 2.02 CASING

- A. House components in weatherproof galvanized steel casing with weather resistant, baked enamel finish.
- B. Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors or removable access panels.

#### 2.03 CONDENSER COILS

- A. Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Pressure test with leak detection gas, dehydrate, and seal.
- B. Coil Guard: PVC coated steel wire or louvered panels.

#### 2.04 FANS AND MOTORS

- A. Vertical discharge direct driven propeller type condenser fans with fan guard on discharge.
- B. Weatherproof motors suitable for outdoor use, single phase permanent split capacitor with permanent lubricated ball bearings and built in thermal overload protection.
- C. Motors: To NEMA MG-1.



## 2.05 COMPRESSORS, 11 TONS CAPACITY AND LESS

- A. Construction: Hermetic scroll or reciprocating type with heat treated forged steel or cast iron shafts, rings to prevent gas leakage, suction and discharge valves, and sealing surface immersed in oil.
- B. Mounting: Statically and dynamically balance rotating parts and mount on vibration isolators.
- C. Motor: Constant speed suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting, to NEMA MG-1. Furnish with starter, to NFPA 70.
- D. Crankcase Heater: Evaporates refrigerant returning to crankcase during shut down.

## 2.06 REFRIGERANT CIRCUIT

- A. Provide complete refrigerant circuit factory supplied and piped. Comply with ASHRAE 15.
- B. Provide the following for each refrigerant circuit:
  - 1. Filter dryer, replaceable core type.
  - 2. Liquid line sight glass and moisture indicator.
  - 3. Thermal expansion valve for maximum operating pressure.
  - 4. Insulated suction line.
  - 5. Suction and liquid line service valves and gage ports.
  - 6. Liquid line solenoid valve.
  - 7. Charging valve.
  - 8. Discharge line check valve.
  - 9. Compressor discharge service valve.
  - 10. Condenser pressure relief valve.
- C. Refrigerant: Fully charge completed system with R 410 A or R 407C.
- D. Provide pre-insulated ACR copper refrigerant piping set.

## 2.07 CONTROLS, 11 TONS CAPACITY AND LESS

- A. Unit mounted weatherproof steel control panel, containing power and control wiring, disconnect switch, factory wired for single point power connection.
- B. For each compressor, provide across-the-line starter, non-recycling compressor overload, starter relay, and control power transformer. Provide manual reset current overload protection. For each condenser fan, provide across the line starter with starter relay.
- C. Provide the following safety controls arranged so that operating any one will shut down machine and require manual reset:
  - 1. High discharge pressure switch.
  - 2. Low suction pressure switch.

- 3. Oil Pressure switch.
- D. Provide the following operating controls:
  - 1. Thermostat located in room cycles compressors and activates solenoid valves in refrigerant circuit.
  - 2. Five minute off timer prevents compressor from short cycling.
  - 3. Low ambient temperature controls.
- E. Provide controls to permit operation down to 25 DegF (-4 DegC) ambient temperature.
  - 1. Thermostat to cycle fan motors in response to outdoor ambient temperature.
  - 2. Head pressure switch to cycle fan motors in response to refrigerant condensing pressure.
  - 3. Solid state control to vary speed of one condenser fan motor in response to refrigerant condensing pressure.
- F. Provide low voltage, programmable thermostat to control supply fan to maintain temperature setting.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions and NFPA 90A.
- B. Provide for connection to electrical service.
- C. Install units on concrete base.
- D. Provide connection to refrigeration piping system and evaporators. Comply with ASHRAE 15.

#### 3.02 MANUFACTURER'S FIELD SERVICES

- A. Prepare and start systems under provisions of Division 01.
- B. Provide initial and cooling season startup during first year of operation, including routine servicing and check out.
- C. Supply initial charge of refrigerant and oil for each refrigerant circuit. Replace losses of refrigerant and oil.

#### 3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of equipment, including piping and electrical connections.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### 3.04 DEMONSTRATION

- A. Startup Services: Engage a factory-authorized service representative to perform startup services and to demonstrate and train Owner's maintenance personnel as specified below.
1. Train Owner's Maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventive maintenance.
  2. Review data in the operation and maintenance manuals. Refer to Section 01 33 04 "Operation and Maintenance Manuals."
  3. Schedule a 2 HR training session with Owner with at least 7 days' advance notice.

**END OF SECTION**

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## **SECTION 23 80 00 - HVAC EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Heating, ventilating, and cooling equipment.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - General Requirements.
- C. Section 01 61 02 - Basic Mechanical Requirements.
- D. Section 01 61 03 - Equipment Basic Requirements.
- E. Section 01 61 04 - Electrical Requirements for Mechanical Equipment.
- F. Section 23 05 48 - Vibration Control.
- G. Section 23 05 93 - Testing, Adjusting, and Balancing .
- H. Section 23 09 00 - HVAC Instrumentation and Controls .
- I. Section 23 09 93 - Sequence of Operation.
- J. Section 23 31 10 - Ductwork.
- K. Section 23 62 13 - Air Cooled Condensing Units.
- L. Section 23 81 30 - Variable Refrigerant Volume (VRV) Systems.
- M. Section 23 81 23 - Computer Room Air Conditioning Units.

#### **1.03 REFERENCED STANDARDS**

- A. American Iron and Steel Institute (AISI):
  - 1. Steel Products Manual.
- B. Air Movement and Control Association (AMCA).
- C. Air Conditioning and Refrigeration Institute (ARI).
- D. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
  - 1. HVAC Applications Handbook, Chapter entitled "Sound and Vibration Control."
  - 2. 20, Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.
  - 3. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

4. 90.1-2007, Energy Standard for Buildings Except Low-Rise Residential Buildings.
- E. Canadian Standards Association (CSA).
- F. FM Global (FM).
- G. National Electrical Manufacturers Association (NEMA):
  1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- H. National Fire Protection Association (NFPA):
  1. 70, National Electrical Code (NEC).
- I. National Roofing Contractors Association (NRCA).
- J. Underwriters Laboratories, Inc. (UL):
  1. 507, Standard for Electric Fans.
- K. Building code:
  1. International Code Council (ICC):
    - a. International Building Code and associated standards, 2012 Edition including all amendments, referred to herein as Building Code.

#### 1.04 SUBMITTALS

- A. Shop Drawings:
  1. Submit under provisions of section 01 33 00.
  2. Fabrication and/or layout drawings.
  3. 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.
  4. Certifications:
    - a. Provide certification of thickness of corrosion-protection coating.

#### B. Operation and Maintenance Manuals:

1. See Specification Sections 01 61 02 and 01 33 04 for requirements for:
  - a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.

#### 1.05 QUALITY ASSURANCE

##### A. 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.

#### 1.06 EXTRA STOCK

- A. Provide clean filters in all units at time of installation.
- B. Provide clean filters in all units at project final completion after all interior finishes are complete.
- C. Provide one additional set of replacement filters for all units. Deliver to Owner at job site.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Heating coil - electric:
    - a. Carrier.
    - b. Daikin Applied.
    - c. Trane.
    - d. Johnson Controls.
  2. Unit heater - electric:
    - a. Brasch.
    - b. Chromalox.
    - c. QMark.
  3. Energy recovery units – rotary enthalpy wheel type:
    - a. Greenheck.
    - b. Venmar.
    - c. Carnes.
    - d. Cook.
  4. Air-cooled condensing units - split system: Refer to specification section 23 62 13 for condensing units serving Computer Room Air Conditioning Units.

- a. Carrier.
  - b. Daikin Applied.
  - c. Trane.
  - d. Johnson Controls.
5. Air-Handling Units:
- a. Daikin Applied.
  - b. Trane.
  - c. Carrier.
  - d. Johnson Controls.
6. Packaged Terminal Air Conditioning Equipment:
- a. Amana.
  - b. LG.
  - c. Mitsubishi.
  - d. Trane.

B. Submit request for substitution in accordance with Specification Section 01 33 00.

## 2.02 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.

## 2.03 MANUFACTURED UNITS

### A. Equipment Coils:

- 1. Cooling 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-percent nickel, 20-percent chromium elements.



- c. Maximum heating density: 35 watts/SQ IN.
- 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. SCR controller.
- l. Single point electrical connection.
- m. Size and capacity as scheduled on Drawings.

B. Unit Heater - Electric:

- 1. Type: Horizontal.
- 2. UL listed for non-rated areas.
- 3. Material:
  - a. Cabinet: 18 GA steel.
  - b. Heating elements: Copper-clad steel.
- 4. Fan motors:
  - a. See Specification Section 01 61 03.
  - b. Built-in automatic reset overload protection.
- 5. Dynamically balanced fan.
- 6. Built-in automatic reset cutout protection.
- 7. Accessories:
  - a. Mounting bracket.
  - b. 40 to 90 DegF, 5 DegF differential internal thermostat.
- 8. Electrical, fan motor, and airflow data as scheduled on Drawings.

C. Duct Heaters - Electric:

- 1. UL listed for zero clearance.
- 2. Materials:
  - a. Frame: Stainless steel.
  - b. Heating elements: 80-percent nickel and 20-percent chromium.
  - c. Element terminals: Stainless steel.
  - d. Insulators and bracket bushings: Non-porous ceramic.
  - e. Terminal box: Aluminized steel.

3. Heating elements:
    - a. Coils: See paragraph(s) in Article 2.3, Equipment Coils.
  4. Automatic reset thermal cutout.
  5. Standard, manually replaceable, thermally operated secondary cutout.
  6. Duct mounting: flanged.
  7. Size and capacity as scheduled on Drawings.
- D. Energy Recovery Unit (ERU) - Rotary Enthalpy Wheel Type:
1. Rotary type air-to-air total enthalpy wheel shall be furnished with desiccant coated aluminum heat transfer media.
  2. Energy recovery component certified in accordance with ARI standard 1060-2001.
  3. Unit shall have housing suitable for interior floor mounting or suspended installation with lifting lugs, integral heating and cooling with remote condenser where indicated on plans, drain connections side access panels and base frame.
  4. Cabinet:
    - a. 18 gauge Galvanized (G90) steel construction for components that do not receive a painted finish. Components that receive a painted finish per A/E specification shall be of 18 gauge type A60 galvaneal steel and shall be painted with a baked industrial enamel finish.
    - b. Solid double wall construction with 1in. 3lb. density insulation where indicated on plans.
    - c. Inlet and outlet configuration as indicated on plans.
  5. Access panels / doors: Unit shall be equipped with insulated, hinged doors or removable access panels to provide easy access to all major components. Doors and access panels shall be fabricated of 18 gauge galvanized G90 steel.
  6. Fans, forward curved, centrifugal type with statically and dynamically balanced impellers shall be supplied for both supply and exhaust. Blower assembly shall be mounted on heavy gauge rails and further mounted on 1.125in thick neoprene vibration isolation pads.
  7. Factory mounted variable frequency drives on supply and exhaust fans for ease of balancing. Variable frequency drive shall operate at a constant speed to obtain airflows listed on plans.
  8. Fan motor shall be thermally protected.
  9. Factory-wired starters shall be furnished.
  10. Backdraft dampers shall be supplied for both exhaust and supply airstreams.
  11. Filter: The supply and exhaust air streams shall be filtered prior to entering the energy wheel by means of a 2", MERV 8 throw-away filters for all buildings except the Yard Building. For the Yard Building, provide MERV 13 filter in tandem. Refer to plans and specification section 23 40 10 for additional requirements.

12. Cooling Coil:

- a. Where indicated on plans.
- b. Refer to paragraph on equipment coils.

13. Heating Coil:

- a. Electric heating coil where indicated on plans.
- b. Open coil heating elements.
- c. High grade Nickel-Chrome alloy coils.
- d. Corrosion resistant frame.
- e. Ceramic coil support bushings.
- f. SCR controller.

14. Control:

- a. Factory mounted DDC controller programmed for BACnet IP protocol with capability of communication with HVAC controls. Provide necessary software/hardware
- b. Refer to specification section 23 09 93 for ERU sequence of operation.
- c. The unit shall be compatible and controlled by the installed VRV system control panel.
- d. The unit shall be capable of the following method of control:
- e. Centralized control – The unit shall be operable by a centralized control without the need for a local remote controller to be connected.
- f. The unit shall be capable of the following modes of operation:
  - 1) Energy recovery.
  - 2) Bypass ventilation – The unit shall be capable of bypass ventilation which diverts air flow around the heat exchanger core. No energy recovery is performed.
  - 3) Auto Mode – The unit shall be capable of automatically determining the need for performing energy recovery or bypassing the heat exchanger core based on the current fan coil operation mode and the current indoor and outdoor temperatures.
  - 4) Fresh-up Mode (supply) – The unit shall be capable of entering Fresh-up Supply operation in which the incoming supply air ratio is greater than the exhaust air ratio.
  - 5) Fresh-up Mode (exhaust) – The unit shall be capable of entering Fresh-up Exhaust operation which in the incoming supply air ratio is less than the exhaust air ratio.
  - 6) Night Time Free Cooling – The unit shall be capable of Night Time Free Cooling in which the unit will automatically energize to lower the space temperature based on the current outdoor temperature, the current indoor temperature, current set point, and the operating state of the indoor fan coils.

15. Factory mounted and wired phase and brown out protection.
  16. Size and capacity as scheduled on Drawings.
- E. Air-Cooled Condensing Units - Split System:
1. Refer to specification section 23 62 13 for Condensing units serving Computer Room Air Conditioning Units.
  2. ARI rated.
  3. UL listed.
  4. Materials:
    - a. Casing: Galvanized steel.
    - b. Mounting/lifting rails: Steel.
    - c. Outdoor coil: Seamless aluminum tubing and aluminum fins.
    - d. Fan blades: Aluminum.
  5. Weatherproof casing:
    - a. Hail screen for condenser coil.
    - b. Access panels.
  6. Compressor:
    - a. Hermetically sealed.
    - b. Internal pressure protector.
    - c. Crankcase heater.
    - d. Internal spring mounts.
    - e. Centrifugal oil pump.
    - f. Built-in overload protection.
  7. 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.
  8. Built-in refrigerant filter dryer.
  9. Built-in liquid line and gas line service valves with gage ports.
  10. Outdoor coil:
    - a. Fins mechanically bonded to tubing.

- b. Lab tested to 2000 psi.
- 11. 24 V factory-wired controls to include fusing and control power transformer.
- 12. Size and capacity as scheduled on Drawings.
- F. Air-Handling Units:
  - 1. ARI certified.
  - 2. UL listed.
  - 3. Unit Construction:
    - a. Fabricate unit with 16 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 IN nominal thick; thermal broke double wall assembly, injected with 1" expanded foam insulation.
      - 1) Construct the outer panel and the inner liner of G90 galvanized steel.
    - c. Panel deflection:
      - 1) Do not exceed L/240 ratio at 125 percent of design static pressure, maximum positive or negative 8 IN 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 IN of negative static pressure or 5 IN 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: Provide a 4 IN full perimeter base rail for structural rigidity and condensate trapping.
    - g. Access doors:
      - 1) Flush mounted to cabinetry, with minimum of two (2), 6 IN long stainless steel piano-type hinges, latch and full size (4.5 IN minimum) handle assembly (provide inspection window for fan section).
      - 2) Swing outward for unit sections under negative pressure (inward for unit sections under positive pressure).
      - 3) Provide a secondary latch to relieve pressure and prevent injury upon access on doors limited from swinging inward (such as side access filter sections) on positive pressure sections.
    - h. Construct drain pans from microbial resistant coated galvanized steel or 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. Fan section:
    - a. Fans:
      - 1) Double-width, double-inlet, multiblade centrifugal type.
      - 2) Statically and dynamically balanced.
      - 3) Hollow or Solid shafts.
      - 4) Forward curved fans.
      - 5) Die formed fan housing.
      - 6) 200,000 HR grease lubricated ball-bearings.
  5. Motors: See Specification Section 01 61 03.
  6. V-belts and drives sized for 150 percent motor capacity.
  7. Factory mounted variable frequency drives on supply fans for ease of balancing. Variable frequency drive shall operate at a constant speed to obtain airflow listed on plans.
  8. Heating coil section:
    - a. Electric: See paragraph(s) in Equipment Coils.
  9. Cooling coil section:
    - a. Direct expansion: See paragraph(s) in Equipment Coils.
  10. Filter section:
    - a. Filters: Refer to plans and specification section 23 40 10 for requirements.
    - b. Non-insulated cabinet.
    - c. Access doors for filter removal.
  11. Insulated drain pan with drain connections.
  12. Control panel for electric heat:
    - a. Integral.
    - b. Controls and safety devices, factory-wired, in accordance with NFPA 70 requirements.
    - c. NEMA 12 construction.
  13. Type: Draw through.
  14. Size and capacity as scheduled on Drawings.

G. Packaged Terminal Air Conditioning Units:

  1. Packaged, self-contained, through-the-wall air-cooled, terminal heat pump unit with wall sleeve, room cabinet, electric refrigeration system, electric heat, outside air louvers, remote thermostat.

2. Cabinet:
  - a. Wall mounted, 18 gauge galvanized steel with epoxy coated finish, removable front panel with concealed latch. Color selection by the Architect/Owner.
  - b. Discharge grille and access door: Integral front discharge grille with hinged door in top or front of cabinet for access to controls.
3. Wall Sleeves and Louvers:
  - a. Wall sleeves: 15 gauge galvanized steel with protective mastic coating.
  - b. Louver: Companion flanged anodized aluminum. Color selection by the Architect/Owner.
4. Refrigeration System:
  - a. Direct expansion coil.
  - b. Hermetically sealed compressor with internal spring isolation, external isolation, permanent split capacitor motor and overload protection.
  - c. Condenser coil and fan.
  - d. Reversing valve.
5. Air System: Centrifugal forward curved evaporator fans with permanent split capacitor motor, permanent washable filters, positive pressure ventilation damper with concealed manual operator.
6. Heating Coil: Electric Hot water.
7. Install a drain pan under each cooling coil meeting requirements as outlined in ASHRAE 62.1. The drain pans shall extend the entire width of each coil, including piping and header if in the air stream. The length shall be as necessary to limit water droplet carryover beyond the drain pan to 0.0044 oz per FT<sup>2</sup>1.3 g/m<sup>2</sup> of face area per hour under peak sensible and peak dew point design conditions, considering both latent load and coil face velocity. Pitch drain pans in two directions towards the outlet, with a slope of at least 1/8 IN 10 mm per footmeter.
8. The use of chlorofluorocarbon (CFC)-based refrigerants is prohibited.
9. Controls:
  - a. Remote mounted, weekly programmable thermostat with heat anticipator, off-heat-auto-cool, and high-low fan settings.
  - b. Electric resistance heater shall be locked out when heating load can be met by heat pump alone with exception of outdoor defrost cycles.

## PART 3 - EXECUTION

### 3.01 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.

C. Provide with full refrigerant charge.

3.02 FIELD QUALITY CONTROL

A. Comply with Specification Section 23 05 93.

3.03 ADJUSTING

A. Install new filters on units which have been running prior to acceptance of Project.

**END OF SECTION**



## **SECTION 23 81 23 - COMPUTER ROOM AIR CONDITIONING UNITS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes:
  - 1. Air conditioning units.
  - 2. Controls and control panels.

#### **1.02 REFERENCED STANDARDS**

- A. ANSI/ASME - Boilers and Pressure Vessels Code.
- B. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- D. ASHRAE 52 - Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
- E. FS TT-C-490 - Cleaning Method and Pretreatment of Ferrous Surfaces for Organic Coatings.
- F. UL - Underwriters Laboratories.

#### **1.03 REGULATORY REQUIREMENTS**

- A. Conform to ANSI/NFPA 90A for the installation of computer room air conditioning units.

#### **1.04 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.
- B. Submit shop drawings and product data for manufactured products and assemblies required for this project.
- C. Indicate water, drain, electrical, and refrigeration rough-in connections on shop drawings or product data.
- D. Submit manufacturer's installation instructions.

#### **1.05 OPERATION AND MAINTENANCE DATA**

- A. Submit under provisions of section 01 33 04.
- B. Include manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

#### **1.06 EXTRA STOCK**

- A. Provide clean filters in all units at time of installation.
- B. Provide clean filters in all units at project final completion after all interior finishes are complete.

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- C. Provide one additional set of replacement filters for all units. Deliver to Owner at job site.

#### 1.07 WARRANTY

- A. Provide five (5) year manufacturer's compressor warranty under provisions of Section 01 78 34 Guarantees, Warranties, and Bonds.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Liebert.
- B. Data Air.
- C. Mitsubishi.

#### 2.02 MANUFACTURED UNITS

- A. Provide packaged, air cooled, factory assembled, pre-wired and pre-piped unit, consisting of cabinet, fans, filters, humidifier, controls.
- B. Assemble floor mounted unit for up-flow air delivery in draw-through or blow-through configuration.

#### 2.03 CABINET AND FRAME

- A. Structural Frame: 14 gauge (1.8mm) welded steel suitably braced for rigidity, capable of supporting compressors and other mechanical equipment and fittings.
- B. Insulation: Thermally and acoustically line cabinet interior with 1 IN (25 mm) thick acoustic duct liner.
- C. Finish of Exterior Surfaces: FS TT-C-490 prepared, baked-on textured vinyl enamel; off- white color.

#### 2.04 INDOOR UNIT

##### A. EVAPORATOR FANS AND MOTORS

- 1. Fans: Double inlet, forward curved centrifugal fans, statically and dynamically balanced, on steel shaft with self- aligning permanently lubricated ball bearings, and directly driven.
- 2. Motor: Drip proof, permanently lubricated ball bearing motor with built-in current and overload protection.

##### B. EVAPORATOR COILS

- 1. Alternate row circuits, direct expansion cooling coils of seamless copper tubes expanded into aluminum fins, in a flat face configuration.
- 2. refrigeration circuits, with hot gas mufflers, thermal expansion valve with external equalizer, liquid line solenoid valve, liquid line filter-drier, refrigerant sight glass with moisture indicator, service shut-off valves and charging valves, accumulator sized for liquid seal under light load.

3. Mount coil assembly in stainless steel drain pan.

## 2.05 OUTDOOR UNIT

### A. Condensing Units:

1. Refer to Section 23 62 13 for condensing units.

## 2.06 FILTERS

- A. Media: Pleated, lofted, non-woven, reinforced cotton fabric or pleated fiberglass; supported and bonded to welded wire grid; enclosed in cardboard frame; 2 IN (50 mm) nominal thickness.
- B. Rating: ASHRAE 52; 25-30 percent dust spot efficiency, 90-92 percent weight arrestance; 400 FT/min (2.03 m/sec) face velocity, 0.30 IN WG (75 Pa) initial resistance, 0.5 IN WG (125 Pa) recommended final resistance.

## 2.07 STEAM GRID HUMIDIFIER

- A. The environmental control system shall be equipped with a steam generating humidifier that is controlled by the microprocessor control system. It shall be complete with disposable canister, all supply and drain valves, 1 IN (25.4mm) air gap on fill line, inlet strainer, steam distributor and electronic controls. The need to change canister shall be annunciated on the microprocessor wall box control panel. The humidifier shall have a capacity of 3 LB/HR (1.4kg/h). An LED light on the humidifier assembly shall indicate cylinder full, overcurrent detection; fill system fault and end of cylinder life conditions.

## 2.08 ELECTRICAL PANEL

- A. Service Connections, Wiring, and Disconnect Requirements: Conform to Section 26 24 16 Panelboards.
- B. Control Cabinet: NEMA 250; Integral in the condensing unit, UL listed, with access panel or door, grounding lug, combination magnetic starters with overload relays, and fusible control circuit transformer.
- C. Disconnect Switch: By electrical.

## 2.09 MICROPROCESSOR CONTROL SYSTEM

- A. Logic Circuitry: Microprocessor shall continuously monitor operation of process cooling system; continuously digitally display room temperature and room relative humidity; sound alarm on system malfunction and simultaneously display problem. When more than one malfunction occurs, flash fault in sequence with room temperature, remember alarm even when malfunction cleared, and continue to flash fault until reset.
- B. Malfunctions: Power Loss, Loss of Air Flow, Clogged Air Filter, High Room Temperature, Low Room Temperature, High Humidity, Low Humidity, Compressor Overload, Low Pressure and, High Pressure.
- C. Light Emitting Diodes Display: Control Power On, System On, Humidification, De-humidification taking place, Compressor operating.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify that system is ready to receive work and opening dimensions are as indicated on shop drawings and instructed by the manufacturer.
- B. Verify that proper power supply is available.

### 3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Coordinate installation of computer room air conditioning units.
- C. Provide adequate drainage connections for condensate and humidifier flushing system. Drain to nearest floor drain or mop sink.
- D. Provide shut-off valves in humidifier water inlet.

### 3.03 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of equipment, including piping and electrical connections.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### 3.04 DEMONSTRATION

- A. Startup Services: Engage a factory-authorized service representative to perform startup services and to demonstrate and train Owner's maintenance personnel as specified.
  - 1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventive maintenance.
  - 2. Review data in the operation and maintenance manuals.
  - 3. Schedule a 2 HR training session with Owner with at least 7 days' advance notice.

**END OF SECTION**

## **SECTION 23 81 30 - VARIABLE REFRIGERANT VOLUME (VRV) SYSTEMS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Variable capacity, heat recovery air conditioning system.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
- B. Division 01 - General Requirements.
- C. Section 01 61 03 - Equipment: Basic Requirements.
- D. Section 23 05 93 - Testing, Adjusting, and Balancing.
- E. Section 23 09 00 - HVAC Instrumentation and Controls.
- F. Section 23 09 93 - Sequence of Operation.
- G. Section 23 31 10 - Ductwork.
- H. Section 23 80 00 - HVAC: Equipment.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.
- B. Trained Installer Certification.
- C. Shop Drawings.
  - 1. Wiring diagrams.
  - 2. Control diagrams.
- D. Product data.
- E. Contract closeout information:
  - 1. Operating and maintenance data.
  - 2. Government instruction report.
  - 3. Test reports.

#### **1.04 QUALITY ASSURANCE**

- A. The installation shall be by a contractor certified by the equipment manufacturer.
- B. Unit shall be ETL labeled.
- C. System shall be AHRI-1230 certified.
- D. The outdoor unit shall be factory charged with R410A.
- E. Factory tested.

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- F. The system shall be capable of refrigerant piping up to 540 actual feet or 620 equivalent feet, a total combined length of 3,280 FT of piping between the heat pump unit and fan coil units with 295 FT maximum vertical difference, without any oil traps or additional equipment.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store in clean dry place and protect from weather and construction traffic.
  - 1. Handle carefully to avoid damage to components, enclosures and finish.

#### 1.06 WARRANTY

- A. Submit under provisions of section 01 78 34.
- B. The units shall have the manufacturer's parts warranty for a period of ten (10) years from date of installation. All compressors shall have a parts warranty of ten (10) years (total) from date of installation. All warranty service work shall be performed by a factory trained service professional. Warranty shall be administered by the manufacturer or local manufacturer's representative. All service persons shall be factory trained and certified with a minimum of 3 years documented experience with the installed manufacturer's equipment. If the manufacturer or local distribution representative does not have a local service department, then the contractor shall assume all warranty obligations during this period. If warranty is a "contractor warranty" then it shall be clearly indicated in the equipment submittal. The contractor's factory certification shall be provided in the equipment submittal.
- C. Installation Requirements:
  - 1. The system must be installed by a factory trained contractor/installer. The bidders shall be required to submit training certification proof prior to award of contract. Should the installing contractor use a manufacturer other than the basis of design, all coordination related to differences between basis of design and the alternate manufacturer shall be the responsibility of the installing contractor including any required additional evaluation requirements by the engineering firm.
- D. Units shall have a 10 year manufacturer's warranty from the date of installation.
- E. Units shall have a 1 year labor warranty from the date of installation, executed by the installing Contractor
- F. The compressors shall have a warranty of 10 years from the date of installation.

#### 1.07 EXTRA STOCK

- A. Provide clean filters in all units at time of installation.
- B. Provide clean filters in all units at project final completion after all interior finishes are complete.
- C. Provide one additional set of replacement filters for all units. Deliver to Owner at job site.

#### 1.08 OPERATING RANGE

- A. The outside air cooling operating range shall be 23 DegF DB to 122 DegF DB.

- B. The outside air heating operating range shall be 0 DegF DB to 77 DegF DB.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

#### A. Acceptable Manufacturers:

1. Variable Refrigerant Volume, Heat Recovery (VRV) Systems:
  - a. Base:
    - 1) Daikin.
  - b. Optional:
    - 1) Mitsubishi.
    - 2) LG.
2. Other manufacturers desiring approval comply with Division 01 and requirements below:
  - a. Optional equipment supplier shall provide to the bidding Mechanical Contractor and Engineer a complete equipment data package.
    - 1) This package shall include, but is not limited to, equipment capacities at the design condition, power requirements, indoor units CFM/static pressures, fan curves, installation requirements, and physical dimensions.
  - b. Nominal performance data is not acceptable.
  - c. The mechanical contractor shall request and receive the equipment data package 15 days prior to bid date and submit this package with the alternate bid.
    - 1) The Mechanical Contractor shall list the equipment supplier and submit the required data package with the bid detailing a complete comparison of the proposed alternate equipment to the specified equipment and the associated cost reduction of the alternate equipment.
    - 2) The Contractor bids an alternate manufacturer with full knowledge that the manufacturer's product may not be accepted or approved.
    - 3) The installation shall be a contractor certified by the equipment manufacturer.

### 2.02 SYSTEM DESCRIPTION

- A. The variable capacity, heat recovery, heat pump air conditioning system shall be a variable refrigerant flow split system. The system shall consist of multiple evaporators using PID control and inverter driven outdoor unit. The unit shall consist of direct expansion (DX), air-cooled heat pump air conditioning system, variable speed driven compressor multi zone split system. The outdoor unit may connect an indoor evaporator capacity of 50 - 130 percent to that of the outdoor unit capacity.

## 2.03 OUTDOOR HEAT RECOVERY UNIT

1. Outdoor Unit - General: The outdoor unit is designed specifically for use with the manufacturer's components:
  - a. Refrigerant: R410A.
  - b. The outdoor unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant control. The refrigeration circuit of the outdoor unit shall consist of a compressor, motors, fans, condenser coil, electronic expansion valves, oil separators, service ports, liquid receivers, and accumulators.
  - c. Both liquid and suction lines shall be individually insulated between the outdoor and indoor units.
  - d. The connection ratio of indoor units to outdoor unit shall be 50 - 130 percent.
  - e. The sound pressure dB(A) at rated conditions shall be a value no greater than 64 decibels at 4 FT from the outdoor unit at full load at fan height.
  - f. The system shall automatically restart operation after a power failure and shall not cause any settings to be lost, thus eliminating the need for re-programming.
  - g. The following safety devices shall be included on the outdoor unit: high pressure switch, control circuit fuses, fusible plug, high pressure switch, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature. Oil recovery cycle shall be automatic as required to maintain oil levels at the outdoor unit.
  - h. The outdoor unit shall be able to operate in heating mode to 0 DegF dry bulb ambient temperature without additional ambient controls.
  - i. The outdoor unit shall have air cooled heat exchange coils constructed from copper tubing with aluminum fins. The systems shall have a single fan mounted on top of the coils. The coils shall be capable of being divided into sections to enable the outdoor unit to match the capacity required by the indoor units and to allow individual defrosting to take place as required.
  - j. The outdoor unit shall have at least one inverter controlled compressor. The system shall use a control sequence to ensure that indoor loads are matched to the compressor capacity control.
  - k. The refrigeration process of the outdoor unit will be maintained by pressure and temperature sensors controlling solenoid valves, check valves and bypass valves. The heating or cooling mode of the outdoor unit will be controlled using a combination of 2 and 3 way valves which shall reverse the cycle of the refrigerant to change the mode of the outdoor unit.
  - l. Unit Cabinet: The outdoor unit model shall be completely weather proof and corrosion resistant. The outdoor unit shall be constructed from steel plate and treated with acrylic paint. Provide hail guards to protect equipment within cabinet.



m. Fan:

- 1) The outdoor unit shall be furnished with direct drive variable speed propeller type fans.
- 2) The fans shall be a vertical discharge. The fan motors shall have inherent protection and permanently lubricated bearings and be mounted.
- 3) The fan motors shall be provided with a fan guard to prevent contact with moving parts.

n. Condenser Coil: The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond. Coil fins shall have a factory applied corrosion resistant finish.

o. Compressor:

- 1) The variable speed compressor shall be capable of changing the speed to follow the variations in total cooling load as determined by the suction gas pressure as measured in the outdoor unit.
- 2) The inverter driven compressor in each outdoor unit shall be DC, hermetically sealed, rotary type or scroll type compressor.
- 3) The capacity control range shall be a minimum of 20 to 100 percent of total capacity.
- 4) Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
- 5) Oil separators shall be standard with the equipment together with an oil balancing circuit.
- 6) The compressor shall be mounted to avoid the transmission of vibration.

2.04 BRANCH CIRCUIT CONTROLLERS/SOLENOID VALVE KITS /BRANCH SELECTOR

- A. The unit shall be constructed from galvanized steel plate and be internally insulated with polyurethane foam. The connection to the system shall be either via brazed connection or flare nuts.
- B. The unit shall be connected to the indoor units or group of indoor units via its own dedicated connection. This connection shall supply power and control signals to the solenoid valves in the unit.
- C. The unit shall have integral controls and be factory assembled, wired, and piped.
- D. The unit shall include an integral drain pan and condensate pump as required.
- E. The unit electrical power shall be 208-230V/1-phase/60Hz.
- F. Provide unit with at least two (2) additional unused connections for future expansion and maintenance. Provide isolation valves on all connections and caps on unused connections.

## 2.05 INDOOR FAN COIL UNIT

- A. General – Each indoor unit shall have a heat exchanger which shall be constructed from copper tubing with aluminum fins. The flow of refrigerant through the heat exchanger shall be controlled by an electronic proportional expansion valve. This valve shall be controlled by two pipe thermistors, a return air and discharge air thermistor and shall be capable of controlling the variable capacity of the indoor unit between at least 25 and 100 percent. The units shall be shipped from the factory fully charged with dehydrated air.
  - 1. Unit type shall be as scheduled on the plans.
- B. 4-Way Ceiling Recessed Cassette:
  - 1. The indoor unit shall be a ceiling cassette indoor unit for installation into the ceiling cavity equipped with an air panel grille to be connected to indoor unit as scheduled and specified in this section. The indoor unit shall have a four-way air distribution type, ivory white, impact resistant, and washable decoration panel. The supply air shall be distributed via motorized louvers which can be horizontally and vertically adjusted from 0 degree to 90 degree angle.
  - 2. Acoustic Performance: The indoor units sound pressure shall range from 27 dB(A) to 33 dB(A) at low speed measured at 5 feet from the unit.
  - 3. Construction:
    - a. The indoor unit shall be completely factory assembled and tested. The unit shall include factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
    - b. The 4-way supply airflow shall be field modifiable to 3-way and 2-way airflow to accommodate various installation configurations including corner installations.
    - c. Return air shall be through the concentric panel, which shall include a filter.
    - d. The indoor units shall be equipped with a condensate pan and condensate pump.
    - e. All refrigerant lines shall be insulated separately from the outdoor unit.
    - f. The indoor units shall be equipped with a return air thermistor.
    - g. The indoor unit shall be separately powered with 208-230V/1-phase/60Hz.
  - 4. Unit Cabinet:
    - a. The cabinet shall be space saving and shall be recessed into the ceiling.
    - b. Provide fresh air intake kit where used and indicated on the drawings. A branch duct knockout shall exist for branch ducting supply air.
    - c. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
  - 5. Fan:

- a. The fan shall be direct-drive turbo fan type with statically and dynamically balanced impeller with high and low fan speeds available.
  - b. The airflow rate shall be adjustable and have high, medium and low fan settings.
  - c. The fan motor shall be thermally protected.
- 6. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin.
- 7. Coil:
  - a. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
  - b. The refrigerant connections shall be flare connections. Coordinate condensate piping material with Hydronic Piping section.
- 8. Condensate Pump:
  - a. Contractor shall provide condensate pump as required to remove condensate from indoor unit. Coordinate pump requirements with electrical contractor.
  - b. A condensate pump with at least 18 IN lift shall be located below the coil in the condensate pan with a built in high level safety alarm to shut down the unit. Pump shall be provided if gravity drainage is not possible.
- C. Ceiling Concealed Ducted:
  - 1. The indoor unit shall be a built-in ceiling concealed indoor unit, ability to obtain external static pressure listed on the plans, for installation into the ceiling cavity. The unit shall be constructed of a galvanized steel casing to be connected to a heat pump outdoor unit. The indoor unit shall be manufactured for ducted horizontal discharge air with ducted horizontal return air configuration as shown on the plans. The maximum external static pressure shall be as scheduled on the drawings. The external static pressure setting shall be adjustable through switches on the unit to aid in balancing of the unit's airflow.
  - 2. Acoustic Performance: The indoor units sound pressure shall range from 22 dB(A) to 31 dB(A) at low speed 5 feet from the unit.
  - 3. Construction:
    - a. The indoor unit shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have selectable switch for adjustable static pressure capability.
    - b. All refrigerant lines shall be insulated separately from the outdoor unit.
    - c. The indoor units shall be equipped with a condensate pan and condensate pump. Provide pump if gravity drainage is not possible.
    - d. The indoor units shall be equipped with a return air thermistor.
    - e. The indoor unit shall be separately powered with 208-230V/1-phase/60Hz.

- f. Switch box shall be reached from the side or bottom for ease of service and maintenance.
- 4. Unit Cabinet:
  - a. The cabinet shall be located in the ceiling and ducted to the supply and return openings.
  - b. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
  - c. The cabinet shall be factory insulated for use in un-conditioned indoor spaces.
  - d. Concealed slim units where listed on the schedules shall be a maximum of 8 IN deep. All concealed units where listed on the schedules shall be a maximum of 12 IN deep.
- 5. Fan:
  - a. The fan shall be direct-drive fan, statically and dynamically balanced impeller with high, medium and low fan speeds.
  - b. The airflow rate shall be available in high and low settings.
  - c. The fan motor shall be thermally protected.
- 6. Filter: The return air shall be filtered by means of a washable long-life filter with mildew proof resin. Filter may be integral or suitable for field installation in pre-fabricated filter box attached to the unit. Filter box shall be provided by the VRF manufacturer.
- 7. Coils:
  - a. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
  - b. The refrigerant connections shall be flare connections. Coordinate condensate piping material with Hydronic Piping section.
- 8. Condensate Pump:
  - a. Contractor shall provide condensate pump as required to remove condensate from indoor unit. Coordinate pump requirements with electrical contractor. Condensate pump shall not require a separate electrical connection.
  - b. A condensate pump with at least 18 IN of lift shall be located below the coil in the condensate pan with a built in high level safety alarm to shut down the unit. Provide pump if gravity drainage is not possible.

## 2.06 CONTROLS

### A. GENERAL

- 1. The unit shall have controls provided with the unit by the manufacturer to perform input functions necessary to operate the system.
- 2. Computerized PID control shall be used to maintain room temperature within 1°= DegF of setpoint.

3. The unit shall be equipped with a programmable drying cycle that dehumidifies while inhibiting changes in room temperature.

#### B. INDIVIDUAL VRF CONTROL

1. Each unit shall be supplied with a wall mounted thermostat controller. The controller shall have a backlit LCD display and be able to support the following display items and user input operations:
  - a. On/Off control
  - b. Automatic change of mode of operation
  - c. Set point adjustment
  - d. Reading of both heating and cooling set point temp
  - e. Reading of actual room temp
  - f. Fan speed setting
  - g. Mode of operation on the unit display
  - h. Individual Heating and Cooling (dual) set point adjustment
2. The controllers shall be capable of diagnostic use and provide malfunction codes to indicate the type of failure that has occurred.
3. The controllers shall be capable of accepting independent set points for cooling and heating operation. The use of a common set point is not allowable.
4. The system shall provide automatic change-over from heating to cooling mode of operation.
  - a. If, in heating mode, the space temperature rises 1 degree above the cooling set point, the system shall change from heating to cooling mode. If, in cooling mode, the space falls 1 degree below the heating set point, the system shall change from cooling to heating mode.
5. Adjustable setback temperature
  - a. The controllers shall allow for independent and adjustable setback temperature at each unit. The setback temperature (adjustable) shall determine the “override” temperature to start the system when in setback mode if the temperature rises or falls outside of the specified range.
6. The schedule of operation hours shall be controlled at the Central Controller.
7. Refer to plans , Specification Section 23 09 00, and Specification Section 23 09 93 for additional requirements.

#### C. CENTRAL CONTROLLER

1. This controller shall be wall mounted and hard wired, either directly to the control system or via gateway. It will be manufactured in ABS plastic with an LCD display and will be the manufacturer’s standard color. The controller will be capable of individually controlling/displaying the following functions on at least 128 indoor units:
  - a. Central control of set points, schedules, fan speed, and heat/cool mode.
  - b. Scheduling of zones and individual units.

- c. Adjustable control of setback (override) temperature settings during occupied period
  - d. Adjustable temperature limits to restrict local wall mounted thermostat set point ranges.
  - e. Visible and audible alarm indication of any system malfunctions with descriptive error code.
  - f. External Digital input/output and display of external input values from outside air handling units.
  - g. External Analog input/output and display of external input values from outside air handling units.
  - h. Tiered hierarchy allowing for control of fan coil units independently or as a group.
  - i. Able to remotely disable of individual functions of the wall mounted controllers.
2. Provide floor plan layout on each central controller as well as accessible for remote control from the web.
    - a. Floor plan shall represent the specific project building floor plan layout.
    - b. Floor plan shall include capability to control indoor unit and auxiliary inputs/outputs for all of the outside air handling units. The floor plan shall be configured as indicated below.
      - 1) Up to four status to be assigned to the control point icon (room name, room temperature, set point, and mode).
      - 2) Status and control points to display on corresponding location zone served on floor plan.
      - 3) Digital input and output icons will display on/off status.
      - 4) Analog input icons will display analog values
  3. Each central controller unit can be accessed either locally or remotely via standard Internet Explorer IE6 or IE7 software. The central controller will be able to indicate system alarms via volt free contacts as well as providing control points for other devices. Additionally, the central controller shall be able to monitor individual tenant's usage of heating and cooling demands, report alarm and conditions to nominated email address, and enable remote alteration of systems set points to registered users. All required software costs and licensing fees shall be included for the life of the systems.
  4. Provide dedicated power supply for each controller.
  5. Refer to plans for approximate location of central controllers. Coordinate exact final location of each central controller with the Owner/Architect. Coordinate location and quantity of power and technology outlets with the Electrical and Technology contractors after final locations are determined.
  6. Refer to plans , Specification Section 23 09 00, and Specification Section 23 09 93 for additional requirements.

#### D. SEQUENCE

1. Install a remote mounted thermostat.
2. The thermostat shall stage heating or cooling as required to maintain space setpoint at 72°F (adj.).
3. Thermostat shall automatically change the indoor unit mode based on the space setpoint.

#### E. Wiring:

1. Wiring shall be in compliance with Division 16.
2. Control voltage between the indoor units and outdoor unit shall be 16 Vdc.
3. Use non-shielded 2-conductor cable.
4. Control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one outdoor unit with one (1) 2-cable wire.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. The VRV system must be installed by a manufacturer's factory trained contractor/dealer.
- B. Install in accord with manufacturer's instructions and recommendations.
- C. Provide float switch at condensate drain pan to automatically shut-off the unit upon condensate overflow.
- D. Provide new filters on units which have been running prior to acceptance of Project.
- E. Test and balance systems in accordance with Specification Section 23 05 93.

#### 3.02 FIELD QUALITY CONTROL

- A. Perform the following field tests/inspections and prepare test reports:
  1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Remove and replace malfunctioning units and retest as specified above.

#### 3.03 COMMISSIONING

- A. Upon completion of the installation and field quality control, this Contractor shall load all system software and start up the system. This Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning in full accordance with these specifications.

- B. This Contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100 percent of the input and output points of the DDC system operation.
- C. This Contractor shall prove that the controls network is functioning correctly and within acceptable bandwidth criteria and shall test the system with an approved protocol analysis tool. Provide a log and statistics summary showing that each channel is within acceptable parameters. Each channel shall be shown to have at least 25 percent spare capacity for future expansion.
- D. Upon completion of the performance tests described above, repeat these tests, point by point, as described in the validation log above in the presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.
- E. System Acceptance: Satisfactory completion is when this Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

#### 3.04 TRAINING

##### A. On-Site:

1. After completion of commissioning, the manufacturer shall provide 8 hours of training for four (4) Owner's representatives. The training course shall enable the Owner's representatives to perform Day-to-Day Operations as defined herein. A factory-trained instructor with experience in presenting the training material and the system programmer for this project shall perform the training.

**END OF SECTION**



## **SECTION 26 05 00 - ELECTRICAL BASIC REQUIREMENTS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Basic requirements for electrical systems.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Section 01 61 03 - Equipment: Basic Requirements.**

##### **B. Division 05 - Metals.**

##### **C. Section 26 05 19 - Wire and Cable - 600 Volt and Below.**

##### **D. Section 26 05 33 - Raceways and Boxes.**

#### **1.03 REFERENCED STANDARDS**

##### **A. Aluminum Association (AA).**

##### **B. American Iron and Steel Institute (AISI).**

##### **C. ASTM International (ASTM):**

1. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

##### **D. ETL Testing Laboratories (ETL).**

##### **E. Institute of Electrical and Electronics Engineers, Inc. (IEEE):**

1. C2, National Electrical Safety Code (NESC).

##### **F. National Electrical Manufacturers Association (NEMA):**

1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

##### **G. National Fire Protection Association (NFPA):**

- a. 70, National Electrical Code (NEC).

##### **H. Underwriters Laboratories, Inc. (UL).**

#### **1.04 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.
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.

#### 1.05 SUBMITTALS

##### A. Shop Drawings:

1. See Specification Section 01 61 03 and individual specification sections for submittal requirements for products defined as equipment.
2. General requirements:
  - a. Provide manufacturer's technical information on products to be used, including product descriptive bulletin.
  - b. Clearly indicate the proposed items (by drawing schedule symbol: i.e. Light Fixture "D"), the manufacturer's name, supplier, catalog number, cuts, diagrams, drawings, capacities, characteristics and details in conformance with the drawings or schedules. The manufacturer shall certify capacities, dimensions and special features required.
    - 1) Clearly identify all optional accessories.
  - c. Acknowledgement that products are UL or ETL listed or are constructed utilizing UL or ETL recognized components.
  - d. Manufacturer's delivery, storage, handling and installation instructions.
  - e. Product installation details.
  - f. Shop submittals shall bear the stamp of the contractor and shall indicate that the contractor has reviewed and approved the shop submittals for the application. Shop submittals without the contractor's signature indicating approval shall be returned without action.
  - g. Indicate the Manufacturer's delivery time for the item after receipt of approval by the Engineer.
  - h. See individual specification sections for any additional requirements.
3. Product technical data:

- a. Provide submittal data for all products specified in PART 2 of this Specification Section.

B. Operation and Maintenance Manuals:

1. Prior to final approval of the installation, obtain and submit to the Engineer, three (3) bound copies and one (1) electronic copy on Flash-drive of descriptive literature, maintenance and operation data, and parts lists of each item of electrical equipment requiring maintenance and special operation procedures, furnished and installed under the contract.
2. Turn over to the Engineer drawings, instructions and manuals supplied with equipment furnished by others.

1.06 QUALITY ASSURANCE

- A. Where UL test procedures have been established for the product type, use UL or ETL approved electrical equipment and provide with the UL or ETL label.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 01 65 50.
- B. Protect nameplates on electrical equipment to prevent defacing.

1.08 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.

1.09 SITE ACCESS

- A. Contractor and any sub-contractors shall comply with Union Pacific e-Railsafe including but not limited to background information and personnel credentials. Go to [eRailsafe.com](http://eRailsafe.com) for information.

1.10 SAFETY

A. GENERAL

1. As part of Union Pacific Railroad's focus on safety, we want to make certain that our Contractors establish and maintain safe work practices, including the proper training of their employees. Union Pacific will not allow contractors to perform work on our property unless they have been properly trained for the work they are performing.

2. Training for Engineering Department contractors falls into two primary categories:
  - a. Regulatory Training:
    - 1) Training is required by federal, state or local workplace safety regulations. This training includes, but is not limited to:
      - a) FRA Roadway Worker Protection (for those working within 25 FT of any track). This training is available from several sources, including other railroads, railroad industry training professionals and computer based training. Several internet web sites now offer RWP training for a modest fee, including:
        - (1) [www.railroadeducation.com](http://www.railroadeducation.com)
        - (2) [www.nrcma.org](http://www.nrcma.org)
        - (3) UPRR does not endorse any specific RWP training program nor does it require contractor employees to be trained specifically on UP's On-Track Safety Program. However, we do require that our contractors properly train their employees on RWP as required by 49CFR214.343.
        - (4) OSHA Fall Protection (for those working on elevated structures 6 FT or higher).
        - (5) OSHA Confined Space Entry (for those working in confined spaces).
    - 2) Please note that Union Pacific Railroad does not provide regulatory training for contractors' employees but will assist contractors in locating training resources. The frequency of training is mandated in each regulation.
    - 3) Union Pacific Railroad insists on 100% compliance with all governmental regulations by its Contractors and their employees.
  - b. UPRR Safety Training:
    - 1) Training is required for Engineering Department contractor employees or design consultants to perform work on UP property. This training is in addition to the regulatory training described above and is available in several different formats:
      - a) Pamphlet entitled "Minimum Safety Requirements for UPRR Contractors". A PDF copy of the pamphlet is available at [www.uprr.com/suppliers/sup\\_ovr/terms.shtml](http://www.uprr.com/suppliers/sup_ovr/terms.shtml) for download.
      - b) Pamphlet entitled "UPRR Electrical Safety Rules" (Document #PB20502).
      - c) Online Training program via [www.contractororientation.com](http://www.contractororientation.com). The information presented is the same as the video and pamphlet; however, this web site also provides record keeping and testing services. Once a person completes the course, they are sent a wallet-size card showing successful completion.

- d) UPRR Safety Training must be completed every calendar year. Please note that this training does not meet the requirements for Roadway Worker Protection Training.
- e) Contractors must furnish employees with documentation that they have completed the required regulatory and UPRR safety training. This can be accomplished by issuing cards denoting the employee's training, issuing list of employees who have completed specific training or by having available, at the job site, other forms of documentation.
- f) Under government workplace safety regulation, each employer is responsible for the training of their employees. Union Pacific Railroad provides the necessary resources to train our employees and we expect the same from our contractors.
- g) Contractors to UP also have oversight responsibilities for monitoring the training and compliance of employees of sub-contractors. Make sure that the sub-contractors you hire are familiar with and comply with the training requirements outlined above.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, refer to specific Electrical Specification Sections and specific material paragraphs below for acceptable manufacturers.
- B. Substitutions for Materials Specified:
  - 1. Materials and items of equipment furnished must meet the requirements of the drawings and specifications as to quality, performance, suitability and appearance.
  - 2. Any proposed substitutions will be judged on the basis of quality, performance, appearance and on the governing space limitations. The reputation of the manufacturer, time requirements and the availability of repair, or replacement, parts may also be considered.
  - 3. The Owner also reserves the right to reject, or accept, material, or equipment items, which fail to meet all of the stipulated requirements. Allow a suitable credit for a substitution. All substitutions and credits must be approved by the Engineer in writing.
  - 4. The Engineer is the sole and final judge as to the suitability of substitution items. Approval of substitutions shall be in writing prior to installation.
  - 5. The entire cost of all changes of any kind due to Contractor requested substitutions, will be borne by the Contractor.
- C. Provide all components of a similar type by one (1) manufacturer.

## 2.02 SELECTED SUPPLIERS AND MANUFACTURERS

- A. Union Pacific has purchasing agreements with the following suppliers. Identify the project as being for Union Pacific Railroad to obtain pricing. Obtain the following materials from the indicated suppliers unless a specific supplier is indicated on the drawings. No substitutions shall be accepted unless indicated on the drawings.
1. Medium Voltage Pad Mount Switches:
    - a. Manufactured by S&C Electric Company, Contact: Larry Schultz, Telephone: 913-768-1115
  2. 600 Volt Distribution Equipment:
    - a. Manufactured by Square D Equipment, Graybar, Contact: Kyle Naughton, Telephone: 402-592-7676
  3. High Mast Lighting:
    - a. Manufactured by MUSCO Light Structure with 10 year performance warranty, MUSCO, Contact: Adam DeJong, Telephone: 800-825-6020
  4. Area Lighting:
    - a. Manufactured by Holophane Mongoose or GE Tiger, GEXPRO, Contact: Daniel Bilka, Telephone: 402-951-5615
  5. Lamps:
    - a. Manufactured by Phillips, GEXPRO, Contact: Daniel Bilka, Telephone: 402-951-5615
  6. Lighting Contactors:
    - a. Manufactured by Square D Equipment, Graybar, Contact: Kyle Naughton, Telephone: 402-592-7676
  7. UPS & TVSS:
    - a. Manufactured by MGE, Power Protection Products, Contact: Brian Branigan, Telephone: 402-393-1223
  8. Engine Generator and Automatic Transfer Switches:
    - a. Cummins, Contact: Darin Buskohl, Telephone 605-929-8939
    - b. CAT, Nebraska Machinery Co, Contact: Tracy Henke (less than 600kW), Telephone: 402-891-7656, Tyler Harm (600kW and greater), Telephone: 402-891-7567
  9. Oil-Filled Transformers:
    - a. Manufactured by ABB, Eaton, or Howard Industries; Echo Electric, Contact: Alan Devereaux, Telephone: 402-330-9995; Gexpro, Contact: Daniel Bilka, Telephone: 402-951-5615; or Graybar, Contact: Kyle Naughton, Telephone: 402-592-7676
  10. Reclosers:
    - a. Manufactured by Cooper Kyle W-group hydraulically controlled
      - 1) Coordinate with Utility and Engineer before purchasing

11. Recloser Bypass Switch:

- a. Manufactured by Cooper, ABB, or S&C

12. Gang Operated Switch:

- a. Manufactured by Cooper, Hubbel, or S&C

13. Overhead Cable Warning Marker Sphere:

- a. All sizes: TANA Manufacturing, P.O. Box 370, California, MO 65018
- b. 36 IN& 20 IN sizes: P&R Technologies, P.O Box 554, Portland, OR 97207, Telephone: 503-292-8682

2.03 MATERIALS

A. Electrical Equipment Support Pedestals and/or Racks:

1. Approved manufacturers:

- a. Modular strut:
  - 1) Unistrut Building Systems.
  - 2) Eaton B-Line.
  - 3) Globe Strut.
  - 4) Thomas & Betts Superstrut.

2. Material requirements:

- a. Modular strut:
  - 1) All Strut shall be 1 ½" minimum
    - a) Galvanized steel: ASTM A123/123M or ASTM A153/A153M.
    - b) Stainless steel: AISI Type 316.
    - c) PVC coated galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 mil PVC coating.
    - d) Aluminum: AA Type 6063-T6.
- b. Mounting hardware:
  - 1) Galvanized steel.
  - 2) Stainless steel.
- c. Anchorage per Division 5.

B. Field touch-up of galvanized surfaces.

1. Zinc-rich primer.

- a. One (1) coat, 3.0 mils, ZRC by ZRC Products.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install and wire all equipment, including pre-purchased 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 IN 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): 48 IN.
    - b. Receptacle in architecturally finished areas (to center): 18 IN.
    - c. Receptacle on exterior wall of building (to center): 18 IN.



- d. Receptacle in non-architecturally finished areas (to center): 48 IN.
  - e. Telephone outlet in architecturally finished areas (to center): 18 IN.
  - f. Telephone outlet for wall-mounted phone (to center): 54 IN.
  - g. Safety switch (to center of operating handle): 54 IN.
  - h. Separately mounted motor starter (to center of operating handle): 54 IN.
  - i. Pushbutton or selector switch control station (to center): 48 IN.
  - j. Panelboard (to top): 72 IN.
- 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 in equipment locations in accordance with the following without obtaining the Engineer's approval:
    - a. 1 FT at grade, floor and roof level in any direction in the horizontal plane.
    - b. 1 FT for equipment other than lighting at ceiling level in any direction in the horizontal plane.
    - c. 1 FT for lighting fixtures at ceiling level in any direction in the horizontal plane.
    - d. 1 FT on walls in a horizontal direction within the vertical plane.
    - e. Changes in equipment location exceeding those defined above require 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 05 50 10.
  - 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 corrosion resistant spacers to maintain 1/4 IN separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Basins, Clarifiers, Digesters, Reservoirs, etc.
- 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. Equipment Identification:
  - 1. Identify all panelboards and switchboards, disconnects, starters, equipment enclosures and components, with a permanently attached, engraved, plastic or phenolic nameplate. The nameplate shall have a white background with contrasting black lettering not smaller than 3/8" in height. Indicate equipment name, or designation and voltage, phase, and wire characteristics, i.e. 120/208V, 3P, 4W.
  - 2. Identify all junction boxes 4" x 4" and larger with system, equipment served and/or circuit numbers. Adhesive plastic tape may be used for the purpose.
  - 3. Tag all empty conduits at each end; identify system served, origin and terminal points.
  - 4. Identify all terminal boxes and pull boxes, with embossed labels and clear overlay to identify item, system, service and contents.
  - 5. Number all transformers according to transformer schedule. Label all transformers with kVA rating if not already labeled. Overhead transformer KVA rating shall be readable from the ground.
- R. Cleanup and Painting:
  - 1. Clean the interior of all panelboards, pull boxes, and equipment and enclosures of the electrical work.
  - 2. Wash and wipe clean all lighting fixtures, lenses and lamps.
  - 3. All equipment shall have factory applied finish. Damaged finishes shall be refinished.

### 3.02 FIELD QUALITY CONTROL

- A. Verify exact rough-in location and dimensions for connection to electrified equipment, provided by others.
- B. Replace equipment and systems found inoperative or defective and re-test.
- C. Cleaning:
  - 1. See Specification Section 01 77 10.
- D. 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.
- E. Replace nameplates damaged during installation.

### **END OF SECTION**

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## SECTION 26 05 09 - MOTORS

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Section Includes:

1. Motors.

#### 1.02 SUBMITTALS

##### A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data.
  - a. Provide submittal data for all products specified in this Specification Section.
  - b. See Specification Section 26 05 00 for additional requirements.

### PART 2 - PRODUCTS

#### 2.01 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Wire all permanently installed motors, starters and line voltage control systems, furnished under the contract, or by the Owner, unless specifically noted to the contrary. Check for proper rotation, proper lubrication and proper overload protection on all motors prior to start-up.
- B. Unless otherwise specified, motors shall be general purpose with open-type enclosures, and rated for a temperature rise of 40 DegC. Where motor horsepower are specified in connection with equipment drive, the horsepower specified shall be considered as minimums. The manufacturer furnishing motors shall, in all cases, verify motor horsepower with the characteristic power curves of the driven. In no case shall the power requirement of the driven machine exceed the nominal nameplate rating plus the service factor of the motor furnished. Advantage shall not be taken of service factors for normal operation loading in the selection of the motors.
- C. Except where otherwise specified with certain equipment items, motors smaller than 1/2 horsepower shall be rated single phase, 60 hertz, 115 volts, and motors 1/2 horsepower and larger shall be rated 3-phase, 60 hertz, 200 or 460 volts as applicable. The motor voltages stated above are utilization, or nameplate, ratings for use on nominal system voltages of 120, 208, and 480 respectively.
- D. Single Phase motors shall be capacitor-start, split phase, or shaded pole-type, or as approved for individual application. Polyphase motors shall be squirrel-cage induction-type, with speed and torque as required for individual application.

- E. Motor speeds, horsepower, classification as to splash-proof drip-proof, totally enclosed, etc., are in general specified with equipment drives as shown in the schedule on the drawings. Where not called for specifically, the Contractor shall obtain the information from the manufacturer of the equipment unit and have the application approved by the Engineer prior to ordering starters. Totally enclosed motors of all sizes shall be fan cooled.
- F. Motors for V-belt drives shall be provided with slide rails. Motors for direct drive with couplings shall be doweled to the base plate at two points.

### PART 3 - EXECUTION

#### 3.01 FIELD QUALITY CONTROL

- A. Alignment of all motors factory coupled to equipment and all motors field coupled to equipment shall be rechecked after all connections have been completed and after 48 hours of operation in designated service.

**END OF SECTION**

## **SECTION 26 05 13 - MEDIUM VOLTAGE CABLE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Material and installation requirements for:
  - a. Medium voltage cable (601 V and above).
  - b. Cable terminations and splices.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 05 00 - Electrical: Basic Requirements.
- B. Section 26 08 13 - Acceptance Testing.
- C. Section 26 05 19 - Wire and Cable: 600 Volt and Below.

#### **1.03 REFERENCED STANDARDS**

##### **A. Association of Edison Illuminating Companies (AEIC).**

1. CS8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 Through 46kV.

##### **B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):**

1. 48, Standard for Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5kV Through 756kV or Extruded Insulation Rated 2.5 kV through 500 kV.
2. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
3. 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems.
4. 400.3, Guide for Partial Discharge Testing of Shielded Power Cable Systems in a Field Environment.
5. 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V.
6. 495, Guide for Testing Faulted Circuit Indicators.
7. {510, Recommended Practices for Safety in High-Voltage and High-Power Testing. WITHDRAWN WITH NO REPLACEMENT}

##### **C. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):**

1. WC 71/S-96-659, Standard for Non-Shielded Cables Rated 2001 - 5000 Volts for Use in the Distribution of Electric Energy.

2. WC 74/S-93-639, 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
- D. InterNational Electrical Testing Association (NETA):
  1. ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- E. National Fire Protection Association (NFPA):
  1. 70, National Electrical Code (NEC).
  2. 70E, Standard for Electrical Safety in the Workplace.
- F. National Institute for Certification in Engineering Technologies (NICET).
- G. National Institute of Standards and Technology (NIST).
- H. Occupational Safety and Health Administration (OSHA).
- I. Underwriters Laboratories, Inc. (UL):
  1. 486A-486B, Wire Connectors.
  2. 1072, Standard for Safety Medium Voltage Power Cables.

#### 1.04 SUBMITTALS

- A. Shop Drawings:
  1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  2. Product 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.
  3. Fabrication and/or layout drawings:
    - a. Cable pulling plan and tension calculations.
- B. Informational Submittals:
  1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  2. Cable pulling tension measurements.
  3. Submit the following before terminating cables:
    - a. Cable Technician qualifications.

#### 1.05 QUALITY ASSURANCE

- A. Qualifications:
  1. Cable technician:
    - a. Three (3) years experience in handling, terminating and splicing medium voltage cables.



- b. Specifically trained by a factory representative on the terminations and splices to be used on the project.
  - 1) If not trained on the products to be used, on-site training by the factory representative shall be performed before any terminations or splices are made.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Ship cable with removable watertight end seals, and store in dry place.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Wire and cable:
    - a. Aetna Insulated Wire.
    - b. General Cable.
    - c. The Kerite Company.
    - d. The Okonite Company.
    - e. Prysmian Cable Corporation.
    - f. Southwire Company.
  - 2. Lugs, connectors and terminations:
    - a. 3M Company.
    - b. Elastimold, a Thomas and Betts Company.
    - c. Joslyn/McLean.
    - d. Raychem.
    - e. Eaton Cooper Power Systems.
- B. Submit request for substitution in accordance with Specification Section 26 05 00.

#### 2.02 MEDIUM VOLTAGE CABLES

- A. Ratings:
  - 1. 15kV class unless otherwise indicated on the Drawings.
- B. Standards:
  - 1. NEMA/ICEA WC 74/S-93-639.
  - 2. AEIC CS8.
  - 3. UL 1072.
- C. Conductor Material:

1. Regular or compressed concentric stranded copper or Aluminium as indicated on drawings.
2. To prevent oxidation, fill the conductor strandings with an oxidation preventing compound.

D. Insulation:

1. Temperature rating: Type MV-105 per NFPA 70.
2. Ethylene-propylene-rubber (EPR).
3. 133 percent insulation level.

E. Shielding:

1. Shielding on cables rated above 2 kV consists of:
  - a. Semiconductor conductor screen.
  - b. Semiconductor insulation screen.
  - c. Copper concentric neutral.

F. Neutrals:

1. Cables with a concentric copper neutral shall have full or 1/3 concentric neutral as required.
  - a. Full on single phase circuit, one cable.
  - b. 1/3 on three phase circuit with 3 cables triplexed.

G. Grounds:

1. Bare copper per Specification Section 26 05 19.

H. Jackets:

1. Jacket: Low Density Polyethylene Jacket (LLDPE).
2. Color markings and terminology markings as indicated on drawings or as coordinated with engineer.

## 2.03 CABLE ACCESSORIES

A. Lugs and Connectors:

1. Lugs:
  - a. Compression type for use with copper or aluminum.
  - b. Standard: UL 486B for aluminum conductors.
  - c. Voltage rating: Up to 35 kV.
  - d. Current rating: Continuous operation at the rating of the cable.
  - e. Material: Tin-Plated, High-Conductivity Aluminum.
  - f. Number of holes: Two (2).
2. Splice connectors:
  - a. Standard: UL 486B for aluminum conductors.

- b. Voltage rating: Up to 35kV.
- c. Current rating: Continuous operation at the rating of the cable.
- d. Material: Tin-plated Aluminum.
- e. Barrel: Standard or Long with solid center stop.

B. Terminations:

1. Terminations must be provided in a kit, including skirts, stress control terminator, ground clamp, connectors, lugs and complete instructions for assembly and installation. Terminations must be the product of one manufacturer, suitable for the type, diameter, insulation class and level, and materials of the cable terminated. Do not use separate parts of copper or copper alloy in contact with aluminum alloy parts in the construction or installation of the terminator.
2. End caps:
  - a. Cold or hot shrink.
  - b. Used to environmentally seal and mechanically protect exposed cable ends.
3. Cold shrink kits:
  - a. Standard: IEEE 48, Class 1 termination.
  - b. Voltage rating: Same as the cable rating.
  - c. Current rating: Continuous operation at the rating of the cable.
  - d. One-piece design, where high-dielectric constant stress control is integrated within a skirted insulator made of silicone rubber.
  - e. Suitable for contaminated indoor and outdoor locations.
4. Molded rubber kit:
  - a. Standard: IEEE 48.
  - b. Voltage rating: Same as the cable rating.
  - c. Current rating: Continuous operation at the rating of the cable.
  - d. One-piece design or modular with stress cone and skirts, where high-dielectric constant stress control is integrated within a skirted insulator made of EPDM rubber.
  - e. Suitable for contaminated indoor and outdoor locations.
5. Elbow connectors:
  - a. Standard: IEEE 386.
  - b. Voltage rating: Same as the cable rating.
  - c. Current rating:
    - 1) 200A Loadbreak.
    - 2) 600A Deadbreak.
  - d. One-piece design, comprised of an insulation shield, insulation layer and an outer shield constructed of EPDM rubber.

- e. Deadfront type with:
    - 1) Hot stick pulling eye.
    - 2) Grounding tab.
    - 3) Test point.
  - f. Accessories to be constructed in a similar manner as the elbow connector:
    - 1) Bushing inserts.
    - 2) Bushing well plugs.
    - 3) Feed thru inserts.
    - 4) Protective caps.
- C. Cable Shield Grounding Adapters:
- 1. Type: Molded rubber with constant force spring and solder-blocked tinned copper braid pigtail.
  - 2. Waterproof, providing a positive seal for the cable jacket.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Do not install cable during wet conditions.
- 1. Prior to pulling cables, drain or pump out manholes and other low points if standing water is present.
  - 2. Blow out conduits with dried compressed air if moisture is present in conduits.
  - 3. Install end caps immediately on all cut ends of cable prior to pulling, and maintain end caps while pulling in cable.
    - a. If end caps are damaged, remove and install new end caps.
    - b. Do not remove end caps until ready to terminate or splice cable.
- B. Do not install conductors when ambient temperature is near minimum as recommended by manufacturer for installation of the type of conductor insulation.
- C. Provide components in kit form, complete with instructions, supplied by a single approved manufacturer and suitable for each shielded cable termination.
- 1. Select correct termination to match cable diameter and construction.
  - 2. Form and install terminations in strict accordance with instructions of cable manufacturer and termination manufacturer.
- D. Splices:
- 1. No below grade splices are allowed in yards with concrete encased duct banks.
  - 2. Splices are permitted when underground primary cable in conduit is installed direct buried in soil outside of yard.

- E. The ground shield grounding adaptors shall be grounded:
    - 1. Shired and elbow terminators: Grounded to ground bar or cable loop in equipment.
    - 2. Splices: Grounded to ground bar or rod in handhole.
    - 3. Connect with insulated, stranded #6 AWG wire.
- 3.02 FIELD QUALITY CONTROL
- A. See Specification Section 26 08 13 for acceptance testing requirements.
  - B. Provide cable pulling plan showing proposed cable pulling direction for each pull.
  - C. Provide cable pulling tension calculations.
  - D. Provide measurement of tensions during the pull.

**END OF SECTION**

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## **SECTION 26 05 19 - WIRE AND CABLE 600 VOLT AND BELOW**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Material and installation requirements for:
  - a. Building wire.
  - b. Power cable.
  - c. Control cable.
  - d. Instrumentation cable.
  - e. Wire connectors.
  - f. Insulating tape.
  - g. Pulling lubricant.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 05 00 - Electrical: Basic Requirements.
- B. Section 26 08 13 - Acceptance Testing.

#### **1.03 REFERENCED STANDARDS**

##### **A. Aluminum Association (AA).**

##### **B. ASTM International (ASTM):**

1. G21, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
2. 1580, Recommended Practice for Marine Cable for Use on Shipboard and Fixed or Floating Marine Platforms.

##### **C. Insulated Cable Engineers Association (ICEA):**

1. S-58-679, Standard for Control Cable Conductor Identification.
2. S-76-474, Neutral-Supported Power Cable Assemblies with Weather-Resistant Extruded Insulation Rated 600 Volts.

##### **D. Instrumentation, Systems, and Automation Society (ISA):**

1. MC96.1, Temperature Measurement Thermocouples.
2. SP50.02, Fieldbus Standard for Use in Industrial Control Systems Part 2: Physical Layer Specification and Service Definition.

##### **E. National Electrical Manufacturers Association (NEMA):**

1. ICS 4, Industrial Control and Systems: Terminal Blocks.

- F. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
  - 1. WC 57/S-73-532, Standard for Control Cables.
  - 2. WC 70/S-95-658, Non-Shielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
- G. National Fire Protection Association (NFPA):
  - 1. 70, National Electrical Code (NEC).
  - 2. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- H. Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA):
  - 1. 598-C, Optical Fiber Cable Color Coding.
- I. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
  - 1. 568, Commercial Building Telecommunications Cabling Standard.
- J. Underwriters Laboratories, Inc. (UL):
  - 1. 13, Standard for Safety Power-Limited Circuit Cables.
  - 2. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
  - 3. 83, Standard for Safety Thermoplastic-Insulated Wires and Cables.
  - 4. 467, Standard for Safety Grounding and Bonding Equipment.
  - 5. 486A, Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors.
  - 6. 486C, Standard for Safety Splicing Wire Connections.
  - 7. 510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.
  - 8. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
  - 9. 1569, Standard for Safety Metal-Clad Cables.
  - 10. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.
  - 11. 1666, Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts.
  - 12. 2225, Cables and Cable Fittings for Use in Hazardous (Classified) Locations.
  - 13. 2250, Standard for Safety Instrumentation Tray Cable.

#### 1.04 DEFINITIONS

- A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
- B. Instrumentation Cable:

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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.
- G. Messenger Supported Cable (Multiplex Cable): A cable with one (1) or more insulated conductors supported by a messenger wire.

#### 1.05 SUBMITTALS

- A. Shop Drawings:
  1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  2. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section except:
      - 1) Insulating tape.
      - 2) Cable lubricant.
    - b. See Specification Section 26 05 00 for additional requirements.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 26 05 00.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Building wire, power and control cable and multiplex cable:

- a. . Advanced Digital Cable (ADC)
- b. Cerrowire.
- c. Encore Wire Corporation.
- d. General Cable.
- e. Nexans Cable.
- f. Okonite Company.
- g. Service Wire.
- h. Southwire Company.

2. Shielded VFD cable:

- a. Belden Inc.
- b. General Cable.
- c. Nexans Cable.
- d. Okonite Company.
- e. Olfex Wire and Cable, Inc.
- f. Priority Wire and Cable (Prysmian).
- g. Rockbestos-Surprenant Cable Corp.
- h. 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.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

## 2.02 MANUFACTURED UNITS

### A. Building Wire:

- 1. Conductor shall be copper with 600 V rated insulation.
- 2. Conductors shall be stranded, except for conductor sizes 12 through 10 shall be 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.

### 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. Number of conductors as required, including a bare ground conductor.
- 5. Individual conductor color coding:
  - a. ICEA S-58-679, Method 4.
  - b. See PART 3 of this Specification Section for additional requirements.
- 6. Conform to NFPA 70 Type TC .

### C. Messenger Supported Cable (Multiplex Cable)

- 1. Factory Assembled with insulated conductors twisted around the messenger conductor in accordance with ICEA S-76-474.
- 2. Insulated Conductors
  - a. Aluminum with 600 V rated and sunlight and moisture resistant cross-linked polyethylene (XLPE) insulation.
  - b. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.

3. Individual Color Coding
  - a. ICEA S-58-679, Method 4.
  - b. See Part 3 of this specification section for additional requirements.
4. Messenger/Bare Neutral Conductor
  - a. Aluminum conductor steel reinforced (ACSR).
  - b. Same Size as insulated conductors.
5. Types
  - a. Duplex: One (1) insulated conductor twisted around a messenger conductor.
  - b. Triplex: Two (2) insulated conductors twisted around a messenger conductor.
  - c. Quadruplex: Three (3) insulated conductors twisted around a messenger conductor.

D. 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. 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).
5. 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.
6. Conform to NFPA 70 Type TC .

E. 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.

F. 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 percent tinned copper braid, full size tinned copper drain wire and 100 percent 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 or 5 mil copper tape, longitudinally applied with a minimum overlap of 15 percent.
    - c. Number of conductors: 3 PH and 3 equally spaced ground conductors.
  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 .
- G. 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 percent 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 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 NFPA 262 and NFPA 70 Type ITC.
- 4. Messenger Supported Cable (Multiplex Cable):
  - a. Factory assembled with insulated conductors twisted around messenger conductor in accordance with ICEA S-76-474.
  - b. Insulated conductors:
    - 1) Aluminum with 600 V rated and sunlight and moisture resistant cross-linked polyethylene (XLPE) insulation.
    - 2) Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
  - c. Individual conductor color coding:
    - 1) ICEA S-58-679, Method 4.
    - 2) See PART 3 of this Specification Section for additional requirements.
  - d. Messenger/bare neutral conductor:
    - 1) Aluminum conductor steel reinforced (ACSR).
    - 2) Same size as insulated conductors.
  - e. Types:
    - 1) Duplex: One (1) insulated conductor twisted around a messenger conductor.
    - 2) Triplex: Two (2) insulated conductors twisted around a messenger conductor.
    - 3) Quadplex: Three (3) insulated conductors twisted around a messenger conductor.

#### H. 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.
- I. 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.
  - 7. Comply with UL 510.
- J. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation.

## PART 3 - EXECUTION

### 3.01 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 below grade.
  - 2. Interior Applications: Type THHN and THHN -2:
    - a. Building wire and power and control cable No. 10 AWG and smaller in architectural and non-architectural finished areas.
  - 3. Exterior Applications: Type THWN and THWN-2
    - a. Building wire and power and control cable No. 10 AWG and smaller in architectural and non-architectural finished areas.
  - 4. 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.

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. Wiring serving exterior lighting and equipment remote from building shall be minimum #10.
3. Control conductors shall not be smaller than No. 14 AWG unless otherwise indicated on the Drawings.
4. 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:

	240 V, 208 V, 240/120 V, 208/120 V	480 V, 480/277 V
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:
  - 1) Insulated phase and neutral conductors shall be identified by one (1) of the following methods:
    - a) Continuous colored outer finish along its entire length.
    - b) 3 IN of colored tape applied at the termination.
  - 2) Insulated grounding conductor shall be identified by one (1) 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 IN 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 IN 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 (1) 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 IN of colored tape, per the Table herein, applied at the terminations.
- 5. Messenger supported cables:
  - a. ICEA S-58-679, Method 4 with insulated conductors identified with 3 IN of colored tape, per the Table herein, applied at 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 lighting, receptacle and other 120 Vac circuits are allowed to be combined into a common raceway.
    - a. 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.
- G. Ground the drain wire of shielded instrumentation cables at one (1) 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, above ground, in the indicated enclosure type.
  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) No splices shall be made in handholes or manholes.
  2. Control circuits:
    - a. Junction and pull boxes: Terminal block type connector.
    - b. 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. Messenger supported cable may be spliced or tapped, at support locations, with a compression type connector rated to connect an aluminum conductor to a copper conductor.

5. 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.

3.02 FIELD QUALITY CONTROL

A. Acceptance Testing:

1. See Specification Section 26 08 13.

**END OF SECTION**

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## **SECTION 26 05 26 - GROUNDING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Material and installation requirements for grounding system(s).

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 10 14 00 - Identifying Devices.
- B. Section 26 05 00 - Electrical: Basic Requirements.
- C. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
- D. Section 26 05 33 - Raceways and Boxes.
- E. Section 26 08 13 - Acceptance Testing.

#### **1.03 REFERENCED STANDARDS**

##### **A. ASTM International (ASTM):**

1. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

##### **B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):**

1. 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.

##### **C. National Fire Protection Association (NFPA):**

1. 70, National Electrical Code (NEC).
  - a. Article 250, Grounding and Bonding.
  - b. Article 610, Cranes and Hoists.

##### **D. Society of Cable Telecommunications Engineers (SCTE):**

1. 77, Specification for Underground Enclosure Integrity.

##### **E. Underwriters Laboratories, Inc. (UL):**

1. 467, Grounding and Bonding Equipment.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data.
  - a. See Specification Section 26 05 00 for additional requirements.

## 1.05 QUALITY ASSURANCE

- A. Assure ground continuity is continuous throughout the entire Project.

## PART 2 - PRODUCTS

### 2.01 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. Burndy.
  - b. Harger Lightning Protection.
  - c. Heary Brothers.
  - d. Joslyn.
  - e. Robbins Lightning Protection.
  - f. Thomas & Betts Blackburn.
  - g. Thompson.
2. Exothermic weld connections:
  - a. Erico Products Inc., Cadweld.
  - b. Harger Lightning Protection.
  - c. Thermoweld.
  - d. Thomas & Betts Furseweld.
3. Prefabricated composite test stations:
  - a. Quazite Composolite.
  - b. Armorcast Products Company.

- B. Submit request for substitution in accordance with Specification Section 01 33 00.

### 2.02 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 IN thick.
    - b. 2 or 4 IN wide.

- c. 24 IN long minimum in main service entrance electrical rooms, 12 IN 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 IN x 10 FT, or as indicated on the Drawings.
  - 2. Copperclad:
    - a. Heavy 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.
- 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 FT depth.
  - 5. Cover:

- a. Engraved legend of "GROUND".
- b. Lay-in non-bolt down.
- 6. Size: 12 IN round or 12 IN square.

## PART 3 - EXECUTION

### 3.01 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 nonconducting material from contact surfaces before making ground connections.
- 4. Where ground conductors pass through floor slabs or building walls provide nonmetallic sleeves.
- 5. Do not splice grounding conductors except at ground rods.
- 6. Install ground rods and grounding conductors in undisturbed, firm soil.
  - a. Install ground rod a minimum of 3' from disturbed soil.
  - b. Provide excavation required for installation of ground rods and ground conductors.
  - c. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
  - d. Unless otherwise specified, connect conductors to ground rods with compressor type connectors.
  - e. Provide sufficient slack in grounding conductor to prevent conductor breakage during backfill or due to ground movement.
  - f. Backfill excavation completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.

#### B. Grounding Electrode System:

- 1. Provide a grounding electrode system in accordance with NFPA 70, Article 250 and as indicated on the Drawings.
- 2. Grounding conductor terminations:
  - a. Ground bars mounted on wall, use compression type terminal and bolt it to the ground bar with two bolts.
  - b. Ground bars in electrical equipment, use compression type terminal and bolt it to the ground bar.
  - c. Piping systems use mechanical type connections.
  - d. Building steel, below grade and encased in concrete, use compression type connector or exothermic weld.



- e. 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 grounding conductor looped around the structure.
  - b. Placed at a minimum of 10 FT from the structure foundation and 2 FT-6 IN below grade.
  - c. Provide a minimum of four (4) 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.
    - 2) Bond alternate building/structure metal support columns along the perimeter of the structure to the ground ring.
  - e. Grounding conductor: Bare conductor, size as indicated on the Drawings or minimum #2 AWG.
  - f. Ground rod test stations:
    - 1) Provided where grounding electrode is connected to ground ring..
    - 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.
  - 2. Metal light poles:
    - a. Connect metal pole 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.

D. Low Voltage Transformer Separately Derived Grounding System:

1. Ground separately mounted step-down transformers per the below:
  - a. Primary side equipment grounding conductor: Bond equipment grounding conductor from primary feeder to ground terminal bar in transformer.
  - b. Supply side bonding jumper: bond ground terminal bar in transformer to ground terminal bar in service disconnect.
  - c. Neutral conductor: bond XO terminal in transformer to the neutral terminal bar in the service disconnect
  - d. System bonding jumper: bond ground terminal bar in service disconnect to neutral terminal bar in service disconnect.
  - e. Grounding electrode conductor: bond neutral terminal bar in service disconnect to:
    - 1) Exterior applications
      - a) Ground rod or ground ring.
    - 2) Interior applications
      - a) Closest building steel using mechanical type terminal bolted to the steel, compression type connection or exothermic welds
      - b) Closest water pipe using a mechanical type connection.

E. Raceway Bonding/Grounding:

1. All metallic conduit shall be installed so that it is electrically continuous.
2. All conduits to contain a grounding conductor 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 conduit, 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.

F. Equipment Grounding:

1. All utilization equipment shall be grounded with an equipment ground conductor.

G. Handhole Grounding:

1. Provide a ground rod and ground bar, when indicated or as needed, in each handhole with exposed metal parts.
  - a. Expose a minimum of 4 IN 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.

H. Pad Mounted Switch and Above Grade Sectionalizing Terminal Cabinet Grounding:

1. Provide a ground rod(s) in each enclosure with a minimum of 4 IN of rod exposed above the floor for connection to the rod.
  - a. Connect metal frame to the ground rod.
  - b. Connect medium voltage cable shields to the ground rod.

I. Pad Mounted Oil Filled Transformer Grounding:

1. 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. Connect medium voltage cable shields to the ground rod.
  - d. Connect surge arrestor to the ground rod.
  - e. Connect the XO and ground pad to the ground rod.
  - f. Connect exposed metallic conduits to the ground rod.

3.02 FIELD QUALITY CONTROL

- A. Leave grounding system uncovered until observed by Owner.
- B. Acceptance testing:
  1. See NEC 250
  2. See Specification Section 26 08 13.

**END OF SECTION**

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## **SECTION 26 05 33 - RACEWAYS AND BOXES**

### **PART 1 - GENERAL**

#### **1.01 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.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 05 00 - Electrical: Basic Requirements.
- B. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
- C. Section 26 05 43 - Electrical: Exterior Underground.
- D. Section 26 27 26 - Wiring Devices.

#### **1.03 REFERENCED STANDARDS**

- A. Aluminum Association (AA).
- B. American Iron and Steel Institute (AISI).
- C. ASTM International (ASTM):
  1. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  2. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  3. D2105, Standard Test Method for Longitudinal Tensile Properties of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Tube.
  4. D2447, Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter.
  5. D2564, Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
  6. D3350, Standard Specification for Polyethylene Plastic Pipe and Fittings Materials.
  7. D3485, Standard Specification for Smooth-Wall Coilable Polyethylene (PE) Conduit (Duct) for Preassembled Wire and Cable.

8. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
  9. F512, Standard Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation.
- D. National Electrical Manufacturers Association (NEMA):
1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  2. RN 1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit (IMC).
  3. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
  4. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
  5. {TC 6&8, Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations.}
- E. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
1. C80.1, Electric Rigid Steel Conduit (ERSC).
  2. C80.3, Steel Electrical Metallic Tubing (EMT).
  3. C80.5, Electrical Aluminum Rigid Conduit.
  4. C80.6, Intermediate Metal Conduit (EIMC).
  5. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
- F. National Fire Protection Association (NFPA):
1. 70, National Electrical Code (NEC).
- G. Underwriters Laboratories, Inc. (UL):
1. 1, Standard for Flexible Metal Conduit.
  2. 6, Standard for Electrical Rigid Metal Conduit - Steel.
  3. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
  4. 94, Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
  5. 209, Standard for Cellular Metal Floor Raceways and Fittings.
  6. 360, Standard for Liquid-Tight Flexible Steel Conduit.
  7. 467, Grounding and Bonding Equipment.
  8. 514A, Metallic Outlet Boxes.
  9. 514B, Conduit, Tubing, and Cable Fittings.
  10. 651, Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings.
  11. 651A, Type EB and A Rigid PVC Conduit and HDPE Conduit.
  12. 651B, Standard for Continuous Length HDPE Conduit

13. 797, Electrical Metallic Tubing - Steel.
14. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
15. 884, Standard for Underfloor Raceways and Fittings.
16. 886, Standard for Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations.
17. 1242, Standard for Electrical Intermediate Metal Conduit - Steel.
18. 1660, Liquid-Tight Flexible Nonmetallic Conduit.
19. 1684, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

H. Building code:

1. International Code Council (ICC):
  - a. International Building Code and associated standards, {2006}{2009}{2012} Edition including all amendments, referred to herein as Building Code.

1.04 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
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 00 for additional requirements.
3. Fabrication and/or layout drawings:
  - a. Identify dimensional size of pull and junction boxes to be used.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 26 05 00.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Rigid metallic conduits:
    - a. Allied Tube and Conduit Corporation.
    - b. Triangle PWC Inc.
    - c. Western Tube and Conduit Corporation.
    - d. Wheatland Tube Company.
    - e. LTV Steel Company.

2. PVC coated rigid metallic conduits:
  - a. Thomas & Betts Ocal.
  - b. Rob-Roy Ind.
3. Rigid nonmetallic conduit:
  - a. Prime Conduit (Carlon).
  - b. Cantex.
  - c. Osburn Associates.
4. Flexible conduit:
  - a. AFC Cable Systems.
  - b. Anamet, Inc.
  - c. Electri-Flex.
  - d. Flexible Metal Hose Company.
  - e. International Metal Hose Company.
  - f. Triangle PWC Inc.
  - g. LTV Steel Company.
5. Wireway:
  - a. Hoffman Engineering Company.
  - b. Wiegmann.
  - c. Square D.
6. Conduit fittings and accessories:
  - a. Appleton Electric Co.
  - b. Carlon.
  - c. Cantex.
  - d. Crouse-Hinds.
  - e. Killark.
  - f. Osburn Associates.
  - g. OZ Gedney Company.
  - h. RACO.
  - i. Steel City.
  - j. Thomas & Betts.
7. Support systems:
  - a. Unistrut Building Systems.
  - b. Eaton B-Line.
  - c. Kindorf.



- d. Minerallac Fastening Systems.
  - e. Caddy.
  - f. Thomas & Betts Superstrut.
8. Outlet, pull and junction boxes:
- a. Appleton Electric Co.
  - b. Eaton Crouse-Hinds.
  - c. Killark.
  - d. O-Z/Gedney.
  - e. Thomas & Betts Steel City.
  - f. Raco.
  - g. Bell.
  - h. Hoffman Engineering Co.
  - i. Wiegmann.
  - j. Eaton B-Line.
  - k. Adalet.
  - l. Rittal.
  - m. Stahlin.
- B. See also Selected Suppliers and Manufacturer's list in Specification Section 26 05 00, paragraph 2.A.
- C. Submit request for substitution in accordance with Specification Section 26 05 00.

## 2.02 RIGID METALLIC 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: NEMA/ANSI C80.1, UL 6.
- B. PVC-Coated Rigid Steel Conduit (PVC-RGS):
- 1. Nominal 40 mil Polyvinyl Chloride Exterior Coating:
    - a. Coating: Bonded to hot-dipped galvanized rigid steel conduit conforming to NEMA/ANSI C80.1.
    - b. The bond between the PVC coating and the conduit surface: Greater than the tensile strength of the coating.
  - 2. Nominal 2 mil, minimum, urethane interior coating.
  - 3. Urethane coating on threads.

4. Conduit: Epoxy prime coated prior to application of PVC and urethane coatings.
  5. Female Ends:
    - a. Have a plastic sleeve extending a minimum of 1 pipe diameter or 2 IN, whichever is less beyond the opening.
    - b. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used with it.
  6. Standards: NEMA/ANSI C80.1, UL 6, NEMA RN 1.
- C. Electrical Metallic Tubing (EMT):
1. Mild steel with continuous welded seam.
  2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
  3. Internal coating: Baked lacquer, varnish, or enamel for a smooth surface.
  4. Standards: NEMA/ANSI C80.3, UL 797.

## 2.03 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 DegC wire and shall be marked "maximum 90 DegC".
  5. Standards: NEMA TC 2, UL 651.

## 2.04 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: 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: UL 360.

## 2.05 WIREWAY

- A. General:
1. Suitable for lay-in conductors.

2. Designed for continuous grounding.
  3. Covers:
    - a. Hinged or removable in accessible areas.
    - b. Non-removable when passing through partitions.
  4. Finish: Rust inhibiting primer and manufacturers 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.

## 2.06 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.
  - 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 IN 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 IN nominal straight-line conduit movement in either direction.
  - b. 30-degree 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 886.
- B. Fittings for Use with PVC-RGS:
  - 1. The same material and construction as those fittings listed under paragraph "Fittings for Use with RGS " and coated as defined under paragraph "PVC Coated Rigid Steel Conduit (PVC-RGS)."
- C. 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.

D. Fittings for Use with FLEX:

1. Connector:
  - a. Zinc plated malleable iron.
  - b. Squeeze or clamp-type.
2. Standard: UL 514B.

E. Fittings for Use with FLEX-LT :

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.

F. 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.

G. 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.

## 2.07 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.

## 2.08 OUTLET BOXES

A. Metallic Outlet Boxes:

1. Hot-dip galvanized steel.

2. Conduit knockouts and grounding pigtail.
  3. Styles:
    - a. 2 IN x 3 IN rectangle.
    - b. 4 IN square.
    - c. 4 IN 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 manufacturers 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 886.
- C. See Specification Section 26 27 26 for wiring devices, wallplates and coverplates.

## 2.09 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 (4) 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 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.

D. 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.

E. 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.

F. NEMA 7 and NEMA 9 Rated:

1. Cast gray iron alloy or copper-free aluminum with manufacturers 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.

G. 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.

H. Miscellaneous Accessories:

1. Rigid handles for covers larger than 9 SF or heavier than 25 LBS.
2. Split covers when heavier than 25 LBS.
3. Weldnuts for mounting optional panels and terminal kits.
4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.

I. Standards: NEMA 250, UL 50.

## 2.10 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.

## 2.11 OPENINGS AND PENETRATIONS IN WALLS AND FLOORS

A. Sleeves, smoke and fire stop fitting through walls and floors:

1. See Specification Section 07 84 13.

## PART 3 - EXECUTION

### 3.01 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 IN.
    - b. Wireway: 2-1/2 IN x 2-1/2 IN.
- 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.
  - 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 IN 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. Fill openings in walls, floors, and ceilings and finish flush with surface.

### 3.02 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.
  4. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.
  5. Provide pull boxes or conduit bodies as needed so that there is a maximum of 315 degrees of bends in the conduit run or in long straight runs to limit pulling tensions.
- B. All rigid conduits within a structure shall be installed exposed except as follows:
  1. As indicated on the Drawings.
  2. Concealed above gypsum wall board or acoustical tile suspended ceilings.
  3. Concealed within stud frame, poured concrete, concrete block and brick walls of an architecturally finished area.
  4. Embedded in floor slabs or buried under floor slabs where shown on the Contract Drawings or with approval of the Engineer's.
- C. Maintain minimum spacing between parallel conduit and piping runs in accordance with the following when the runs are greater than 30 FT:
  1. Between instrumentation and telecommunication: 1 IN.
  2. Between instrumentation and 125 V, 48 V and 24 Vdc, 2 IN.
  3. Between instrumentation and 600 V and less AC power or control: 6 IN.
  4. Between instrumentation and greater than 600 Vac power: 12 IN.
  5. Between telecommunication and 125 V, 48 V and 24 Vdc, 2 IN.
  6. Between telecommunication and 600 V and less AC power or control: 6 IN.
  7. Between telecommunication and greater than 600 Vac power: 12 IN.

8. Between 125 V, 48 V and 24 Vdc and 600 V and less AC power or control: 2 IN.
  9. Between 125 V, 48 V and 24 Vdc and greater than 600 Vac power: 2 IN.
  10. Between 600 V and less AC and greater than 600 Vac: 2 IN.
  11. Between process, gas, air and water pipes: 6 IN.
- 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. 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.
  2. Conduits and accessories embedded in concrete where shown on the Contract Drawings:
    - a. Shall not be considered to replace structurally the displaced concrete except as indicated in the following:
      - 1) Conduit and fittings shall not displace more than 4 percent of the area of the cross-section of a column on which stress is calculated or which is required for fire protection.
      - 2) Size and locate sleeves or conduits passing through floors, walls, or beams so as not to significantly impair the strength of the construction.
      - 3) Sleeves or conduits passing through floors, walls or beams may be considered as replacing the displaced concrete structurally in compression.
        - a) Shall not be exposed to rusting or other deterioration.
        - b) Nominal inside diameter shall not exceed 2 IN.
        - c) Minimum spacing: 3 DIA OC.
    - b. Shall not be larger in outside diameter than one-third the thickness of the slab, column or beam.
    - c. Shall have a minimum spacing of 3 DIA OC.
    - d. In reinforced concrete construction:
      - 1) Conduit shall not be run in beams.

- 2) Place conduit after reinforcing steel has been laid.
- 3) The reinforcement steel shall not be displaced by the conduit.
- 4) Provide a minimum of 1-1/2 IN of cover over conduit, excluding surface finish.
- 5) Conduits parallel to main reinforcement shall be run near the center of the wall.
- 6) Conduits perpendicular to main reinforcement shall be run midway between wall or slab supports.

### 3.03 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.
5. Telecommunication cables: All raceway types.

#### B. Permitted Raceway Types Per Area Designations:

1. Dry areas:
  - a. RGS.
  - b. EMT above 10 FT.
2. Wet areas:
  - a. RGS.
3. Corrosive areas:
  - a. PVC-RGS.
4. Highly corrosive areas:
  - a. PVC-RGS.
  - b. PVC-80.
5. NFPA 70 hazardous areas:
  - a. RGS.

#### 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.
- 4. Embedded in poured concrete walls and floors:
  - a. PVC-40.
  - b. PVC-RGS when emerging from concrete into areas designated as wet, corrosive or highly corrosive.
- 5. Beneath floor slab-on-grade:
  - a. PVC-40.
- 6. Through floor penetrations:
  - 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. PVC-RGS in areas designated as wet, corrosive or highly corrosive.
- 7. Direct buried conduits and ductbanks:
  - a. PVC-80.
  - b. PVC-40.
  - c. 90 degree elbows for transitions to above grade:
    - 1) PVC-RGS.
    - 2) RGS wrapped with applied weather and corrosion protection tape.
  - d. Long sweeping bends greater than 15 degrees:
    - 1) PVC-RGS.
    - 2) RGS wrapped with applied weather and corrosion protection tape.
- 8. Concrete encased ductbanks:
  - a. PVC-40.
  - b. 90 degree elbows for transitions to above grade:
    - 1) PVC-RGS.
    - 2) RGS wrapped with factory applied weather and corrosion protection tape.
  - c. Long sweeping bends greater than 15 degrees:
    - 1) RGS for sizes 2 IN and larger.
    - 2) Fiberglass long sweep bends are only allowed on plastic (PVC) ductbanks.
- D. Flexible conduits shall be installed for connections to light fixtures, HVAC equipment and other similar devices above ceilings in buildings. Flexible conduit shall not be used outside buildings.
  - 1. The maximum length shall not exceed:
    - a. 6 FT to light fixtures.

- b. 3 FT to all other equipment.
- E. Liquidtight flexible conduits shall be installed in buildings 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. Liquidtight flexible conduits shall not be used outside buildings.
  - 1. The maximum length shall not exceed:
    - a. 6 FT to light fixtures.
    - b. 3 FT to motors.
    - c. 2 FT 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. HAZ-FLEX shall not be used outside buildings.
  - 1. The maximum length shall not exceed:
    - a. 3 FT to motors.
    - b. 2 FT to all other equipment.
- G. NEMA 1 Rated Wireway:
  - 1. Surface mounted in electrical rooms.
  - 2. Surface mounted above removable ceiling 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.

### 3.04 CONDUIT FITTINGS AND ACCESSORIES

- A. Conduit Seals:
  - 1. Installed in conduit systems located in hazardous areas as required by the NFPA 70.
  - 2. Filler 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 FT.
  - 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 (2) 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 (2) 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 3R rated enclosures:
  - a. Watertight, insulated and gasketed hub and locknut
6. In NEMA 7 and NEMA 9 rated enclosures:
  - a. Into an integral threaded hub.
7. 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.

### 3.05 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.
  2. 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.
  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.
  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.
- 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.
    - c. PVC coated fasteners may be used with PVC-RGS 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 LBS.
    - 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.

### 3.06 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 FT 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.
3. Permitted uses of NEMA 4 enclosure:
  - a. Pull or junction box surface mounted in areas designated as wet.
4. Permitted uses of NEMA 4X metallic enclosure:
  - a. Pull or junction box surface mounted in areas designated as wet and/or corrosive.
5. 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.
6. Permitted uses of NEMA 12 enclosure:
  - a. Pull or junction box surface mounted in areas designated as dry.

**END OF SECTION**

## **SECTION 26 05 36 - CABLE TRAY**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Cable tray and associated fittings and supports.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 07 84 13 - Firestopping.
- B. Section 10 14 00 - Identification Devices.
- C. Section 26 05 00 - Electrical: Basic Requirements.
- D. Section 26 05 26 - Grounding.
- E. Section 26 05 33 - Raceways and Boxes.

#### **1.03 REFERENCED STANDARDS**

##### **A. American Iron and Steel Institute (AISI).**

##### **B. ASTM International (ASTM):**

1. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. A510, Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
3. A1011, 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. B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
5. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

##### **C. National Electrical Manufacturers Association (NEMA):**

1. FG-1, Fiberglass Cable Tray Systems.
2. VE-1, Metal Cable Tray Systems.
3. VE-2, Metal Cable Tray Installation Guidelines.

##### **D. Underwriters Laboratories, Inc. (UL).**

1. 94, Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

##### **E. National Fire Protection Association (NFPA):**

1. 70, National Electrical Code (NEC).

F. Building code:

1. International Code Council (ICC):
  - a. International Building Code and associated standards, Latest Edition including all amendments, referred to herein as Building Code.

1.04 DEFINITIONS

A. Types of Cable Tray:

1. Ladder: A prefabricated metal structure consisting of two (2) longitudinal side rails connected by individual transverse members of rungs.
2. Wire-mesh: A rigid tray systems constructed from high strength wire spaced parallel with 2 IN longitudinal and 4 IN transverse wire, spot welded at all intersections.

1.05 SYSTEM DESCRIPTION

A. The following is a brief description of the types of the trays to be used.

1. All Buildings: Wire-mesh, Ladder.

B. Miscellaneous:

1. Cable tray systems are sized on the Drawings.
2. When cable tray system size is not shown on the Drawings or scheduled, the cable tray shall be sized in accordance with the NFPA 70 and the requirements of this Specification Section.
3. Cable tray runs, where shown, are diagrammatic and intended to be used as a guide, unless otherwise indicated on the Drawings.
  - a. Site conditions may affect actual routing.
  - b. Contractor shall coordinate routing and measurement with other trades and with equipment suppliers to avoid interference with equipment, piping, ductwork, etc.
  - c. When not specifically shown on the drawings, the Contractor can provide cable tray per the following, with approval by the Engineer:
    - 1) Ladder tray in Prefabricated Electrical Rooms.
    - 2) Tray size and fill per NFPA 70.

1.06 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
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 00 for additional requirements.

3. Fabrication and/or layout drawings:
  - a. Routing, size and fittings.
  - b. Seismic location installation details.
- B. Informational Submittals:
  1. Cable tray fill calculations.
  2. Cable schedule of cables in cable trays.

#### 1.07 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 26 05 00.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Metallic and nonmetallic cable tray systems:
    - a. Eaton B-Line.
    - b. T.J. Cope.
    - c. Husky/Burndy.
    - d. Thomas & Betts.
    - e. P-W Ind.
  2. Wire-mesh cable tray systems:
    - a. Eaton B-Line.
    - b. T.J. Cope.
    - c. Husky/Burndy.
    - d. Cablofil.
    - e. Chalfant.
    - f. Niedex.
    - g. Thomas & Betts.
  3. Telecommunications cable ladders:
    - a. Homaco.
    - b. Middle Atlantic Products.
  4. Cable tray conduit and ground clamps and brackets:
    - a. Eaton B-Line.
    - b. P-W Ind.
    - c. O.Z. Gedney.

d. Thomas & Betts.

B. Submit request for substitution in accordance with Specification Section 01 33 00.

## 2.02 COMPONENTS

A. Wire-Mesh Tray:

1. Material:

a. Steel wires and fasteners: ASTM A510 carbon steel hot-dipped galvanized after fabrication per ASTM A123/A123M or electroplated per ASTM B633.

2. Fabrication:

- a. Wires formed into a 2 IN by 4 IN mesh pattern with intersecting wires welded together.
- b. The top of the side rails formed to create a safety system for the cables and installers (e.g., rounded transverse wire ends, top wire T welded to transverse wires).
- c. Fittings (bends, risers, tees, etc.) to be constructed on-site using side action bolt croppers and fastened using spring action couplers or clamps with bolts and nuts.
- d. Useable clear loading depth: Minimum 2 IN.
- e. Useable clear loading width: As indicated in Drawings.
- f. UL classified per NFPA 70 as an equipment grounding conductor.

## 2.03 ACCESSORIES

A. Accessories including but not limited to, splice plates, barrier strips, drop outs, 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 26 05 00 for material specifications.
- 2. See PART 3 of this Specification Section for material type.



## PART 3 - EXECUTION

### 3.01 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 IN or less) in location or 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 IN) in location or 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. Insure openings are provided in walls that cable tray will penetrate.
  - 5. Fire stop penetrations in fire rated walls.
    - a. Use a removable fire stopping system such as pillows.
- D. Cable Tray Supports:
  - 1. Provide supports at required locations to provide the loading capacity per the Contractor's fill calculations.
  - 2. Cantilever bracket type when cable tray is installed adjacent to a wall.
  - 3. Trapeze type hangers for all other applications.
  - 4. For vertical runs in excess of 20 FT support the tray by angles bolted through the side rails and suspended from hanger rod, which is connected to a cantilevered support.
  - 5. In seismic locations provide required supports and/or sway bracing per local Building Codes.
- E. Permitted prefabricated bracket or trapeze type 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 (1) of the following:
  - 1. Expansion connector allowing a minimum of 1 IN straight-line movement of sections.
  - 2. A 2 IN 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 (1) 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 26 05 26.
- I. Secure cables, in vertical runs of cable tray, with cable clamps or ties as near as practical to the top and bottom of the vertical run and at a maximum of 6 FT spacing over the length of the run.
  - 1. Plastic wire ties to be UV resistant type.
- J. Conduit terminating at a cable tray system:
  - 1. See Specification Section 26 05 33.
- K. Use flanged fittings to terminate cable tray systems at switchgear, motor control centers, and other equipment, unless indicated otherwise on the Drawings.
- L. Install flat, solid, flanged covers on vertical cable tray to a minimum 6 FT above finished floor and walkways.
- M. Cover cable tray systems passing under open grating type walkways and platforms.
  - 1. Peak flanged.

N. Install barrier strips in cable tray systems containing both power and control wiring to physically separate the control cables from the power cables.

O. Cable Installation:

1. Conductors #4/0 AWG and less, shall be in a multi-conductor cable.
2. Conductors 250 kcmil and larger, shall be single conductor cables bundled together, Phase A, B, C and neutral and/or ground when required.

### 3.02 FIELD QUALITY CONTROL

A. Tray Fill Calculations:

1. Cable tray fill shall not exceed NFPA 70 requirements.
  - a. The Contractor shall 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**

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## **SECTION 26 05 43 - ELECTRICAL EXTERIOR UNDERGROUND**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Material and installation requirements for:
  - a. Handhole.
  - b. Underground conduits and ductbanks.
  - c. Steel casement pipe.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Division 03 - Concrete.
- B. Section 03 09 00 - Concrete.
- C. Section 10 14 00 - Identification Devices.
- D. Section 26 05 26 - Grounding.
- E. Section 26 05 33 - Raceways and Boxes.
- F. Division 31 - Earthwork.

#### **1.03 REFERENCED STANDARDS**

- A. American Association of State Highway and Transportation Officials (AASHTO):
  1. HB, Standard Specifications for Highway Bridges.
- B. ASTM International (ASTM):
  1. A536, Standard Specification for Ductile Iron Castings.
  2. A139, Standard Specification for Electric-Fusion Welded Steel Pipe.
  3. A252, Standard Specification for Welded and Seamless Steel Pipe Piles.
- C. National Electrical Manufacturers Association (NEMA):
  1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. National Fire Protection Association (NFPA):
  1. 70, National Electrical Code (NEC).
- E. Society of Cable Telecommunications Engineers (SCTE):
  1. 77, Specification for Underground Enclosure Integrity.

#### **1.04 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.
- B. Concrete encased ductbank: An individual (single) or multiple conduit(s), arranged in one or more planes, encased in a common concrete (Slurry) envelope.
- C. Steel casing pipe: An individual pipe used to protect single or electrical power or signal-type conduits.

#### 1.05 SUBMITTALS

##### A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
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. Provide dimensional drawings of each manhole indicating all specified accessories and conduit entry locations.
  - b. Provide cross-sectioned sketch of each concrete encased ductbank (if any).
    - 1) Dimension spacing between conduits.
    - 2) Dimension concrete envelope and reinforcing, where applicable.
  - c. Provide cross-section sketch of each direct-buried ductbank (if any).
    - 1) Dimension from grade to direct buried ductbank.
    - 2) Dimension from direct buried ductbank to other utilities in the route.
  - d. Precast cable trench (if any):
    - 1) Provide dimensions, loading information, and installation instructions for underground cable trench system.
    - 2) Provide detailed layout drawings showing the following as a minimum:
      - a) Physical dimensions of the system.
      - b) Dimension cable trench to other utilities in the path of the trench.
      - c) Dimension cable trench to site structures.
      - d) Cross-sectional sketch of the trench showing:
        - (1) Power cable runs.
        - (2) Control cable runs and support.
        - (3) Shielded I and C cable runs in RGS conduit.
        - (4) Trench grounding.
        - (5) Conduit exit for all cables.

- 3) Cable identification schedule for all cables run within the precast cable trench.
- 4) Verification of trench covers rated for vehicle crossing.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Precast handholes:
  - a. Jensen Precast.
  - b. Utility Vault Co.
  - c. Oldcastle Precast, Inc.
  - d. Lister Industries.
2. Handhole and ductbank accessories:
  - a. Neenah.
  - b. Unistrut.
  - c. Condux International, Inc.
  - d. Underground Devices, Inc.
3. Utility marker posts
  - a. Rhino Marking & Protection Systems

B. Submit request for substitution in accordance with Specification Section 26 05 00.

### 2.02 HANDHOLES

A. Precast Handholes:

1. 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 an 18 IN DIA, open sump with aluminum grate.
5. Gasketed removable top slab with lifting eyes and cast in frame for cover.
6. Cover extension rings as required.
7. Cable pulling eyes opposite all conduit entrances.
  - a. Coordinate exact location with installation contractor.

### 2.03 CONCRETE HANDHOLE ACCESSORIES

A. Cover and Frame:

1. Galvanized steel traffic cover, bolt down.

2. AASHTO live load rating: H-20.
  3. Cast the legend "ELECTRICAL 480V", "HIGH VOLTAGE", SIGNAL" or "COMMUNICATIONS" into handhole covers. Also include "UPRR" on legend.
- B. Ground Rods and Grounding Equipment: See Specification Section 26 05 26.

#### 2.04 UNDERGROUND CONDUIT AND ACCESSORIES

- A. Concrete: Comply with 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.
  3. Provide 2 IN minimum spacing between conduits.
  4. Accessories, as required:
    - a. Hold down bars.
    - b. Ductbank strapping.

#### 2.05 STEEL CASEMENT PIPE

- A. Grade B seamless black steel
1. Minimum yield: 35,000 psi
  2. Minimum tensile: 60,000 psi
  3. Schedule 40 for sizes 6" and smaller
  4. Schedule 20 for sizes 8" and larger

#### 2.06 STEEL CASEMENT PIPE ACCESSORIES

1. Casing spacers: PSI model PE or equal, as required
2. Pull-on casing end seal: PSI model S or equal, as required

### PART 3 - EXECUTION

#### 3.01 GENERAL

- A. Drawings indicate the intended location of handholes 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. Under 600V, underground splices shall not be permitted. Over 600V, underground splices shall be permitted.
  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 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.
  - E. Install and arrange cabling in handholes in a clean and workmanlike manner. Under 600V, no underground splices shall be permitted in handholes.
  - F. Comply with Division 31 for trenching, backfilling and compacting.

### 3.02 HANDHOLES

#### A. 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 hooks:
  - c. In each handhole, drive 3/4 IN x 10 FT long copper clad ground rod into the earth with approximately 6 IN 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 handhole if the quantity of ground wires exceeds three (3).
      - a) Connect ground bar to ground rod with a #2/0 AWG minimum copper wire.
3. Place handhole on a foundation of compacted 1 IN crushed rock a minimum of 12 IN thick and 6 IN larger than handholes footprint on all sides.
4. Install so that the top of cover is 1/2 IN above finished grade.
5. After installation is complete, backfill and compact soil around handholes.
6. Handhole size:
  - a. Minimum floor dimension of 4 FT x 4 FT and minimum depth of 4 FT.

### 3.03 UNDERGROUND CONDUITS

#### A. General Installation Requirements:

1. All buried conduits shall have a 6 IN wide warning tape installed - depth as indicated.

2. Ductbank types per location:
  - a. Concrete encased ductbank (400psi Slurry):
    - 1) Under railroads.
    - 2) Under roads.
  - b. Concrete encased ductbank (100psi Slurry):
    - 1) Conduits containing medium voltage cables.
    - 2) Pad mounted transformer secondaries.
    - 3) Plant process equipment feeders and controls.
  - c. Steel casing pipe ductbank
    - 1) Under railroads
    - 2) As noted on drawings
  - d. Direct-buried conduit(s) as noted on drawings.
3. Do not place concrete or soil until conduits have been observed by the Engineer or Engineer's designated on-site representative.
4. Do not place within 12 IN of any culvert.
5. Ductbanks shall be sloped a minimum of 4 IN per 100 FT or as detailed on the Drawings.
  - a. Low points shall be at manholes or handholes where possible.
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 IN and less: 3 FT.
    - 2) 1-1/4 to 3 IN: 5 FT.
    - 3) 3-1/2 to 6 IN: 7 FT.
  - b. Place supports and spacers for rigid steel conduit on maximum centers as indicated for the following trade sizes:
    - 1) 1 IN and less: 10 FT.
    - 2) 1-1/4 to 2-1/2 IN: 14 FT.
    - 3) 3 IN and larger: 20 FT.
  - 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 IN vertically.
9. Make conduit joints watertight and in accordance with manufacturer's recommendations.

10. Accomplish changes in direction of runs exceeding a total of 15 degrees by long sweep bends having a minimum radius of 25 FT.
  - a. Sweep bends may be made up of one or more curved or straight sections or combinations thereof.
11. Furnish manufactured bends at end of runs.
  - a. Minimum radius of 18 IN for conduits less than 3 IN trade size and 48 IN for conduits 3 IN trade size and larger.
  - b. All long sweep elbows shall be rigid galvanized steel (RGS).
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 IN
      - b) Diameter: Approximately 1/4 IN 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 FT beyond ends of conduit.
15. 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 manholes or handholes.
  - 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. Depth as indicated.
17. Placement of conduits stubbing into handholes shall be located to allow for proper bending radiuses of the cables.
18. The location of all buried conduits longer than 660 ft shall be identified by above ground utility marker posts.
  - a. Utility marker posts shall be placed a maximum of 1/8 mile apart. Marker posts shall be placed at vaults, hand holes, and on both sides of any under track or under road bore.

- b. Marker posts shall be Rhino 3 rail markers, 66", with Poly Tech coating, white, Item # FR66C-W, with decals pre-installed.
  - 1) Where power only is being installed without fiber the decals shall use artwork "SD-7636K".
  - 2) Where fiber only is being installed without power the decals shall use artwork "SD-8432K".
  - 3) Where power and fiber are both being installed the decals shall use artwork "SD-8431-K".

B. Concrete Encased Ductbank:

- 1. Ductbank system consists of conduits completely encased in minimum 3 IN of red 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 36 IN below grade (under 600V) or 48 IN below grade (over 600V),
  - b. And is not less than 54 IN below base of rail,
  - c. And is below pavement sub-grading.
- 3. For concrete/slurry encased ductbanks the encasement shall extend 10 FT either side of the area.
- 4. Conduit supports shall provide a uniform minimum clearance of 2 IN between the bottom of the trench and the bottom row of conduit.
- 5. Conduit separators shall provide a uniform minimum clearance of 2 IN between conduits or as required in Specification Section 26 05 33 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 36 IN below grade (under 600V) 48 IN below grade (over 600V),
  - b. And is not less than 54 IN below base of rail,
  - c. And is below pavement sub-grading.
- 2. Provide a uniform minimum clearance of 2 IN between conduits or as required in Specification Section 26 05 33 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) or concrete per Division 03 - Concrete.

- 2) Install the multilevel conduits one level at a time.
    - a) Each level is backfilled with the appropriate amount of soil and compaction to maintain the required separations.
3. Minimum buried depth per conduit type:
  - a. Above 600V
    - 1) RGS – 48 IN
    - 2) PVC-RGS – 48 IN
    - 3) Schedule 80 PVC – 84 IN
    - 4) HDPE of equivalent wall thickness to schedule 80 PVC – 84 IN
  - b. Below 600V
    - 1) RGS – 36 IN
    - 2) PVC-RGS – 36 IN
    - 3) Schedule 80 PVC – 42 IN
    - 4) HDPE of equivalent wall thickness to schedule 80 PVC – 42 IN
- D. Steel Casement Pipe(s):
  1. Install so that the top of the uppermost conduit within the casement, at any point:
    - a. Is not less than 36 IN below grade (under 600V) 48 IN below grade (over 600V),
    - b. And is not less than 54 IN below base of rail,
    - c. And is below pavement sub-grading.
  2. Provide 4 IN minimum clearance between casement pipe.
  3. Casement pipe shall be extend a minimum of 15' from centerline of track unless otherwise noted on drawings.
- E. Conduits embedded in concrete structure (e.g., sidewalks, bridge decks) where shown on the Contract Drawings:
  1. Shall not be considered to replace structurally the displaced concrete.
  2. Shall not be larger in outside diameter than one-third the thickness of concrete.
  3. Shall have a minimum spacing of 3 DIA OC.

**END OF SECTION**

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## **SECTION 26 05 98 - POWER DISTRIBUTION CENTER- GEAR HOUSES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Material, design, fabrication and installation requirements for:
  - a. Power Distribution Center – Gear House.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 05 00 - Electrical: Basic Requirements.
- B. Section 26 05 26 - Grounding.
- C. Section 26 13 13 - Medium Voltage Metal-Clad Paralleling Switchgear
- D. Section 26 22 13 - Dry-Type Transformers.
- E. Section 26 24 16 - Panelboards.
- F. Section 26 33 00 - Battery and Battery Charging Systems.

#### **1.03 REFERENCED STANDARDS**

- A. American Institute of Steel Construction (AISC).
- B. Air Movement and Control Association (AMCA).
- C. American National Standards Institute (ANSI):
  1. A250.8, SDI-100 - Recommended Specifications for Standard Steel Doors and Frames.
  2. C2, National Electrical Safety Code (NESC).
  3. C80.1, Rigid Steel Conduit - Zinc-Coated.
  4. C80.3, Electrical Metallic Tubing - Zinc-Coated.
  5. C82 Series, Standards for Electric Lamp Ballasts.
- D. Air Conditioning and Refrigeration Institute (ARI).
- E. ASTM International (ASTM):
  1. A36, Carbon Structural Steel.
  2. A276, Stainless Steel Bars and Shapes.
  3. A666, Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  4. A924, General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
  5. F593, Stainless Steel Bolts, Hex Cap Screws, and Studs.
- F. American Welding Society (AWS):

1. D1.1, Structural Welding Code - Steel.
- G. National Electrical Manufacturers Association (NEMA):
  1. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
  2. WD-1, Wiring Devices.
  3. WD-6, Wiring Devices - Dimensional Requirements.
- H. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
  1. WC 70/ICEA S-95-658, Non-Shielded Power Cable 2000 V or Less.
- I. National Fire Protection Association (NFPA):
  1. 70, National Electrical Code (NEC).
  2. 72, National Fire Alarm Code.
- J. Occupational, Health and Safety Administration (OSHA):
  1. 1910.145, Specification for Accident Prevention Signs and Tags.
- K. Underwriters Laboratories, Inc. (UL):
  1. 6, Rigid Metal Conduit.
  2. 20, General Use Snap Switches.
  3. 83, Thermoplastic-Insulated Wires and Cables.
  4. 498, Attachment Plugs and Receptacles.
  5. 514A, Metallic Outlet Boxes.
  6. 797, Safety Electrical Metallic Tubing.
  7. 924, Emergency Lighting and Power Equipment.
  8. 935, Fluorescent Lamp Ballasts.
  9. 943, Ground-Fault Circuit-Interrupters.
  10. 1029, High Intensity Discharge Lamp Ballasts.
  11. 1570, Fluorescent Lighting Fixtures.
  12. 1572, High Intensity Discharge Lighting Fixtures.

#### 1.04 DEFINITIONS

- A. Power Distribution Center (PDC): Skid mounted, factory fabricated, environmentally controlled, walk-in enclosure used to house low or medium voltage electrical gear.



## 1.05 SYSTEM DESCRIPTION

- A. The PDC will be used to provide an air conditioned and heated enclosure for the MEDIUM-VOLTAGE METAL-CLAD PARALLELING SWITCHGEAR as specified in 26 13 13, BATTERY AND BATTERY CHARGING SYSTEMS as specified in 26 33 00, dry type transformers, panelboards, control and communication systems and related equipment/systems specified, required and as indicated on the Drawings.

## 1.06 SUBMITTALS

### A. Shop Drawings:

1. See Section 26 05 00.
2. Product technical data.
  - a. Doors and hardware.
  - b. Cleaning and painting system.
  - c. HVAC equipment.
  - d. HVAC calculations.
  - e. Electrical equipment.
3. Fabrication and/or layout drawings.
  - a. Structural drawings including but not necessarily limited to:
    - 1) Plan view.
    - 2) Skid detail.
    - 3) Elevations.
    - 4) Stair or landing details.
    - 5) Anchor bolt pattern.
    - 6) Foundation load drawing showing location, direction and magnitude of loads applied to foundation.
  - b. Shipping split information.
  - c. HVAC equipment layout and wiring diagrams.
  - d. Electrical equipment layout and wiring diagrams.
4. Certifications.
  - a. Certification, stamped by a Professional Structural Engineer registered in the State where the project is located, stating the enclosure has been designed in accordance with the specified criteria and loads.
  - b. Certification, stamped by a Professional Mechanical Engineer registered in the State where the project is located, stating the HVAC system has been designed in accordance with the specified criteria and loads.
  - c. Certification, stamped by a Professional Electrical Engineer registered in the State where the project is located, stating the PDC electrical system has been designed in accordance with the specified criteria and loads.

B. Operation and Maintenance Manuals:

1. See Specification Section 01 33 00 for requirements for:
  - a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.
2. See Specification Section 26 05 00 for additional requirements.

C. Miscellaneous:

1. Project list of similar projects dating back a minimum of 3 years.
2. Statement that factory tests were performed.

1.07 QUALITY ASSURANCE

A. Qualifications:

1. The supplier shall have manufactured Power Distribution Centers for similar applications for a minimum of 5 years.
2. Welders shall be certified through the AWS D1.1 4G position.

1.08 DELIVERY, STORAGE, AND HANDLING

A. See Section 26 05 00.

1.09 SITE CONDITIONS

A. Building Code:

1. Uniform Building Code (UBC).

B. Design outside temperatures:

1. High: refer to Special Conditions
2. Low: refer to Special Conditions

C. Design outside relative humidity:

1. High: refer to Special Conditions
2. Low: refer to Special Conditions

D. Altitude above sea level: refer to Special Conditions

E. Roof Live Loads: Per Building Code.

F. Wind Loads:

1. Design structure for wind loading as set forth in the Building Code. Project site conditions are as follows:
  - a. Basic wind speed: refer to Special Conditions
  - b. Site exposure: refer to Special Conditions

G. Seismic (Earthquake) Loads:

1. Design structure for seismic forces as set forth in the Building Code. Project site conditions are as follows:
  - a. Seismic zone: refer to Special Conditions
  - b. Site-structure resonance: 2.0 unless analysis, submitted to and approved by the Engineer, shows a lesser value may be used.

H. Floor Live Loads:

1. 150 PSF minimum uniformly distributed.
2. Concentrated load for the specific floor mounted equipment to be installed.

I. Auxiliary Loads:

1. Other superimposed loads shall be considered as part of the design requirements and combined with the normal design (dead, live, seismic and wind) loads. Auxiliary loads include but not limited to:
  - a. Switchgear, switchboards and/or panelboards.
  - b. Step down transformers.
  - c. Battery systems.
  - d. Cable trays with associated conductors.
2. Magnitude and location of auxiliary loads as shown on Drawings and as specified.
  - a. Contractor to coordinate and verify magnitude and location of auxiliary loads before fabrication.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURED UNITS

A. General:

1. Designed and fabricate PDC for outdoor use per the site conditions specified in paragraph SITE CONDITIONS.
2. Proposed PDC dimensions, door locations and equipment layout are shown on the drawings. Actual dimensions and layout to be coordinate with exact equipment to be installed in the PDC and manufacturer's recommended working clearance (e.g. around drawout circuit breakers; aisle depth to allow to breakers to pass each other), and NEC and NESC working clearances.
3. Welding: AWS D1.1.
4. Fastening hardware shall be zinc plated or stainless steel.
5. Design and fabricate building to minimize or prevent loss of conditioned air and to prevent entry of blowing rain, sleet, snow, moisture or vermin.

6. All switches, outlets, lights, HVAC equipment, panelboards, etc. shall be installed and wired by the manufacturer, such that a single, 480v, 3-phase circuit, installed by electrical contractor and indicated on the drawings, shall energize the entire PDC electric distribution system.
  - a. Provide final loads to engineer.
7. Provide concrete slab sized to actual dimensions of PDC and as indicated in the structural drawings and specifications.

**B. Structure Frame and Base:**

1. Integral welded steel structure base. Bolting shall be permissible for removable panels, doors and door hardware.
2. Welded seamless construction utilizing ASTM A36 structural steel members composed of wide flange, channel angle and tube shapes. Construct remaining frame of square tubular steel. Size members and arrange for proper strength, such that structure is able to withstand the stress and loads which will result when lifting the complete factory fabricated and equipped assemblies.
3. Suitable for installation on a concrete pad or piers.
4. Expansion Anchor Bolts:
  - a. Stainless steel, Type 304, 314 or 316 with matching nut and washer.
  - b. ASTM A276, A666 and F593.
  - c. Provide minimum edge distance cover and spacing as recommended by manufacturer, or as indicated on Drawings whichever is larger.
    - 1) Minimum embedment as recommended by manufacturer or eight diameters of bolt, whichever is larger.
    - 2) Notify Engineer if required depth of embedment cannot be achieved at a particular anchor bolt location.
    - 3) Follow manufacturer's recommendations for installation and torque.
  - d. Submit manufacturer's load test data to verify at least the anchor bolt capacities at the following embedment depths:
    - 1) Data must be based on actual tests performed in unreinforced mass of concrete of not more than 4000 psi compressive strength.
    - 2) Capacity must be at a concrete temperature of at least 130 DegF.

ANCHOR BOLT DIAMETER (IN)	EMBEDMEN T (IN)	MINIMUM ULTIMATE TENSION CAPACITY (KIP)
3/8	3	4.8
1/2	4	8.1
5/8	5	11.4
3/4	6	15.4
7/8	7	20.1
1	8	24.7

1-1/4	10	34.3
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e. Expansion anchor bolts:

- 1) Kwik Bolt by Hilti, Inc.
- 2) Trubolt by ITW Ramset/Red Head.
- 3) Powerbolt by Power Rawl.

C. Floor:

1. Minimum of 3/16 IN steel plate with reinforcement below.
2. Continuously welded seams.
3. Provide gasketed and galvanized cover plates secured to the floor with screws for the cable or conduit cutouts under electrical equipment

D. Exterior Roof:

1. Minimum: 14 GA galvanized steel panels.
2. ASTM A924, G90.
3. Self-framing interlocking design.
4. Gabled with a minimum slope of 1/4 IN per foot.

E. Interior Ceiling:

1. Minimum: 16 GA galvanized steel panels.
2. ASTM A924, G90.
3. Self-framing interlocking design.

F. Walls:

1. Exterior walls.
  - a. Minimum: 14 GA galvanized steel panels.
  - b. ASTM A924, G90.
  - c. Self-framing interlocking design.
  - d. Welding of galvanized steel or rivets shall not be an acceptable method of exterior fastening.
2. Interior walls.
  - a. Minimum: 16 GA galvanized steel panels.
  - b. ASTM A924, G90.
3. Completely frame bulkhead penetrations with 1/4 IN aluminum coverplates with neoprene gasket. Make all wall penetrations in the walls prior to bending with the appropriate machinery. No manual cutting of wall penetrations via jigsaw, plasma torch, etc. shall be permitted.

G. Personnel and Equipment Doors:

1. Personnel doors:

- a. 36 IN x 84 IN.
    - b. Quantity and location as indicated on Drawings (1 minimum).
  - 2. Equipment doors:
    - a. 48 IN x 84 IN.
    - b. Minimum 12 IN removable transom.
    - c. Quantity and location as indicated on Drawings (1 minimum).
  - 3. 1-3/4 IN thick.
  - 4. ANSI A250.8 Level 3, Model 2 and physical performance level A, insulated minimum R10.
  - 5. Galvanized per ASTM A924, A60 coating.
  - 6. Doors shall be compatible with door hardware as required.
  - 7. If only two doors are provided they shall be located at opposite ends of the gear house.
  - 8. Hardware:
    - a. Provide panic hardware and keyed locks.
    - b. Hinges:
      - 1) Three, non-removable pin type.
      - 2) Stainless steel.
      - 3) Minimum: 4-1/2 IN x 5 IN.
    - c. Weather strip.
    - d. Automatic closer with built-in hold open device and all weather fluid.
    - e. Threshold.
  - 9. Frame:
    - a. Minimum: 14 GA steel.
    - b. Galvanized per ASTM A924, A60 coating.
  - 10. OSHA style danger sign: "DANGER, HIGH VOLTAGE, KEEP OUT".
- H. Electrical Gear Rear Access Doors (if required):
- 1. Minimum: 14 GA galvanized steel.
  - 2. Insulated with metal inner skin over insulation welded to door.
  - 3. Drip shields/water flashing.
  - 4. Gasketed.
  - 5. Stainless steel hinge.
  - 6. 3-point latching system with stainless steel padlockable handles.
  - 7. Hold open device.
  - 8. OSHA style danger sign: "DANGER HIGH VOLTAGE".

I. Insulation:

1. Roof, walls and floor insulation: Minimum R-11 flame retardant or flame resistant insulation.
2. Secured to exterior walls and floor.

J. Painting:

1. Clean, prime and paint all surfaces.
2. Paint Systems - General:
  - a. P=prime coat. F1, F2 . . . Fn = first finish coat, second finish coat . . . nth finish coat.
  - b. If two finish coats of same material are required, Contractor may, at his option and by written approval from paint manufacturer, apply one coat equal to mil thickness of two coats specified.
  - c. Products specified are manufactured by Themec.
3. Exterior surfaces:
  - a. Manufacturer standard harsh condition paint system.
  - b. Color: as noted on the drawings.
4. Interior wall and ceiling:
  - a) Manufacturer Standard for interior.
  - b. Color: as noted on the drawings.
5. Interior floor color:
  - a. Waterborne Epoxy-Amine Adduct Skid Resistant Primer and Waterborne Epoxy-Amine Adduct Top Coat.
    - 1) Prime coat(s):
      - a) P1=1 coat, 4 mils, Series 287 Enviro-Tread (Waterborne Epoxy-Amine Adduct), VOC=1.78
      - b) P1 Additive = 1 coat, 4 mils, 287-300c Skid Resistant Sand (10 LBS per GAL of mixed material)
    - 2) Finish coat:
      - a) F1=1 coat, 4 mils, Series 287 Enviro-Tread (Waterborne Epoxy-Amine Adduct), VOC=1.78
  - b. Color: as noted on the drawings.

K. Heating, Ventilating and Air Conditioning:

1. HVAC system sized considering:
  - a. Ambient site conditions.
  - b. Dimensions of the building.
  - c. Solar heat generated within the building.
  - d. Heat generated by the equipment within the building.

- e. Sensible cooling capacity, not the total cooling capacity, will maintain an ambient temperature within the building between 55 DegF and 80 DegF.
  - f. One or more air conditioning unit(s) as required for the required capacity.
  - g. Ventilation system with one or more exhaust fan(s) and motorized intake louvers that provide an economy cooling feature when air conditioning unit is not required and emergency ventilation in the event of failure to the air conditioning unit.
2. Packaged air conditioning units:
- a. ARI certified.
  - b. UL listed.
  - c. Materials:
    - 1) Casing: Heavy gage steel.
    - 2) Casing insulation: 1 IN, 3/4 LB fiberglass blanket.
  - d. Casing: Removable access panels.
  - e. Fan section:
    - 1) Fans:
      - a) Twin blower, multiple centrifugal type.
      - b) Statically and dynamically balanced.
      - c) Solid shafts.
      - d) Forward curved fans.
      - e) Die formed fan housings.
      - f) Permanently lubricated ball bearings.
  - f. Motors: See motor paragraph within this specification.
  - g. Direct drive.
  - h. Cooling coils – direct expansion:
    - 1) ARI certified.
    - 2) Material:
      - a) Aluminum.
      - b) Copper with aluminum fins for use in administration units only.
    - 3) Fin spacing: Minimum 80 fins per foot.
    - 4) Minimum standard operating limit: 250 psi.
    - 5) Size and capacity as required.
  - i. Filter section:
    - 1) Filters: 30 percent 2 IN pleated.
    - 2) Access doors for filter removal.



- j. Drain pan with drain connections.
  - k. Control: See Environmental Control Panel (ECP) paragraph within this specification.
3. Motor - NEMA design squirrel cage induction type:
- a. Designed and applied in compliance with NEMA and IEEE for the specific duty imposed by the driven equipment.
  - b. Permanently lubricated sealed bearings conforming to ABMA standards with built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element.
  - c. Premium efficient type that are measured in accordance with NEMA MG-1.
  - d. Motor insulation in accordance with NEMA standards for Class F insulation with Class B temperature rise above a 40 DegC ambient.
  - e. Design motors for continuous duty.
  - f. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 15 percent greater than the maximum HP requirements of the driven equipment over its entire operating range.
    - 1) 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.
  - g. Motor enclosure and winding insulation application:
    - 1) DPFG: dry locations or within equipment housings.
    - 2) TEFC: wet locations.
4. Environmental Control Panel (ECP):
- a. Permits the automatic selection of the appropriate function (heating, air conditioning or economy cooling) based on an adjustable, pre-selected maximum (for cooling) and minimum (for heating) temperature setting on the panel.
  - b. Operator-selectable timed thermostat that will permit manual override of the automatic selection by the operator to a temporary selection of temperature. The timer will return the control to the automatic selection after eight hours.
  - c. Each function, heating, air conditioning, or ventilation interlocked to prevent the simultaneous operation of more than one function.
  - d. A pre-selected temperature indicates an air conditioning failure and initiates the emergency ventilation system and disables the air conditioning function.
  - e. Normally open alarm contacts for emergency ventilation and power failure conditions.
  - f. Visible indication of the following functions: automatic operation, manual operation, power on, heat on, air conditioner on, economy cooling on, emergency venting on.

L. Electrical Equipment:

1. Distribution equipment:
  - a. See Drawings for one-line diagram and floor plan layout. Note that drawings are not to scale – provide floorplans based on actual equipment sizes – provide working clearances per NEC.
  - b. See Section 26 24 16 for panelboards.
    - 1) Provide minimum quantity of one (1) - 48 Circuit, 208V, 3-phase, kaic as calculated (minimum 20kaic) panelboard for gear house lighting, receptacle and air conditioning, and battery charger loads. Provide 480V-208V 2-phase xfmr. Provide minimum ten (10) spare 20A, 1-pole breakers. Provide ampacity as calculated plus an additional 25% minimum. Provide panel schedule and calculated loads to engineer.
  - c. See Section 26 22 13 for dry-type transformers.
  - d. See Section 26 28 16 for safety switches.
2. Grounding:
  - a. Locate a stainless steel ground pad or lug in opposite corners of the base.
  - b. Provide grounding electrode system per the drawings and Section 26 05 26.
  - c. Provide green grounding conductor in all HVAC, lighting and receptacle conduits.
3. Gear House Power: HVAC, lighting and receptacles to be powered from distribution equipment as described above.
4. Lighting:
  - a. Interior luminaires:
    - 1) Fluorescent twin tube with wrap around prismatic diffuser, F32T8 lamps and emergency electronic ballast with 90 minutes runtime.
    - 2) ANSI C82.1, UL 935, 1570.
    - 3) Illumination: Minimum of 30 footcandles at 30 IN above floor. Controlled by 2- or 3-way switches as required at each personnel door.
  - b. Interior emergency lighting units:
    - 1) Two head (lamp) continuously charged battery powered unit.
    - 2) UL 924.
    - 3) Located above each personnel door.
  - c. Exterior luminaires:
    - 1) Minimum 5000 lumen LED wall pack with emergency backup battery.
    - 2) ANSI C82.4, UL 1029, 1572.
    - 3) Located above each door and as indicated on the drawings. All luminaires controlled by a photocell.
5. Wiring devices:
  - a. Switches:

- 1) Switches shall be located adjacent to each personnel and equipment door.
- 2) Toggle type, quiet action, Standard Specification grade.
- 3) Self grounding with grounding terminal.
- 4) Solid silver cadmium oxide contacts.
- 5) Rugged urea housing and one-piece switch arm.
- 6) Rated 20 A, 120/277 Vac.
- 7) Switch handle color: Ivory.
- 8) UL 20, 514A; NEMA WD-6.
- 9) Coverplate: Zinc plated malleable iron or galvanized steel..
- b. Receptacles:
  - 1) Receptacles shall be located adjacent to each personnel door indoor and exterior.
  - 2) Duplex, straight blade, Standard Specification grade.
  - 3) Brass triple wipe line contacts.
  - 4) One piece grounding system with double wipe brass grounding contacts and self grounding strap.
  - 5) Rated 20 A, 125 Vac.
  - 6) High impact nylon body.
  - 7) Receptacle body color: Ivory.
  - 8) Types:
    - a) Interior/Exterior: Feed-through type ground fault circuit interrupter with test and reset buttons.
  - 9) Configuration: NEMA 5-20R.
  - 10) Coverplate:
    - a) Interior: Zinc plated malleable iron or galvanized steel.
    - b) Exterior: Weather resistant zinc plated or aluminum, gasketed, self-closing cover, heavy duty, while in use - using stainless steel spring.
  - 11) Standards: UL 498, 514A, 943; NEMA WD-1, WD-6.
6. Conduit:
  - a. Minimum 3/4 IN.
  - b. Electrical metallic tubing:
    - 1) ANSI C80.3, UL 797
    - 2) Interior applications.
  - c. Rigid galvanized steel:
    - 1) ANSI C80.1, UL 6

- 2) Exterior applications.
- 7. Outlet boxes:
  - a. Recessed locations:
    - 1) Hot-dip galvanized steel.
    - 2) Conduit knockouts and grounding pigtail.
    - 3) NEMA OS 1, UL 514A.
  - b. Surface mounted locations:
    - 1) Zinc plated cast iron or die-cast copper free aluminum with manufacturers standard finish.
    - 2) Threaded hubs and grounding screw.
    - 3) UL 514A.
- 8. Conductors for building HVAC, lighting and receptacles:
  - a. Conform to NEMA/ICEA WC 70/S-95-658 and UL 83 for type THHN/THWN and THHN/THWN-2 insulation.
  - b. Minimum 12 AWG for power and 16 AWG for control.

## 2.02 SOURCE QUALITY CONTROL

### A. Factory Tests:

- 1. Continuity test of all wiring installed.
- 2. Operational/functional test of HVAC system, lights and receptacles.
- 3. Perform factory tests as indicated for distribution equipment as specified in associated Division 26 specification.

## 2.03 MAINTENANCE MATERIALS

- A. Two separate one-quart containers of touchup paint, of each type and color of finish paint.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Connect PDC to support foundation as required by manufacture's recommendations and submitted drawings.

### 3.02 FIELD QUALITY CONTROL

- A. Provide a seven day notice to OWNER and ENGINEER prior to testing. All testing to be witnessed by OWNER or ENGINEER.
- B. Field Tests.
  - 1. Operational/functional test of HVAC system, lights and receptacles.

2. Perform field tests as indicated for distribution equipment as specified in associated Division 26 specification.

**END OF SECTION**

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## **SECTION 26 08 13 - ACCEPTANCE TESTING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Basic requirements for acceptance testing.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 13 13 - Medium Voltage Metal-Clad Paralleling Switchgear.
- B. Section 26 32 14 - Engine Generator Diesel.
- C. Section 26 33 00 - Battery and Battery Charging Systems.

#### **1.03 REFERENCED STANDARDS:**

##### **A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):**

1. 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems.
2. 400.3, Guide for Partial Discharge Testing of Power Cable Systems in a Field Environment.

##### **B. InterNational Electrical Testing Association (NETA):**

1. ATS-2013, Standard for Acceptance Testing Specifications for Electric Power Equipment and Systems.

##### **C. Nationally Recognized Testing Laboratory (NRTL).**

##### **D. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):**

1. 455-78-B, Optical Fibres - PART 1-40: Measurement Methods and Test Procedures - Attenuation.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

##### **B. General for all equipment:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Qualifications of testing firm and personnel to include:
  - a. Company resumes with similar experience.
  - b. Individual Resumes demonstrating qualifications and experience.
    - 1) Copies of all Certifications and Licenses.

3. Testing plan for:
  - a. Electrical Equipment.
  - b. Electrical Connections.
  - c. Control Systems.
4. Prior to energizing equipment:
  - a. Coordinated phasing diagram.
  - b. Photocopies and pdf format of continuity tests.

#### 1.05 QUALITY ASSURANCE

##### A. Qualifications:

1. A testing firm shall be used for any testing and analysis the contractor is not qualified or capable of performing
  - a. The testing firm shall be an independent, third party entity which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of the equipment or systems being evaluated.
  - b. The testing firm shall be regularly engaged in the testing of electrical equipment, installations, and systems.
  - c. The testing firm shall use personnel who are regularly employed for testing services.
  - d. The testing firm shall be a NETA Accredited Company designated by the InterNational Electrical Testing Organization.
2. Field personnel:
  - a. Technicians performing electrical tests and inspections shall be trained and experienced concerning the apparatus and systems being evaluated. These individuals shall be capable of conducting the tests in a safe manner and with complete knowledge of the hazards involved. They must evaluate the test data and make a judgment on the serviceability of the specific equipment.
  - b. As an alternative, field personnel may be certified by the equipment manufacturer.
3. Testing personnel:
  - a. Technicians shall be certified in accordance with ANSI/NETA ETT-2010, Standard for Certification of Electrical Testing Technicians. Each supervising technician shall hold a current certification, Level III or higher, in electrical testing.
  - b. As an alternative, supervising technician may be certified by the equipment manufacturer.

##### B. 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.

## PART 2 - PRODUCTS

### 2.01 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 field acceptance testing requirements specified in this Specification Section.

## PART 3 - EXECUTION

### 3.01 FIELD QUALITY CONTROL

- A. General:
  1. Employ and pay for services of in-house qualified personnel and testing firm and equipment manufacturer's field service representatives.
  2. Furnish equipment manufacturer's field quality control services and testing as specified in the individual equipment Specification Sections.
  3. Perform and report on all tests required by the equipment manufacturer's Operation and Maintenance Manual.
  4. Provide testing of electrical equipment and connections in accordance with the Electrical specifications.
  5. 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 (1) 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. Perform testing on Electrical equipment and connections in accordance with the Electrical specification requirements.
  - 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 50 HP or above.
    - b. Ensure motor has been lubricated.
    - c. Bump motor to check for correct rotation.
  - 3. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.
- F. Other Testing:
  - 1. Perform tests and inspections not specifically listed but required to assure equipment is safe to energize and operate.
  - 2. Subbase that supports the equipment base and that is made in the form of a cast iron or steel structure that has supporting beams, legs, and cross members that are cast, welded, or bolted shall be tested for a natural frequency of vibration after equipment is mounted.
    - a. The ratio of the natural frequency of the structure to the frequency of the disturbing force shall not be between 0.5 and 1.5.
- G. Infrared Thermography Testing Program:
  - 1. Perform infrared thermography testing for equipment specified in other Divisions during the Equipment Demonstration Period.
    - a. Perform on all rotating and reciprocating equipment having drivers 25 HP or greater.
    - b. Perform on electrical equipment and connections: See Specification Section 26 08 13.
  - 2. Additional requirements for infrared thermography monitoring and testing equipment:
    - a. Temperature range: -10 to 350 DegC.
    - b. Accuracy: +/-2 percent or 2 DegC, whichever is greater.
    - c. Repeatability: +/-1 percent or 1 DegC, whichever is greater.
    - d. Temperature indication resolution: 0.1 DegC.
    - e. Minimum focus distance: 0.3 meters.
    - f. Output in color palettes: JPEG, BMP, or other digital format compatible with Windows.

3. Perform inspection per ASTM E1934.
  - a. Operate VFD driven equipment at 100 percent speed during thermographic inspection.
4. Acceptability of electrical connections and components based on temperature comparison between components and ambient air temperatures not greater than 10 DegC per ASTM E1934.
5. Acceptability of motors and equipment bearings based on temperature rise not greater than 5 DegC above the equipment and/or bearing manufacturers published criteria.
6. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.

H. Equipment Vibration Monitoring and Testing Program:

1. Perform vibration monitoring and testing for equipment specified in other Divisions during the Equipment Demonstration Period.
2. Provide vibration testing on all rotating and reciprocating equipment having driver 25 HP and greater.
3. Additional requirements for vibration monitoring and testing equipment:
  - a. Frequency response: 0.18 Hz to 25 kHz.
  - b. Resolution: 6400 lines.
  - c. Amplitude range: 18 bit for 96 dB dynamic range.
  - d. Supports measurements of acceleration, velocity, displacement, envelope demodulation for bearing defect detection.
  - e. Capable of two-place computer balancing.
  - f. Requirements for vibration sensor:
    - 1) Sensitivity: +/- 5 percent at 25 DegC= 100 mV/g.
    - 2) Acceleration range: 80 g peak.
    - 3) Amplitude nonlinearity: 1 percent.
    - 4) Frequency response:
      - a) +/- 5 percent = 3-5000 Hz.
      - b) +/- 10 percent = 1-9000 Hz.
    - 5) Permanently attach vibration test and monitoring mounting pads to mechanical equipment at location recommended by the equipment manufacturer or as recommended by the testing firm.
    - 6) Acceptability of equipment conditions, except pumps, based on ISO 1940-1 Balance Quality Grade G2.5 criteria.
    - 7) Acceptability of pumping equipment to be based on HI 9.6.4 criteria.
    - 8) Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.

4. Utilize an Engineer approved testing agency to perform vibration monitoring and testing on equipment defined in the schedule as shown on the drawings.
5. Permanently attach vibration test and monitoring mounting pads to the equipment at locations recommended by the equipment manufacturer or as recommended by the vibration testing agency.
6. Utilize mounting pads suitable for permanent installation and for incorporation into a predictive maintenance program.
7. For variable speed equipment provide vibration testing at 1 Hz increments throughout entire operating range.
8. Diagnosis to include, but is not limited to the following:
  - a. Unbalance.
  - b. Misalignment.
  - c. Bent shaft.
  - d. Journal bearing related problems.
  - e. Rolling contact bearing problems.
  - f. Mechanical looseness.
  - g. Resonance.
  - h. Foundation flexibility.
  - i. Electrically induced problems.
  - j. Pump problems.
  - k. Fan problems.
  - l. Coupling problems.
  - m. Drive belt problems.
  - n. Gear problems.
  - o. Centrifugal compressor problems.
  - p. Electric motor induced vibration from VFD or VFD carrier frequency.
9. Provide machinery condition diagnosis based on an acceptable machinery vibration severity guide or machinery fault guide analysis provided by the testing agency, ISO 1940 Balance Quality Grade 6.3 as a minimum.
10. Tolerances for pumping equipment shall be per HI published standards.
11. Repair or replace equipment shown to be out of range of the specified tolerance until the equipment meets the specified normal operation range required in the machinery fault guide analysis.
12. Document testing with written report.
  - a. Report to include initial testing results, acceptance criteria, corrective action taken to meet acceptance, verification of corrective action and acceptance report and baseline.

### 3.02 SPECIFIC EQUIPMENT TESTING REQUIREMENTS

#### A. Switchgear and Switchboards:

1. Perform inspections and tests per NETA ATS 7.1.
2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
3. Perform the following additional tests:
  - a. Weatherproof switchgear/switchboards:
    - 1) Verify correct location, operation and current draw of heaters.
    - 2) Verify correct operation of thermostat.

#### B. 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 percent of nominal under normal load after approval of Engineer.
4. Record as-left tap connections.

#### C. Transformers - Liquid Filled:

1. Perform inspections and tests per NETA ATS 7.2.2. except the following:
  - a. Bushing power factor.
  - b. Core insulation resistance.
2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
3. 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 start-up.
4. Adjust tap changer setting as required to provide secondary voltage within 2-1/2 percent of nominal under normal load after approval of Engineer.
5. Record as-left tap changer setting.

#### D. Cable - Low Voltage:

1. Perform inspections and tests per NETA ATS 7.3.2.

#### E. Cable - Medium Voltage:

1. Perform inspections and tests per NETA ATS 7.3.3.
2. Perform both Dielectric Withstand and Baseline Diagnostic Tests.

F. Cable - Optical Fiber:

1. Perform inspections on tests per NETA 7.25 and TIA/EIA/ANSI 455-78-B, including:
  - a. Optional time domain reflectometer test.
  - b. Power attenuation test.
  - c. Gain margin test.

G. Medium Voltage Source Transfer System;

1. Perform applicable inspections and test per:
  - a. NETA ATS 7.5.1.2 Switches, Air , Medium Voltage, Metal-Enclosed Interrupter Switches.
  - b. Manufacturer's instructions.

H. Medium Voltage Circuit Breakers:

1. Perform inspections and tests per NETA ATS 7.6.3.
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. Control wiring insulation resistance.
  - b. Minimum trip and close voltage.
  - c. Overpotential.
  - d. Power factor.
4. Perform the following additional tests:
  - a. High-potential vacuum integrity test per manufacturer's recommendations.

I. 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.

J. 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.

K. Protective Relays:

1. Perform inspections and tests per NETA ATS 7.9.
  - a. Tests to be performed using secondary injection of 3 PH current and potential at final settings.
  - b. Test at manufacturer's recommended test points and critical timing points identified on relay setting sheet.
2. Perform all tests identified as optional per NETA ATS.
3. Perform the following additional tests:
  - a. Verification of direct trip of associated lockout relay or circuit breaker(s) by using relay test function or shorting trip contact at relay case.
  - b. Microprocessor-based relays:
    - 1) Complete commissioning procedure per manufacturer's instructions, followed by tests of each relay element at final settings.
    - 2) Verification of all internally-programmed logic.
  - c. Verification of all auxiliary input and output signals.
  - d. Verification of power supply/self-diagnostic alarm contact and remote annunciation.
4. Record as-left settings.

L. 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.

M. 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.

N. 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.
- O. Ground Fault Protection:
1. Perform inspections and tests per NETA ATS 7.14.
  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. Control wiring insulation resistance.
  4. Perform the following additional tests for four-wire systems:
    - a. Primary current injection into switchgear bus with test set configured to simulate transformer source and high current jumper used to simulate unbalanced load and ground fault conditions.
    - b. Verify no tripping for unbalanced load on each feeder and each main breaker.
    - c. Verify no tripping for unbalanced load across tie breaker for dual-source schemes.
    - d. Verify tripping for ground fault on load side of feeder each feeder and on each main bus.
    - e. Verify tripping for ground fault on a single feeder and on each main bus through tie breaker(s) for multiple-source schemes.
- P. Motors:
1. Perform inspections and tests per NETA ATS 7.15.
- Q. Motor Controllers:
1. Perform inspections and tests per NETA ATS 7.16 and 7.17.
  2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
- R. Generators (small generators):
1. Perform inspections and tests per NETA ATS 7.15.
  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 Specification Section 26 32 14.
- S. DC Power Systems:
1. Perform inspections and tests per NETA ATS 7.18.
  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. Cell impedance test.
- T. 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 and proper operation of the system in normal and emergency scenarios.
  - 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**

## **SECTION 26 09 13 - ELECTRICAL METERING DEVICES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Digital metering equipment.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Section 26 05 00 - Electrical: Basic Requirements.**

##### **B. Section 26 08 13 - Acceptance Testing.**

#### **1.03 REFERENCED STANDARDS**

##### **A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):**

1. C57.13, Standard Requirements for Instrument Transformers.

##### **B. National Electrical Manufacturers Association (NEMA):**

1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

##### **C. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):**

1. C12.20, For Electricity Meter - 0.2 and 0.5 Accuracy Classes.

##### **D. National Fire Protection Association (NFPA):**

1. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

##### **E. Underwriters Laboratories, Inc. (UL):**

1. 508, Standard for Safety Industrial Control Equipment.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. 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.

##### **B. Operation and Maintenance Manuals:**

1. See Specification Section 01 33 00 for requirements for:
  - a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.

2. See Specification Section 26 05 00 for additional requirements.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Eaton.
  2. General Electric Company.
  3. Square D Company.

### 2.02 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 DegF to 150 DegF.
  7. Standards:
    - a. NEMA/ANSI C12.20.
    - b. UL 508.
- B. Type 'C' High Range Meter:
  1. Model: Square D Powerlogic or equal.
  2. Display the following minimum electrical parameters (accuracy):
    - a. RMS current per phase (+0.2 percent full scale).
    - b. RMS voltage line-to-line and line-to-neutral (+0.2 percent full scale).
    - c. Real power (W): 3 PH total (+0.4 percent full scale).
    - d. Apparent power (VA): 3 PH total (+0.4 percent full scale).
    - e. Reactive power (VAR): 3 PH total (+0.4 percent full scale).
    - f. Power factor (+1.0 percent).
    - g. Frequency (+0.04 percent).
    - 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 percent).
    - k. VAR-hours (1.0 percent).

- l. VA-hours (0.5 percent).
- m. Ampere demand (+0.2 percent full scale).
- n. Watt demand (+0.4 percent full scale).
- o. VAR demand (+0.4 percent full scale).
- p. VA demand (+0.4 percent full scale).
3. NEMA/ANSI C12.20, Class 0.2 revenue accuracy.
4. Communication ports and protocols: 100BASE-TX or better Ethernet Communications , and/or Modbus TCP and/or as required for a functioning system.
5. Supply voltage: 120 Vac.

## 2.03 ACCESSORIES

### A. Communication Cable:

1. Belden as indicated on drawings or manufacturer recommended cable.
2. Ethernet cable shall conform with CATEGORY 6 or better specifications. Individual Ethernet cable distances shall not exceed 100 meters.
3. Standard: NFPA 262.

### B. Software:

1. Power management and control software.

## PART 3 - EXECUTION

### 3.01 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 Types:

1. Type C meters: Connected to 13.8kV breakers and 480V main breakers, unless otherwise indicated on the Drawings.
  - a. Provide integral to equipment as indicated.
  - b. Provide 125Vdc or 120Vac as available.
  - c. If meter needs to be provided adjacent to equipment, provide enclosure, NEMA rated as appropriate.

#### C. Master Control Display Configuration:

1. See Specification 26 13 13.

2. Type 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 (7) day kW, kVA and kVAR trend average.
  - m. Peak demands shall be resettable by the operator.
3. Meter Types shall have the following 15 minute trending graphs.
  - a. Duration: Adjustable, with a seven (7) day default.
  - b. Phase A current: Minimum, maximum and average.
  - c. Phase B current: Minimum, maximum and average.
  - d. Phase C current: Minimum, maximum and average.
  - e. Neutral current: Minimum, maximum and average.
  - f. Phase A Watts: Minimum, maximum and average.
  - g. Phase B Watts: Minimum, maximum and average.
  - h. Phase C Watts: Minimum, maximum and average.
  - i. Watts total.
  - j. Phase A Voltamps: Minimum, maximum and average.
  - k. Phase B Voltamps: Minimum, maximum and average.
  - l. Phase C Voltamps: Minimum, maximum and average.
  - m. Voltamps total.
  - n. Phase A power factor: Minimum, maximum and average.
  - o. Phase B power factor: Minimum, maximum and average.
  - p. Phase C power factor: Minimum, maximum and average.
  - q. Power factor total.

### 3.02 TRAINING

- A. A qualified factory-trained manufacturer's representative shall provide the Owner with 8 HRS of on-site training in the operation and maintenance of the metering system and its components.

**END OF SECTION**

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## **SECTION 26 09 16 - ELECTRICAL CONTROLS AND RELAYS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Operator control devices (selector switches, pushbuttons, indicator lights, etc.).
2. Control devices (timers, relays, contactors, etc.).
3. Control panels and operator stations.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 05 00 - Electrical: Basic Requirements.
- B. Section 26 09 10 – Control Panels

#### **1.03 REFERENCED STANDARDS**

##### **A. National Electrical Manufacturers Association (NEMA):**

1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
2. ICS 2, Industrial Control and System Controllers, Contactors and Overload Relays Rated 600 Volts.
3. ST 1, Specialty Transformers (Except General-Purpose Type).

##### **B. Underwriters Laboratories, Inc. (UL):**

1. 508, Standard for Safety Industrial Control Equipment.
2. 508A, Standard for Safety Industrial Control Panels.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data:
  - a. Provide submittal data for all products specified in PART 2 of this Specification:
  - b. Control panel bill of material.
  - c. See Section 26 05 00 for additional requirements.
3. Fabrication and/or layout drawings.
  - a. Control panel interior and exterior layout.
  - b. Control panel wiring diagrams.

##### **B. Operation and Maintenance Manuals:**

1. See Specification Section 01 33 00 for requirements for:
  - a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.
2. See Specification Section 26 05 00 for additional requirements.

#### 1.05 QUALITY ASSURANCE

##### A. Miscellaneous:

1. Supplier of Industrial Control Panels shall build control panel under the provisions of UL 508A.
  - a. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control Panel" prior to shipment to the jobsite.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Pilot devices and relays:
    - a. Allen Bradley
    - b. Idec.
    - c. Potter & Brumsfield.
    - d. Time Mark.
    - e. ATC Diversified Electronics.
  2. Lighting Contactors:
    - a. Square D Company
  3. Contactors:
    - a. Eaton.
    - b. General Electric Company.
    - c. Square D Company.
  4. Photocells and time clocks:
    - a. Grasslin.
    - b. Tork.
    - c. Intermatic.
    - d. Paragon.
  5. Alarm devices:
    - a. Edwards Signaling.
    - b. Federal Signal Corp.

6. Terminal blocks:
  - a. Phoenix Contact.
  - b. Allen-Bradley.
7. Enclosures:
  - a. Hoffman Engineering Co.
  - b. Wiegmann.
  - c. Eaton B-Line.
  - d. Adalet.
  - e. Stahlin.

## 2.02 PILOT DEVICES

### A. General Requirements:

1. Standards: NEMA ICS 2, 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:

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 for START or ON and red color for STOP or OFF.
- f. 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. Glass lens.
- 6. Color code lights as follows:
  - a. Green: OFF or stopped; valve open.
  - b. Amber: Standby; auto mode; ready.
  - c. Red: ON or running; valve closed.

## 2.03 RELAYS

A. General Requirements:

- 1. Standards: NEMA ICS 2, 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:
- 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 HRS.
    - i. Repeat accuracy: +1 percent.
  - 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 HRS.
    - h. Repeat accuracy: +1 percent.
  - 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 sec or 5 - 180 sec.
- f. Repeat accuracy: Greater than +10 percent.

## 2.04 LIGHTING CONTACTORS

### A. General Requirements

- 1. Lighting contactor as specified on the Drawings. Custom built by Square D.
  - a. 30 A fused overcurrent device = Model #8903REQ3948G1
  - b. 50 A fused overcurrent device = Model #8903REQ3948G2
  - c. 100 A fused overcurrent device = Model #8903REQ3948G3
  - d. 30 A breaker overcurrent device = Model #8903REQ3948G4
  - e. 50 A breaker overcurrent device = Model #8903REQ3948G5
  - f. 100 A breaker overcurrent device = Model #8903REQ3948G6

## 2.05 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.

## 2.06 PHOTOCELLS AND TIME CLOCKS

### A. Photocells:

1. Weatherproof enclosure.
2. Adjustable turn-on range, initially set at 1.0 footcandles.
  - 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. 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 HR 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.

## 2.07 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 FT.
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.
  - e. NEMA 4X, hazardous location surface mounting in wet and hazardous areas.
    - 1) Fixed volume: 97 dB at 10 FT.

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.



## 2.08 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 percent.
6. Sealed against dirt and moisture.
7. Tamperproof.

## 2.09 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 DegC.
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.
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.

## 2.10 ENCLOSURES

A. 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.
- 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 SF or heavier than 25 LBS.
  - e. Split covers when heavier than 25 LBS.
  - 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.
- B. Operator Control Stations:
  - 1. NEMA 4/13 rated:
    - a. Die cast aluminum body with manufacturers standard finish.
    - b. Gasketed die cast aluminum cover with manufacturers standard finish.
    - c. Number of device mounting holes as required.
  - 2. NEMA 4X rated:
    - a. Type 304 or 316 stainless steel body.
    - b. Gasketed Type 304 or 316 stainless steel cover.
    - c. Number of device mounting holes as required.

3. NEMA 7 and 9 rated:
  - a. Zinc plated cast iron or die-cast copper free aluminum, with threaded hubs, grounding screw and with manufacturers standard finish.
  - b. "EDS" or "EFS" style.
  - c. Single or multiple gang or tandem.
  - d. Accessories: 40 mil PVC exterior coating and two (2) mil urethane interior coating.

## 2.11 MAINTENANCE MATERIALS

- A. Provide 100 percent replacement lamps for indicating lights.
- B. Provide 10 percent replacement caps for indicating lights.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
- B. Control Panels:
  1. Size as required to mount the equipment.
  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 or highly corrosive.
  4. Permitted uses of NEMA 7 enclosure:
    - a. Surface mounted in areas designated as Class I hazardous.
  5. Permitted uses of NEMA 12 enclosure:
    - a. Surface mounted in areas designated as dry and/or dusty architecturally or non-architecturally finished areas.
- C. Operator Control Stations:
  1. Permitted uses of NEMA 4/13 enclosure:
    - a. Surface mounted in areas designated as dry and/or dusty architecturally or non-architecturally finished areas and wet.
  2. Permitted uses of NEMA 4X enclosure:
    - a. Surface mounted in areas designated as wet and/or corrosive or highly corrosive.

3. Permitted uses of NEMA 7 enclosure:

- a. Surface mounted in areas designated as Class I hazardous with PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.

3.02 FIELD QUALITY CONTROL

- A. See Section 26 05 00.

**END OF SECTION**

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## **SECTION 26 09 43 - RADIO OPERATED LIGHTING CONTROL**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Radio Operated lighting control

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

- ##### **A. UP standard radio operated lighting control for areas indicated.**

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- ##### **A. Radio control panel may be integrated with lighting contactor(s) to control specified areas.**

**END OF SECTION**

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## **SECTION 26 12 19 – PAD-MOUNTED DISTRIBUTION TRANSFORMERS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Distribution pad-mounted transformers.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Section 26 05 00 - Electrical: Basic Requirements.**

##### **B. Section 26 08 13 - Acceptance Testing.**

##### **C. Section 26 05 13 - Medium Voltage Cable.**

#### **1.03 REFERENCED STANDARDS**

##### **A. American National Standards Institute (ANSI).**

##### **B. FM Global (FM).**

##### **C. Institute of Electronic and Electronics Engineers, Inc. (IEEE):**

1. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600 V.
2. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
3. C57.12.25, Transformers - Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with Separable Insulated High-Voltage Connectors; High Voltage, 34 500 GrdY/19 920 Volts and Below; Low-Voltage, 240/120 Volts; 167 kVA and Smaller
4. C57.12.34, Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers (2500 kVa and Smaller) - High-Voltage: 34 500 GrdY/19 920 Volts and Below; Low-Voltage: 480 Volts and Below.
5. C57.12.70, Standard Terminal Markings and Connections for Distribution and Power Transformers.
6. C57.12.80, Standard Terminology for Power and Distribution Transformers.
7. C57.12.90, Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers.
8. C62.11, Standard for Metal-Oxide Surge Arresters for Alternating Current Power Circuits (>1 kV).

##### **D. National Fire Protection Association (NFPA):**

1. 70, National Electrical Code (NEC).

## 1.04 SUBMITTALS

### A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
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 00 for additional requirements.
3. Fabrication and/or layout drawings.
  - a. Outline Drawings including dimensions, weigh and identification of all components and features.
  - b. Nameplate drawing.
4. Certifications:
  - a. Letter stating compliance with current Department of Energy efficiency requirements.

### B. Operation and Maintenance Manuals:

1. See Specification Section 01 33 00 for requirements for:
  - a. The mechanics and administration of the submittal process.
2. The content of Operation and Maintenance Manuals:
  - a. Instruction and maintenance manual.
  - b. Product technical data provided in the submittal.
  - c. Outline drawing updated for as-built conditions.
  - d. Actual impedance data.
  - e. Factory test report.
  - f. Acceptance testing report.

### C. Informational Submittals:

1. See Specification Section 26 05 00 for additional requirements for4 the mechanics and administration of the submittal process.
2. Factory test report.

## 1.05 DELIVERY, STORAGE, AND HANDLING.

- A. See Specification Section 26 05 00.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

UP General Specifications

PAD-MOUNTED DISTRIBUTION TRANSFORMERS

Issued: 03-26-2019

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1. ABB
2. Eaton
3. Howard Industries

## 2.02 THREE-PHASE TRANSFORMER

### A. General:

1. Transformer to be designed and constructed in accordance with:
  - a. IEEE C57.12.00, IEEE C57.12.28, IEEE C57.12.34, IEEE C57.12.70, IEEE C57.12.80.

### B. Ratings and Configuration:

1. Type: Outdoor, pad-mounted, liquid-immersed, self-cooled, compartmental type.
2. Operation and application: Step-down operation.
3. Configuration:
  - a. Dead-front, loop-feed primary.
4. Voltage and kVA Ratings: As specified on the Drawings.
5. Number of phases: Three (3).
6. Frequency: 60 Hz.
7. Polarity: ANSI standard.
8. Percent impedance: ANSI standard.
9. Basic impulse level (BIL):
  - a. Primary: refer to Special Conditions
  - b. Secondary: refer to Special Conditions
10. Temperature rise: 65 DegC.
11. Efficiency: Meet all current Department of Energy rules.
12. Connections:
  - a. Delta or Wye: As indicated on the Drawings.
  - b. Primary: 200 ampere bushing wells and insert for loadbreak elbows. 600 ampere one-piece bushing/well for deadbreak elbows.
  - c. Secondary:
    - 1) Less than 500 kVA: Four-hole, spade-type minimum or as required.
    - 2) 750 – 1500 kVA: Six-hole, tin plated, spade-type minimum or as required.
    - 3) 2000 kVA and greater: Twelve-hole, tin-plated, spade-type minimum or as required.
    - 4) Removable ground strap on neutral terminal.
13. Tap-changer: De-energized type on H-winding, five (5) total with:

- a. Two (2) 2.5 percent above and two (2) 2.5 percent below nominal tap.
- 14. Sectionalizing oil immersed load break primary switch:
  - a. See drawings for rating and positions.
- C. Components:
  - 1. Core and Coil:
    - a. Core material: Aluminum or copper.
    - b. Windings designed to reduce losses.
    - c. Insulating materials rated for 120 DegC class.
    - d. For grounded wye to grounded wye application, the core assembly shall be a 5-legged distributed-gap, wound core.
      - 1) For ratings above 2500 kVA, a stacked core design may be utilized.
    - e. Core material: High-grade, grain-oriented, non-aging silicon core steel with high magnetic permeability, low hysteresis and eddy current losses.
      - 1) Magnetic flux densities are to be kept well below saturation to allow for a minimum 10 percent overvoltage excitation.
      - 2) Properly annealed to reduce stresses induced during the manufacturing processes and reduce core losses.
    - f. Core frame:
      - 1) Designed to provide maximum support for the core and coil assembly.
      - 2) Welded or bolted to ensure maximum short-circuit strength.
    - g. Designed and manufactured to meet the short circuit requirements of ANSI C57.12.90.
    - h. Vacuum processed and energized or baked in an oven prior to tanking to set the epoxy coating on the insulating paper and remove moisture from the insulating prior to vacuum filing.
  - 2. Tank and Terminal Cabinet Enclosure:
    - a. Carbon steel reinforced with external internal or sidewall braces, with all seams and joints continuously welded.
    - b. Design the tank and attached components to withstand pressures greater than the required operating design value without permanent deformation.
    - c. Sealed-tank construction:
      - 1) 1000kVA and below: Bolted main tank cover.
      - 2) 1500kVA and above: Welded main cover and bolted tamper-resistant handhole.
    - d. Lifting lugs welded to tank.
    - e. Steel divider between high-voltage (right side) and low-voltage (left side) compartments.

- f. No exposed screws, bolts, or other fastening devices that are externally removable.
  - g. Tamper resistant per IEEE 57.12.28.
  - h. Cabinet depth: IEEE standard or 24 IN minimum.
  - i. No openings through which foreign objects such as sticks, rods, or wires may contact live parts.
  - j. 1 IN upper fill plug.
  - k. 1 IN drain valve with sampling device.
  - l. Automatic pressure relief device.
  - m. Grounding pads:
    - 1) 500kVA: Two (2) steel pads with one (1) hole.
    - 2) Above 500kVA: Two (2) stainless steel pads with two (2) holes.
3. Door:
- a. Each compartment will have removable, three-point latching hinged doors equipped for latching in the open position.
  - b. The high-voltage compartment door will have a fastening device that is accessible only through the low-voltage compartment.
  - c. The hinge assemblies made of corrosion-resistant material.
    - 1) Provide stainless-steel hinge pins of 3/8 IN minimum diameter.
  - d. Both compartment doors capable of securing with a single padlock having a maximum 1/2 IN DIA shackle.
  - e. Door secured with a penta head bolt with collar.
4. Overcurrent protection:
- a. Provide an expulsion-type, bayonet fuse (under oil, user serviceable) in series with the current limiting fuse.
  - b. Internal partial-range current limiting backup fuse.
  - c. Provide full range protection two fuse system.
  - d. Dual element, expulsion-type, Bay-O-Net fuse.
    - 1) Under oil, field replaceable.
    - 2) In series with current limiting fuse.
    - 3) Provide Bay-O-Net assembly with flapper valve.
    - 4) Provide metal drip shield on drip guard.
5. Finish:
- a. Manufacturer's standard corrosion protection system in accordance tihe IEEE C57.12.28.
  - b. Dark "padmount" green. Munsell number 7GY 3.29/1.5

6. Dielectric Fluid:
  - a. Tested for compatibility with the transformer.
  - b. Mineral Oil, Certified Non-PCB.
  - c. Permanently affix nameplate to outside of tank stamped "Non PCB".
7. Accessories:
  - a. Liquid level indication.
  - b. Dial-type thermometer.
  - c. Provisions for pressure vacuum gauge.
  - d. Stainless steel or laser-scribed anodized aluminum nameplate, with date of manufacturer.
  - e. Cable parking stands, one per bushing.
  - f. Provisions for secondary metering.

## 2.03 SINGLE PHASE TRANSFORMERS

### A. General:

1. Transformer to be designed and constructed in accordance with IEEE C57.12.00, IEEE C57.12.25, IEEE C57.12.70, IEEE C57.12.80.

### B. Ratings and configurations:

1. Type: Outdoor, pad-mounted, liquid-immersed, self-cooled, compartmental type.
2. Operation and application: Step-down operation.
3. Configuration:
  - a. Dead-front, loop-feed primary.
4. Voltage and kVA Ratings: As specified on the Drawings.
5. Number of phases: One (1).
6. Frequency: 60 Hz.
7. Polarity: ANSI standard.
8. Percent impedance: ANSI standard.
9. Basic Impulse Level (BIL):
  - a. Primary: refer to Special Conditions
  - b. Secondary: refer to Special Conditions
10. Temperature rise: 65 DegC.
11. Efficiency: Meet all current Department of Energy rules.
12. Sound Rating: Per NEMA TP 1
13. Connections:
  - a. Primary: 200 ampere bushing wells and insert for loadbreak elbows..

- b. Secondary: Four-hole, tin-plated, spade type.
- 14. Tap-changer: De-energized type on H-winding, five (5) total, two (2) 2.5 percent above and two (2) 2.5 percent below nominal tap.
- C. Components:
  - 1. Core and Coil:
    - a. Core Material: Aluminum or copper.
    - b. Windings designed to reduce losses.
    - c. Insulating materials rated for 120 DegC class.
  - 2. Tank and Terminal Cabinet Enclosure:
    - a. Sealed-tank construction.
    - b. No exposed screws, bolts, or other fastening devices that are externally removable.
    - c. No openings through which foreign objects such as sticks, rods, or wires may contact live parts.
    - d. 16 IN deep cabinet (minimum)
    - e. Automatic pressure relief device.
    - f. Stainless steel NEMA ground pads.
  - 3. Door: Hinged flip-top.
  - 4. Unit protection:
    - a. Provide unit protection with a partial-range current limiting fuse on each primary phase (under oil, factory replaceable only).
    - b. Provide an expulsion-type, bayonet fuse (under oil, user serviceable) in series with the current limiting fuse.
  - 5. Finish:
    - a. Manufacturer's standard corrosion protection system.
    - b. Dark "padmount" green. Munsell number 7GY 3.29/1.5
  - 6. Dielectric Fluid:
    - a. Tested for compatibility with the transformer.
    - b. Mineral Oil, Certified Non-PCB.
    - c. Permanently affix nameplate to outside of tank stamped "Non PCB".
  - 7. Accessories:
    - a. Stainless steel or laser-scribed anodized aluminum nameplate, with date of manufacturer.
    - b. Box pad (ground sleeve) to increase cable termination height and cable storage.
      - 1) Material: Fiberglass Reinforced Composites (FRC) incorporating fire retardant polyester resins and a UV stabilizer coating.

2) Height: 18 IN minimum.

2.04 SURGE ARRESTORS

- A. Standards: IEEE 386 and IEEE C62.11.
- B. MOV gapless elbow type or parking stand type.
- C. Elbow Connector:
  - 1. One-piece design, comprised of an insulation layer and outer shield constructed of EPDM rubber.
  - 2. 200A, dead front, load break type with hot stick pulling eye and grounding tab.
- D. Voltage Class: As indicated on the Drawings.
- E. Arrestor MCOV Rating: refer to Special Conditions

2.05 SOURCE QUALITY CONTROL

- A. Factory Tests: At a minimum provide all routine tests as specified in IEEE C57.12.00 in accordance with IEEE C57.12.90.

2.06 MAINTENANCE MATERIALS

- A. Touch-up paint, two (2) separate one (1) quart containers.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install on pad as detailed on the Drawings and in accordance with manufacturer's instructions.
- B. Transformer locations as shown on the Drawings are intended to be used as a guide.
  - 1. Field conditions may affect actual transformer location.
  - 2. Coordinate final location with Owner.
- C. Install three-phase transformers on concrete pad per detail on the Drawings.
- D. Install single-phase transformers on concrete pad per detail on the Drawings.
- E. See Specification Section 26 05 13 for cable termination requirements.

3.02 FIELD QUALITY CONTROL

- A. Acceptance Testing: See Specification Section 26 08 13.

**END OF SECTION**



## **SECTION 26 13 13 - MEDIUM VOLTAGE METAL-CLAD PARALLELING SWITCHGEAR**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Material and installation requirements for:
  - a. Medium voltage metal-clad switchgear.
  - b. Medium voltage circuit breakers and associated protective relays.
  - c. Medium voltage fuses.
  - d. Generator Controls.
  - e. Master Controls.
  - f. Field Services.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 10 14 00 - Identification Devices.
- B. Section 26 05 00 - Electrical: Basic Requirements.
- C. Section 26 05 98 - Power Distribution Center – Gear Houses.
- D. Section 26 08 13 - Acceptance Testing.
- E. Section 26 09 13 - Electrical Metering Devices.
- F. Section 26 09 16 - Control Equipment Accessories.
- G. Section 26 13 23 - Sectionalizing Equipment.
- H. Section 26 33 00 - Battery and Battery Charging Systems.
- I. Division 40 - Process Interconnections.

#### **1.03 REFERENCED STANDARDS**

- A. American National Standards Institute (ANSI).
- B. Institute of Electrical and Electronics Engineers (IEEE).
  1. C37.04, Standard Rating Structure for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
  2. C37.06, Standard for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis -Preferred Ratings and Related Required Capabilities for Voltage Above 1000 V.
  3. C37.11, Standard Requirements for Electrical Control for AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
  4. C37.20.2, Standard for Metal-Clad Switchgear.

5. C37.90, Standard for Relays and Relay Systems Associated with Electric Power Apparatus.
  6. C57.13, Requirements for Instrument Transformers.
  7. C62.11, Standard for Metal-Oxide Surge Arresters for AC Power Circuits (> 1 kV).
- C. National Electrical Manufacturers Association (NEMA):
1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  2. SG 4, Alternating-Current High-Voltage Circuit Breakers.
- D. Underwriters Laboratories, Inc. (UL):
1. 44, Thermoset-Insulated Wires and Cables.

#### 1.04 SYSTEM DESCRIPTION

- A. Switchgear configured to parallel multiple generators and to parallel on site generation and to provide open transition between generator and utility.
- B. Contractor shall refer to drawings for equipment operating voltage.
1. Generators will match system voltage and be provided with neutral resistors or reactors sized per ANSI and NEMA standards to limit single phase-to-ground fault current to the three-phase fault current value.
- C. Switchgear, controls and other equipment as specified and indicated in the contract documents shall be provided in a Power Distribution Center - Gear House. All layouts, clearances, calculations and coordination shall be provided. Supply one complete package as specified and indicated in the contract documents.
1. See Specification Section 26 05 98.

#### 1.05 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  2. Product technical data including:
    - a. Submittal data for all products specified in PART 2 of this Specification Section.
      - 1) See Specification Section 26 05 00 for additional requirements.
    - b. Bill of material.
    - c. Instrument transformer performance curves and data.
    - d. Nameplate data for all equipment.
    - e. Mounting details and loading information for concrete foundation design.
    - f. Installation instructions and procedures.
  3. Fabrication and/or layout drawings:

- a. General arrangement plan view showing door swings, cable entrance locations, shipping splits, etc.
  - b. Cross sections, elevations and details.
  - c. Mimic bus layout.
  - d. Complete single-line and three-line diagrams.
  - e. AC and/or DC schematics of breaker control, protective relaying, etc.
  - f. Point-to-point/terminal block wiring diagrams.
- 4. Test reports:
  - a. Certified reports of all design tests shall be available upon request.
  - b. Certified reports of all factory production tests.
  - c. Results of all field tests.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.
  - 2. See Specification Section 26 05 00 for additional requirements.
  - 3. Fabrication and/or layout drawing shall also be provided in electronic format (MicroStation or AutoCAD).
  - 4. Provide recommended spare parts list in paper format and electronic format in either MS Word or MS Excel.
  - 5. Relay Setting Sheets.
- C. Informational Submittals:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Factory Acceptance Test (FAT):
    - a. FAT test plan.
  - 3. Field Performance and Demonstration:
    - a. Field Performance and Demonstration plan.
  - 4. Protective Coordination Study.
    - a. Relay setting sheets.
  - 5. Submit proposed functional performance test procedure to Engineer for review a minimum of six (6) weeks before scheduling testing specified in PART 3 of this Specification Section.
  - 6. Record of test results, inspections and procedures witnessed or performed by factory service representative.

## 1.06 QUALITY ASSURANCE

### A. Qualifications:

1. History of service in similar applications for not less than three (3) years.

## 1.07 DELIVERY, STORAGE, AND HANDLING

- ### A. See Specification Section 26 05 00.

## 1.08 PROJECT/SITE CONDITIONS

- ### A. Switchgear assembly shall perform as intended under the following conditions without damage to equipment, structure, or derating:

1. At ambient temperatures from -30 DegC through +40 DegC.
2. At altitude through 3300 FT.

- ### B. Switchgear shall be suitable for installation in the space available (see Drawings).

## PART 2 - PRODUCTS

## 2.01 MANUFACTURERS

- ### A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

#### 1. Circuit breakers:

- a. ABB.
- b. Eaton.
- c. General Electric.
- d. Siemens.
- e. Square D Company.

#### 2. Instrument transformers:

- a. ABB.
- b. ITI.

#### 3. Protective relays:

- a. As scheduled.

#### 4. Utility grade control switches:

- a. Electrosch Series 24.
- b. GE SB Series.

#### 5. Test switches:

- a. ABB.
- b. States Electric.

- ### B. Submit request for substitution in accordance with Specification Section 26 05 00.

## 2.02 METAL-CLAD SWITCHGEAR

### A. Ratings:

1. Operating voltage: As indicated on the Drawings.
2. Rated maximum voltage: As indicated on the Drawings
3. Amperage: As indicated on the Drawings.
4. Number of phases: 3.
5. Frequency: 60 Hz.
6. Short circuit current: 18 kA RMS SYM at maximum voltage.
7. Basic impulse level (BIL): 95 kV.
8. Comply with IEEE C37.06 for ratings not specified.

### B. Construction:

1. Standards: IEEE C37.20.2, NEMA SG 4.
2. Individual, freestanding, vertical sections housing various combinations of circuit breakers and auxiliaries and bolted together to form a rigid metal-clad switchgear assembly.
3. Front and rear access.
4. Vertical sections isolated from adjoining sections by grounded metal barriers.
5. Circuit breakers, buses, instrument transformers, control power transformers, and cable terminations isolated from each other by grounded metal barriers.
6. Provide shutters that close automatically when the circuit breaker is in the test position, disconnected position or withdrawn.
7. Provide rails to allow withdrawal of the circuit breakers to the test, disconnected and withdrawn positions from the operating position.
  - a. Provide means to padlock the racking mechanism in the fully withdrawn position.
8. Provide fully equipped spaces for future and spare circuit breakers shown on the Drawings, complete with relays, current transformers, control devices, and all internal wiring connected to field wiring terminal boards to permit future installation of circuit breakers with a minimum of work required in the switchgear cubicles.
9. Enclosure:
  - a. NEMA 1, minimum.
  - b. Hinged, gasketed and removable front doors over each circuit breaker or auxiliary equipment compartment.
    - 1) Doors shall be able to be closed with the breaker in the fully withdrawn position.
    - 2) Provide access to racking mechanism through door to allow racking with door closed.

- 3) Door shall have a bonding wire across hinge to structure.
  - c. Bolted on rear covers for each vertical section.
    - 1) Half-height.
    - 2) With lifting handles.
  - d. Interior and exterior steel surfaces cleaned and painted with rust inhibiting primer and manufacturer's standard paint.
- C. Buses:
- 1. Material: Tin- or silver-plated copper rectangular bars.
  - 2. Insulation: Void-free heat shrink or fluidized epoxy coating.
  - 3. Bus supports, stand-off insulators and through-bushings: Porcelain or epoxy.
  - 4. Main bus: Amperage rating as indicated on the Drawings.
  - 5. Ground bus: 1/4 x 2 IN copper, minimum, continuous over length of the switchboard.
  - 6. Provisions for future extension from both ends of lineup.
  - 7. Bus joints, when required, fully insulated and connected using through bolts and conical spring-type washers for maximum conductivity.
  - 8. Arrange buswork so that Phase A, B and C are arranged from left to right (viewed from the front of the switchgear), front to back or top to bottom.
- D. Control Power:
- 1. Individual generator controls: 24 Vdc from engine starting system.
  - 2. Master controls: 125 Vdc supplied from external sources.
  - 3. Switchgear trip and close power: 125 Vdc from external sources.
  - 4. Provide a single external connection point for each bus and for each control assembly.
  - 5. Separate internal circuits with individual overcurrent devices required for:
    - a. Trip circuit: Each circuit breaker.
    - b. Close circuit: Each circuit breaker.
    - c. Bus differential and lockout relays: Each bus.
  - 6. Provide a diode-based "best battery" circuits for the main and tie and generator circuit breakers to allow trip and close power to be supplied from either bus.
  - 7. Provide a power supervision relay on the load side of each overcurrent device.
    - a. Contacts wired in series or parallel to provide a common DC Power Failure alarm for each bus.

## 2.03 COMPONENTS

### A. Circuit Breakers.

- 1. Standards: IEEE C37.04, IEEE/ANSI C37.06, IEEE/ANSI C37.11.

2. Ratings:
  - a. Rated voltage: 15 kV.
  - b. Continuous current: As indicated on the Drawings.
  - c. Frequency: 60 Hz.
  - d. Short Circuit Current: 50 kA RMS SYM at 15 kV.
  - e. Duty cycle: Two (2) unit operations with 15 second interval between operations (CO - 15s - CO).
  - f. Rated interrupting time: 5 cycles.
3. Vacuum type interrupter.
4. Silver-plated copper primary disconnecting contacts.
5. Horizontal drawout type.
6. Operated by a motor-charged stored energy spring mechanism.
  - a. Normally charged by an electric motor with an emergency manual handle.
7. Silver-plated copper secondary contacts automatically engage in the connected position and are manually engaged in the test position.
8. Interlocks:
  - a. Prevent closing of a breaker between connected and test positions.
  - b. Trip breaker upon insertion or removal from enclosure.
  - c. Discharge stored energy mechanisms upon insertion or removal from enclosure.
9. Control voltages:
  - a. 125 Vdc closing power, closing control and tripping.
  - b. From external DC supply as specified and indicated on Drawings.
10. Auxiliary and control devices:
  - a. One (1) trip coil.
  - b. One (1) close coil.
  - c. Auxiliary contacts: Minimum of twelve (12) "a" and twelve (12) "b."
  - d. Cell mounted auxiliary contacts as required: MOC and TOC type.
  - e. Contact wear indicators.
  - f. Manual trip button.
  - g. Manual close button.
  - h. Open-Close indicator.
  - i. Manual spring charging capability.
  - j. Spring charge-discharge indicator.
  - k. Event counter.

1. Nameplate.
11. Auxiliary devices mounted on switchgear:
  - a. Breaker control switch.
  - b. Red and green indicator lights indicating breaker contact position.
- B. Control Switches:
  1. General:
    - a. Double-sided, double-wiping, knife-type rotary contacts.
    - b. Silver plated contacts.
    - c. Engraved escutcheon plate.
  2. Breaker control:
    - a. Three (3) position, spring return: Close, Trip and Normal.
    - b. Red and green mechanical target on escutcheon plate.
    - c. Pistol-grip handle.
  3. Lockout Relays:
    - a. Two (2) position: Trip and Reset.
    - b. Manual reset.
    - c. Red and green mechanical target on escutcheon plate.
    - d. Pistol-grip handle.
- C. Auxiliary Control Devices:
  1. Selector switches, pushbuttons, indicating lights and control relays as specified in Specification Section 26 09 16.
- D. Metering:
  1. Owner:
    - a. See Specification Section 26 09 13 for meter requirements.
- E. Current Transformers:
  1. Standard: IEEE C57.13.
  2. Current ratios: As required.
  3. Window type current transformers shall be accessible from front of cubicle to permit changing or adding, without disconnecting bus joints.
  4. Accuracy, minimum: Standard relay accuracy as listed in IEEE C37.20.2.
  5. Ground sensor current transformers:
    - a. Window type.
    - b. Single ratio: 50/5.



6. Connections:
  - a. All taps wired out to shorting terminal block.
  - b. Connections between CTs made at shorting terminal block, not behind shutters.
  - c. Ground connections made at shorting terminal block.

F. Potential Transformers:

1. Standard: IEEE C57.13.
2. Voltage ratio: As required.
3. Drawout mounted with primary and secondary disconnecting contacts and automatic grounding in open position.
4. Primary current-limiting fuses.
5. Secondary fuses or circuit breaker.
6. Mechanical and thermal ratings coordinated with breaker ratings.
7. Accuracy class: 0.3 at burden W thru Z and 0.6 at burden ZZ.
8. Thermal burden rating: Exceed maximum connected burden.

G. Test Switches:

1. Base and cover constructed of polycarbonate insulating material.
2. Semi-flush, through panel mounting with screw or stud type terminal connections on rear of switches separated by polycarbonate barriers.
3. Provide 120V, 20A circuit from Gear House panelboard for test circuit power.
4. Individual switches:
  - a. Ratings: 600 V, 30 amp.
  - b. Knife blade type separated by insulated barriers.
  - c. Phenolic insulated handle with provisions for identification cards.
  - d. Provisions for horizontal interlocking bar.
  - e. Types:
    - 1) Potential (transformer) non-shorting.
    - 2) Current (transformer) non-shorting with test jack.
    - 3) Current (transformer) shorting, make-before-break.
5. Test plugs:
  - a. Provide one (1) separate source test plug for each switchgear lineup.
  - b. Provide one (1) series test plug for each different test switch configuration for each switchgear lineup.
6. ABB Type FT-1 or equal.

H. Heavy-duty (Utility) Terminal Blocks:

1. General:
  - a. Ratings: 600 V, 30 amps.
  - b. Molded one-piece thermoplastic body.
  - c. Washer head terminal screws to accommodate up to a #10 AWG wire.
2. Current transformer shorting terminal blocks:
  - a. Short circuiting strip for shorting screws and screw “parking stations.”
  - b. GE Type EB-27.
3. Non-shorting terminal blocks:
  - a. GE Type EB-25.

I. Battery and Battery Charging System:

1. See Specification Section 26 33 00.

J. Surge Arresters:

1. Standard: IEEE C62.11.
2. MCOV rating: As indicated on the Drawings.
3. Metal oxide type, station class.

K. Control Wire:

1. Conductor shall be copper with 600 V rated insulation.
2. Conductors shall be stranded.
3. Minimum #12 AWG.
4. Surface mark with manufacturers name or trademark, conductor size, insulation type and UL label.
5. Conform to UL 44 for type SIS or MTW insulation.

L. Wire Terminators:

1. Ratings: 600 V.
2. Tin plated high strength copper alloy.
3. Solderless, non-insulated, ring type.

2.04 CONTROLS – GENERAL REQUIREMENTS

- A. Provide one (1) generator control assembly for each engine generator and one (1) master control assembly for the system.
1. Master Control Assembly:
    - a. Free-standing control panel or integrated into switchgear assembly.
  2. Generator control assembly:
    - a. Integrated into switchgear assembly.

- B. Provide control assemblies for all generators indicated, including future generators.
  - 1. Make provisions for future generator control in system controls so that a minimum of work and re-commissioning is required to integrate an additional engine-generator into the system.
- C. Free-standing Control Panel Construction:
  - 1. Fully front-accessible.
  - 2. Indoor drip-proof enclosure.
  - 3. Painted sheet steel with rigid structural frame.
  - 4. Full-length hinged door with 3-point roller-cam latching mechanism and wind brace.
  - 5. Provisions for anchoring to control room floor and to back wall.
- D. Wiring:
  - 1. 600 V copper type SIS or MTW.
  - 2. Minimum #12 AWG for potential and current circuits.
  - 3. Ring terminal connectors for current, potential and DC voltage conductors.
  - 4. Labeled at both ends to correspond to the schematic and wiring diagrams.
  - 5. Provide segregation of wiring between voltage levels and signal types:
    - a. DC and AC potential and current circuits.
    - b. 24 Vdc digital signals.
    - c. 24 Vdc analog signals.
    - d. RTD and thermocouple circuits.
- E. Terminal Boards:
  - 1. 600 V, 30 A, screw-clamp type with center marker strip for all current, potential and DC voltage wiring; GE Type EB-25.
  - 2. Provide for all field wiring and inter-unit connections.
  - 3. Provide for internal wiring of control panel as required.
  - 4. Segregate field wiring terminal boards from internal and inter-unit wiring terminal boards.
- F. Arrangement of Controls and Indicators:
  - 1. Provide color-coded mimic bus, minimum 1/2 IN wide bright plastic laminate, continuous between control panels to show arrangement and connections of generators, circuit breakers, and feeders.
  - 2. Arrange operator controls and indicators in an intuitive manner following the mimic bus and logical groupings.
- G. Connect all generator control panel equipment current circuits to metering current transformers in switchgear.
  - 1. Relaying current transformers are dedicated to generator protection relay.

## 2.05 MASTER CONTROLS

### A. General:

1. Master control assembly provides system control functions.
2. Includes the items listed below as a minimum, plus all other items and components required for specified performance and function.

### B. Operator Interface Station

1. The Operator Interface Station shall be located in the PDC. The Station shall be as described in Specification 26 05 98.

### C. Circuit breaker control switches with indicator lights shall be located on the Mimic One Line Diagram in the PDC. The control switches shall be for the Utility Main, Generator and Tie circuit breakers, and the feeder circuit breakers.

### D. For circuit breaker testing only, control switches and indicating lights shall be mounted on the door of each circuit breaker. These test switches shall be capable of tripping and closing the circuit breakers only when the circuit breaker is racked out to the TEST position.

### E. Over/under frequency and over/under voltage sensors to detect abnormal condition on generator bus.

1. Over/under frequency and overfrequency failure causes alarm horn to sound and red fail lamp to light.
2. Underfrequency condition initiates load shedding as well as sounding alarm horn and lighting red fail lamp.

### F. Regulated power supply derived from 125Vdc switchgear station battery system.

1. Provide proper operation over input voltage range of 115 to 130 Vdc.
2. Provide diode-based “best battery” selector to provide control power supply and downstream of the overcurrent protection on each separate branch of the 125Vdc supply.
3. Provide over- and undervoltage monitoring of control power supply and downstream of the overcurrent protection on each separate branch of the 125 Vdc supply.

## 2.06 CONTROL SYSTEM INTERFACE

### A. Operator interface to the PLC based control system shall be via a 21” touchscreen LCD panel PC. Panel PLC shall be mounted in front of the low-voltage cabinet in the switchgear section which shall be accessible to the operator without having to enter the high-voltage side. Panel PC shall be equipped with the following features:

1. Intel Core i5 CPU
2. 8 GB RAM SO-DIMM
3. 2 X 2.5” SATA HDDs in RAID configuration
4. RS-232 and RS-485 serial ports
5. Gigabit Ethernet ports

6. Windows 7 OS
  7. IP 65 compliant
  8. UL listed
- B. Acceptable manufacturers include:
1. Advantech model PPC-4211 W
  2. Owner approved equal
- C. Panel PC shall be loaded with the latest version of Rockwell Automation FactoryTalk View SE HMI software. Vendor shall purchase licenses for FactoryTalk View SE Server and FactoryTalk View Studio configuration software for developing and testing the HMI applications. All licenses shall be turned over to the Owner following final acceptance of equipment by Owner. Vendor shall also provide RSLinx Enterprise. Provide a single-point open Ethernet/IP or Modbus TCP interface to the panel PC to transfer and display all generator and system control, status, alarm, and shutdown data points on the HMI screen.
- D. A separate alarm summary screen shall be provided on the HMI that lists all active and operator acknowledged but not cleared alarms. Once an alarm has been cleared by the PLC it shall be removed from the alarm summary screen but shall be stored in the historical data screen. Historical alarm and event logging shall be set up by the vendor.
- E. The main screen on the HMI shall display the Paralleling Switchgear data and the SCADA network showing the North and South loops with all Sectionalizing Switchgear. The operator shall be able to press any switchgear graphic which shall take the operator to a separate screen displaying all I/O points associated with that switchgear. On this screen the operator shall be able to open and close any switch or read power meter data associated with that switchgear. Power meter data shall also be displayed on the main screen. All screens shall have a navigation button that shall take the operator to the main screen as well as a navigation button to take the operator to the alarm summary screen. Popup shall also be provided as applicable.
- F. The vendor shall follow Union Pacific WINC HMI Standards for developing HMI graphics. It shall be the vendors responsibility to obtain the standards document from Union Pacific or the Engineer. The standard provides guidelines to an HMI developer including but not limited to default colors, symbols, text and screen layout. The HMI developer shall be expected to adhere to these standards. Any deviation from the standards shall be brought to the Owner's attention for resolution by the Owner.

## 2.07 CONTROL COMPONENTS

- A. General Requirements:
1. Solid state devices:
    - a. Meet or exceed transient overvoltage withstand test and surge withstand capability tests (SWC) per IEEE C37.90.
    - b. In addition, where UL standards exist for components, devices and/or assemblies, such standards apply.

2. Provide control relays suitable and adequately rated for intended service in control system.
  - a. Provide relays used in low-voltage, low-current DC control circuits with gold flashed contacts to ensure positive contact make.
  - b. Relays used for other than logic and dry contact switching to have contact ratings suitable for make and carry of their duty current at voltage of operation.
  - c. Provide plug-in type relays for control circuit duty with retaining clips and transparent plastic or glass covers.
    - 1) Clearly mark relays for control voltage.
- B. Use utility-grade control switches for the following applications:
  1. Circuit breaker control circuits, including breaker control switches, synchroscope switches, and auto/manual selector switches.
  2. Instrument selector switches.
  3. Engine mode selector switches.
- C. Use industrial-grade, heavy-duty, oil-tight control switches for low-voltage, low-current applications.
- D. Programmable Logic Controllers (PLCs) – If indicated on Drawings :
  1. Generator controls shall be comprised of power supply, single CPU, and single I/O connections on a common backplane or extended backplanes.
  2. Master controls shall utilize redundant power supplies, CPUs and I/O in a hot standby configuration.
    - a. PLC failure or power supply failure in mid-sequence shall not interrupt control action.
  3. Power supplies shall separately fed from the 125Vdc station batteries.
  4. CPUs shall be of sufficient memory to effectively double the computing requirements of the processor without running out of memory.
  5. Scan rates shall not exceed 30 msec.
  6. CPUs shall have a separate programming port that shall not be connected to any other device thus held in reserve for programming functions only.
  7. CPUs shall be programmable in ladder logic or some other higher-level language.
  8. PLC hardware and software shall be fail safe.
    - a. If a failure occurs with the individual engine PLC, the engine controls and circuit breakers still operate manually and the PLC failure will be alarmed.
  9. Acceptable manufacturers:
    - a. Rockwell Automation ControlLogix 1756-L72
    - b. Modicon (Schneider Electric) Momentum
    - c. Owner approved equal

E. Ethernet Switches:

1. Ethernet switches shall be rack-mount fixed configuration switches.
2. Compact 1 rack unit (RU)
3. Rugged design for industrial Ethernet application
4. Fanless convection cooling
5. Front and read LED panels allowing reverse mounting and easy reading of switch status
6. Switches shall support common Industrial Ethernet protocols
7. Acceptable manufacturers:
  - a. Cisco Industrial Ethernet 3010 series or;
  - b. Owner approved equal

F. Router:

1. Provide a rack-mount router for future connection to Owner's network.
2. Router shall be connected to the Ethernet switches and be equipped to transmit data to the Owner network (future).
3. Router shall have built-in firewall and gigabit Ethernet switching capability.
4. Acceptable manufacturers:
  - a. Cisco 2900 series

G. Network Rack Unit:

1. Provide a 6U wall-mounted rack which shall house the Ethernet switches and router.
2. Adjustable mounting depths with front vertical rackmount rails
3. Ventilated or clear front door and side panels for increased airflow
4. Locking, removable side panels
5. Locking, reversible front door
6. Acceptable manufacturers:
  - a. Tripplite model SRW6U
  - b. APC (Schneider Electric) model NetShelter WX 6U
  - c. Owner approved equal

2.08 PROTECTIVE RELAYING

A. General:

1. Microprocessor based multi-function type, unless otherwise specified.
2. Mounting: Semi-flush.
3. Functions: As indicated and specified in the contract documents.
4. Utility grade IEEE C37.90.

5. Protective relays shall be provided with drawout construction or test switches for testing, maintenance and interchange flexibility.
  - a. Test switches or test blocks shall be provided in each current, potential circuit and trip circuit.
6. Protective Coordination:
  - a. The supplier shall perform a protective coordination study for all relays in the switchgear.
  - b. The study shall be closely coordinated with the Engineer, including a minimum of one (1) meeting.
  - c. The supplier shall do all programming of the relays based on the approved coordination study.
- B. Protective relays indicated on the drawings and scheduled below are not intended as part of the automatic control system except where specifically indicated as providing signals to the PLC.
  1. Vendor shall provide all sensors and relays necessary for control system operation independently of these relays.
  2. Utility protection relay will provide communication to Master Control Panel to indicate line voltage and/or frequency outside of acceptable range.
  3. Generator protection relay may provide contact closure to Master Control Panel to indicate generator line voltage and frequency within acceptable range.
- C. Relay Schedule:
  1. Utility protection relay (Device UPR):
    - a. Schweitzer Engineering Laboratories SEL-351-7.
    - b. Beckwith Electric M-3450.
  2. Generator protection relay (Device GPR):
    - a. Schweitzer Engineering Laboratories SEL-300G.
    - b. General Electric SR-489.
    - c. Beckwith M-3425A.
    - d. Basler GPS-100.
  3. Feeder protection relay: (Device FPR):
    - a. Schweitzer Engineering Laboratories SEL-351.
    - b. General Electric SR-750.
    - c. Beckwith M-3410.
    - d. Basler BE1-851.
  4. Bus differential (Device 87B): Basler Electric BE1-87B.
  5. Lockout relay (Device 86): Electroschwitch Series 24 LOR.
  6. Synchronism-check relay (Device 25C): Basler Electric BE1-25.



D. Tripping Schemes:

1. All overcurrent and fault protection relay functions directly trip the circuit breakers through trip contacts or lockout relay contacts in the breaker control circuit.
  - a. These functions do not go through the PLC.
2. Feeder relays shall direct trip feeder circuit breakers.
3. Feeder protection relays (FPR) will have two (2) setting groups, one (1) enabled when the bus is supplied from the utility or the utility and on-site generation; the other enabled when the bus is supplied only from the on-site generation.
4. Bus differential relays shall direct trip associated lockout relay.
  - a. Lockout relay shall direct trip and block close of all circuit breakers connected to the bus.
5. Paralleling Switchgear Main Breaker protection relay (UPR) shall be provided with two (2) trip output contacts:
  - a. One (1) contact will be actuated by relay elements providing backup protection for faults inside the plant, that is, in the forward direction viewed from the utility source.
    - 1) This contact shall direct trip utility lockout relay 86M, which shall direct trip and block close of the affected utility breaker and the tie breaker.
  - b. One (1) contact will be actuated by relay elements providing protection from faults on the utility system when the generation is in parallel with the utility.
    - 1) Contact will direct trip the utility breaker, but will not trip the lockout relay.
    - 2) Provide an input signal from breaker auxiliary contacts that will be programmed to enable this output contact only when generation is in parallel.
6. Generator protection relay (GPR) shall be provided with two (2) trip output contacts:
  - a. One (1) contact will be actuated by relay elements providing backup protection for system faults not related to internal failure of the generator.
    - 1) This contact will direct trip the utility breaker, but will not trip the lockout relay.
  - b. One (1) contact will be actuated by relay elements providing protection for internal generator faults.
    - 1) This contact shall direct trip generator lockout relay 86G, which shall direct trip and block close of the generator circuit breaker, de-energize the field, and shutdown the engine.

E. Provide the following additional inputs and outputs to each UPR and GPR:

1. Breaker status 52a contact.
2. Auxiliary output contact for Trip No. 1 available for possible future use.

3. Auxiliary output contact for Trip No. 2 available for possible future use.
  4. Relay failure to PLC.
    - a. Failure of any intertie relay shall prevent parallel operation of generation with that feeder.
    - b. Failure of generator protection relay shall prevent operation of that generator.
- F. Synchronism Check:
1. Provide synchronism check function with contacts hard-wired in breaker close circuit, requiring sync-check permissive for close for utility main, bus tie and transformer tie circuit breakers.
  2. Paralleling Switchgear main breakers, sync-check element in MPR:
    - a. Live Line - Dead Bus.
  3. Bus Tie Breaker, discrete relay:
    - a. Live Line - Dead Bus.
    - b. Dead Line - Dead Bus.
    - c. Dead Line - Live Bus.
  4. Generator Breakers, sync-check element in GPR:
    - a. Live Line - Live Bus.
    - b. Live Line - Dead Bus.
- G. Provide breaker auxiliary contacts wired to field wiring terminal boards for generator parallel signal to utility protection relays.

## 2.09 ACCESSORIES

- A. Mimic Bus:
1. Plastic mimic bus placed on the face of the switchgear depicting incoming lines, outgoing lines, breakers, generators, voltage transformers and control power transformers.
  2. Blue in color.
  3. Fastened with countersunk screws.
- B. Circuit breakers accessories for testing, inspection, maintenance and operation:
1. Tool to charge closing springs manually.
  2. Portable lift crane for removing breakers.
  3. Lifting yoke.
  4. Test jumper for electrically operating the breaker while out of its compartment.
  5. Wall-mountable test station for operating breakers separately from the switchgear.
    - a. Trip and close controls.
    - b. Power on and breaker status indicator lights.

- c. Flexible cable and connection plug.
- 6. Levering crank to crank breakers between Test and Connected positions.
- 7. Rail extensions.
- 8. Other maintenance tools or equipment recommended by breaker manufacturer.
- C. Draw-out manual switchgear ground and test device to permit hot-stick voltage testing, phasing checks and application of protective grounds to the bus or line side terminals of each breaker compartment from the front of the switchgear.
  - 1. Rated for the short circuit withstand rating of the switchgear.
  - 2. Quantity of two (2) devices.
  - 3. For devices without integral mechanical grounding, provide each device with a three-phase set of mating protective ground cables, rated for the withstand capability of the switchgear.
- D. Digital Metering Package:
  - 1. Digital meters, per Specification Section 26 09 13. Meters will be sent to the supplier for incorporation into the switchgear.
  - 2. The supplier will be responsible for any additional CT's or PT's required for the meter.

## 2.10 SOURCE QUALITY CONTROL

- A. Switchgear shall be completely assembled and wired at factory, with functional checks of all wiring and controls, and then disassembled as required for shipment.
- B. Factory Tests:
  - 1. Make design tests specified in IEEE C37.20.2.
  - 2. Make production tests specified in IEEE C37.20.2, including:
    - a. Low frequency withstand, 1 minute.
    - b. Mechanical operations.
    - c. Grounding of instrument transformer cases.
    - d. Control wiring continuity.
    - e. Control wiring insulation.
    - f. Polarity verification.
    - g. Sequence tests.
  - 3. Complete functional test of assembled switchgear and control system with simulated voltage for utility and generator.
    - a. Verify all programming and wiring.
  - 4. Functional test to be witnessed by Engineer and Owner.

## 2.11 MAINTENANCE MATERIALS

- A. Extra Materials: Furnish paint for touch up and application instructions.

B. Spare Parts:

1. Spare current limiting fuses:
  - a. For potential transformers: Four (4) spares for each fuse type and size.
2. Spare fuses for AC auxiliary and DC control power: Four (4) spares for each type and size used in switchgear.
3. Indicating lamps (LED and incandescent type): 25 spare lamps.

2.12 FACTORY ACCEPTANCE TEST

- A. The purpose of the Factory Acceptance Test (FAT) shall be to verify the communication and handshaking between all Modbus TCP modules with the Master PLC located in the Paralleling Switchgear. The FAT shall ensure that the various Modbus TCP modules and the main PLC function as a fully integrated system as called out in the Contract Documents.
- B. The hardware tested shall be the actual hardware to be installed at site.
- C. Prior to commencement of FAT, the Paralleling Switchgear vendor shall test the operation of the PLC, Ethernet switch, panel PC and associated HMI graphics.
- D. After all SCADA components to be installed in the low-voltage section of the Paralleling Switchgear have been tested, the Paralleling Switchgear vendor shall coordinate with the Sectionalizing Switchgear vendor about the factory acceptance test. The Sectionalizing Switchgear vendor shall ship the Modbus TCP modules and Ethernet switches which are to be installed in each Sectionalizing Switchgear to the Paralleling Switchgear vendor's factory location. Sectionalizing Switchgear vendor shall bear all shipping and handling costs as well as shipping and handling costs from the factory back to the Sectionalizing Switchgear vendor's facility.
- E. Factory Acceptance Test shall take place at the Paralleling Switchgear vendor's factory.
- F. Paralleling Switchgear vendor shall make provisions for one SCADA programmer to be available for the entire duration of the FAT. The SCADA programmer available for the FAT shall be the same programmer involved in the programming of the PLC and HMI thereby having familiarity with the project. The programmer shall coordinate with the Sectionalizing Switchgear vendor's programmer to make any necessary corrections and/or changes to the logic to get the system and communication network to be fully operational for a successful FAT.
- G. FAT duration shall be ONE week. FAT shall commence on a Monday and shall be completed the following Friday of that week. Paralleling Switchgear vendor shall coordinate the FAT schedule and date with the Sectionalizing Switchgear vendor and shall provide at least a 30 day notice to the Owner and Engineer.
- H. Paralleling Switchgear vendor shall coordinate with the Sectionalizing Switchgear vendor and shall submit a detailed FAT procedure to the Owner and Engineer for review. All Owner and Engineer comments shall be incorporated into the FAT procedure prior to commencement of FAT.

- I. At the FAT the vendor shall demonstrate operation and communication of at least 4 discrete inputs and 4 discrete outputs at each switchgear Modbus TCP module. It shall be demonstrated that the operator is able to open and close switches from the touchscreen panel PC located in the Paralleling switchgear SCADA cabinet. To simulate this, indicating lights shall be wired to those outputs that are to be tested. Toggle switches shall be wired to the inputs that are to be tested. A simulated Modbus RTU input shall be used to test the power meters. The Owner shall be able to randomly choose to test any discrete input or output at the Owner's discretion. All test benchboards, pilot lights, fiber optic patch cords, handheld meters, etc. shall be provided by the Paralleling Switchgear vendor. The toggle switch and pilot light benchboard shall be permitted to be removed and wired to each Modbus TCP module as the FAT progresses. Thus a benchboard consisting of about 10 toggle switches and 6 pilot lights shall be sufficient for the FAT.
- J. The Factory Acceptance Test shall be deemed complete only after all the Modbus TCP modules have been tested to be able to successfully communicate (read and write) data to and from the Master PLC in the Paralleling Switchgear cabinet.
- K. Minor issues and incompletions found during the FAT shall be recorded in the FAT punch-list. All items in the punch-list shall be completed prior to final shipment at site.
- L. A separate FAT shall be performed to demonstrate the paralleling control logic which shall require simulated inputs for the generator supplied controller. The vendor shall provide a 30 day notice to the Engineer and Owner prior to commencement of the FAT to enable the Engineer and Owner to make travel arrangements. The vendor shall submit a FAT test plan for this portion of the FAT to the Owner and Engineer at least 30 days prior to commencement of the FAT.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install switchgear in accordance with manufacturer's instructions.
- B. Arrange switchgear as shown on the Drawings.
- C. Indoor Locations:
  - 1. NEMA 1 enclosure, minimum.
  - 2. Do not provide a housekeeping pad.
  - 3. Provide floor sills (C channels) set level (within 1/8 IN) on steel floor of PDC.
  - 4. Securely bolt or weld switchgear to floor sills.
- D. Miscellaneous:
  - 1. Neatly lace all control wires and have flexibility at hinge locations.
  - 2. Paint any scratched surfaces with touch-up paint.
  - 3. Tag switchboard, all devices and conductors per Specification Section 10 14 00.

#### 3.02 SEQUENCE OF OPERATION

- A. Refer to Drawings for Generator Sequence of Operation.

UP General Specifications

MEDIUM VOLTAGE METAL-CLAD PARALLELING SWITCHGEAR

Issued: 03-26-2019

26 13 13-21

B. General:

1. The generator switchgear control system provides for automatic and manual control of the Paralleling Switchgear main circuit breakers, tie circuit breaker, generators, generator circuit breakers and Sectionalizing Gear motorized operators in the following modes of operation:
  - a. Automatically re-energize the buses from paralleled generators on loss of both utility sources.
  - b. Manually-initiated automatic parallel operation of generators.
  - c. Manually initiated testing of automatic operation.
  - d. Manual operation of generators and circuit breakers on system PLC failure.
    - 1) Manual control will be through the HMI and control switches.
  - e. In addition to the required monitoring and control functions outlined herein the HMI shall display/control:
    - 1) Sectionalizing gear.

C. System Operator Controls (The following shall be performed with the engine-generator control panel HMI):

1. System master selector - AUTO or MANUAL:
  - a. In AUTO position, control is by the system PLC per sequences described in the drawings and specifications.
  - b. In MANUAL position :
    - 1) Manual control will be through the HMI and control switches.
  - c. Alarm at HMI when switch is in MANUAL position.
2. Return mode selector switch (AUTO/MANUAL):
  - a. In AUTO position, return to normal conditions occurs automatically when dictated by PLC logic and timing functions as specified.
  - b. In MANUAL position, return to normal conditions occurs when PLC logic conditions are satisfied and operator initiates local or remote return-to-normal signal.
3. Load demand control selector - ENABLE or DISABLE:
  - a. In ENABLE position, number of generators remaining on line in emergency or test modes is automatically matched to load as described below.
  - b. In DISABLE position, all available generators remain on line regardless of load.
4. Load shed control selector - ENABLE or BYPASS (keyed switch):
  - a. In ENABLE position, load shedding based on bus overload and underfrequency is enabled.
  - b. In BYPASS position, load shed signals are disabled.

5. System test selector:
  - a. Three (3) position maintained contact switch with MODE 1 - OFF - MODE 2 legend.
  - b. In MODE 1 position, initiates system test with interruption of load.
    - 1) Coordinate with Test Modes paragraph below.
  - c. In MODE 2 position, initiates system test without interruption of load.
    - 1) Paralleling with Utility is not permitted at this time.
  - d. In OFF position test is terminated.

D. Indicator Lights:

1. For each breaker control switch provide red (closed) and green (open) indicator lights.
2. Flashing amber light to indicate automatic controls are blocked by breaker trip condition.
3. Solid amber light to indicate return to normal enabled.

E. Safety Interlocks:

1. Refer to Drawings.

F. Load Demand Control Mode:

1. Manually initiated automatic sequence to avoid extended operation of engines at light load after system has stabilized in standby operation.
2. Operator selects number of units to take off line.
3. Load on selected engines is automatically reduced, generator circuit breakers open, engines go through cooldown cycle and shutdown.
4. One (1) off-line engine is automatically started and synchronized if load on remaining units exceeds a preset level for a preset time delay.
5. All off-line units are automatically started and synchronized if any of the following occur:
  - a. A pre-alarm or shutdown condition occurs on any on-line generator.
  - b. An overload condition is detected on any on line generator.
  - c. Generator bus frequency drops below a preset level.

G. Return of Utility Service - Open Transition:

1. When acceptable utility voltage and frequency has returned to the line side of the main circuit breaker and is maintained for an adjustable (initial setting: 15 minutes) period of time, the system will transfer the load from the generators back to the utility by opening the tie breaker, all generator circuit breakers, and then closing the main circuit breakers.
2. After the generator circuit breakers open, the engines will enter a cooldown cycle and shut down, and the system will return to normal conditions.

H. Test Modes:

1. Operator initiates tests of system operation through Master Control System.
  2. Test Mode 1: Test signal simulates loss of acceptable utility voltage on only the selected source and system automatically transfers to the other source with an interruption to the effected bus.
  3. Test Mode 2: Test signal simulates loss of acceptable utility voltage at both sources, and system automatically operates circuit breakers and generators to transfer plant load from utility to generators with an interruption to both buses during generator starting period.
  4. Test Mode 3: Test signal simulates loss of acceptable utility voltage at both sources, and system automatically operates circuit breakers and generators to exercise generators with portable load bank. (Portable load bank not specified to be included with this system). Load bank will be terminated to generator swing buss in paralleling gear as indicated.
  5. Test is automatically terminated when test switch is returned to neutral position or remote test signal is removed and system automatically returns to normal conditions as described above.
- I. Load Shed:
1. Sustained current overload or short-duration underfrequency condition of on-line generators shall initiate load shed signal to open Sectionalizing Equipment downstream 13.8kV actuated switches not serving critical loads.
    - a. See 26 13 23
  2. Load shed signal is sustained until generator load and bus frequency have returned to normal for an adjustable period and load shed condition is reset by operator pushing the reset button at the master or remote controls.
  3. Load shed signal to be sent to SG-A2-2, SG-A8-2, SG-A10-2, SG-A12-2, SG-A15-2, and SG-B8-2. All loads shed simultaneously.
- J. Fault On Switchgear Bus:
1. Fault is cleared and bus is isolated by appropriate differential and lockout relays.
  2. Locked out breakers are no longer PLC controllable.
  3. Alarm is annunciated.
- K. Generator Circuit Breaker Fail to Close on PLC command:
1. Fail to Sync/Close alarm annunciated.
  2. System automatically advances sequence to close next generator circuit breaker.
- L. Utility Circuit Breaker Fail to Close on PLC command:
1. Fail to Sync/Close alarm is annunciated.
  2. Load remains on generators.
- M. Circuit Breaker Fail to Open on PLC command:
1. Fail to Sync/Close alarm annunciated.
- N. Utility or Generator Breaker Fail to Open on Protective Relay Trip:



1. Breaker failure logic trips all breakers on that bus.
  2. Locked out breakers are no longer PLC controllable.
  3. Fail to Trip/Breaker Failure alarm is annunciated.
- O. System PLC Fault or Power Failure:
1. Alarm is annunciated.

### 3.03 FIELD QUALITY CONTROL

- A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.
- B. Provide complete field acceptance testing of the switchgear and control system per Specification Section 26 08 13.
1. Submit completed acceptance testing reports before scheduling performance test and demonstration.
- C. Perform a complete field performance test and demonstration:
1. To be witnessed by Engineer and Owner.
  2. To follow a written test procedure.
    - a. Submit test procedure for Engineer review.
    - b. Procedure shall cover all operating modes of the system including contingency modes such as breaker trip, breaker fail, PLC fail, etc.
    - c. Procedure shall be step-by-step and define each action to be taken and expected response of system.
    - d. Acceptance criteria shall be satisfactory operation of the system per specified sequence of operation in all modes without debugging, programming changes, troubleshooting, or other un-specified operator intervention.
    - e. Any failure during demonstration shall require a complete retest.
    - f. Any program change shall require a complete retest.
    - g. Contractor shall successfully execute the test procedure independently prior to scheduling the demonstration for Engineer and Owner; any failure during demonstration will result in Contractor responsibility for Owner's and Engineer's expenses for retesting.

### 3.04 TRAINING

- A. A qualified factory-trained manufacturer's representative shall provide the Owner with 4 HRS minimum of on-site training in the operation and maintenance of the switchgear and its components.

- B. A qualified SCADA technician shall provide the Owner with a one (1) day on-site training in the operation, configuration, programming, troubleshooting and maintenance of the SCADA components including the PLC, HMI and Ethernet switches. Training shall include information on how to set up and configure a new off-the-shelf PLC components, panel PC and/or Ethernet switch to replace an existing one in the network. Training shall be performed by the same SCADA programmer performing the FAT and project programming.

**END OF SECTION**

## **SECTION 26 13 23 - SECTIONALIZING EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Pad mounted sectionalizing switchgear.
2. Sectionalizing terminal cabinets.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 05 00 - Electrical: Basic Requirements.
- B. Section 26 05 13 - Medium Voltage Cable.
- C. Section 26 13 13 - Medium Voltage Metal-Clad Paralleling Switchgear.

#### **1.03 REFERENCED STANDARDS**

##### **A. Institute of Electronic and Electrical Engineers (IEEE):**

1. 386, Standard for Separable Insulated Connector Systems for Power Distribution Systems Above 600V.
2. C37.20.3, Standard for Metal-Enclosed Interrupter Switchgear.
3. C57.12.28, Standard for Pad-Mounted Equipment – Enclosure Integrity.
4. C62.11, Standard for Metal-Oxide Surge Arresters for AC Power Circuits (>1 kV).

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
  - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
  - b. Nameplate data.
  - c. See Specification Section 26 05 00 for additional requirements.
3. Fabrication and/or layout drawings:
  - a. General arrangement plan view showing door swings, cable entrance locations, etc.
4. Test reports:
  - a. Certified reports of all factory production tests.

##### **B. Operation and Maintenance Manuals:**

1. See Specification Section 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.
  2. See Specification Section 26 05 00 for additional requirements.
- C. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  2. Record of test results, inspections and procedures witnessed or performed by factory service representative.

#### 1.05 DELIVERY, STORAGE AND HANDLING

- A. See Specification Section 26 05 00.

### PART 2 - PRODUCTS

#### 2.01 PAD MOUNTED SECTIONALIZING SWITCHGEAR

- A. Manufacturers
1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    - a. S&C Electric Company.
- B. General:
1. Deadfront construction similar to PME style.
  2. Configuration: As indicated on the Drawings.
- C. Ratings:
1. Voltage: 15 kV class (14.4kV).
  2. Amperage: 600A Switches, 200A Fuses.
  3. Number of phases: 3.
  4. Number of wires: 3.
  5. Frequency: 60 Hz.
  6. Short circuit:
    - a. Fault closing and momentary: 22.4 kA.
    - b. Short time (1 second): 14 kA.
    - c. Peak Withstand: 36 kA.
    - d. RMS Symmetrical: 14 kA.
  7. Basic impulse level: 95 kV.
- D. Construction:
1. Standards: IEEE C37.20.3 and IEEE C57.12.28.

2. Enclosure:
  - a. Heavy-duty channelized galvanized-steel construction with stainless steel hardware.
  - b. Domed roof.
  - c. Full length removable doors with:
    - 1) Stainless steel hinges and hardware.
    - 2) Positive 3-point latching system.
    - 3) Automatically latching door holders.
    - 4) Recessed Pentahead locking actuator
  - d. Lifting provisions.
3. Full length steel barriers separate side-by-side compartments.
4. Fiberglass-reinforced polyester barriers (front, interphase and end) for all fuses and switches.
5. Recessed lockable switch handle pocket.
6. Folding switch handles for all switches, secured inside switch operating pockets.
7. Shaft lock for each switch so switch can be locked in open or closed positions.
8. Grounding provisions in each section.
9. Viewing window for viewing switch position.
10. Nameplate with circuit diagram, switchgear ratings, manufacturer name and date of manufacture.
11. Compartmental and phase identification labels.
12. Interior and exterior steel surfaces cleaned and painted with rust inhibiting primer and manufacturer's standard paint.
  - a. Finish color: Dark green.
13. Accessories:
  - a. Storage rack for fuses in each fuse compartment.
  - b. Mounting provisions for fault indicator in each switch compartment with viewing window in door.
  - c. No key interlocks on fuse compartment doors.
  - d. Mounting provisions for surge arrestors.
  - e. Insulated parking stands.
  - f. Base spacer to increase cable termination height:
    - 1) Material: Steel.
    - 2) Height: 12 IN.
  - g. Ground sleeve to increase cable termination height.

- 1) Material: Fiberglass Reinforced Composites (FRC) incorporating fire retardant polyester resins and a UV stabilizer coating.
  - 2) Height: 36 IN minimum.
- E. Buses:
1. Material: Tin-plated aluminum or silver-plated copper.
  2. Bus supports, stand-off insulators and sleeves: Porcelain or epoxy.
- F. Connector Bushings:
1. Loadbreak connectors.
    - a. Voltage Rating: 15kV.
    - b. Continuous: 200A.
    - c. Fault Closure/Short Time: 10kA.
  2. See 26 05 13 for connections.
- G. Load Interrupter Switches:
1. Three-pole, two-position, gang operated.
  2. Manual quick-make, quick-break utilizing a heavy-duty coil spring to provide openings and closing energy.
  3. Arc extinguishing system.
  4. Insulating barriers between each phase and enclosure.
  5. Form C position indication switches.
    - a. Refer to I/O list, as required
- H. Fuses:
1. Current limiting.
  2. E-rated.
  3. Size as indicated on the Drawings.
- I. Surge Arresters:
1. Standards: IEEE 386 and IEEE C62.11.
  2. MCOV rating: 7.65 kV for 12.47kV Systems. 8.4kV for 13.2 kV and 13.8kV systems. Consult drawings or project engineer for other system voltages.
  3. Metal oxide varistor elbow type.
- J. Fault Interrupter Switches:
1. 600Amp continuous at 14.4kV.
  2. Controlled circuit interruption.
    - a. De-ionization Action.
    - b. No external arc of flame.
  3. Short Circuit Rating: 25kA

4. Motor actuated where indicated.
  - a. CPT: Sized as required.

## 2.02 SECTIONALIZING TERMINAL CABINETS

### A. Manufacturers

1. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - a. Single Phase
    - 1) Howard Industries
    - 2) Eaton Cooper Power
  - b. Three Phase
    - 1) Hoffman
    - 2) Maysteel
    - 3) Hubbel

### B. Configuration:

1. As indicated on the Drawings.
2. Single phase or Three phase, as indicated on the Drawings
3. Junctions as indicated on the Drawings.

### C. Enclosure:

1. Material: Heavy-duty Galvanized steel.
2. Tamperproof per IEEE and ANSI standards.
3. Recessed Pentahead locking means.
4. Hinged cover.
5. Universal cable junction mounting plates.
6. Parking stands.
7. Ground nuts.
8. Interior and exterior steel surfaces cleaned and painted with rust inhibiting primer and manufacturer's standard paint.
  - a. Finish color: Dark green.
9. Ground sleeve to increase cable termination height.
  - a. Material: Fiberglass Reinforced Composites (FRC) incorporating fire retardant polyester resins and a UV stabilizer coating.
  - b. Height: 18 IN minimum.

### D. Multi-point Cable Junctions:

1. Standard: IEEE 386.
2. Voltage Class: 15 kV.

3. Current rating: 600A.
4. Connector Elbows: 200A loadbreak or 600A deadbreak as required.
5. Bushing: One piece design, comprised of an insulation shield, insulation layer and an outer shield constructed of EPDM rubber.
6. Bus: Electrical grade plated aluminum.
7. Bracket: Stainless steel with ground lug and parking stands.

#### 2.03 SOURCE QUALITY CONTROL

- A. Switchgear factory tests in accordance with IEEE and ANSI standards.

#### 2.04 MAINTENANCE MATERIALS

- A. Touch-up paint.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Arrange as shown on the Drawings.
- C. Install Pad Mounted Sectionalizing Switchgear and Sectionalizing Terminal Cabinet with Ground Sleeve.
- D. Miscellaneous: Paint any scratched surfaces with touch-up paint.

#### 3.02 FIELD QUALITY CONTROL

- A. A qualified factory-trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations.

### END OF SECTION



## **SECTION 26 22 13 - DRY-TYPE TRANSFORMERS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Dry-type transformers, 300 kVA and less. Primary voltages of 750V and less.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Section 26 05 00 - Electrical: Basic Requirements.**

##### **B. Section 26 05 26 - Grounding.**

#### **1.03 REFERENCED STANDARDS**

##### **A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):**

1. C57.12.01, Standard General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid Cast and/or Resin-Encapsulated Windings.
2. C57.96, Guide for Loading Dry-Type Distribution and Power Transformers.

##### **B. National Electrical Manufacturers Association (NEMA):**

1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
2. ST 20, Dry-Type Transformers for General Applications.
3. TP 1, Guide for Determining Energy Efficiency for Distribution Transformers.

##### **C. Underwriters Laboratories, Inc. (UL):**

1. 506, Standard for Safety Specialty Transformers.
2. 1561, Standard for Safety Dry-Type General Purpose and Power Transformers.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
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 00 for additional requirements.
3. Fabrication and/or layout drawings.
  - a. Nameplate drawing.
4. Certifications:
  - a. Sound level certifications.

B. Operation and Maintenance Manuals:

1. See Specification Section 01 33 00 for requirements for:
  - a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.
2. See Specification Section 26 05 00 for additional requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Square D Company.

2.02 GENERAL PURPOSE DRY-TYPE TRANSFORMERS

- A. Ventilated or non-ventilated, air cooled, two (2) 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 (2) 5 percent FCBN.
  3. 1 PH, 25 kVA and above: Two (2) 2.5 percent FCAN and four (4) 2.5 percent FCBN.
  4. 3 PH, 3 to 15 kVA: Two (2) 5 percent FCBN.
  5. 3 PH, 15 kVA and above: Two (2) 2.5 percent FCAN and four (4) 2.5 percent 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:
  - 1. Ventilated, 15 kVA and larger: Energy efficient meeting minimum efficiency requirements of US Department of Energy, 10 CFR Part 431, April 18, 2013, Energy Conservation Program: Energy Conservation Standards for Distribution Transformers; Final Rule effective January 1, 2016.
- H. Insulating Material (600 V and below):
  - 1. 3 to 15 kVA units: 185 DegC insulation system with a 115 DegC rise.
  - 2. 15 kVA and above units: 220 DegC insulation system with a 150 DegC 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.

## PART 3 - EXECUTION

### 3.01 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 less than 15 kVA units and below and where indicated on the Drawings.
  - 3. Mount less than 15 kVA units where indicated on Drawings
  - 4. Mount 15 kVA units and above where indicated on Drawings.
  - 5. Provide rubber vibration isolation pads.
- C. Outdoor Locations:
  - 1. Provide non-ventilated type.
  - 2. Mount non-ventilated type on 6" cast-in-place concrete pad unless indicated differently on Drawings.
- D. Enclosures: Painted steel in all areas, except stainless steel in highly corrosive areas.
- E. Ground in accordance with Section 26 05 26.

### END OF SECTION

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## **SECTION 26 24 13 - SWITCHBOARDS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Low voltage (750V and less) switchboards.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 05 00 - Electrical: Basic Requirements.
- B. Section 26 09 13 - Electrical Metering Devices.
- C. Section 26 09 16 - Control Equipment Accessories.
- D. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.
- E. Section 26 43 13 - Low Voltage Surge Protective Devices (SPD).

#### **1.03 REFERENCED STANDARDS**

##### **A. National Electrical Manufacturers Association (NEMA):**

1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
2. PB 2, Deadfront Distribution Switchboards.

##### **B. Underwriters Laboratories, Inc. (UL):**

1. 891, Standard for Safety Dead-Front Switchboards.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data.
  - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
3. See Specification Section 26 05 00 for additional requirements.
4. Fabrication and/or layout drawings:
  - a. Switchboard layout with alphanumeric designation, protective devices size and type, as indicated in the one-line diagram or switchboard schedule.
  - b. Front elevation and plan drawing of the assembly.
  - c. Three-line or single line and schematic diagrams.
  - d. Conduit space locations within the assembly.

##### **B. Operation and Maintenance Manuals:**

1. See Specification Section 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.
  2. See Specification Section 26 05 00 for additional requirements.
  3. Fabrication and/or layout drawings updated with as-build conditions
- C. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  2. Ground fault protection system test report signed by the projects supervising electrical foreman.

#### 1.05 QUALITY ASSURANCE

- A. Verify the space required for the switchboard is equal to or less than the space allocated.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Square D Company.

#### 2.02 SWITCHBOARDS

- A. Ratings:
1. Voltage, number of phases, number of wires, and main bus current rating as indicated on the Drawings.
  2. Assembly short circuit current and interrupting device rating of 65 KAIC RMS symmetrical minimum or as indicated on the Drawings.
  3. When low voltage power circuit breakers are utilized, the switchboard shall have a 30 cycle withstand rating corresponding to the breaker rating.
  4. Service Entrance Equipment rated.
  5. 100 percent rated breakers installed.
  6. Ground Fault Protection, as required or indicated by Drawings.
- B. Construction:
1. Standards: NEMA PB 2, UL 891.
  2. Completely enclosed, dead-front, self-supporting metal structure.
  3. Vertical panel sections bolted together.
  4. Frames bolted together to support and house bus, cables and other equipment.

5. Frames and insulating blocks to support and brace main buses for short circuit stresses up to ratings indicated on the Drawings.
6. All sections rear aligned.
7. Devices front removable and load connections front accessible for mounting switchboard against a wall.
8. NEMA 1 rated enclosure for indoor, dry locations or as indicated on Drawings.
9. NEMA 3R rated weatherproof enclosure for wet/damp locations or as indicated on Drawings:
  - a. Nonwalk-in type with sloping roof downward toward rear.
  - b. Thermostatically controlled space heaters to minimize internal condensation.
  - c. Power for heater derived internal to the switchboard.
10. Interior and exterior steel surfaces cleaned and painted with rust inhibiting primer and manufacturers standard paint.

C. Buses:

1. Material: Tin-plated aluminum or silver-plated copper.
2. Main horizontal bus:
  - a. Fully rated and continuous over length of switchboard with all three (3) phases arranged in the same vertical plane.
  - b. Sufficient size to limit temperature rise to 65 DegC over average air temperature outside the enclosure of 40 DegC.
3. Neutral bus: Fully rated and continuous over length of switchboard.
4. Ground bus: 1/4 x 2 IN copper, continuous over length of switchboard and solidly grounded to each vertical section structure.
5. Bus joints connected using through bolts and conical spring-type washers for maximum conductivity.

D. Overcurrent and Short Circuit Protective Devices:

1. Main overcurrent protective device:
  - a. Individually mounted insulated case circuit breaker.
2. Feeder overcurrent protective devices:
  - a. Group mounted molded case circuit breaker.
3. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.
4. Factory installed.
5. Means to padlock all main and feeder devices in the open position.

E. Surge Protective Device: Externally mounted, see Specification Section 26 43 13.

F. Metering:

1. Power monitor:

- a. Through cabinet mounting.
- b. See Specification Section 26 09 13 for meter requirements.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install switchboards in accordance with manufacturer's instructions.
- B. Arrange switchboard as shown on the Drawings.
- C. Indoor, dry locations:
  - 1. NEMA 1 enclosure.
  - 2. Install on 4" minimum concrete housekeeping pad or as indicated on Drawings, align front of switchboard with top edge of pad chamfer and securely fasten to pad.
- D. Outdoor damp/wet locations:
  - 1. NEMA 3R enclosure.
  - 2. Install on 6" minimum concrete pad or as indicated on Drawings, align front of switchboard with top edge of pad chamfer and securely fasten to pad.
- E. Miscellaneous:
  - 1. Provide circuit protective devices and other associated equipment as indicated on the Drawings.
  - 2. All control wiring shall be neatly laced and have flexibility at hinge locations.

#### 3.02 FIELD QUALITY CONTROL

- A. Test the ground fault protection system as indicated in Specification Section 26 28 00.

**END OF SECTION**



## **SECTION 26 24 16 - PANELBOARDS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Lighting and appliance panelboards.
2. Power distribution panelboards.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 05 00 - Electrical: Basic Requirements.
- B. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.
- C. Section 26 43 13 - Low Voltage Surge Protective Devices (SPD).

#### **1.03 REFERENCED STANDARDS**

##### **A. National Electrical Manufacturers Association (NEMA):**

1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
2. PB 1, Panelboards.

##### **B. National Fire Protection Association (NFPA):**

1. 70, National Electrical Code (NEC).

##### **C. Underwriters Laboratories, Inc. (UL):**

1. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
2. 67, Standard for Panelboards.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
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 00 for additional requirements.
3. Fabrication and/or layout drawings:
  - a. Panelboard layout with alphanumeric designation, branch circuit breakers size and type, as indicated in the panelboard schedules.

##### **B. Operation and Maintenance Manuals:**

1. See Specification Section 01 33 00 for requirements for:

- a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.
2. See Specification Section 26 05 00 for additional requirements.
3. Panelboard schedules with as-built conditions.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Square D Company.

### 2.02 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. Panelboards rated 240 Vac or less: 10,000 amp minimum short circuit rating or as indicated in the schedule.
  3. Panelboards rated 480 Vac: 14,000 amp minimum short circuit rating or as indicated in the schedule.
  4. Service Entrance Equipment rated when indicated on the Drawings.
- 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 mechanical type approved for copper and aluminum wire.
- D. Bus Bars:
  1. Main bus bars:
    - a. Plated aluminum or copper sized to limit temperature rise to a maximum of 65 DegC above an ambient of 40 DegC.
    - 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 percent rated or as indicated on the Drawings, and with solderless mechanical type connectors.
- E. 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. Lighting and appliance panelboard:
    - a. Trims supplied with hinged door over all circuit breaker handles.
    - b. Trims for surface mounted panelboards, same size as box.
    - c. Trims for flush mounted panelboards, overlap the box by 3/4 IN on all sides.
    - d. Doors lockable with corrosion resistant chrome-plated combination lock and catch, all locks keyed alike.
    - e. Nominal 20 IN wide and 5-3/4 IN deep with gutter space in accordance with NFPA 70.
    - f. Clear plastic cover for directory card mounted on the inside of each door.
    - g. NEMA 3R or NEMA 12 rated: Door gasketed. The door shall be capable of being padlocked in the closed position.
  4. Power distribution panelboard:
    - a. Trims cover all live parts with switching device handles accessible.
    - b. Less than or equal to 12 IN deep with gutter space in accordance with NFPA 70.
    - c. Clear plastic cover for directory card mounted front of enclosure.
    - d. NEMA 3R or NEMA 12 rated: Doors gasketed and lockable with corrosion resistant chrome-plated combination lock and catch, all locks keyed alike. The door shall be capable of being padlocked in the closed position.
- F. Overcurrent and Short Circuit Protective Devices:
1. Main overcurrent protective device:
    - a. Molded case circuit breaker, bolt-in type.
  2. Branch overcurrent protective devices:
    - a. Mounted molded case circuit breaker, bolt-in type.
    - b. Tandem or half-size circuit breakers shall not be permitted.
  3. See Section 26 28 00 for overcurrent and short circuit protective device requirements.
  4. Factory installed.
- G. Integral surge protective device (where indicated): See Specification Section 26 43 13.

## PART 3 - EXECUTION

### 3.01 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 1, NEMA 3R or NEMA 12 rated enclosure as indicated on the Drawings.
- D. Provide each panelboard with a typed directory:
  - 1. Identify all circuit locations in each panelboard with the load type and location served. Unused circuit breakers shall be labeled "spare".
  - 2. Mechanical equipment shall be identified by Owner-furnished designation if different than designation indicated on the Drawings.
  - 3. Room names and numbers shall be final building room names and numbers as identified by the Owner if different than designation indicated on the Drawings.
- E. Prior to final inspection, clean all panelboard interiors, adjust trims, covers and locks. If necessary, refinish fronts to original condition. Do not use compressed air to assist in cleaning.
- F. Balance load on all panelboards so phases are balanced to within 15% of each other.

**END OF SECTION**

## **SECTION 26 24 19 - MOTOR CONTROL EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Separately mounted motor starters (including those supplied with equipment).
2. Manual motor starters.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 05 00 - Electrical: Basic Requirements.
- B. Section 26 29 23 - Variable Frequency Drives - Low Voltage.
- C. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.
- D. Section 26 43 13 - Low Voltage Surge Protective Devices (SPD).
- E. Section 26 09 13 - Electrical Metering Devices.
- F. Section 26 09 16 - Control Equipment Accessories.

#### **1.03 REFERENCED STANDARDS:**

- A. International Electrotechnical Commission (IEC).
- B. National Electrical Manufacturers Association (NEMA):
  1. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).
  2. ICS 2, Controllers, Contactors and Overload Relays Rated 600 V.
  3. ICS 3, Medium-Voltage Controllers Rated 2001 to 7200 V AC.
- C. Underwriters Laboratories, Inc. (UL):
  1. 508, Standard for Industrial Control Equipment.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
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 00 for additional requirements.
3. 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 as indicated on the Drawings and/or loop descriptions.

B. Operation and Maintenance Manuals:

1. See Specification Section 01 33 00 for requirements for:
  - a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.
2. See Specification Section 26 05 00 for additional requirements.
3. Fabrication and/or layout drawings updated with as-built conditions.
4. Provide a Table that includes the following data for all motors controlled in an MCC or separately mounted starter:
  - a. Equipment tag number.
  - b. Starter type and size.
  - c. Motor nameplate HP.
  - d. Motor nameplate FLA.
  - e. Motor nameplate RPM.
  - f. Motor nameplate safety factor.
  - g. Overload heater type and model number.
  - h. Overload heater settings/size.
  - i. MCP or CB type/model number.
  - j. MCP or CB setting/size.
5. Electronic files in CAD format of all drawings and diagrams.

1.05 QUALITY ASSURANCE

A. 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.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Square D Company.

B. Submit request for substitution in accordance with Specification Section 26 05 00.

## 2.02 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:

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 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.
  - a. The following devices are the minimum required unless otherwise indicated on the Drawings:
    - 1) Three-position switch (HAND-OFF-AUTO).
    - 2) Red ON indicator light.
    - 3) Green OFF indicator light.
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 percent 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.

## 2.03 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 insensitive, adjustable solid state type with phase loss protection, phase imbalance protection and manual reset. Provide trip delay relay adjustable from 1-10 seconds, unbalance adjustment from 2 to 10%, and repeat accuracy of 1% of full accuracy, with automatic reset, capable of operating either shunt trip breakers or motor control circuits.
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. Two (2) additional normally open spare field replaceable auxiliary contacts.
- C. Full Voltage Reversing (FVR) Magnetic Starters:
- 1. Two (2) FVNR starters with one (1) 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 (2) FVNR starters with two (2) overload relays assembled together.
  - 2. Configured for two (2) winding or one (1) winding consequent pole motors.
  - 3. See FVNR paragraph for additional requirements.
- E. Reduced Voltage Autotransformer (RVAT) Starter:
- 1. Closed transition design using three (3) contactors and two (2) or three (3) autotransformers.
  - 2. Transformer taps: 50, 65 and 80 percent, factory set at 65 percent.
  - 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 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. Provide trip delay relay adjustable from 1-10 seconds, unbalance adjustment from 2 to 10%, and repeat accuracy of 1% of full accuracy, with automatic reset, capable of operating either shunt trip breakers or motor control circuits.
    - b.
    - c. Overload alarm contact, normally open.
    - d. Normally open auxiliary contact, for remote run status.
    - e. Additional field replaceable auxiliary contacts as required per the Sequence of Operation.
    - f. Two (2) additional normally open spare field replaceable auxiliary contacts.

7. Rated for continuous 115 percent of the full load current of the motor that is installed.
  8. Bypass contactor to be engaged after motor is at full speed.
- F. Variable Frequency Drives: See Specification Section 26 29 23.

## 2.04 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.
    - b. No knockouts
    - c. With external mounting flanges.
  3. NEMA 4X rated:
    - a. Type 304 or 316 stainless steel.
    - b. No knockouts
    - c. With 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

### 3.01 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. 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.
- D. Combination and Manual Starter Enclosures:
  - 1. Permitted uses of NEMA 1 enclosure:
    - a. Surface or flush mounted in architecturally finished areas.
    - b. Surface mounted above 10 FT 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.
  - 7. Motors above 20 horsepower or as required by the local utility shall have soft start reduced voltage starters as per paragraph 2.03. Coordinate starter with the motor provided.

3.02 FIELD QUALITY CONTROL

A. Acceptance Testing: See Specification Section 26 08 13.

**END OF SECTION**

## **SECTION 26 26 13 - PACKAGE POWER SUPPLY**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Package power supply consisting of a transformer and panelboard.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 05 00 - Electrical: Basic Requirements.
- B. Section 26 05 26 - Grounding.
- C. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.

#### **1.03 REFERENCED STANDARDS**

##### **A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):**

1. C57.96, Loading Dry-Type Distribution and Power Transformers.

##### **B. National Electrical Manufacturers Association (NEMA):**

1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
2. PB 1, Panelboards.
3. ST 20, Dry-Type Transformers for General Applications.

##### **C. Underwriters Laboratories, Inc. (UL):**

1. 67, Standard for Safety Panelboards.
2. 1561, Standard for Safety Dry-Type General Purpose and Power Transformers.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
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 00 for additional requirements.
3. Fabrication and/or layout drawings:
  - a. Nameplate drawing.
  - b. Panelboard layout with alphanumeric designation, branch circuit breakers size and type, as indicated in the panelboard schedules.

##### **B. Operation and Maintenance Manuals:**

1. See Specification Section 01 33 00 for requirements for:
  - a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Square D Company.

### 2.02 PACKAGED POWER SUPPLY

A. General:

1. Standards: IEEE C57.96, NEMA PB 1, NEMA ST 20, UL 67 and UL 1561.
2. Package power supply includes a main primary circuit breaker, an encapsulated dry-type transformer and a secondary panelboard with main circuit breaker.

B. Ratings:

1. Single or three (3) phase as indicated on the Drawings.
2. KVA and voltage ratings as indicated on the Drawings.
3. Suitable for use as service entrance equipment.

C. Transformer:

1. Non-ventilated, air cooled, two (2) winding type.
2. Core and coil assembly encapsulated in a proportioned mixture of resin and aggregate to provide a moisture proof, shock resistant seal.
3. Cores:
  - a. High grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses.
  - b. Magnetic flux densities are to be kept well below the saturation point.
4. Coils: Continuous wound with electrical grade aluminum and grounded to the enclosure.
5. Insulation system: 185 DegC with a 115 DegC rise.
6. Taps: Two (2) 5 percent FCBN.
7. Sound levels:
  - a. Manufacturer shall guarantee not to exceed the following:
    - 1) 9 kVA and less: 40 dB.
    - 2) 10 to 30 kVA: 45 dB.

D. Panelboard and Protective Devices:

1. Bus: Aluminum or copper.
  2. Factory installed wiring between primary breaker and transformer, secondary breaker and transformer and distribution section.
  3. 480 Vac primary circuit breaker: 18,000 amp minimum interrupting rating.
  4. 240 Vac or less secondary circuit breaker: 10,000 amp minimum interrupting rating.
  5. Feeder breakers:
    - a. Bolt-in type with 10,000 amp minimum interrupting rating.
    - b. See Section 26 28 00 for additional requirements.
- E. Enclosure:
1. Main, secondary and feeder circuit breakers enclosed with a padlockable hinged door.
  2. Wiring compartment suitable for conduit entry and large enough to allow convenient wiring.
  3. Totally enclosed, NEMA 3R, steel finished with a rust inhibitor primer and manufacturer's standard paint.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Ground in accordance with Section 26 05 26 or as indicated on the Drawings.

### **END OF SECTION**

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## **SECTION 26 27 26 - WIRING DEVICES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Material and installation requirements for:
  - a. Light switches.
  - b. Receptacles.
  - c. Device wallplates and coverplates.
  - d. Occupancy sensors.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 05 00 - Electrical: Basic Requirements.
- B. Section 26 05 33 - Raceways and Boxes.
- C. Section 26 24 19 - Motor Control Equipment.

#### **1.03 REFERENCED STANDARDS**

##### **A. National Electrical Manufacturers Association (NEMA):**

1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
2. WD 1, General Color Requirements for Wiring Devices.
3. WD 6, Wiring Devices - Dimensional Requirements.

##### **B. Underwriters Laboratories, Inc. (UL):**

1. 20, General-Use Snap Switches.
2. 498, Standard for Attachment Plugs and Receptacles.
3. 514A, Metallic Outlet Boxes.
4. 894, Standard for Switches for Use in Hazardous (Classified) Locations.
5. 943, Ground-Fault Circuit-Interruption.
6. 1010, Standard for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
7. 1449, Standard for Surge Protective Devices.

#### **1.04 SUBMITTALS**

##### **A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
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 00 for additional requirements.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Light switches and receptacles:
    - a. Hubbell.
    - b. Pass & Seymour/Legrande.
    - c. Eaton Crouse-Hinds.
    - d. Appleton Electric Co.
    - e. Killark
    - f. Midwest.
  - 2. Occupancy sensors:
    - a. Cooper Controls.
    - b. Lighting Design and Control (LD&C).
    - c. Watt Stopper.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

### 2.02 LIGHT SWITCHES

- A. General requirements unless modified in specific requirements paragraph of switches per designated areas or types:
  - 1. Toggle type, quiet action, Industrial Specification Grade.
  - 2. Self grounding with grounding terminal.
  - 3. Back and side wired or factory supplied plug connector with wire leads.
  - 4. Solid silver cadmium oxide contacts.
  - 5. Rugged urea housing and one-piece switch arm.
  - 6. Rated 20 A, 120/277 Vac.
  - 7. Switch handle color:
    - a. Normal power:
      - 1) White for interior areas in commercial buildings, office and locker buildings, gate houses, offices within industrial buildings, and other non-industrial areas.
      - 2) Gray for industrial buildings and facilities, shops, warehouses and all exterior and weatherproof locations.

8. Types as indicated on the Drawings:
  - a. Single-pole.
  - b. Double-pole.
  - c. 3-way.
  - d. 4-way.
9. Standards: UL 20, UL 514A, NEMA WD 6.
- B. Architecturally Finished Areas:
  1. Wallplate:
    - a. White colored high impact thermoplastic or nylon.
    - b. Single or multiple gang as required.
- C. Dry Non-architecturally Finished Areas:
  1. Coverplate:
    - a. Zinc plated malleable iron or galvanized steel.
    - b. Single or multiple gang as required.
- D. Wet Non-architecturally Finished Areas:
  1. Coverplate:
    - a. Gasketed zinc plated malleable iron or aluminum with stainless steel screws utilizing rocker, front mounted toggle or pull type switch.
    - b. Single or multiple gang as required.
- E. Corrosive Areas:
  1. Corrosion resistant nickel plated metal parts.
  2. Coverplate:
    - a. Gasketed zinc plated malleable iron or copper free aluminum with stainless steel screws utilizing rocker, front mounted toggle or pull type switch.
    - b. Single or multiple gang as required.
- F. Highly Corrosive Areas:
  1. Corrosion resistant nickel plated metal parts.
  2. Coverplate:
    - a. PVC-RGS conduit system:
      - 1) PVC coated zinc plated malleable iron or copper free aluminum with stainless steel screws utilizing rocker, front mounted toggle or pull type switch.
      - 2) Single or multiple gang as required.
    - b. PVC conduit system:
      - 1) Gray colored high impact thermoplastic.

2) Single or multiple gang as required.

G. Hazardous Areas:

1. Rated for Class I, Division 1 and 2, Groups B, C, and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
2. Switch enclosed in separate sealing chamber.
  - a. Sealing chamber has prewired factory sealed pigtail leads.
3. Coverplate:
  - a. Zinc plated malleable iron or copper free aluminum with stainless steel screws utilizing rocker or front mounted toggle type switch.
  - b. Single or multiple gang as required.
4. Standards: UL 894.

2.03 RECEPTACLES

- A. General requirements unless modified in specific requirements paragraph of receptacles per designated areas:
1. Straight blade, Industrial Specification Grade.
  2. Brass triple wipe line contacts.
  3. One-piece grounding system with double wipe brass grounding contacts and self grounding strap.
  4. Back and side wired.
  5. Rated 20 A, 125 Vac.
  6. High impact nylon body.
  7. Receptacle body color:
    - a. Normal power:
      - 1) White for interior areas in commercial buildings, office and locker buildings, gate houses, offices within industrial buildings, and other non-industrial areas.
      - 2) Gray for industrial buildings and facilities, shops, warehouses and all exterior and weatherproof locations.
    - b. Isolated ground
      - 1) Orange
  8. Types as indicated on the Drawings:
    - a. Normal: Self grounding with grounding terminal.
    - b. Ground fault circuit interrupter: Non-feed-through type with test and reset buttons.
    - c. Isolated ground: Grounding terminal insulated from metal mounting yoke.
  9. Duplex or simplex as indicated on the Drawings.

10. Configuration: NEMA 5-20R.
  11. Standards: UL 498, UL 514A, UL 943, NEMA WD 1, NEMA WD 6.
- B. Architecturally Finished Areas:
1. Wallplate: White (or gray colored plates shall be installed over gray color devices)colored high impact thermoplastic or nylon.
- C. Dry Non-architecturally Finished Areas:
1. Coverplate:
    - a. Zinc plated malleable iron or galvanized steel.
    - b. Single or multiple gang as required.
- D. Wet Non-architecturally Finished Areas:
1. Coverplate: Weatherproof (NEMA 3R) while in use, gasketed, copper-free aluminum, 2.5 IN minimum cover depth.
- E. Exterior Locations:
1. Coverplate: Weatherproof (NEMA 3R) while in use, gasketed, copper-free aluminum, 2.5 IN minimum cover depth.
- F. Corrosive Areas:
1. Corrosion resistant nickel plated metal parts.
  2. Receptacle body color: Yellow.
  3. Coverplate:
    - a. Zinc plated malleable iron or galvanized steel.
    - b. Single or multiple gang as required.
- G. Highly Corrosive Areas:
1. Corrosion resistant nickel plated metal parts.
  2. Receptacle body color: Yellow.
  3. Coverplate:
    - a. PVC-RGS conduit system:
      - 1) PVC coated zinc plated malleable iron or copper free aluminum.
      - 2) Single or multiple gang as required.
    - b. PVC conduit system:
      - 1) Gray colored high impact thermoplastic.
      - 2) Single or multiple gang as required.
- H. Hazardous Areas:
1. Rated for Class I, Division 1 and 2, Groups B, C, and D; and Class II, Division 1 and 2 areas, Groups F and G.
  2. Factory-sealed receptacle/switch/coverplate.

- a. Zinc plated malleable iron or copper free aluminum with stainless steel screws and gasketed spring-loaded cover.
  - 3. "Dead-front" construction requiring plug to be inserted and rotated to activate receptacle.
    - a. Ordinary nonhazardous plug shall not activate the receptacle.
  - 4. Standard: UL 1010.
- I. Welding Receptacles: Provide and install Siemens 60A 3pole disconnect switch and receptacle combination, fuse block enclosures and thread lubrication as noted below. All material with the exception of the lubrication shall be purchased through Echo Electric, Alan Devereaux, phone 402-330-9998 for UPRR National Contract Pricing.
  - 1. Siemens 60A 3 pole disconnect switch and receptacle combination. catalog number HNF362JCH.
  - 2. Killark cord cap for each welder, catalog number VP6485 60A
  - 3. Provide and apply Killark "LUB-G" type lubrication or equal to receptacle thread surfaces to prevent galling between the receptacle and locking ring threads.
  - 4. Custom fuse boxes shall be installed near panelboards where welding receptacle circuits originate. Fuse box shall be installed in series with all welding receptacle circuits.
    - a. Single circuit version: Catalog number A1412CHQR-UPRR CUSTON#1
      - 1) Sample Part List: Hoffman A1412CHQR enclosure, Hoffman A1412 din rail, one 3 phase Class J fuse block, three 60A Class J fuses.
    - b. Double circuit version: Catalog number A1412CHQR-UPRR CUSTON#2
      - 1) Sample Part List: Hoffman A1412CHQR enclosure, Hoffman A1412 din rail, two 3 phase Class J fuse block, six 60A Class J fuses.
    - c. Triple circuit version: Catalog number A1412CHQR-UPRR CUSTON#2
      - 1) Sample Part List: Hoffman A1412CHQR enclosure, Hoffman A1412 din rail, three 3 phase Class J fuse block, nine 60A Class J fuses.-
- J. Isolated Ground Receptacles:
  - 1. Approved Manufactures:
    - a. Pass & Seymour – Catalog# IG5362
    - b. Hubbell – Catalog# IG5362
- K. Special Purpose Receptacles:
  - 1. NEMA configuration as indicated on the Drawings.
  - 2. Coverplate: See requirements per area designations herein.

## 2.04 MISCELLANEOUS WIRING DEVICES

- A. Manual Motor Starters: Horsepower rated with or without thermal overloads, see Specification Section 26 24 19.

## 2.05 OCCUPANCY SENSORS

### A. Low Voltage Passive Infrared Ceiling Sensor:

1. Detection of changes in the infrared energy: Sensor to respond only to those signals caused by human motion.
2. Analog and digital processing to provide immunity to RFI and EMI.
3. Temperature compensated, dual element sensor and a multi-element lens with a minimum field of view of 110 degrees.
4. Daylight filter or compensation for short wavelength infrared wave from the sun.
5. Cover up to 300 SF at normal mounting heights.
6. System voltage: 24 Vdc through power pack, or 120, 240 Or 277 Vac.
7. Adjustable time delay set at 30 minutes
8. Adjustable sensitivity set at maximum.
9. Adjustments and mounting hardware under a removable cover.
10. Parallel wiring of multiple sensors to allow coverage of large areas.

### B. Passive Infrared Wall Switch:

1. Wattstopper DSW-100 Self contained control system that replaces a standard toggle switch.
  - a. Latching air gap relay switching mechanism, compatible with electronic ballasts, compact fluorescent and inductive loads.
2. Detection of changes in the infrared energy: Sensor to respond only to those signals caused by human motion.
3. Analog and digital processing to provide immunity to RFI and EMI.
4. Temperature compensated, dual element sensor and a multi-element Fresnel lens.
5. Cover up to 300 SF for walking motion, with a field of view of 180 degrees.
6. System voltage: 120 Vac or 277 Vac.
7. No minimum load.
  - a. 0 to 500 watts incandescent, 0 to 800 watts fluorescent or 1/6 HP at 120 Vac, 60 Hz.
  - b. 0 to 1200 watts fluorescent or 1/3 HP at 277 Vac, 60 Hz.
8. DIP switch to control the following functions:
  - a. Built-in light level feature adjustable from 8 to 180 foot candles.
  - b. AUTOMATIC-ON or MANUAL-ON operation.
  - c. Time delay adjustable from 30 seconds to 30 minutes.
  - d. High/low sensitivity adjustments.
9. Adjustments and mounting hardware under a removable, tamper resistant cover.
10. Normal operation: OFF and AUTO.

C. Ultrasonic Ceiling Sensor:

1. Detection of Doppler shifts in transmitted ultrasound.
2. Ultrasonic sensing is volumetric in coverage with a frequency of 32 kHz and automatically adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled areas.
3. Temperature and humidity resistant, 32 kHz tuned ultrasonic receivers.
  - a. Receivers have less than a 6 dB shift in the humidity range of 10 percent to 90 percent and less than a 10 dB shift in the temperature range of -20 to 60 DegC.
4. DIP switch to control the following functions:
  - a. Override-ON function for use in the event of failure.
  - b. Time delay adjustable from 15 seconds to 30 minutes.
  - c. High/low sensitivity adjustments.
5. Cover 360 degrees and hallway and corridor sensors shall cover up to 90 linear feet.
6. Additional single-pole, double-throw isolated relay with normally open, normally closed, and common outputs rated at 1 amp for 24 Vdc.
  - a. The isolated relay is for use with HVAC control, data logging and other control options.

D. Power Pack:

1. Self contained transformer and relay module.
2. Dry contacts capable of switching:
  - a. 20 amp ballast load, 13 amp incandescent, 1 HP at 120 Vac, 60 Hz.
  - b. 20 amp ballast at 277 Vac, 60 Hz.
3. 24 Vdc, 100 mA output.
4. Capable of parallel wiring without regard to AC phases on primary.
5. Used as a standalone, low voltage switch or wired to sensor for auto control.
6. Low voltage Teflon coated leads, rated for 300 V, suitable for use in plenum applications.

## PART 3 - EXECUTION

### 3.01 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 (1) receptacle is installed in a room, they shall be symmetrically arranged.
- E. Provide blank plates for empty outlets.
- F. Occupancy Sensors:
  - 1. Locations and quantity of sensors shown on the Drawings are diagrammatic and indicate only the rooms and spaces to be provided with sensors.
  - 2. Verify sensor type, quantity, location, aiming and sensitivity with manufacturer's recommendations.
  - 3. All controlled spaces shall be tested to insure 90 to 100 percent coverage of the controlled space.
    - a. If test fails, adjust sensitivity, re-aim, relocate, and/or add sensor(s) as required at no cost to Owner.
  - 4. Power supplies and slave units if required shall be located above accessible ceilings.

**END OF SECTION**

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## **SECTION 26 28 00 - OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Low voltage circuit breakers.
2. Low voltage fuses.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 05 00 - Electrical: Basic Requirements.
- B. Section 26 08 13 - Acceptance Testing.

#### **1.03 REFERENCED STANDARDS**

##### **A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):**

1. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).
2. 399, Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book).
3. C37.13, Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.
4. C37.16, Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations.
5. C37.17, Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers.

##### **B. National Electrical Manufacturers Association (NEMA):**

1. AB 1, Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures. (Equivalent to UL 489)

##### **C. National Fire Protection Association (NFPA):**

1. 70, National Electrical Code (NEC).

##### **D. Underwriters Laboratories, Inc. (UL):**

1. 248-1, Low-Voltage Fuses - Part 1: General Requirements.
2. 248-4, Low-Voltage Fuses - Part 4: Class CC Fuses.
3. 248-8, Low-Voltage Fuses - Part 8: Class J Fuses.
4. 248-10, Low-Voltage Fuses - Part 10: Class L Fuses.
5. 248-12, Low-Voltage Fuses - Part 12: Class R Fuses.
6. 489, Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

7. 943, Standard for Safety for Ground-Fault Circuit-Interrupters.
8. 1053, Standard for Ground-Fault Sensing and Relaying Equipment.
9. 1066, Standard for Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.
10. 1699, Standard for Arc-Fault Circuit-Interrupters.

#### 1.04 SUBMITTALS

##### A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. 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. Operation and Maintenance Manuals:

1. See Specification Section 01 33 00 for requirements for:
  - a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.
2. See Specification Section 26 05 00 for additional requirements.

##### C. Informational Submittals:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Ground fault protection system test reports signed by the projects supervising electrical foreman.
3. Reports:
  - a. As-built condition of all circuit breakers that have adjustable settings.
4. Power system study: See Power System Analysis Specification Section 26 99 00.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- #### A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Circuit breakers:
    - a. Square D Company.
  2. Fuses:
    - a. Eaton Bussmann, Inc.
    - b. Littelfuse, Inc.

- B. Submit request for substitution (fuses only) in accordance with Specification Section 01 33 00.

## 2.02 CIRCUIT BREAKERS

### A. Molded Case Type:

#### 1. General:

- a. Standards: NEMA AB 1, 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 (3) 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.
- k. Bolt on type.
  - 1) All 20 Amp breakers shall be switching duty (SWD) type.
  - 2) Provide HACR type breakers for use with air conditioning, heating and refrigeration equipment having motor group combinations.

#### 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).

#### 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 percent 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.
    - c. Frame size 1600 amp and above:
      - 1) 100 percent rated.
      - 2) Interchangeable current sensor or rating plug.
      - 3) Adjustable long time pick-up setting.
        - a) Adjustable from 50 to 100 percent of the current sensor or rating plug.
      - 4) Adjustable long time delay setting.
      - 5) Adjustable short time pick-up setting.
      - 6) Adjustable instantaneous pick-up setting.
      - 7) Adjustable ground fault pick-up setting, when indicated on the Drawings.
      - 8) Adjustable ground fault delay setting, when indicated on the Drawings.
  - 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.

B. Insulated Case Type:

  - 1. Inverse time overload, instantaneous short circuit and ground fault protection by means of a solid state trip element, associated current monitors and two-step stored energy trip mechanism.
  - 2. Standards: NEMA AB 1, UL 489.
  - 3. 100 percent rated.
  - 4. Manually operated (MO) unless electrically operated (EO) is indicated on the Drawings.
  - 5. Electrically operated breakers:
    - a. 120 Vac operators.
    - b. Close/open pushbuttons.
    - c. Red and green indicators to indicated breaker position.

- d. AC source: Control power transformer internal to the switchgear.
- 6. Motor driven operator for charging mechanism with open, close and charge push button.
- 7. Draw out construction:
  - a. Roll out type operated by removable crank handle and interlocked with the door.
  - b. Four (4) positions: Connected, test, disconnected and removed.
- 8. Current and interrupting ratings as indicated on the Drawings.
- 9. Selective override circuit on breakers with short time settings and without instantaneous settings that allow selectivity up to the breakers RMS symmetrical short time rating.
  - a. The selective override circuit shall allow the breaker to ride through a fully offset (asymmetrical) fault equal to its RMS symmetrical short time rating in a system having an X/R ratio of 6.6 with a maximum single phase peak current of 2.3 times the RMS symmetrical short time range.
- 10. Frame size 400 amp and above:
  - a. Interchangeable current sensor or rating plug:
  - b. Adjustable long time pick-up setting.
    - 1) Adjustable from 50 to 100 percent of the current sensor or rating plug.
  - c. Adjustable long time delay setting.
  - d. Adjustable short time pick-up setting.
  - e. Adjustable instantaneous pick-up setting.
  - f. Adjustable ground fault pick-up setting, when indicated on the Drawings.
  - g. Adjustable ground fault delay setting, when indicated on the Drawings.

## PART 3 - EXECUTION

### 3.01 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. Frame sizes 1000 amp and above shall include integral ground fault protection.
  - d. Motor circuit protectors sized for the connected motor.
- 2. Insulated case circuit breakers shall incorporate the following, unless indicated otherwise on the Drawings:
  - a. Set current sensor or rating plugs long time pick-up setting so that the indicated trip level is near the 75 percent trip point.
  - b. Frame sizes 1000 amp and above shall include integral ground fault protection.
- E. Fuses:
  - 1. UL Class L: Use for main and feeder devices over 600 amps.
  - 2. UL Class RK-1 (fast acting): Use for 600A and smaller.
  - 3. UL Class RK-1 (dual element): Use for motor feeder and branch circuit devices.
  - 4. UL Class RK-5: Use for motor feeder and branch circuit devices.
- F. Testing:
  - 1. Acceptance testing: See Specification Section 26 08 13.

**END OF SECTION**



## **SECTION 26 28 16 - SAFETY SWITCHES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes:
  - 1. Safety switches.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 26 05 00 - Electrical: Basic Requirements.
- B. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.

#### **1.03 REFERENCED STANDARDS**

- A. National Electrical Manufacturers Association (NEMA):
  - 1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 2. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. Underwriters Laboratories, Inc. (UL):
  - 1. 98, Enclosed and Dead-Front Switches.

#### **1.04 SUBMITTALS**

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 2. Product technical data:
    - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
    - b. Provide a table that associates safety switch model number with connected equipment tag number.
    - c. See Specification Section 26 05 00 for additional requirements.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.
  - 2. See Specification Section 26 05 00 for additional requirements.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following safety switch manufacturers are acceptable:

1. Square D Company.

### 2.02 SAFETY SWITCHES

A. General:

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 (1) 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 ON and OFF position. If field drilled, paint holes to prevent corrosion.
  - c. Interlocked to prevent door from opening when the switch is in the ON position with a defeater mechanism.
10. Provide fuse rejection clip.

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 with 1 N.O. and 1 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 On and 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

#### 3.01 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 with the switch is in the open position.
- D. Permitted uses of NEMA 1 enclosure:
  - 1. Surface in areas designated dry in architecturally finished areas.
- E. Permitted uses of NEMA 3R enclosure:
  - 1. Surface mounted in exterior location.
- 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

## **SECTION 26 29 23 - VARIABLE FREQUENCY DRIVES LOW VOLTAGE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Variable frequency drives (VFDs) for operation of inverter duty motors.
2. Variable frequency drives (VFDs) for operation of standard motors.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 00 – Submittals and Substitutions.
- B. Section 01 61 03 - Equipment: Basic Requirements.
- C. Section 10 14 00 - Identification Devices.
- D. Section 23 00 00 – Heating, Ventilating, and Air Conditioning (HVAC).
- E. Section 26 05 00 - Electrical: Basic Requirements.
- F. Section 23 09 93 – Sequence of Operation.
- G. Section 40 00 00 – Process Interconnections.

#### **1.03 REFERENCED STANDARDS**

- A. American National Standards Institute (ANSI).
- B. ETL Testing Laboratories (ETL).
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - 1. 399, Recommended Practice for Industrial and Commercial Power Systems Analysis.
  - 2. 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
  - 3. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- D. National Electrical Manufacturer's Association (NEMA):
  - 1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 2. MG 1, Motors and Generators.
- E. National Fire Protection Association (NFPA):
  - 1. 70, National Electrical Code (NEC):
    - a. Article 430, Motors Motor Circuits, and Controllers.
- F. Occupational Safety and Health Administration (OSHA).
- G. Underwriters Laboratory, Inc. (UL):
  - 1. 508, Standard for Industrial Control Equipment.

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2. 508A, Standard for Industrial Control Panels.

#### 1.04 DEFINITIONS

##### A. Variable Torque (VT):

1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as speed is reduced below full rated.
2. This type of load permits the VFD and the motor to operate at reduced output current at reduced speed.

##### B. Constant Torque (CT):

1. Defines a load characteristic in which the torque delivered from the motor to the load remains constant as speed is varied.
2. This type of load requires the VFD to be able to continuously deliver rated output current over the entire speed range.

##### C. Constant Horsepower:

1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as the speed is increased.
2. This characteristic is required for operation of the VFD and motor above rated frequency to maintain output current within the rated value.

##### D. Inverter Duty Motor: An AC induction motor complying with all requirements of NEMA MG 1 Part 31 for definite-purpose inverter-fed motors.

##### E. Standard Motor: An AC induction motor that fails to comply with one (1) or more requirements of NEMA MG 1 Part 31.

##### F. Low Voltage: 600 Vac or less.

#### 1.05 SUBMITTALS

##### A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Provide a schedule for each VFD including the following information:
  - a. Equipment Tag Number.
  - b. VFD Complete Catalog Number.
  - c. VFD Amp Frame Size.
  - d. Variable or Constant Torque Rating Basis.
  - e. Rated Input Current.
  - f. Rated Continuous Output Current.
  - g. Rated Short Circuit Current.
  - h. VFD cable type specified (shielded or non-shielded).
  - i. VFD Maximum Motor Lead Length for the type of cable used.

- j. Motor Manufacturer.
- k. Motor Frame Size.
- l. Motor Full Load Amps.
- m. Motor Service Factor.
- n. As installed motor Lead Length.
- o. VFD options provided to meet harmonic or motor protection specifications.
- 3. Submit VFD Shop Drawings concurrently with driven equipment and motor Shop Drawings.
- 4. Product technical data:
  - a. Complete electrical ratings and performance specifications confirming compliance with specified ratings and performance.
  - b. Maximum rate of heat rejection from VFD and all related components and associated cooling requirements.
  - c. Manufacturer's installation instructions.
  - d. Manufacturer's programming and operating instructions.
  - e. See Specification Section 26 05 00 for additional requirements.
- 5. Fabrication and/or layout drawings:
  - a. Top, front and side exterior views, with details showing maximum overall dimensions of enclosure, mounting provisions and conduit/cable entry provisions.
  - b. Identify minimum clearances from other VFDs or electrical equipment required for proper cooling at top, bottom, side and back of enclosure.
  - c. Three-line diagrams showing AC schematic of VFD, input, output and bypass devices including device ratings.
  - d. Interior layout drawings showing location of all components within enclosure, field wiring terminal boards, and power and grounding connections.
  - e. Field wiring diagrams showing locations and sizes of all electrical connections, ground terminations, and requirements for shielded wire usage or any other special installation considerations.
- 6. Certifications:
  - a. Submit with Shop Drawings:
    - 1) Identification and location of closest authorized service organization.
    - 2) Harmonic analysis at each point of common coupling (PCC) per Harmonic Protection Requirements in PART 2 of this specification section.
  - b. Submit prior to shipment:
    - 1) Certified factory test reports confirming compliance with specified requirements.

- c. Submit after installation:
  - 1) Certified field service reports showing:
    - a) Each VFD is operational.
    - b) Each VFD and its driven equipment motor are compatible.
    - c) Each VFD responds correctly to the input control signals.
    - d) Critical frequencies of the drive system and that the VFD has been set to lockout these frequencies.
    - e) Measured harmonic levels per Harmonic Protection Requirements in PART 2 of this specification section.
    - f) Measured motor terminal peak voltages per Motor Protection Requirements in PART 2 of this specification section.

B. Operation and Maintenance Manuals:

- 1. See Specification Section 01 33 00 for requirements for:
  - a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.
- 2. See Specification Section 26 05 00 for additional requirements.
- 3. Approved copy of VFD schedule per Submittals requirements.
- 4. Manufacturer's instruction manuals.
- 5. Troubleshooting procedures with a cross-reference between symptoms and corrective recommendations.
- 6. Connection data to permit removal and installation of recommended smallest field-replaceable parts.
- 7. Recommended spare parts list.
- 8. Commissioning sheets showing "as-left" values of all user-programmable or adjustable drive parameters.

## 1.06 QUALITY ASSURANCE

A. Qualifications:

- 1. Provide drives that are listed and labeled by UL, ETL, or other Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA regulations, or that have been inspected and subsequent field-labeled by such NRTL.
- 2. Where listed drives and other components are installed in a common enclosure, the assembly shall be listed and labeled per UL 508 and UL 508A or equivalent NRTL standard.
  - a. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control Panel" or equivalent NRTL label prior to shipment to the jobsite.
- 3. VFD Supplier shall maintain an authorized service organization within 300 miles of the Project Site.



B. Coordination:

1. The intent of this Specification Section is to allow the VFD manufacturer to provide the best solution for the harmonic and motor protection outlined herein.
  - a. This solution shall include, but not be limited to, all aspects of the distribution system including standby generation, motor feeder cable type and available floor space.
2. Motor and VFD coordination: See Specification Section 01 61 03.
3. VFD shall be supplied complete with all required control components.
  - a. Provide control as indicated:
    - 1) On the electrical drawings.
    - 2) As specified in this Specification Section.
    - 3) As specified in the HVAC control system sequences of operation.
      - a) See Specification Section 23 09 93.
  - b. VFD manufacturer shall review the application and provide, at no additional cost to the Owner, the hardware and software necessary to allow the VFD to control the driven equipment motor over its required operating range.
    - 1) These may include, but are not limited to, analog and digital interface modules, communication interface modules, switches, lights and other devices.
  - c. Coordinate control devices with devices furnished with driven equipment such as vibration switches, thermal sensors, leak detectors, etc.
4. Verify plan dimensions with equipment space requirements as indicated on the Drawings.
  - a. Equipment which exceeds the allotted maximum dimensions may not be acceptable.
  - b. Equipment which reduces clear working space below the minimums established by the NFPA 70 shall not be acceptable.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Allen Bradley.
  2. ASEA Brown Bovari (ABB).
  3. Eaton.
  4. General Electric Company.
  5. Square D Company.
  6. Toshiba.

- B. Submit request for substitution in accordance with Specification Section 01 33 00.

## 2.02 GENERAL

- A. VFDs shall consist of a rectifier-DC bus-inverter combination producing a sine-coded pulse-width-modulated (PWM) output voltage waveform.
- B. VFDs, whether installed in motor control center (MCC) construction or separately-mounted, shall constitute a complete combination motor controller per NFPA 70, Article 430 and shall provide the following per the requirements of that article without the addition of any external components or devices.
  - 1. Motor control.
  - 2. Motor overload protection.
  - 3. Motor and motor branch circuit short circuit and ground fault protection.
  - 4. Motor and controller disconnecting means.
- C. It is the intent of this Specification that VFDs shall be an “engineered” or “configured” drive package in which the VFD chassis, all input, output and bypass power devices, VFD accessories, ancillary switches, contactors, relays, and related control devices are selected, furnished, factory-assembled and -tested by the VFD manufacturer in a single enclosure requiring only connection of the power supply circuit, motor branch circuit, and external control wiring in the field.

## 2.03 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Application:
  - 1. VFD(s) shall be of sufficient capacity and shall provide a quality of output waveform for stepless motor control from 10 to 100 percent of base speed of the driven equipment.
  - 2. VFDs shall be compatible with the application they will be used in:
    - a. Inverter duty induction motors.
    - b. Standard induction motors.
    - c. Special purpose submersible induction motor/pump.
  - 3. VFDs shall be suitable for Constant Torque (CT) or Variable Torque (VT) applications.
    - a. VFD manufacturer shall coordinate with the manufacturer of the driven equipment to identify CT and VT applications.
  - 4. VFDs shall be designed to operate successfully under the following site conditions:
    - a. Ambient:
      - 1) Temperature: 0-50 DegC.
      - 2) 95 percent non-condensing relative humidity.
    - b. Elevation: refer to Special Conditions

- 1) At elevations above 3,300 FT above MSL, equipment must be derated by the manufacturer.
  - c. Power supply characteristics:
    - 1) 480Vac, 3 PH, 60 Hz, 3 wire, (+/- 10 percent).
    - 2) Effectively grounded.
- B. Ratings and Performance Specifications:
1. Voltage rating:
    - a. Nominal: 460 or 480Vac, 3 PH, 60 Hz.
    - b. Range for continuous full load operation: +/-10 percent of nominal.
    - c. Voltage imbalance tolerance for full load operation: 3 percent minimum.
  2. Current ratings:
    - a. Continuous:
      - 1) Equal to or greater than the motor nameplate full load.
    - b. Short-term overload:
      - 1) VT: 110 percent for 1 minute.
      - 2) CT: 150 percent for 1 minute.
      - 3) Permissible for 1 minute every 10 minutes continuously.
    - c. Short circuit:
      - 1) 65,000 A RMS SYM, minimum as indicated on the Drawings.
      - 2) Where a short circuit rating is not indicated or specified for individual VFDs, each VFD shall have a rating not less than indicated on the Drawings for the MCC, switchboard or panelboard the VFD is supplied from.
      - 3) Where specified short circuit rating indicates additional input impedance is required to protect semiconductors, provide input AC line reactors, whether required to meet harmonic performance specifications or not.
  3. Efficiency:
    - a. 97 percent, minimum, at full speed and full load.
    - b. 93 percent, minimum at 1/2 speed and full load.
  4. Displacement power factor:
    - a. 95 percent, minimum from 50 percent to 100 percent speed and load.
  5. Efficiency and power factor criteria apply from the input terminals to the output terminals of the VFD alone, excluding losses of input and output power circuit accessories.
  6. Frequency drift:
    - a. +0.5 percent of set frequency.
  7. Speed regulation (motor dependent): 3 percent.

8. Speed range: 10:1.
  9. Control type:
    - a. Volts/Hertz ratio; constant over the entire operating range of the VFD except:
      - 1) When operating under voltage boost.
      - 2) At frequencies over 60 Hz.
- C. Operational Features:
1. Insensitive to input phase sequence.
  2. Continued operation with momentary voltage dips of 25 percent of rated voltage, or single phase condition: 4 second, minimum.
  3. Controls power loss ride-through: 500 msec, minimum.
  4. Electronic reversing.
  5. DC injection braking.
  6. Anti-windmilling: Synchronization of VFD starting frequency with spinning or coasting load, forward or reverse.
  7. Critical frequency band lockout:
    - a. Minimum of three (3) settings.
    - b. Adjustable bandwidth, 1 - 5 Hz.
  8. Capable of operating without the motor connected for start-up and troubleshooting.
- D. The VFD shall be provided with the following minimum user-programmable parameters:
1. Carrier frequency.
  2. Independent maximum and minimum speeds for forward and reverse operation.
  3. Start frequency and hold time.
  4. Independent linear acceleration and deceleration time.
  5. Preset "jog" speed.
  6. Three (3) critical frequency bands.
  7. One (1) preset speed selectable by logic input.
  8. Volts/Hertz ratio.
  9. Voltage boost, magnitude and frequency range.
  10. Process controller gain, offset and bias.
  11. Current limit.
  12. Overcurrent pickup.
  13. Overcurrent delay.
  14. Ground fault pickup.

15. DC injection level and time.

E. The VFD shall be designed such that the power circuit components are fully protected from line side disturbances and load side faults:

1. General:

a. Shutdown conditions associated with supply circuit conditions which can be corrected external to the VFD-motor system shall be provided with automatic reset, with shutdown cause logged in memory:

- 1) Input under voltage.
- 2) Input over voltage.
- 3) Input under frequency.
- 4) Input over frequency.
- 5) Input Phase loss.
- 6) DC Bus under voltage.

b. Shutdown conditions which indicate overload or fault within the VFD, the output circuit, or the motor shall require local manual reset at the VFD, requiring operator intervention.

- 1) Over temperature.
- 2) Blown fuse.
- 3) Component failure.
- 4) Overload.
- 5) Short circuit.
- 6) Ground fault.
- 7) DC Bus over voltage.
- 8) External safety input (e.g., motor thermal protection).
- 9) Logic fault.

c. When automatic shutdown occurs, VFD shall restart immediately upon reset, whether automatic or manual.

d. VFD shall hold cause of trip data for a minimum of four (4) shutdowns in memory.

- 1) Data to be accessible through the keypad, local communication link and remotely.

2. Input protection:

a. Input circuit breaker or current-limiting fuses with externally operable disconnect.

- 1) Fault current interrupting rating equal to or greater than the specified withstand rating of the VFD.
- 2) Handle padlockable in the OFF position.

- b. Provide full protection for semiconductors integral to the VFD; units requiring current-limiting fuses or circuit breakers in the supply circuit are not acceptable.
- c. Incoming line transient suppression.
  - 1) 6000V peak per IEEE C62.41.
  - 2) Phase-to-phase and phase-to-ground protection.
- d. Sustained over voltage trip.
- 3. Internal protection:
  - a. Surge suppression and power device snubbers.
  - b. Power devices rated at 2.5 times line voltage.
  - c. Instantaneous over current trip.
  - d. DC bus over voltage trip.
  - e. Power device over temperature trip.
  - f. Control logic circuit malfunction trip.
- 4. Output protection:
  - a. Inverse-time overload trip:
    - 1) UL Class 10 characteristic.
  - b. Over voltage trip.
  - c. Over frequency trip.
  - d. Short circuit trip.
    - 1) Line to line and line to ground.
  - e. Ground fault trip.

## 2.04 OPERATOR AND REMOTE CONTROL INTERFACE

- A. Drive controls shall be microprocessor-based with on-board human machine interface and both local and remote digital communications capability.
  - 1. All monitoring and control functions, other than those shutdowns specified to be manual reset only, shall be available both locally and remotely.
- B. Control circuits shall be 120 Vac or 24 Vac or 24 Vdc.
  - 1. 120 Vac supplied by CPT in the VFD.
    - a. CPT shall have minimum additional capacity of 60 VA greater than that required by control devices.
    - b. CPT shall have two (2) fuses on the primary side and one (1) fuse on the secondary side.
    - c. CPT shall have surge protection on the primary side independent of any other surge protection in the VFD.
  - 2. 24 Vac or 24 Vdc supplied by Class 2 power supply in the VFD.

- a. Power supply shall have minimum additional capacity of 33 percent greater than that required by control devices.
- b. Provide two (2) current-limiting fuses on the AC supply to the power supply.
- c. Power supply shall have surge protection on the primary side independent of any other surge protection in the VFD.

C. Operator Interface:

- 1. Door mounted sealed keypad, membrane type with LED or LCD display.
  - a. Messages shall be in English and engineering units.
  - b. Drive operating parameters shall be programmable.
  - c. Menu driven.
  - d. Password security.
  - e. Display fault and diagnostic data.
  - f. Operating parameters, fault and diagnostic data maintained in non-volatile memory with historic log of fault and diagnostic data.
  - g. Gold plated plug-in contacts.
- 2. Provide indication and control interface, integral in the keypad, as required in the sequence of operation and Drawings.
  - a. Minimum indications:
    - 1) Run.
    - 2) Stop.
    - 3) Ready.
    - 4) Alarm.
    - 5) Fault.
    - 6) Local control.
    - 7) Remote control.
    - 8) Control source local.
    - 9) Control source remote.
    - 10) Speed indication.
  - b. Minimum control functions:
    - 1) Local/Remote switch.
    - 2) Stop button.
    - 3) Start button.
    - 4) Reset button.
    - 5) Speed control buttons.
- 3. Diagnostic indicators located externally on the face of the drive shall show the type of fault responsible for drive warning, shutdown or failure.

- a. On occurrence of more than one (1) condition, each shall be recorded or indicated by the diagnostics.
- D. Remote Control Interface:
- 1. Local portable computer interface via USB or Ethernet communications port:
    - a. Capability to:
      - 1) Start-Stop VFD.
      - 2) Control VFD Speed.
      - 3) Access fault and diagnostic data.
  - 2. Analog and discrete inputs:
    - a. Speed reference (setpoint) signal 4-20 mA DC.
    - b. Isolated process PID controller with user-programmable setpoint, gain, rate, reset and span for accepting a remote 4-20 mADC process variable signal.
  - 3. Analog and discrete outputs:
    - a. 4-20 mADC output for remote speed indication, as a function of frequency, calibrated 0 to 100 percent.
    - b. Drive FAULT contacts.
    - c. Drive RUNNING contacts.
    - d. Drive selector switch in REMOTE status contacts.
  - 4. Contacts:
    - a. Contacts shall be rated 2 A inductive at 120 Vac.
    - b. All contacts shall be wired to field wiring terminal boards.
  - 5. As shown on the VFD Control schematics, drive shutdown on external fault input:
    - a. Provide isolated input for dry contact from external motor or system safety devices to cause immediate shutdown of VFD.
    - b. Safety shutdown to be operable in all operating modes of drive, including local operation from keypad.
    - c. For submersible pump/motors incorporate the temperature/leak detection monitor and shut down.
    - d. Local safety switch, to driven equipment, auxiliary contact to lock-out VFD from running when safety switch is open.
  - 6. Network communications capability:
    - a. Provide VFD with communication card, protocol and required programming for digital communication of all VFD program and operational parameters to plant control system via:
      - 1) Ethernet/IP.
      - 2) Modbus TCP/IP



- b. Refer to Specification Section 23 and Specification Section 40 for additional requirements.

## 2.05 HARMONIC PROTECTION REQUIREMENTS

- A. All VFDs shall be capable of satisfactory operation from a source having voltage distortion and notch characteristics identified as acceptable for a “dedicated system” in IEEE 519 Table 10.2.
- B. With all VFDs operating under worst-case harmonic current conditions, and the facility supplied from either or both the utility and generator sources, the VFDs shall not produce harmonic effects in excess of the following limits at any point of common coupling (PCC).
  - 1. Voltage distortion and notch characteristics: IEEE 519 Table 10.2 for General System.
  - 2. Current distortion: IEEE 519 Table 10.3, based on  $I_{SC}/I_L < 20$ .
- C. Point of Common Coupling (PCC) shall be considered:
  - 1. Building service entrance switchgear, switchboard or MCC.
  - 2. Each MCC, switchboard, switchgear, or panelboard supplying a VFD branch circuit.
- D. Provide the following topologies:
  - 1. 6-pulse rectifier topology with tuned passive filter with controls such that the filter is not energized when VFD is off or starting. 12-pulse rectifier topology for each VFDs with input current ratings in excess of 11 A.
  - 2. 18-pulse rectifier topology for each VFDs with input current ratings in excess of 34 A.
- E. VFD manufacturer shall determine, for their proposed equipment, uncorrected harmonic distortion levels and mitigation techniques required to meet the specified limits and shall furnish the VFD types and all accessory items and equipment necessary to do so, whether specified herein or not.
- F. Following start-up, with facility at full load operation, provide measurement of harmonic voltage, current and notch characteristics at each PCC according to the requirements of IEEE 519 Section 9.
  - 1. Values in excess of specified limits require correction by contractor and re-measurement.
  - 2. Provide certification of compliant measurements as part of Field Service Engineer’s final report.

## 2.06 MOTOR PROTECTION REQUIREMENTS

- A. The VFD shall produce a quality of output waveform adequate to allow the motor to produce rated torque at rated RPM continuously without exceeding the temperature rise given in NEMA MG 1 Table 31-2.
- B. Provide motor overload, short circuit and ground fault protection integral to drive electronics.

- C. The VFD shall not produce voltage spikes in excess of the following values at the motor terminals when operated with the feeder types shown on the Drawings and the actual installed feeder lengths.
  - 1. If unmitigated voltage peaks exceed the specified limits, provide output line reactors, filters, or other devices as required to meet the specified limits:
    - a. Inverter duty motors: 1280 V.
    - b. Standard motors: 800 V.
    - c. Rise time shall be greater than or equal to 0.1 microsecond.
    - d. Motor lead length and data shall be determined by the Contractor based on the actual routing of the conductors..
- D. Following start-up, provide measurement of peak voltage at the terminals of each motor, unless the lead lengths are 10 percent shorter than the manufacturers published literature for maximum lead length for the type of cable installed.
  - 1. Values in excess of specified limits require correction by contractor and re-measurement.
  - 2. Provide certification of compliant measurements as part of Field Service Engineer's final report.

## 2.07 EQUIPMENT CONSTRUCTION

### A. Fabrication and Assembly:

- 1. Each VFD system shall be factory-assembled in an enclosure for remote mounting, and shall utilize interchangeable plug-in printed circuit boards and power conversion components wherever possible.
  - a. Factory assembly shall be performed by the VFD manufacturer or authorized agent.
  - b. Systems fabricated or assembled in whole or in part by parties other than the VFD manufacturer or authorized agent will not be acceptable.
- 2. Reactors and/or filters, where required, shall be mounted within or in an ancillary enclosure adjacent to the drive enclosure, or with the Engineer's permission may be mounted in a separate enclosure.
- 3. Cooling fans, as required, shall be provided to run when drive is running.
- 4. Enclosures for separately mounted VFD's:
  - a. NEMA Type 1 for installation in Electrical Rooms.
  - b. NEMA Type 12 for installation in other unclassified areas.
  - c. NEMA Type 4, 4X stainless steel, or 4X non-metallic as indicated on the Drawings for installations in wet, damp or outdoor areas.
    - 1) Provide enclosure cooling required to not exceed drive temperature ratings.

B. Wiring:

1. The wiring in the VFD shall be neatly installed in wire ways or with wire ties where wire ways are not practical.
  - a. Where wire ties are used, the wire bundles are to be held at the back panel with a screw-mounted wire tie mounting base.
  - b. Bases with a self-sticking back will not be allowed.
2. All plug-in contacts shall be gold-plated.
3. Provide terminal boards for all field wiring and inter-unit connections, including analog signals.
  - a. Provide terminals for shield continuity where required.
4. Terminal blocks shall be complete with marking strip, covers and pressure connectors.
  - a. Non-brittle, interlocking, track-mounted type.
  - b. Screw terminals will not be allowed.
  - c. A terminal for each conductor of external circuits plus one (1) ground for each shielded cable.
  - d. For free-standing panels, 8 IN of clearance shall be provided between terminals and the panel base for conduit and wiring space.
  - e. Not less than 25 percent spare terminals shall be provided.
  - f. Terminals shall be labeled to agree with identification indicated on the supplier's submittal drawings.
  - g. Individually fuse each control loop or system and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.
5. All grounding wires shall be attached to the enclosure sheet metal with a ring tongue terminal.
  - a. The surface of the sheet metal shall be prepared to assure good conductivity and corrosion protection.
6. Wiring shall not be kinked or spliced and shall have markings on both ends or be color coded.
  - a. Markings or color code shall match the manufacturer's drawings.
7. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, type MTW or SIS, insulated for not less than 600 V, with a moisture-resistant and flame-retardant covering rated for not less than 90 DegC.

C. Nameplates:

1. All devices mounted on the face of the drive shall be provided with a suitable nameplate as specified in Specification Section 10 14 00.
2. Push buttons, selector switches, and pilot lights shall have the device manufacturer's standard legend plate.

3. Relays, terminals and special devices inside the control enclosure shall have permanent markings to match identification used on manufacturer's wiring diagrams.
- D. Painting: Enclosure, after being phosphate washed, shall be thoroughly cleaned and given at least one (1) coat of rust-inhibiting primer on all inner surfaces prior to fabrication.

## 2.08 COMPONENTS AND ACCESSORIES

### A. Reactors:

1. Impedance: As required.
2. Continuous current: Not less than drive rating.
3. Current overload: 150 percent for 1 minute.
4. Insulation temperature rating: 180 DegC.
5. Copper windings.
6. Saturation current rating: 3.5 to 5 times rated current.
7. Hi-potential rating: 2500 Vac line to ground and line to line, for 1 minute.
8. Noise reduction features:
  - a. Epoxy over cast coil.
  - b. Extra dips and bakes of varnish over continuous wound coil.

## 2.09 SOURCE QUALITY CONTROL

### A. Factory Tests:

1. Conduct all standard tests in accordance with NEMA and ANSI standards to ensure conformance to Specification requirements.
2. Prior to final assembly:
  - a. Inspect incoming components.
  - b. Test and inspect power devices.
  - c. Circuit cards:
    - 1) Component and functional tests:
    - 2) Burn-in chamber or temperature cycling test.
    - 3) System test after burn-in or temperature cycling.
3. After final assembly:
  - a. Continuity and insulation test of 480 power control circuits.
  - b. Drive tests:
    - 1) Burn-in complete drive at full load for 24 HRS.
    - 2) Verify all auxiliary circuits operation.
    - 3) Monitor output variables.

- c. Systems test:
  - 1) Provide inputs to field connections and simulate on-site operation.
  - 2) Test all auxiliary equipment.

## 2.10 MAINTENANCE MATERIALS

- A. Provide manufacturer's recommended renewable spare parts (e.g., power and control fuses).
- B. Spare parts utilized during pre-start-up or start-up and demonstration testing shall be immediately restocked, at no cost to the Owner.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and as indicated on the Drawings.
- B. Verify the installed motor nameplate electrical requirements do not exceed the VFD capacity.
- C. Provide services of manufacturer's representative to perform start-up services.
- D. The selection of input and output harmonic and voltage spike protection shall also be made on the available physical space.
  - 1. The space available on the Drawings shall not be exceeded.

### 3.02 START UP

- A. Pre-start-up Services:
  - 1. Shall be completed a minimum of 30 days prior to the start-up and demonstration period.
  - 2. Shall consist of:
    - a. Physical and electrical installation check.
    - b. Final adjustments and calibration of drive parameters.
    - c. VFD operation from simulated input signals.
  - 3. Shall be complete when VFD(s) are fully operational.
- B. Field Quality Control:
  - 1. Perform field measurement of harmonics at each point of common coupling (PCC) per the Harmonic Protection Requirements.
    - a. For each individual VFD.
    - b. For the maximum number of VFDs that will be operational at the same time.
    - c. When all loads are at 75 percent load minimum.
    - d. Duration: 1 HR minimum.

2. Perform field measurement of the maximum voltage peak at the terminals of each motor fed from a VFD per the Motor Protection Requirements.
    - a. Use a high speed oscilloscope to produce a plot of Voltage (Y axis) versus Time (X axis).
      - 1) Time shall be measured in microseconds.
    - b. Tests shall be performed at full:
      - 1) Full voltage and speed.
      - 2) Loaded to 75 percent minimum.
      - 3) Duration: 1 HR minimum.
  3. Record all data necessary for the preparation of required test reports.
- C. Start-up and Demonstration Services:
1. Supervise start-up of all units including recheck of settings made during the pre-start-up tests.
    - a. Perform all work in the presence of the Owner's designated representatives.
  2. Setup all VFDs with carrier frequency at minimum value consistent with proper operation; inform Engineer of carrier frequencies set in excess of 5 kHz and reason for setting.
  3. Simulate operation of the VFD and its associated control and instrumentation system in both the manual and automatic modes.
    - a. Ensure compatibility of VFD with associated control and instrumentation signals.
  4. Simulate VFD failures and demonstrate troubleshooting aids.
- D. Instruct Owner's designated personnel:
1. Minimum of 8 HRS at the jobsite.
  2. Include both field and classroom instruction.
  3. Instructions shall include proper operation and maintenance procedures including, but not limited to:
    - a. Lubrication.
    - b. Troubleshooting.
    - c. Repair and replacement.
    - d. Parts inventory.
    - e. Maintenance records.

## **END OF SECTION**

## **SECTION 26 32 14 - ENGINE GENERATOR DIESEL**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Engine generator set and accessories.
2. Generator fuel tank filling equipment and accessories.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 00 – Submittals and Substitutions.
- B. Section 26 05 00 - Electrical: Basic Requirements.
- C. Section 26 13 13 – Medium Voltage Circuit Breaker Switchgear Metal-Clad Paralleling Switchgear
- D. Section 40 05 03 - Piping Materials and Methods.

#### **1.03 REFERENCED STANDARDS**

##### **A. American National Standards Institute (ANSI):**

1. C57.16, Requirements, Terminology, And Test Code For Dry-Type Air-Core Series-Connected Reactors.
2. C62.11, Metal-Oxide Surge Arresters For Ac Power Circuits (> 1 kV).
3. S1.4, Specification for Sound Level Meters.

##### **B. Environmental Protection Agency (EPA):**

1. 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.

##### **C. National Electrical Manufacturers Association (NEMA):**

1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
2. LA-1, Surge Arresters.
3. MG 1, Motors and Generators.

##### **D. National Fire Protection association (NFPA):**

1. 70, National Electrical Code (NEC):
  - a. Article 445, Generators
  - b. Article 700, Emergency Systems.
  - c. Article 701, Legally Required Standby Systems.
  - d. Article 702, Optional Standby Systems.
  - e. Article 705, Interconnected Electric Power Production Sources

- E. Underwriters Laboratories, Inc. (UL):
  - 1. 2200, Standard for Stationary Engine Generator Assemblies.

#### 1.04 SYSTEM DESCRIPTION

- A. The engine generators will be used and rated for:
  - 1. Optional standby power during a utility power outage, NFPA 70, Article 702.
- B. The generator fuel tank fueling system will include fill box, controls, automatic overfill protection, and automatic fill shutoff for multiple tanks.

#### 1.05 SUBMITTALS

- A. Shop Drawings:
  - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  - 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 00 for additional requirements.
    - c. Engine/generator performance curves.
  - 3. Fabrication and/or layout drawings.
    - a. Dimensional plan and elevation drawings.
    - b. Wire interconnection drawings.
  - 4. Complete outline and installation drawings, together with detailed specifications and data covering materials used, parts, devices, and other accessories forming a part of the equipment furnished and the operation and maintenance manuals, shall be submitted in accordance with the submittals section.
  - 5. Test reports:
    - a. Factory test reports.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.
  - 2. See Specification Section 26 05 00 for additional requirements.
- C. Informational Submittals:
  - 1. Unit installation, startup and operational statement.
  - 2. Field Quality Control test reports.
  - 3. Test reports: Sound attenuating enclosure test measurements.



## 1.06 QUALITY ASSURANCE

- A. The engine generator set manufacturer or authorized supplier is designated to have single source responsibility for the supply of all components and delivery and setting of the unit.

## 1.07 SITE CONDITIONS

- A. Ambient air temperature:
  - 1. Minimum: refer to Special Conditions
  - 2. Maximum: refer to Special Conditions
  - 3. Altitude: refer to Special Conditions

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Engine generator unit:
    - a. Caterpillar.
    - b. Cummins Onan.
    - c. Generac.
  - 2. Silencers:
    - a. Maxim.
    - b. GT Exhaust Systems.
    - c. Nelson.
    - d. Cowl.
    - e. Hapco.
  - 3. Battery charger:
    - a. Manufacturer's standard.
  - 4. Governor:
    - a. Manufacturer's standard.
  - 5. Radiator:
    - a. Manufacturer's standard.
  - 6. Vibration isolators:
    - a. Caldyne.
    - b. Mason Inds.
    - c. Ace.
    - d. Korfund Dynamics.

7. Day tank:
  - a. Pryco.
  - b. Simplex Access Controls.
  - c. Tramont.
8. Fuel Tank Fill Box Station:
  - a. Simplex.
  - b. Pryco, Inc.

B. Submit request for substitution in accordance with Specification Section 01 33 00.

## 2.02 EQUIPMENT

### A. Emissions Requirements:

1. A single unit's emissions shall meet all Federal, State and Local government requirements, including but not limited to:
  - a. Environmental Protection Agencies (EPA) New Source Performance Standards (NSPS), 40 CFR Part 60, Subpart IIII.

## 2.03 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 naturally aspirated or turbo charged with inter and after cooling.
2. Fuel supply: Low Sulfur 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:

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.
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 percent 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.
    - e. Radiator shall be rated minimum 49 DegC/120 DegF ambient.
  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. Voltage as noted on the Drawings.
- K. Silencer:
1. Suitable type for industrial silencing.
  2. Seamless, stainless steel, flexible, exhaust adapter for exhaust outlet to silencer.
  3. Silencer is to be the pancake or hockey puck type of construction on order to mount silencer inside of the enclosure.
- L. Exhaust pipe enclosure-roof thimble:
1. Type 304 stainless steel.
  2. Carrier pipe of the same diameter and wall thickness as the interconnecting engine exhaust pipe.
    - a. Thimble to be self ventilating by means of holes drilled in metal plates at either end of the roof thimble.
  3. Mounting plate to completely support the thimble from the roof curb and support the carrier pipe.
  4. Exhaust pipe fitted with a hinged stainless steel rain cap.
- M. Exhaust system insulation:
1. Rigid insulation: High temperature 3 IN calcium silicate type with aluminum jacket fastened with aluminum or stainless steel hardware.
  2. Flexible insulation: High temperature fiberglass, 9 LB per cubic FT.
- N. Engine Instruments and Controls (Meters and gauges are to be digital type to provide highest level of accuracy):
1. Engine-mounted instruments:
    - a. Oil pressure gage.
    - b. Oil temperature gage.

- c. Water temperature gage.
  - d. Run time meter.
  - e. 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 (3) NO auxiliary contacts for interface with louvers, fans or other miscellaneous equipment.
  - a. Contacts shall close when generator is started.
- O. Sub-Base Fuel 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, fuel lines to generator, fill, vent, drain and pressure relief.
  - 4. Manual overfill protection.
  - 5. Low level warning with contacts for remote alarm.
    - a. Set to alarm at 50 percent of capacity.
  - 6. Critical low level shutoff with contacts for remote alarm.
  - 7. Analog signal for fuel tank level.
    - a. Level sensor transducer and transmitter.
  - 8. Leak detection alarm with contacts for remote alarm.
  - 9. Capacity: 24 HRS at full load.
  - 10. Provide stairs and platforms in order to provide full access to the inside of the enclosure for servicing techs. Platforms must meet OHSA requirements for protection in front of every door.
- P. Batteries:
  - 1. Nickel cadmium type.
  - 2. Furnish electrolyte separately for use when installation is complete and unit is ready for testing.
  - 3. Charging alternator is to be a minimum of 65 amps and battery charger to be a minimum of 20 amps.

Q. 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.

R. 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. 0.8 PF, substantiated by manufacturer's standard published curves and conforms to NEMA MG 1 specification.
  - b. Special ratings or maximum ratings are not acceptable.
3. Rated to serve up to 50 percent non-linear load without exceeding rated temperature rise.
4. Minimum efficiency: 92 percent at 50 to 110 percent of nominal standby rating, less than 30 percent 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: 125 DegC temperature rise with minimum Class F 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. Over current protection is by providing differential CTs at the generator set and at the parallel switchgear so that the paralleling gear circuit breaker connected to the generator set will trip upon over current or short circuit detected. A relay in the parallel gear shall also be provided and wired back to the generator set to shut the engine down.

S. Voltage Regulator:

1. SCR type, to maintain 2 percent voltage regulation from 0 to full load with steady state modulation not exceeding plus 1/2 percent including cross-current compensation to provide maximum of 5 percent 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 percent from rated voltage.
6. Mount regulator, volts per hertz type, in generator housing on suitable vibration isolators.

T. Generator Instruments and Controls:

1. General:
  - a. Generator instruments and controls shall be coordinated with the Master Controls as specified in 26 13 13.
  - b. Include the items listed below as a minimum for each generator plus all other items and components required for specified performance and function.
  - c. Provide generator start/stop control, safety shutdown, alarm and status indication and operator controls.
2. Paralleling:
  - a. Generators are to be run in parallel:
    - 1) Primary: Under control from Master Controller
    - 2) Secondary: (In the event the Master Control fails) Provisions shall be provided for generators to automatically synchronize.
      - a) Provide microcontrollers and wiring as required to perform operations.
  3. Generator mounted NEMA 1 type, illuminated vibration isolated instrument and control panel(s). All meters and gauges to be digital for maximum accuracy.
  4. AC voltmeter and phase selector switch.
  5. AC ammeter and phase selector switch.
  6. Frequency meter.
  7. Kilowatt load meter.
  8. Run-off-auto engine, start-stop control switch.
  9. Emergency stop.
  10. Run time meter.
  11. Governor control rheostat.
  12. Voltage level adjustment rheostat.
  13. Cool down time delay 0-15 minute adjustable.
  14. Cycle cranking control.

15. Minimum red shut down indicating lights as follows:
    - a. Overcrank.
    - b. Overspeed.
    - c. Low lubricating oil pressure.
    - d. High engine water temperature.
  16. Minimum amber alarm indicator lights as follows:
    - a. Control switch not in auto position.
    - b. Low engine water temperature (less than 70 DegF).
    - c. Low fuel in day tank.
    - d. Day tank leak.
    - e. Battery charger malfunctioning.
    - f. Low battery voltage.
  17. Minimum amber prealarm indicator lights as follows:
    - a. High engine water temperature.
    - b. Low lubricating oil pressure.
  18. Common dry contact and audible alarm to indicate when one (1) or more alarm or prealarm conditions exist.
  19. Exterior mount white strobe light to indicate when one (1) or more alarm or prealarm conditions exist when the unit is not ready to operate in automatic start mode.
- U. Seismic 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 size and configuration of gen-set provided.
- V. Generator Neutral Grounding Equipment:
1. Provide neutral grounding resistor in screened, ventilated enclosure for roof mounted installation above the individual generators:
    - a. Resistance value selected to make maximum generator phase-ground short circuit current equal to the three phase value per NEMA MG-1, calculated from generator reactances. Size to standard rating from calculated value not exceeding three phase value.
    - b. Comply with ANSI C57.16.
    - c. Self-cooled, Class AA.
    - d. Rated phase to ground voltage of generator.
    - e. 10 second thermal rating.
    - f. 60 kV BIL.

W. Transient Protection Equipment:



1. Provide surge arrestors, surge capacitor, connected to generator terminals.
  2. Surge Arrestors:
    - a. Comply with NEMA LA-1 and ANSI C62.11.
    - b. Designed for rotating machinery protection.
    - c. Gapless metal oxide type.
    - d. Porcelain or polymer housing with metal base.
    - e. Intermediate class.
    - f. MCOV Rating: refer to Special Conditions
- X. Fuel Tank Fill Equipment:
1. Tank Fill Box:
    - a. Provide for freestanding installation at delivery truck curbside, a Simplex Compact Automatic Fuelport for Filling Multiple Tanks grade level fill box or equal with spill containment, overfill prevention and automatic fill shutoff in the filling of multiple above ground storage tanks.
    - b. The tank fill box shall be installed outdoors anchored on a concrete pad.
    - c. The tank fill box shall include the following fittings and features:
      - 1) Steel, weatherproof, lockable box with hinged door finished in white industrial enamel.
      - 2) External stainless steel ground stud for attachment of delivery truck ground cable.
      - 3) 3 IN quick detachable coupling for attachment of delivery hose
      - 4) Inlet angle check valve
      - 5) Twenty (20) gallon spill containment sump with drain hand pump. To remove spill contents to AST via fill pipe. Include check valve and shutoff valve.
      - 6) 3 IN threaded outlet fitting for attachment of fill pipe to each AST.
    - d. The tank fill box shall include a control system for multiple tanks with tank gauging, alarm, overfill alarm, and automatic shutoff system as described below.
      - 1) Electrical; 115 VAC, 1-ph, 15-amp circuit.
    - e. An electronic tank monitor and fill control system shall be provided and shall include:
      - 1) NEMA 3R rainproof, lockable enclosure with hinged door.
      - 2) Level transmitter for installation in each AST.
      - 3) Digital level gauge for each tank, reading in percent level.
      - 4) High visibility red alarm light: 90% level.
      - 5) High visibility red alarm light: 95% level.

- 6) 90 dB audible alarm horn activated at 90%, 95% and on AST leak.
- 7) Control power ON/OFF switch.
- 8) Fill valve OPEN/CLOSE switch.
- 9) Valve restriction at 90% level.
- 10) Automatic valve closure at 95% level.
- 11) Tank selection / electric valve control.
  - a) System shall allow operator selection of tank to be filled.
  - b) Automatic lock out of all off-line tanks.
- 12) Leak sensor alarm circuit input for each tank which activates automatic valve closure
- f. Indicators for:
  - 1) Power available.
  - 2) Fill valve disarm.
  - 3) Fill valve open.
  - 4) Tank leak.
- 2. Electric Operated Ball Valve:
  - a. 3 IN inlet motorized ball valves for closure on each AST; offline, high level, and leak conditions.
  - b. Motorized ball valve shall open based on operator selection.
  - c. Valve shall be compatible with diesel fuel.
  - d. Features:
    - 1) Full port lead free brass ball valve.
    - 2) LED light for continuous status indication.
    - 3) Weatherproof enclosure (IP67 rating).
    - 4) Anti-condensation heater.
    - 5) Manual override with visual valve position indicator.
    - 6) Two auxiliary limit switches to confirm valve position.
  - e. Powered from Fill Box Control Panel.
  - f. Valworx, Series 5680 (568018) or equal.
- 3. Thermal Expansion Pressure Relief Valve:
  - a. Provide one (1) pressure relief valve in main header, relief outlet plumbed into generator fuel tank.
  - b. Materials:
    - 1) Seat: Brass/FKM.
    - 2) Spring: Stainless Steel Type 302.

- 3) Body: Bronze.
- 4) Cap: Brass.
- c. Apollo, 16100 Series, FKM Seat or equal.

## 2.04 ACCESSORIES

- A. Provide terminals, relays and gateway as required for interfacing with the Generator Controls and Master Controls. Coordinate with Systems Integrator.
- B. Generator remote annunciator panel (for remote indication):
  - 1. Surface mounted NEMA 1 or NEMA 4 enclosure as noted on the Drawings. Surface mounted enclosure with Human Machine Interface (HMI).
  - 2. Circuits:
    - a. 120 Vac powered from local 20A circuit.
      - 1) Provide ac/dc converter if necessary.
  - 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 pre-alarm 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 DegF).
      - 3) Low fuel in main storage tank.
      - 4) Low fuel in day tank.
      - 5) Fuel in day tank rupture basin.
      - 6) Battery charger malfunctioning.
      - 7) Low battery voltage.
    - e. Pre-alarm indicator lights as follows:
      - 1) High engine water temperature.
      - 2) Low lubricating oil pressure.

- 3) Excessive ground fault has been detected on the generator main breaker.
- f. Analog indication:
  - 1) Fuel level in day tank.
- C. Manual stop break glass stations:
  1. Shuts down generator/s from remote location.
  2. Verify locations prior to installation.
- D. Generator set walk-in sound attenuating, weatherproof, self-contained, freestanding generator containment.
  1. Attenuate engine-generator produced sound to an A-weighted sound level of 75 dB(A) at 23 FT from enclosure.
  2. Construction:
    - a. Galvanized steel or Aluminum frame and exterior panels.
    - b. Structurally stable in 100 mph wind.
    - c. Support roof load of 40 PSF.
    - d. Fiberglass or mineral wool insulation to provide minimum R11 insulation in side walls and roof for thermal transmission, sound attenuation material can be in addition to or include the thermal insulation.
    - e. Enclosure shall be approved for installation in local seismic zone.
  3. Exterior shall be mill prepainted in color selected by Owner
  4. Resist intake of blown sand or rain through intake air assembly.
  5. Two (2) 36 IN wide man door in one (1) side and two (2) 36 IN wide doors in other side and removable air intake and louver assembly for removal of large assemblies.
  6. Space for routine maintenance and service shall be provided on all four (4) sides of generator.
  7. Anchor bolts for casting into concrete base for attaching enclosure to pad.
  8. Provision for exit of exhaust stack in roof, flashed and sealed to prevent entry of moisture.
    - a. Support for critical silencer on roof.
  9. Lighting fixtures to provide 30 foot-candle lighting for servicing.
  10. Motorized dampers for control of air intake and discharge openings.
  11. Electric unit heaters to maintain internal temperature at 50 DegF and interlock so unit heaters shut off when generators are running.
  12. Coordinate the enclosure with the engine generator furnished to assure physical clearances, sound attenuation, airflow and pressure drop through the system.
  13. Space for mounting electrical panel for serving loads inside enclosure to include but not be limited to lights, unit heaters, engine block heaters, battery chargers, ventilation fans. Loads inside the enclosure shall be pre-wired at the factory.

14. Ventilation fan with gravity damper, thermostatically controlled to operate continuously at internal temperatures adjustable from 60 to 90 DegF and interlocked to prevent them from running when the engine generators are running.
  - a. Interlock ventilation fan with motorized inlet dampers.
  - b. Enclosure shall accommodate an interior pancake style exhaust silencer mounted to the inside roof of the enclosure and the enclosure and walls shall be constructed to support the weight of the exhaust system to prevent weight transferal to the engine.

E. Alarm Annunciator Panel:

1. Furnish a NEMA 4X stainless steel alarm annunciator panel to be installed as noted on the Drawings. The annunciator panel shall display critical generator and paralleling switchgear alarms to alert the operator to take action.
2. Annunciator shall be manufactured by Panalarm (Ametek) Series 90B. Annunciator shall be mounted flush on the front of the NEMA 4X panel. Annunciator shall be capable of receiving at least 10 hardwired normally open inputs for alarm or status display. Vendor shall coordinate with the Owner to obtain alarm and status text which shall be engraved on the annunciator alarm windows (tiles).
3. Install a RuggedCom model RS910 Ethernet switch in the NEMA 4X panel along with two (2) Advantech model ADAM-6050-CE 18 channel Modbus TCP modules. The alarms and statuses to be displayed on the annunciator shall be transmitted via Modbus TCP from the PLC in the Paralleling Switchgear. The Modbus TCP modules shall provide digital outputs wired to the annunciator. All 12 outputs from the Modbus TCP modules shall be wired to the annunciator.
4. The alarm annunciator panel shall be powered by a 120VAC circuit obtained from the nearest lighting panel.
5. It shall be the responsibility of the generator and paralleling switchgear vendor to establish Modbus TCP communication to the annunciator panel from the PLC in the paralleling switchgear to successfully display the alarms and statuses. This communication shall be tested in the Factory Acceptance Test (FAT) and site test described in Specification 26 13 13.

## 2.05 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 no less than 2 HRS.
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 (1) 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.

## 2.06 MAINTENANCE MATERIALS

### A. Spare Parts:

- 1. Provide manufacturer's recommended spare parts.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install all components as indicated and in accordance with manufacturer's recommendations and instructions.
- 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 DegF.
- C. Contractor shall provide fuel for gen-set fuel tanks and oil for unit.
- D. Contractor shall top off fuel and all fluids to normal operating levels after testing is complete.
- E. Install all wiring to engine in conduit.
  - 1. Control wiring on engine may be factory installed in high temperature loom.
- F. Provide control wiring in conduit between generator control panel described under generator instrument and controls paragraph as specified and indicated in the contract documents.
- G. Mount on concrete pad utilizing vibration/seismic isolators, see drawings for pad detail.
- H. 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 Engineer.

### 3.02 FIELD QUALITY CONTROL

- A. 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 Owner's personnel.
  5. Provide 4 HRS of the manufacturer's technical representative's time for on-site training of Owner's personnel.
- B. Provide two (2) load tests and one (1) cycle crank test.
1. Tests one (1) and two (2) shall be for continuous period of no less than 2 HRS each.
  2. Engineer and Owner shall be notified seven (7) days prior to testing.
  3. 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.
  4. Test number two:
    - a. Immediately after completion of test number one, start prime mover and upon reaching rated RPM, pick up 100 percent of nameplate KW rating in one (1) 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.

- 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.
- 5. 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 (2) means of cranking termination shall be utilized so that one (1) will act as a backup to the other to prevent inadvertent starter engagement.
    - 3) Cranking limiter time shall be 75 seconds for cycle crank.
- 6. Furnish load banks of required ratings necessary for tests.
- 7. Record engine fuel consumption by means of test equipment.
- 8. 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.
- 9. Contractor shall be responsible for fuel and all consumables use during the test.

**END OF SECTION**



## **SECTION 26 33 00 -BATTERY AND BATTERY CHARGING SYSTEMS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Material and installation requirements for:
  - a. Batteries.
  - b. Battery charging system.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 00 – Submittals and Substitutions
- B. Section 01 65 50 - Delivery, Storage and Handling
- C. Section 26 05 00 - Electrical: Basic Requirements.
- D. Section 26 05 98 - Power Distribution Center – Gear Houses.
- E. Section 26 13 13 - Medium Voltage Metal-Clad Paralleling Switchgear.

#### **1.03 REFERENCED STANDARDS**

##### **A. ASTM International (ASTM):**

1. D635, Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.

##### **B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):**

1. 450, Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications.
2. 485, Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications.
3. 1106, Recommended Practice for Installation, Maintenance, Testing, and Replacement of Vented Nickel-Cadmium Batteries for Stationary Applications.
4. 1115, Recommended Practice for Sizing Nickel-Cadmium Batteries for Stationary Applications.

##### **C. National Electrical Manufacturers Association (NEMA):**

1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
2. PE 5, Utility Type Battery Chargers.

##### **D. Underwriters Laboratories, Inc. (UL):**

1. 94, Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
2. 1012, Power Units Other Than Class 2.

##### **E. Building code:**

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BATTERY AND BATTERY CHARGING SYSTEMS

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1. International Code Council (ICC):
  - a. International Building Code and associated standards, 2012 Edition including all amendments, referred to herein as Building Code.

#### 1.04 SYSTEM DESCRIPTION

- A. The battery system will be 125Vdc nominal. It will serve MEDIUM VOLTAGE METAL-CLAD PARALLELING SWITCHGEAR. (26 13 13)

#### 1.05 SUBMITTALS

##### A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
  - a. Provide submittal data for all products specified in PART 2 of this Specification:
  - b. Calculations used to size the batteries and chargers in accordance with the specified duty and criteria.
  - c. See Section 26 05 00 for additional requirements.
3. Fabrication and/or layout drawings:
  - a. General arrangement drawing.
  - b. Cross sections, elevations and details.
  - c. Battery cell layout drawing to facilitate the installation process.
  - d. Location in the Power Distribution Center – Gear House.
4. Certifications:
  - a. Guarantee of performance.

##### B. Operation and Maintenance Manuals:

1. See Specification Section 01 33 00 for requirements for:
  - a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.
2. See Specification Section 26 05 00 for additional requirements.

##### C. Informational Submittals:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Qualifications of system designer.
3. Record of test results, inspections and procedures witnessed or performed by factory service representative.

## 1.06 QUALITY ASSURANCE

### A. Qualifications:

1. Battery system design shall be by personnel skilled in the design and construction of the system.
  - a. Experienced in design projects of similar size and character as required for this work.
  - b. Battery system furnished shall use standard components assembled in a general configuration having acceptable history of service in similar applications for more than three (3) uninterrupted years.

## 1.07 DELIVERY, STORAGE, AND HANDLING

### A. See Section 01 65 50.

## 1.08 PROJECT CONDITIONS

### A. Environmental Requirements:

1. Altitude: refer to Special Conditions
2. Specifier: Consult the appropriate building code and include seismic design requirements as necessary.
3. Normal operating conditions: Indoor, air-conditioned environment; nominal +15 to +26 DegC.
4. Maximum temperature: 40 DegC (contingency situation).
5. Minimum temperature: 0 DegC (contingency situation).

### B. Incorporate Batteries and Battery System Chargers into the Power Distribution System - Gear House. Include all required clearances, racks and fastening hardware.

1. Paralleling Gear Manufacturer shall provide the Batteries and Battery System Chargers as a complete package.

## PART 2 - PRODUCTS

## 2.01 MANUFACTURERS

### A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Alcad.
2. C&D.
3. Enersys.
4. GNB.
5. Hoppecke.
6. Stored Energy Systems.

### B. Submit request for substitution in accordance with Specification Section 26 05 00.

## 2.02 MANUFACTURED UNITS

### A. Valve-Regulated Type Lead Acid Battery (VRLA):

1. General:
  - a. AGM (absorbed glass mat) type.
  - b. Lead-calcium or lead-antimony.
  - c. Flat plate type construction.
  - d. Electrolyte: Within the plates and separators.
  - e. Cells: No residual free or bulk liquid electrolyte.
2. Battery ratings:
  - a. Minimum voltage: 110 Vdc.
  - b. Nominal voltage: 125 Vdc.
  - c. Maximum voltage: 140 Vdc.
  - d. Minimum voltage per cell: 1.75 Vdc.
  - e. Float voltage: 2.25 +/-0.01 V per cell.
  - f. Battery life: 10 years minimum.
3. Minimum initial specific gravity: 1.30 at 25 DegC.
4. Each cell shipped completely assembled:
  - a. Filled with electrolyte.
  - b. Fully charged within one (1) week of shipment to at least 90 percent capacity and ready for service.
5. Battery housing:
  - a. Heat resistant and flame retardant.
  - b. Shock absorbing PVC or ABS conforming to UL 94 V-0 flame retardency.
  - c. Cover and case cemented together for permanent leak proof bond with adequate space for sediment below the plates.
  - d. Mark each container with month/year of manufacturer.
6. The cell cover is to incorporate a low-pressure valve with flame arrester element and a vent to avoid flashback explosions into the cell and to provide a release of gas pressures.
7. Cell terminal posts;
  - a. Sealed against any seepage of electrolyte.
  - b. Inserted and suitable for bolted connections.
  - c. Equipped with connector bolts and nuts.
  - d. High capacity cells: Designed with a solid copper core.
8. Intercell and interstep connectors:

- a. Capable of carrying the 1 minute current rating of the battery.
  - b. Constructed to reduce mechanical stress and tensions caused by thermal expansion.
- B. Battery Charger:
- 1. Controller:
    - a. Microprocessor controlled:
      - 1) Programmable customized alarms.
      - 2) Display both volts and current simultaneously.
  - 2. Rating:
    - a. Input voltage: 120 Vac.
      - 1) Voltage deviation: +10 percent.
    - b. Input phase: 1 PH.
    - c. Output voltage: 125 Vdc.
    - d. Output current: Adjustable from 60 percent to 110 percent of nominal rating.
    - e. Maximum RMS ripple voltage: 30mV when connected to battery.
    - f. Used in a DC system consisting of lead-acid batteries and used to maintain the battery in fully charged condition by float charge and to supply DC power to continuous load.
    - g. Service:
      - 1) Used to supply "equalizing charge" to the battery while simultaneously supplying DC power to the continuous loads.
        - a) The equalizing charge rate is to be sufficient to fully charge the battery.
        - b) Sized to meet the requirements of the specification, from its fully discharged condition in 16 HRS while also energizing the continuous load.
        - c) For any setting of the output voltage within the "equalizing charge voltage setting range", the output voltage shall not vary beyond +0.5 percent under full load condition and input supply voltage and frequency variations.
      - 2) The transfer from "floating charging" to "equalizing charging" service is to be automatic.
        - a) The float charge rate is to be sufficient to maintain the battery in its fully charged condition while serving the continuous load.
        - b) For any setting of the output voltage within the "float charge voltage setting range" specified, the output voltage shall not vary beyond +0.5 percent for any load variation from 0 percent to 100 percent and input supply voltage and frequency variations indicated.

- 3) The return to float charge service is to be automatic after the time set on an adjustable timer.
- h. Current limiting circuitry:
  - 1) Limit the output current to a value which will not cause any damage or blow the fuses.
  - 2) The charger voltage is to automatically return to normal value when the overload or short circuit is removed.
- i. The charger shall be self-protecting against all AC and DC transients.
  - 1) The charger shall be designed with or without the option of a blocking diode to prevent power feedback from the batteries during input AC supply failure or a charger internal failure.
  - 2) Upon restoration of AC supply, the pre-set charging rate shall be resumed automatically.
3. Charger enclosure:
  - a. NEMA 1 cabinet.
  - b. Hinged door on which controls and instruments are mounted.
  - c. Provisions for either floor mounting on stand or wall mounting.
4. Protective devices:
  - a. Input circuit breaker with thermal magnetic trip element, operable for the front.
  - b. Two-pole output DC circuit breaker with thermal magnetic trip element, operable from the front.
5. Provide with the following:
  - a. Alarm light for each alarm relay.
  - b. Input AC circuit breaker.
  - c. Output DC circuit breaker.
  - d. Output DC voltmeter and ammeter.
  - e. Input AC failure alarm.
  - f. Ground fault detector.
  - g. Output DC failure alarm.
  - h. High charge volt alarm.
  - i. High DC voltage shutdown.
  - j. Low charge volt alarm.
  - k. Load current display.
  - l. Adjustable timer.
  - m. Input voltage lightning arrestors.

C. Battery Rack and Accessories:

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1. Rack:
    - a. Tiered configuration.
    - b. Constructed of phosphatized steel, coated with powder epoxy acid resistant ASA #61 gray coating or epoxy powder-coated and polyethylene power coated, acid and alkali resistant.
  2. Accessories:
    - a. No-oxide grease in sufficient quantity to coat all posts and connectors.
    - b. Anti-corrosion compound for battery connections.
    - c. Inter-cell connectors (including interstep connectors).
    - d. Individual cell number labels.
    - e. Two (2) solderless lugs for customer use.
- D. Miscellaneous:
1. Battery safety switch: Fused, two-pole NEMA 1 enclosure, heavy duty class and rated as required.
  2. DC Panelboard:
    - a. 100Amp.
    - b. 18 Circuit with 20A breakers.
    - c. 10 kaic.

## 2.03 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Battery amp-hour and battery charger ratings to be sufficient for the following emergency duty cycle (calculations to be performed by supplier and presented to engineer for review) (See Figure 1):
1. Continuous non-emergency amperes before the emergency duty cycle begins:
  2. Length of emergency duty cycle (Time "W"): 8 HRS.
  3. Load "A" during first minute (Time "X") of duty cycle:
  4. Load "B" during next time period (Time "Y"):
  5. Duration of time period "Y": Time "W" minus Time "X" minus Time "Z".
  6. Load "C" during next time period (Time "Z"):
  7. Duration of time period "Z": 6 minutes.
  8. Design factors:
    - a. Aging factor: 1.25.
    - b. Design factor: 1.15.
  9. Battery sized with the capability of supplying the specified emergency duty cycle throughout its life with the initial discharge capacity of the battery at 100 percent of rated discharge capacity.
  10. Battery capacity includes the voltage drop across the connectors.

11. Battery sized to support the above duty cycle with a minimum electrolyte temperature of 0 DegC.

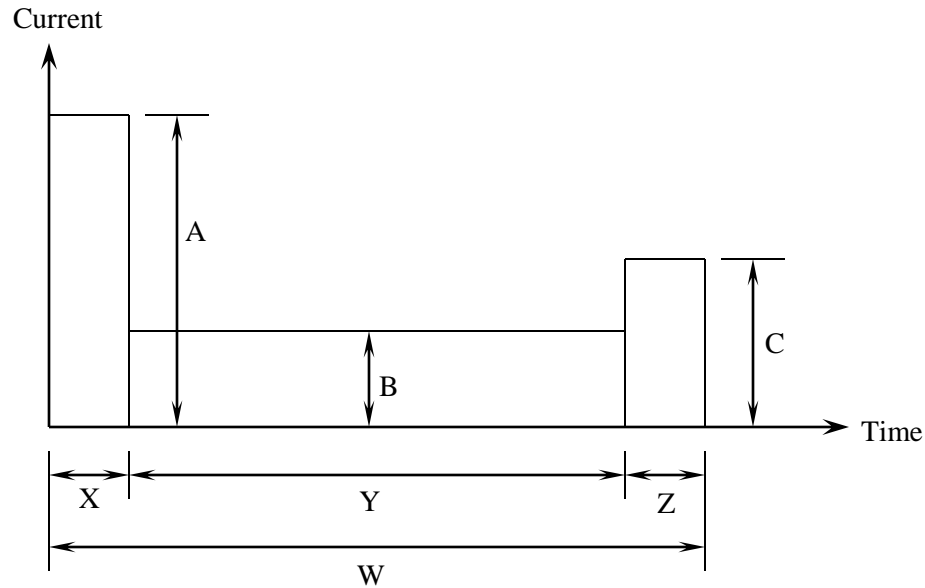


Figure 1 – Emergency Duty

#### 2.04 SOURCE QUALITY CONTROL

- A. The battery and charger are to be inspected and tested for conformance with the specifications prior to shipment.
  - 1. An Owner may be present for all witness testing and inspections.
  - 2. The representative shall notify Owner of all tests and inspections at least three (3) weeks prior to conducting said test or inspection.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a complete installation.

#### 3.02 FIELD QUALITY CONTROL

- A. Field Tests:
  - 1. Inspect the general assembly of the equipment to insure that the battery and charger conform to the Contract Drawings, procedures, and specifications.
  - 2. Provide inspection and test procedures for the battery and charger in accordance with the manufacturer's instructions.



3. The battery and charger performance test are to be conducted in accordance with the manufacturer's instructions.
- B. Provide field services to handle correction of errors, discrepancies or omissions in the equipment and materials furnished.

**END OF SECTION**

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## **SECTION 26 43 13 - LOW VOLTAGE SURGE PROTECTION DEVICES (SPD)**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Type 1 SPD - High exposure locations (switchgear, switchboard, panelboard or motor control center), externally mounted.
2. Type 3 SPD - Medium exposure locations (switchboard, panelboard and motor control center), externally mounted.
3. Type 5 SPD - Medium or low exposure locations at individual equipment locations, external, parallel connection.

#### **1.02 REFERENCED STANDARDS**

##### **A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):**

1. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
2. C62.41.1, Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits.
3. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
4. C62.45, Recommended Practice on Surge Testing For Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits.

##### **B. Military Standard:**

1. MIL-STD-220B, Method of Insertion-Loss Measurement.

##### **C. National Electrical Manufacturers Association (NEMA):**

1. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
2. LS 1, Low Voltage Surge Protective Devices.

##### **D. National Fire Protection Association (NFPA):**

1. 70, National Electrical Code (NEC).

##### **E. Underwriters Laboratories, Inc. (UL):**

1. 1283, Standard for Electromagnetic Interference Filters.
2. 1449, Standard for Safety for Surge Protection Devices.

#### **1.03 DEFINITIONS**

##### **A. Clamping Voltage:**

1. The applied surge shall be induced at the 90 degree phase angle of the applied system frequency voltage.

2. The voltage measured at the end of the 6 IN output leads of the SPD and from the zero voltage reference to the peak of the surge.
- B. Let-Through Voltage:
1. The applied surge shall be induced at the 90 degree phase angle of the applied system frequency voltage.
  2. The voltage measured at the end of the 6 IN 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 percent 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).

#### 1.04 SUBMITTALS

##### A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. 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.
  - 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. See Specification Section 01 33 00 for requirements for:
  - a. The mechanics and administration of the submittal process.
  - b. The content of Operation and Maintenance Manuals.
- 2. See Specification Section 26 05 00 for additional requirements.
- 3. Warranty.

## 1.05 QUALITY ASSURANCE

A. 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 (3) customer references showing satisfactory operation.

## 1.06 WARRANTY

- A. Minimum of a five (5) 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

### 2.01 GENERAL

- A. Standards: IEEE C62.41.1, IEEE C62.41.2, IEEE C62.45, NEMA LS 1, MIL-STD 220B, UL 1283, UL 1449.

### 2.02 MANUFACTURERS

- A. Subject to compliance with Contract Documents, the following manufacturers are acceptable:
  - 1. Eaton.

### 2.03 TYPE 1 SPD

- A. Product:
  - 1. Externally mounted adjacent to switchgear, switchboards or MCCs.
  - 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. Enclosure:
    - a. Metallic NEMA 4 or 12 for interior locations.
    - b. Metallic NEMA 4 or 4X for exterior locations.
  - 6. Field connection:
    - a. Mechanical or compression lugs for each phase, neutral and ground that will accept #10 through #1/0 conductors.
    - b. Preinstalled lead conductors: Size per manufacturer, length as required with a maximum of 2 FT.
  - 7. 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 percent of system peak voltage.
- E. Operating Frequency: 45 to 65 Hz.
- 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 percent 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 IN lead length and measured from the zero voltage reference:

<b>IEEE C62.41</b>				
<b>System Voltage</b>	<b>Test Mode</b>	<b>C High V &amp; I</b>	<b>B Combination</b>	<b>UL 1449</b>
		<b>Wave</b>	<b>Wave</b>	
<b>L-L &lt; 250 V</b>	L-L	1470 V	1000 V	800 V
<b>L-N &lt; 150 V</b>	L-N	850 V	600 V	500 V
	L-G	1150 V	800 V	600 V
	N-G	1150 V	800 V	600 V
<b>L-L &gt; 250 V</b>	L-L	2700 V	2000 V	1800 V
<b>L-N &gt; 150 V</b>	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.

## 2.04 TYPE 3 SPD

- A. Product:

1. Externally mounted adjacent to switchboard, panelboards or motor control centers.
  2. Hybrid solid state high performance suppression system.
    - a. Do not use gas tubes, spark gaps or other components in suppression system 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. Enclosure:
    - a. Metallic NEMA 4 or 12 for interior locations.
    - b. Metallic NEMA 4 or 4X for exterior locations.
  6. Field connection:
    - a. Mechanical or compression lugs for each phase, neutral and ground that will accept #10 through #1/0 conductors.
    - b. Preinstalled lead conductors: Size per manufacturer, length as required with a maximum of 2 FT.
  7. Device monitor:
    - a. Long-life, solid state, externally visible indicators and Form C contact(s) that monitor the on-line status of each mode of the units suppression filter system or 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 the 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 percent of system peak voltage.
- E. Operating Frequency: 45 to 65 Hz.
- F. Short Circuit Rating: Equal to or greater than rating of equipment SPD is connected to.
- G. Maximum Surge Current: Refer to Drawings for per phase maximum and per mode minimum.
- H. Minimum Repetitive Surge Current Capacity: 4000 IEEE C High or B combination waveform impulses with no degradation of more than 10 percent 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 B combination wave 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 IN lead length and measured from the zero voltage reference:

System Voltage	Test Mode	IEEE C62.41		UL 1449
		B Comb. Wave	B3 Ring Wave	
<b>L-L &lt; 250 V</b>	L-L	1000 V	700 V	800 V
<b>L-N &lt; 150 V</b>	L-N	600 V	400 V	500 V
	L-G	800 V	550 V	600 V
	N-G	800 V	550 V	600 V
<b>L-L &gt; 250 V</b>	L-L	2000 V	1400 V	1800 V
<b>L-N &gt; 150 V</b>	L-N	1150 V	800 V	1000 V
	L-G	1550 V	1000 V	1200 V
	N-G	1550 V	1000 V	1200 V

K. EMI-RFI Noise Rejection: Attenuation greater than 30 dB for frequencies between 100 kHz and 100 MHz.

2.05 TYPE 5 SPD

A. Product:

1. Externally mounted next to equipment or internally to control panel for point-of-use loads.
2. 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.
3. Designed for parallel connection.
4. Enclosure:
  - a. Metallic NEMA 4 or 12 for interior locations.
  - b. Metallic NEMA 4 or 4X for exterior locations.
5. Field connection:
  - a. Mechanical or compression lugs for each phase, neutral and ground that will accept #10 through #1/0 conductors.
  - b. Preinstalled lead conductors: Size per manufacturer, length as required with a maximum of 2 FT.

6. Device monitor:
  - a. Long-life, solid state, externally visible indicators and Form C dry contact(s) that monitor the on-line status of each mode of the units suppression filter system or power loss in any of the phase.
  - b. A fuse status only monitor system is not acceptable.
7. Accessories (when specifically specified): Unit mounted disconnect switch.
- B. Operating Voltage: Nominal unit operating voltage and configuration as indicated on the 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 percent of system peak voltage.
- E. Operating Frequency: 45 to 65 Hz.
- F. Short Circuit Rating: Equal to or greater than rating of equipment SPD is connected to.
- G. Maximum Surge Current: 120,000 A per phase, 60,000 A per mode minimum.
- H. Minimum Repetitive Surge Current Capacity: 4000 IEEE C High or B combination waveform impulses with no degradation of more than 10 percent 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 B combination wave 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 IN lead length and measured from the zero voltage reference:

System Voltage	Test Mode	IEEE C62.41		UL 1449
		B Comb. Wave	B Ring Wave	
<b>L-L &lt; 250 V</b> <b>L-N &lt; 150 V</b>	L-L	1000 V	700 V	800 V
	L-N	600 V	400 V	500 V
	L-G	800 V	550 V	600 V
	N-G	800 V	550 V	600 V
<b>L-L &gt; 250 V</b> <b>L-N &gt; 150 V</b>	L-L	2000 V	1400 V	1800 V
	L-N	1150 V	8000 V	1000 V
	L-G	1550 V	1000 V	1200 V
	N-G	1550 V	1000 V	1200 V

- K. EMI-RFI Noise Rejection: Attenuation greater than 30 dB for frequencies between 100 kHz and 100 MHz.

## 2.06 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 IN 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.
  - 2. Single pulse surge current capacity test.
  - 3. Repetitive surge current capacity testing.
  - 4. Spectrum analysis for EMI-RFI noise rejection.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Type 1 and 3 SPD:
  - 1. Mounting options:
    - a. Nipple connection directly to the equipment to be protected.
  - 2. Install leads as short and straight as possible.
  - 3. Maximum lead length: 36 IN.
  - 4. Minimum lead size: #2 stranded AWG or bus bar.
  - 5. Connect leads to the equipment to be protected by one (1) 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 5 SPD:
  - 1. Mounting options:

- a. Nipple connection directly to the equipment to be protected.
2. Install leads as short and straight as possible.
3. Maximum lead length: 36 IN.
4. Minimum lead size:
  - a. Type 5: #10 stranded AWG.
5. When conduit connection is used, provide a minimum of four (4) 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 (1) 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**

## **SECTION 26 50 00 - INTERIOR AND EXTERIOR LIGHTING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Material and installation requirements for:
  - a. Interior building and exterior building mounted luminaires.
  - b. Exterior and site luminaires.
  - c. Lamps and light-emitting diodes (LEDs).
  - d. Ballasts and drivers.
  - e. Light poles.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Division 03 - Concrete.
- B. Section 26 05 00 - Electrical: Basic Requirements.
- C. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
- D. Section 26 09 16 - Control Panels.

#### **1.03 REFERENCED STANDARDS:**

- A. American Association of State Highway and Transportation Officials (AASHTO):
- B. Technical Bulletin No. 270 - A Guide to Standardized Highway Lighting Pole Hardware (LPH-1).
- C. American Concrete Institute (ACI):
  1. 301, Specifications for Structural Concrete.
- D. American National Standards Institute (ANSI):
  1. C78.377, Specification for the Chromaticity of Solid State Lighting Products.
- E. American Society of Mechanical Engineers (ASME):
  1. B18.2.2, Square and Hex Nuts (Inch Series).
  2. B18.5, Round Head Bolts (Inch Series).
- F. ASTM International (ASTM):
  1. A36, Standard Specification for Carbon Structural Steel.
  2. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  3. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

4. A194, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service, or Both.
  5. A252, Standard Specification for Welded and Seamless Steel Pipe Piles.
  6. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  7. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  8. A575, Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
  9. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
  10. A635, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
- G. Alliance for Telecommunications Industry Solution (ATIS):
1. O5.1, Wood Poles - Specifications and Dimensions.
- H. American Wood Protection Association (AWPA) Book of Standards
- I. Certified Ballast Manufacturers (CBM).
- J. Federal Communications Commission (FCC):
1. Code of Federal Regulations (CFR), 47 CFR 18, Industrial, Scientific and Medical Equipment.
- K. International Electrotechnical Commission (IEC).
- L. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
1. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- M. Illuminating Engineering Society of North America (IESNA):
1. LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products.
  2. LM-80, Measuring Lumen Maintenance of LED Light Sources.
- N. National Electrical Manufacturers Association (NEMA):
1. 250, Enclosures for Electrical Equipment (1000Volts Maximum).
  2. 410, Performance Testing for Lighting Controls and Switching Devices with Electronic Fluorescent Ballasts.
  3. LE 4, Recessed Luminaires, Ceiling Compatibility.
- O. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
1. C82.1, Lamp Ballasts - Line Frequency Fluorescent Lamp Ballast.

2. C82.4, Ballasts for High-Intensity Discharge (HID) and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type).
  3. C82.11, High-Frequency Fluorescent Lamp Ballasts - Supplements.
  4. SSL 1, Electronic Drivers for LED Devices, Arrays and Systems.
- P. National Fire Protection Association (NFPA):
1. 70, National Electrical Code (NEC).
  2. 101, Life Safety Code.
- Q. Society of Automotive Engineering (SAE):
1. J429, Mechanical and Material Requirements for Externally Threaded Fasteners.
- R. Underwriters Laboratories, Inc. (UL):
1. 248-4, Low-Voltage Fuses - Part 4: Class CC Fuses.
  2. 844, Standard for Luminaires for Use in Hazardous (Classified) Locations.
  3. 924, Standard for Emergency Lighting and Power Equipment.
  4. 935, Standard for Fluorescent-Lamp Ballasts.
  5. 1012, Power Units Other Than Class 2.
  6. 1029, Standard for High-Intensity-Discharge Lamp Ballasts.
  7. 1310, Class 2 Power Units.
  8. 1598, Luminaires.
  9. 8750, Light Emitting Diode (LED) Equipment for Use in Lighting Products.
- S. United States Department of Energy (USDOE):
1. EPCAct, the National Energy Policy Act.

#### 1.04 DEFINITIONS

- A. Average Rated Life for HID and fluorescent luminaire light sources:
1. The time after which 50 percent of a large group of light sources will have failed and 50 percent will have survived under normal operating conditions.
- B. Useful Life for LED luminaire light sources:
1. The operating hours before reaching 70 percent of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions.
  2. This is also known as 70 percent "Rated Lumen Maintenance Life" as defined in IESNA LM-80.

#### 1.05 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
  2. 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 I, 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) 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.
  - 11) Toxicity Characteristic Leaching Procedure (TCLP) compliance.
  - 12) Warranty information.
- e. Luminaire lamp data sheet:
  - 1) Name of manufacturer.



- 2) Complete order information (catalog number).
  - 3) Wattage.
  - 4) Initial and mean lumens.
  - 5) Luminous efficacy (lumens/Watt).
  - 6) Correlated Color Temperature (CCT).
  - 7) Color Rendering Index (CRI).
  - 8) Lamp life.
  - 9) Base configuration.
  - 10) Toxicity Characteristic Leaching Procedure (TCLP) compliance.
  - 11) Warranty information.
- f. Luminaire ballast data sheet:
- 1) Name of manufacturer.
  - 2) Complete order information (catalog number).
  - 3) Type and quantity of lamps it operates.
  - 4) Ballast factor.
  - 5) Input Wattage.
  - 6) Inrush current.
  - 7) Voltage.
  - 8) End-of-life sensing shut off.
  - 9) Total Harmonic Distortion (THD).
  - 10) T8 linear lamps: NEMA Premium mark.
  - 11) Emergency battery ballast:
    - a) Lumen output of lamp in emergency operation.
    - b) Battery life.
    - c) Description of testing.
  - 12) Warranty information.
- g. Luminaire halogen low voltage transformer:
- 1) Name of manufacturer.
  - 2) Complete order information (catalog number).
  - 3) Type and quantity of lamps it operates.
  - 4) Power rating.
  - 5) Voltage.
  - 6) Overload protection.
  - 7) Remote mounting distance.

- 8) Dimming operation:
    - a) Dimming range.
    - b) Compatible dimming control devices.
  - h. Pole data sheet:
    - 1) Name of manufacturer.
    - 2) Complete order information (catalog number).
    - 3) Description of construction.
    - 4) Length, shaft size and thickness.
    - 5) Wind loading (available luminaire EPA per wind speed).
    - 6) Anchor bolt template.
    - 7) Bolt size and material.
    - 8) Luminaire
  - i. See Specification Section 26 05 00 for additional requirements.
- 3. Test Reports:
  - a. IES LM-79 Test Report for Solid-State Luminaire.
  - b. IES LM-80 Test Report Solid-State Light Source.
- 4. Certifications: Solid-state Luminaire Useful Life Certificate.
- B. Operation and Maintenance Manuals:
  - 1. See Specification Section 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
  - 2. The content of Operation and Maintenance Manuals.
    - a. Submittal data for each component covered by warranty.
    - b. Warranty.

#### 1.06 WARRANTY

- A. Minimum of a two (2) year Warranty from date of manufacture against failure for electromagnetic HID ballasts.
- B. Minimum of a five (5) year Warranty from date of manufacture against failure for electronic HID ballasts.
- C. Minimum of a five (5) year Warranty from date of manufacture against failure for electronic fluorescent ballasts.
- D. Minimum of a five (5) 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 percent of the individual light emitting diodes fail to illuminate.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Luminaires: Per Luminaire Schedule.
  - 2. Lamps:
    - a. Philips Lighting Company.
  - 3. Solid State Light Sources:
    - a. Cree.
    - b. Xicato.
    - c. Luminaire manufacturer's proprietary system.
  - 4. Ballasts:
    - a. Luminaire manufacturer's standard.
  - 5. LED Driver: Luminaire manufacturer's standard.
  - 6. Emergency ballasts:
    - a. Philips Bodine.
  - 7. High bay luminaire lowering device.
    - a. Lighting and Lowering System by North Star Lighting.
  - 8. Poles: Luminaire manufacturer's standard.
  - 9. Power installed pole foundation anchors:
    - a. AB Chance.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

### 2.02 GENERAL REQUIREMENTS

- A. All Luminaires and Electrical Components:
  - 1. UL labeled.
  - 2. Luminaires complete with lamps and ballasts or LED modules and drivers.
  - 3. Rated for area classification as indicated on the Drawings.
    - a. In Class I, Division 1 and 2 areas, the temperature rating of the luminaires and lamp or LED combination shall not exceed the auto-ignition temperature of the atmosphere in which the Luminaire is used.
- B. 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.
- C. 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.
- D. Coordinate luminaire mounting where recessed into building canopies prior to Submitting Shop Drawings. Confirm clearances and luminaire flange compatibility with construction.
- E. Electrical components of recessed luminaires shall be accessible and removable through luminaire without having to remove luminaire from ceiling.
- F. No live parts normally exposed to contact.
- G. When intended for use in wet areas: Mark luminaire "Suitable for wet locations."
- H. When intended for use in damp areas: Mark luminaire "Suitable for damp locations" or "Suitable for wet locations."

## 2.03 LUMINAIRES

- A. Standards:
  1. UL 1598.
  2. UL 844 for hazardous locations.
  3. NEMA LE 4 for recessed locations.
- B. Housings:
  1. As indicated in the Luminaire Schedule.
- C. Trim (Recessed Mounted):
  1. As indicated in the Luminaire Schedule.
- D. Castings:
  1. As indicated in the Luminaire Schedule.
- E. Fasteners:
  1. As indicated in the Luminaire Schedule.
- F. Finishes:
  1. As indicated in the Luminaire Schedule.
- G. Lens/Louver Frames:
  1. As indicated in the Luminaire Schedule.
- H. Lenses:
  1. As Indicated in the Luminaire Schedule.
- I. Reflectors:
  1. As Indicated in the Luminaire Schedule.
- J. Gaskets:
  1. As Indicated in the Luminaire Schedule.
- K. Ventilation:

1. Ventilation openings of adequate size and quantity to permit operation of lamps and ballast without affecting rated output or life expectancy. Include wire mesh screens.

L. Lamp Holders:

1. Position sockets so that lamps are in optically correct relation to luminaire components.
2. Secure sockets by screws to luminaire enclosure or husk. Spring mounted sockets are not approved. Do not use plastic or sheet metal sockets unless specified otherwise.
3. Sockets with open circuit voltage over 300 volts: Safety type, designed to open supply circuit upon lamp removal.
4. Mount lamp holders such that fluorescent lamps on rapid-start circuits are within 1 IN of grounded metal, a minimum of 1IN wide for full length of lamp.
5. Fluorescent: White urea plastic body; silver plated phosphor bronze or beryllium copper contacts.
6. High Intensity Discharge: Porcelain body; nickel plated brass socket, pre-lubricated with silicone compound. Lamp supplied must be compatible with socket orientation (horizontal, base up or base down).

M. Wiring:

1. Factory-wired to be compatible with the project electrical and controls systems.
2. Long tube fluorescent luminaires shall comply with NEC requirements and be supplied with a quick disconnect accessible to qualified persons before servicing or maintaining the ballast.
3. Thermally protect halogen and HID luminaires.

N. 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 effected during relamping 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 IN minimum diameter swivel stem, unless otherwise noted.
    - 2) Safety chain on high bay type.

- 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.
  - 4) For high intensity discharge lamps:
    - a) Use stems suspended from swivel shock-absorbing fittings.

## 2.04 SOLID-STATE LUMINAIRES - ADDITIONAL REQUIREMENTS

### A. Standards:

- 1. IES LM-79, 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. Maximum uniform color temperature of 4,500K.
- 2. Minimum color rendering index (CRI) of 80.
- 3. LED module light output and efficacy: Measured in accordance with IES LM-79 standards.
- 4. LED useful life and lumen maintenance: Measured in accordance with IES LM-80 standards.
- 5. Driver and LED module: Minimum useful life of 50,000 HRS.
- 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 480V with sustained variations of +/- 10 percent (voltage and frequency).

3. Input current Total Harmonic Distortion (THD): Less than 20 percent 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 percent to 1 percent of rated lumen output. Dimming controlled by a 0-10VDC 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. Operating temperature range must be suitable for site temperature conditions within exterior and gasketed luminaires.

E. Emergency Battery Driver:

1. Standard: 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": can operate up to 23W at 770mA.
  - d. Philips Bodine "BSL23C": can operate up to 23W at 770mA in operating conditions ranging from -20 DegC (-4 DegF) to 60 DegC (140 DegF).
  - e. Alternate manufacturer: Iota.

F. Luminaire properly heat sinked to assure LED junction temperature ratings are not exceeded.

1. Provide ambient operating temperature range for which product is warrantied.

## 2.05 EXIT SIGNS AND EMERGENCY LIGHTING UNITS

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 batter, charger and electronic circuitry.
  - d. Solid state charging indicator light to monitor the charger and battery.
  - e. Single-pole test switch.

C. Emergency Lighting Units:

1. Housing: As indicated in the Luminaire Schedule.
2. Lamps: As indicated in the Luminaire Schedule.
3. Battery type: As indicated in the Luminaire Schedule.
4. Self-testing/self-diagnostic.
  - a. Electronic circuitry automatically test emergency lighting for a minimum of 30 seconds every 30 days and 90 minutes once a year.
5. Consist of battery, charger and electronic circuitry.
6. Solid state charging indicator light to monitor the charger and battery.
7. Single-pole test switch.

## 2.06 LAMPS

A. Medium Screw Base Fluorescent and Solid State:

1. Type and initial lumens as indicated in the Luminaire Schedule.
2. Size and shape coordinated with luminaire.
3. Fluorescent:
  - a. Self-ballasted.
  - b. Types: Spiral, reflector.
4. Solid state:
  - a. Integral driver.
  - b. Types: A and PAR.



B. Fluorescent:

1. T8 (265 mA) programmed start linear medium bi-pin lamps (G13):
  - a. Correlated color temperature of 3500 degrees Kelvin.
  - b. Minimum color rendering index (CRI) of 80.
  - c. Minimum initial lumen ratings for each lamp type shall be as indicated on drawings.
  - d. Average rated life:
    - 1) 30,000 HRS at 3 HRS per start.
    - 2) 36,000 HRS at 12 HRS per start.
  - e. Low-mercury, green-tipped type manufactured to be in compliance with the EPA's Toxicity Characteristic Leaching Procedure (TCLP).
2. T4 twin-tube, quad-tube, and/or triple twin-tube compact fluorescent lamps:
  - a. Correlated color temperature of 3500 degrees Kelvin.
  - b. Minimum color rendering index (CRI) of 80.
  - c. Minimum initial lumen ratings for preheat 2-pin twin-tube lamps with a G23 or GX23 base shall be:
    - 1) 600 lumens for 6.5 IN, 9 watt CFT9W lamp.
    - 2) 825 lumens for 7.1 IN, 13 watt CFT13W lamp.
  - d. Minimum initial lumen ratings for rapid-start 4-pin quad-tube lamps with a G24q-1, G24q-2 or G24q-3 base shall be:
    - 1) 900 lumens for 5.2 IN, 13 watt CFQ13W lamp.
    - 2) 1200 lumens for 5.8 IN, 18 watt CFQ18W lamp.
    - 3) 1710 lumens for 6.5 IN, 26 watt CFQ26W lamp.
  - e. Minimum initial lumen ratings for rapid-start 4-pin triple twin-tube lamps with a GX24q-2 or GX24q-3 base shall be:
    - 1) 1200 lumens for 4.6 IN, 18 watt CFTR18W lamp.
    - 2) 1710 lumens for 5.2 IN, 26 watt CFTR26W lamp.
    - 3) 2200 lumens for 5.8 IN, 32 watt CFTW32W lamp.
    - 4) 3200 lumens for 6.3 IN, 42 watt CFTR42W lamp.
  - f. Average rated life:
    - 1) 12,000 HRS at 3 HRS per start.
  - g. Low-mercury, green-tipped type manufactured to be in compliance with the EPA's Toxicity Characteristic Leaching Procedure (TCLP).

C. High Intensity Discharge (HID) Lamps:

1. Metal halide lamps:

- a. In an open luminaire, the lamp shall be rated for use in an open luminaire and incorporate a protective arc tube shroud design.
- b. Medium base pulse-start (pulse-strike) lamps.
  - 1) Coated lamps shall have a correlated color temperature of 3000 degrees Kelvin.
  - 2) Minimum color rendering index (CRI) for coated lamps is 85.
  - 3) Minimum initial lumen ratings for metal halide lamps with a medium base shall be as indicated on drawings.
  - 4) Average rated life:
    - a) 10,000 HRS for 50 watt lamps.
    - b) 15,000 HRS for all other lamps.
  - 5) Designated on the Luminaire Schedule by a 'MH' prefix.
    - a) Coated lamps are designated by a '/C' suffix.
    - b) Protected lamps are designated by a '/P' suffix.

c. Mogul base pulse-start lamps:

- 1) Clear lamps shall have a correlated color temperature of between 3600 and 4100 degrees Kelvin.
- 2) Minimum color rendering index (CRI) for clear lamps is 62.
- 3) Minimum initial lumen ratings for metal halide lamps with a mogul base in a universal position shall be:
  - a) 23,000 lumens for 250 watt, ED-28 (ANSI M153/M138/E) clear lamp.
  - b) 30,600 lumens for 320 watt, ED-28 (ANSI M154/M132/E) clear lamp.
  - c) 42,000 lumens for 400 watt, ED-28 (ANSI M155/M135/M128/E) clear lamp.
- 4) Average rated life:
  - a) 15,000 HRS for 250 watt lamps.
  - b) 20,000 HRS for all other clear lamps.
- 5) Designated on the Luminaire Schedule by a 'MS' prefix.

- 2. Uncoated (clear) unless identified as coated in the luminaire schedule.
- 3. The specified luminaire in the Luminaire Schedule shall dictate the required lamp operating position and base type.
- 4. Provide lamps that have the correct bulb shape for the luminaire specified.

## 2.07 BALLASTS

### A. Fluorescent High-Frequency Electronic Ballasts:

#### 1. General characteristics:

- a. High frequency electronic type and operate lamp(s) at a frequency above 31 kHz to avoid interference with infrared devices and eliminate visible flicker.
  - 1) Avoid frequency ranges of 27-31 kHz, 34-41 kHz, and 55-61 kHz.
- b. Lamp Current Crest Factor of 1.7 or less.
- c. Power Factor greater than 0.98.
- d. Input current shall have Total Harmonic Distortion (THD) of less than 20 percent when operated at nominal line voltage with primary lamp.
- e. Operate from 60 Hz input source of 120V through 277V with sustained variations of +/- 10 percent (voltage and frequency).
- f. Contain auto restart circuitry in order to restart lamps without resetting power.
- g. Class A sound rating or quieter.
- h. Provided with integral leads or poke-in wire trap connectors color coded per ANSI C82.11.
- i. Tolerate sustained open circuit and short circuit output conditions.
- j. UL listed, Class P.
- k. Standards:
  - 1) UL 935.
  - 2) ANSI C62.41 Category A for Transient protection.
  - 3) ANSI C82.11 where applicable.
  - 4) Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
  - 5) NEMA 410 for in-rush current limits.
  - 6) Manufactured in a factory certified to ISO 9001 Quality System Standards.

#### 2. Fluorescent high-frequency electronic ballasts T8 linear lamps:

- a. Programmed Start.
- b. For T8 linear lamps: NEMA Premium.
- c. Parallel operation providing independent lamp operation allowing remaining lamp(s) to maintain full light output when one or more lamps fail.
- d. One circuit-interrupting socket per lamp.
- e. Minimum Ballast Factor, unless otherwise noted in the Luminaire Schedule:
  - 1) T8 lamps: 0.85.

- f. Minimum starting temperature:
    - 1) Standard T8 and T5 lamps: 0 DegF.
    - 2) Energy-saving T8 lamps: 60 DegF.
  - g. Tolerate operation at 158 DegF case temperature without damage.
  - h. Suitable to operate in:
    - 1) Indoor conditioned spaces: 50 – 104 DegF ambient temperature.
    - 2) Outdoor and unconditioned indoor spaces: 0 – 104 DegF ambient temperature.
  - i. Utilize multi-lamp ballasts in luminaires with multiple lamps unless otherwise noted in Luminaire Schedule.
  - j. Five year warranty from date of manufacture for operation at a maximum case temperature of 158 DegF.
3. Fluorescent high-frequency electronic ballasts T4 compact fluorescent lamps:
- a. Rapid Start.
  - b. Contain integral end-of-life auto resetting protection.
  - c. Minimum Ballast Factor unless otherwise noted in Luminaire Schedule:
    - 1) T4 lamps: 1.00.
  - d. Minimum starting temperature: 0 DegF.
  - e. Five year warranty from date of manufacture for operation at a maximum case temperature of 167 DegF.
- B. Fluorescent Emergency Ballasts:
- 1. General characteristics.
    - a. UL924 listed for installation inside, on top of, or remote from the luminaire. Mount inside ballast channel of luminaire wherever possible.
    - b. Self-testing/self-diagnostic fluorescent emergency ballast.
      - 1) Electronic circuitry shall be self-testing in design and automatically test emergency lighting for a minimum of 30 seconds every 30 days and 90 minutes once a year.
    - c. Consist of a high temperature, maintenance-free nickel-cadmium battery, charger and electronic circuitry.
    - d. Solid state charging indicator light to monitor the charger and battery.
    - e. Single-pole test switch.
    - f. Mount components (battery, charger, inverter) in a common enclosure constructed of 20 gage (minimum) steel housing.
    - g. Provide a remote indicator light when luminaire construction prevents visible mounting within luminaire.
    - h. Emergency ballast shall delay AC ballast operation for approximately 3 seconds to prevent false tripping of AC ballast end-of-life shutdown circuits.

- i. Ambient temperature rating: 32 DegF to 122 DegF.
  - j. Five year warranty from date of manufacture.
- 2. Fluorescent emergency ballasts for one T8 fluorescent lamps:
  - a. Capable of operating fluorescent lamps at the following lumen levels initial light output in the emergency mode for a minimum of 90 minutes:
    - 1) One (1) F32T8 lamp: 1100 lumens.
  - b. Suitable for indoor and damp locations and for sealed and gasketed luminaires, including luminaires rated for wet locations.
- C. High Intensity Discharge (HID) Ballasts:
  - 1. General characteristics:
    - a. Standards:
      - 1) NEMA/ANSI C82.4.
      - 2) UL 1029.
    - b. Produced in a factory certified to ISO 9001 Quality System Standards.
    - c. Contain no Polychlorinated Biphenyl (PCB's).
  - 2. Electronic HID (Metal Halide):
    - a. Voltage sensing and operate from a nominal line voltage range of 120-480 volts, +/-10 percent, 50/60 Hz.
    - b. Furnished with integral, color-coded leads.
    - c. Total Harmonic Distortion (THD): Less than 15 percent.
    - d. Power Factor: Greater than 90 percent.
    - e. Lamp end-of-life detection and shutdown circuit.
    - f. Sound Rated A.
    - g. Output frequency to the lamps shall be less than 200 Hz to prevent acoustic resonance inside the lamp arc tube and to minimize visible flicker.
    - h. Lamp Current Crest Factor: Less than 1.5.
    - i. Thermally protected to shut off when operating temperatures reach unacceptable levels.
    - j. Meet Federal Communications Commission rules and regulations, Title 47 CFR Part 18, for Non-Consumer equipment.
    - k. Three-year warranty from the date of manufacture for operation at a case temperature of 122 DegF or less.

## 2.08 POLES

- A. As Indicated in the Luminaire Schedule and the Following:
  - 1. Designed for attached luminaire EPA with a 100 mph maximum wind velocity at the base with a 1.3 wind gust factor.

2. Additional features:
  - a. Handhole near base of pole.
  - b. Grounding lug accessible at handhole.
  - c. Galvanized anchor bolts.
  - d. Anchor bolt covers.
  - e. Vibration dampers shall be installed

B. Metal Poles:

1. Material: as indicated on drawings.
2. Shaft shape: as indicated on drawings.
3. Pole cross section: as indicated on drawings
4. Pole height: as indicated on drawings
5. Designed for attached luminaire EPA with a maximum wind velocity rating, per the Special Conditions, at the base.
6. Additional features:
  - a. Luminaire mounting provisions.
  - b. Handhole near base of pole.
  - c. Grounding lug accessible at handhole.
  - d. Galvanized anchor bolts.
  - e. Anchor bolt covers.
  - f. Vibration dampers, if indicated on drawings
7. Aluminum pole finish: as indicated on drawings.
8. Steel pole finish: as indicated on drawings.

C. Wood Poles:

1. Stamped and certified by AWP and Edison Electric Institute (EEI).
2. Class 3 (minimum) conforming to ATIS O5.1.
3. Douglas Fir or Southern Yellow Pine
4. Pressure treated with pentachlorophenol (Penta) or chromated copper arsenate (CCA).
5. Overall pole length: As Indicated.

D. Fiberglass poles:

1. Material: Continuous fiberglass filament with thermosetting epoxy resin.
2. Direct bury installation, as indicated on drawings
3. Base plate: as indicated on drawings and factory bonded to fiberglass shaft.
4. Shaft shape: as indicated on drawings.
5. Pole cross section: Round.

6. Pole height above grade: as indicated on drawings.
  7. Designed for attached luminaire EPA with a maximum wind velocity rating, per the Special Conditions, at the base.
  8. Additional features:
    - a. Luminaire mounting provisions.
    - b. Handhole near base of pole.
    - c. Galvanized anchor bolts, if indicated on drawings
    - d. Anchor bolt covers, if indicated on drawings.
    - e. Vibration dampers, if indicated on drawings.
  9. Finish: as indicated on drawings. Shall be UV resistant catalyzed urethane.
- E. Concrete Poles:
1. Direct bury installation.
  2. Steel reinforced, with 5/8 IN minimum concrete cover.
  3. Concrete: Fiber reinforced, air-entrained.
  4. Shaft shape: as indicated on drawings.
  5. Pole cross section: as indicated on drawings.
  6. Pole height above ground: as indicated on drawings.
  7. Designed for attached luminaire EPA with a maximum wind velocity rating, per the Special Conditions, at the base.
  8. Additional features:
    - a. Luminaire mounting provisions.
    - b. Handhole near base of pole.
  9. Color: as indicated on drawings.
  10. Finish: as indicated on drawings.
  11. Sealer: as indicated on drawings.

## 2.09 MAINTENANCE MATERIALS

- A. Furnish a minimum of 2 or 10 percent of total of each type and wattage of lamps, whichever is greater.
- B. Furnish a minimum of 10 percent of total of each type and amperage of fuses for fixtures indicated to be fused.
- C. Spare parts are to be stored in a box clearly labeled as to its contents.

## PART 3 - EXECUTION

### 3.01 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 FT wide and 4 FT long: A minimum of four supporting points, one at each corner.
  2. Luminaires 8 FT long: A minimum of five support points, one at center of luminaire and one at each corner.
  3. Luminaires smaller than 2 FT 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 IN before the luminaire is caught by the chain or cable.
- F. Pendant Mounted, Open, Industrial Fluorescent 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 misinstalled 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.
- J. Install exterior luminaires so that water cannot enter or accumulate in the wiring compartment.
- K. Where indicated, provide two-level control of three (3) and/or four (4) lamp fluorescent luminaires.
  - 1. Provide two (2) ballasts per luminaire and control inside lamp(s) in each luminaire by one (1) switch or set of switches and the outside two (2) lamps by a second switch or group of switches.
- L. Emergency Battery Ballasts:
  - 1. Where emergency battery ballasts are shown controlled via switching device, wire ballast so lamps will not operate when normal power is available and switching device turns lights off. Lamps will operate in emergency mode regardless of switch position.
  - 2. Luminaire manufacturer to supply the emergency battery ballasts with luminaire.
- M. Ground luminaire and ballasts.

### 3.02 POLE INSTALLATION

- A. Drawings indicate the intended location of Light Pole:
  - 1. Field conditions may affect actual location.
  - 2. Coordinate location with all existing or new utilities and pavement.
- B. Anchor Base Plated Poles:
  - 1. Mounted on cast-in-place foundations, as detailed on the Drawings.
    - a. Concrete and reinforcing steel, in accordance with Division 03 Specification Sections.
  - 2. Protect pole finish during installation.
    - a. Repair damage to pole finish with manufacturer approved repair kit.
- C. Set wood poles straight and firm.
  - 1. Dig holes large enough to permit proper use of tampers to the full depth of the hole.
  - 2. Place earth into the hole in 6 IN maximum layers, then thoroughly tamped before the next layer is placed.
  - 3. Place surplus earth around each pole in a conical shape and packed tightly to drain water away from poles.
  - 4. Pole setting depth: In good soil, per UPRR Standard Detail ST-D3. In poor soil coordinate depth with UPRR Project Manager.
- D. Ground poles as indicated on the Drawings or Schedules.

E. Conductors:

1. See Specification Section 26 05 19 for required underground conductors.
2. Use interior building wire, as specified in Specification Section 26 05 19, from pole base to luminaire, #10 AWG minimum.

F. Overcurrent and Short Circuit Protection:

1. Protect each phase with a UL Class CC fuse:
  - a. Size: Three (3) times load current.
  - b. Standard: UL 248-4.
2. Fuseholder:
  - a. Watertight, in-line and break-a-way style.
  - b. Accept up to a 30 A, 600 V fuse.
  - c. Neutral conductor shall utilize a fuseholder with a solid copper rod.
  - d. Conductor terminal: Adequate size for the installed conductors.

3.03 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.

3.04 ADJUST AND CLEAN

- A. See Specification Section 01 77 10.
- B. Replace all inoperable lamps with new lamps prior to final acceptance.
- C. Aim all emergency lighting units, so that, the path of egress is illuminated.

**END OF SECTION**

## SECTION 26 99 00 - POWER SYSTEM ANALYSIS

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Contractor is responsible to provide a complete Power System Analysis including; short circuit analysis, equipment evaluation, protective device coordination, and arc flash risk assessment. This Analysis shall be performed by an approved vendor and completed under the direct supervision of a registered Professional Electrical Engineer licensed to practice in the State of {Yard State}.
- B. The electrical distribution system to be evaluated is shown in the drawings in Appendix A. The intent of the Analysis is to evaluate all electrical equipment shown for proper design and to determine hazards that exist at each piece of electrical equipment.
- C. Union Pacific shall determine whether to have a pre-analysis meeting or phone conference and the location if it is a meeting. The discussion shall include:
  - 1. Schedule.
  - 2. Equations for 3 phase and single phase use.
  - 3. Philosophy for conducting site investigations, doing the calculations and analysis, presentation of results and installation of labels.
- D. Site Access:
  - 1. Contractor and any onsite personnel shall comply with Union Pacific e-Railsafe including but not limited to background information and personnel credentials. Go to [e-Railsafe.com](http://e-Railsafe.com) for information.
- E. Safety:
  - 1. As part of Union Pacific Railroad's focus on safety, we want to make certain that our vendors establish and maintain safe work practices, including the proper training of their employees. Union Pacific will not allow vendors to perform work on our property unless they have been properly trained for the work they are performing.
  - 2. Training for Engineering Department vendors falls into two primary categories:
    - a. Regulatory Training – training that is required by federal, state or local workplace safety regulations. This training includes, but is not limited to:
      - 1) FRA Roadway Worker Protection (for those working within 25 FT of any track). This training is available from several sources, including other railroads, railroad industry training professionals and computer based training. Several internet web sites now offer RWP training for a modest fee, including:
        - a) [www.railroadeducation.com](http://www.railroadeducation.com)
        - b) [www.nrcma.org](http://www.nrcma.org)

- c) UPRR does not endorse any specific RWP training program nor does it require vendors employees to be trained specifically on UP's On-Track Safety Program. However, UPRR does require that vendors properly train their employees on RWP as required by 49CFR214.343.
  - d) OSHA Fall Protection (for those working on elevated structures 6 FT or higher).
  - e) OSHA Confined Space Entry (for those working in confined spaces).
- 2) Please note that Union Pacific Railroad does not provide regulatory training for vendors' employees but will assist vendors in locating training resources. The frequency of training is mandated in each regulation.
- 3) Union Pacific Railroad insists on 100 percent compliance with all governmental regulations by its vendors and their employees.
- b. UPRR safety training – training that is required for Engineering Department vendors employees to perform work on UP property. This training is in addition to the regulatory training described above and is available in several different formats:
  - 1) Video and pamphlet entitled "Minimum Safety Requirements for Engineering Department Contractors". One copy of the pamphlet is included with each video. You can order the video (catalog number E-153-99) and additional pamphlets (PB-20834) by calling Staples at 402-898-6448. Please have a credit card ready when ordering.
  - 2) Online Training program via [www.contractororientation.com](http://www.contractororientation.com). The information presented is the same as the video and pamphlet; however, this web site also provides record keeping and testing services. Once a person completes the course, they are sent a wallet-size card showing successful completion.
  - 3) UPRR Safety Training must be completed every calendar year. Please note that this training does not meet the requirements for Roadway Worker Protection Training.
  - 4) Vendors must furnish employees with documentation that they have completed the required regulatory and UPRR safety training. This can be accomplished by issuing cards denoting the employee's training, issuing list of employees who have completed specific training or by having available, at the job site, other forms of documentation.
  - 5) Under government workplace safety regulation, each employer is responsible for the training of their employees. Union Pacific Railroad provides the necessary resources to train our employees and we expect the same from our vendors.
  - 6) Vendors to UP also have oversight responsibilities for monitoring the training and compliance of employees of sub-contractors. Make sure that the sub-contractors you hire are familiar with and comply with the training requirements outlined above.

- 7) Onsite Personnel shall comply with UPRR electrical safety rules and all local facility safety rules.
- 8) A minimum of PPE category 2 (per table 130.7(c)(16) of the NFPA 70E) shall be worn by field data collection personnel at all times when exposed to energized electrical equipment not previously labeled with available incident energy.
- 9) Onsite Personnel shall have up-to-date training in electrical safety and shall supply and utilize their own PPE for electrical shock hazards and arc flash hazards. Union Pacific Railroad personnel shall not be responsible for reviewing or evaluating Vendors' safety program(s) for suitability. Attach information describing your safety training and program in your proposal.
- 10) Vendor providing Onsite Personnel shall have an internal safety program and up-to-date electrical safety training that includes arc flash hazards. Onsite Personnel shall comply with all internal safety program requirements and the UPRR safety regulations during field data collection. Union Pacific Railroad shall not be responsible for development of vendor safety program or safety procedures utilized during the data gathering process.

## 1.02 REFERENCED STANDARDS

### A. Institute of Electrical and Electronics Engineers (IEEE):

1. 141, "Red Book", Recommended Practice for Electric Power Distribution for Industrial Plants.
2. 241, "Gray Book", Recommended practice for Electric Power Systems in Commercial Buildings.
3. 242, "Buff Book", Recommended Practice for Protection and Coordination of Industrial Power Systems.
4. 399, "Brown Book", Recommended Practice for Industrial and Commercial Power Systems.
5. 551, "Violet Book", Recommended Practice for Calculating Short-Circuit Currents in Industrial and Commercial Power Systems.
6. 1015, "Blue Book", Recommended Practice for Applying Low Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
7. 1584, Guide for Arc Flash Hazard Calculations.

### B. American National Standards Institute (ANSI):

1. C37.010, Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
2. C37.13, Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
3. C37.41, Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single Pole Air Switches, Fuse Disconnecting Switches and Accessories.

4. C57.12.00, Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
- C. National Fire Protection Association (NFPA):
  1. 70, National Electrical Code (NEC), latest edition.
  2. 70E, Standard for Electrical Safety in the Workplace, latest edition.
  3. 79, Electrical Standard for Industrial Machinery.
- D. To ensure compliance with all standards, no exceptions, or substitutions to this standard are allowed without written approval of the Union Pacific Manager of Electrical Design. Any discrepancies between these documents and this standard shall be brought to the attention of the Union Pacific Manager of Electrical Design.

### 1.03 DEFINITIONS

- A. Contractor: Vendor holding contract directly with UP to either install electrical equipment/distribution or to perform a power system analysis.
- B. Consultant: Vendor performing the Power System Analysis as described herein.
- C. Onsite Personnel: Individuals who will be on site performing data collection, field adjustments and/or label application. These individuals may be employees of the contractor, consultant or third party vendor hired by the contractor or consultant.

### 1.04 SUBMITTALS

- A. Submittal For Review:
  1. The contractor shall submit the following products to the Union Pacific Railroad Electrical Design Department for review within sixty (60) days of contract award. The submittal for review shall be based upon an infinite utility contribution unless utility company available fault current data is readily available. The submittal for review may be based upon design drawings and submittal data. All Soft Copies shall be in Adobe .pdf format and emailed to the Union Pacific Railroad Electrical Design Department.
    - a. One (1) Soft Copy of the One Line Diagram.
    - b. One (1) Soft Copy of the Equipment Evaluation Table.
    - c. One (1) Soft Copy of the Protective Device Coordination Study table, including both default and recommended device settings.
- B. Submittals For Approval:
  1. The contractor shall submit the following products to the Union Pacific Railroad Electrical Design Department for approval prior to the final submittals and before any arc flash labels are produced. Submittals for approval shall utilize input data produced from on-site data collection to ensure the model reflects the system as installed. Submittal data and design drawings shall not be substituted for on-site data collection All Soft Copies shall be emailed to the Union Pacific Railroad Electrical Design Department.
    - a. One (1) Soft Copy of the interim report.
    - b. One (1) Soft Copy of the SKM files.

- c. One (1) Soft Copy of a sample arc flash warning label.

C. Final Submittals:

1. The contractor shall submit the following products to the Union Pacific Railroad Electrical Design Department upon acceptance of submittal for approval. All Hard Copies shall be mailed to the Union Pacific Railroad Electrical Design Department. All Soft Copies shall be mailed on a CD-ROM to the Union Pacific Railroad Electrical Design Department.
  - a. Three (3) Hard Copies and one (1) Soft Copy of the final report.
  - b. One (1) Soft Copy of the SKM files.
  - c. One (1) Soft Copy of the Arc Flash Labels.

1.05 REPORT

- A. The report shall be stamped by a registered professional electrical engineer licensed to practice in the State of {Yard State}.
- B. The report shall include the following sections in the following order:
  1. Executive Summary:
    - a. The executive summary shall be a brief 1 - 2 pages maximum and cover at an executive level the findings of the study, recommendations, and requirements for maintaining NFPA-70E compliance.
    - b. A synopsis of the overall findings, including but not limited to equipment locations with highest incident energy levels and total number of overcurrent devices with inadequate short circuit current interrupting ratings.
  2. Introduction:
    - a. A brief section to explain the necessity of performing an arc flash risk assessment and the criteria used during the project, as well as the following:
      - 1) The scope of the study. It shall provide details of what actions were performed for each aspect of the study, including short circuit analysis, equipment evaluation, protective device coordination study, and arc flash risk assessment.
      - 2) Description of system and explanation of bus and branch numbering system.
      - 3) Modes of operation studied: Each scenario operating condition shall be thoroughly documented.
  3. Methodology:
    - a. A brief explanation of the basis for each analysis performed for this project.
  4. Assumptions:
    - a. A list of all valid engineering assumptions made and why they were made during the course of the project.
  5. Input Data:
    - a. Input data shall include, but not be limited to the following:

- 1) 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).
  - 2) Transformer input data, including winding connections, secondary neutral ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
  - 3) Reactor data, including voltage rating and inductance.
  - 4) Generation contribution data, (synchronous generators and Utility), including short circuit reactance ( $X''_d$ ), rated MVA, rated voltage, three-phase and single-line-ground contributions (for utility sources) and X/R ratio.
  - 5) Motor contribution data (induction motors and synchronous motors), including short circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.
6. Electrical One-Line:
- a. Electrical one-line in SKM format. Show all electrical distribution. Include at a minimum:
    - 1) All cables including sizes,
    - 2) All Transformers with ratings, impedances and voltages.
    - 3) All Overcurrent Protective Devices and Disconnects with ratings.
    - 4) All Panelboards, Switchboards, Motor Control Centers and other distribution equipment.
    - 5) All Motors, Lumped Motor Groups and Generators.
  - b. Separate one-line for each building's internal distribution is acceptable.
  - c. Sheet shall be sized either 8-1/2 IN x 11 IN, 11 IN x 17 IN, or 24 IN x 36 IN. Only multiple sheets of 24 IN x 36 IN for a single one-line will be allowed.
7. Short Circuit Current Analysis:
- a. Short Circuit Output Data shall include, but not be limited to the following reports:
    - 1) Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
      - a) Voltage.
      - b) Calculated fault current magnitude and angle.
      - c) Fault point X/R ratio.
      - d) Equivalent impedance.
    - 2) Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
      - a) Voltage.



- b) Calculated symmetrical fault current magnitude and angle.
    - c) Fault point X/R ratio.
    - d) Calculated asymmetrical fault currents.
      - (1) Based on fault point X/R ratio.
      - (2) Based on calculated symmetrical value multiplied by 1.6.
      - (3) Based on calculated symmetrical value multiplied by 2.7.
    - e) Equivalent impedance.
  - 3) Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
    - a) Voltage.
    - b) Calculated symmetrical fault current magnitude and angle.
    - c) Fault point X/R ratio.
    - d) No AC Decrement (NACD) ratio.
    - e) Equivalent impedance.
    - f) Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis.
    - g) Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis.
8. Equipment Evaluation:
- a. The results of the equipment duty verification tabular format report shall provide the following data:
    - 1) Equipment name and kV.
    - 2) Manufacture, type, style, and ratings of the device.
    - 3) Short circuit currents through the device and percent over/under duty.
    - 4) Flag for the device showing VIOLATION or WARNING level for visual identification.
  - b. A report of all problem areas shall be provided. A recommended action list shall be provided for all deficient equipment in the system.
9. Protective Device Coordination Study:
- a. The results of the Protective Device Coordination Study shall include, but is not limited to the following:
    - 1) Summary of the findings of the Protective Device Coordination Study.
    - 2) Table of Contents and descriptions for all TCCs included directly before TCC curves in the report.
    - 3) All TCCs needed to illustrate the system.

- 4) A setting table shall be developed to summarize the selected settings, default or recommended, for the protective devices. The table shall include the following:
  - a) Device identification.
  - b) For low voltage breakers, the circuit breaker manufacturer, type, and style, sensor rating, long-time, short-time, instantaneous settings, and time bands. For breakers with ground fault capability, the pickup and time delay.
  - c) Fuse manufacturer, type, style, and rating.
  - d) Protective relay manufacturer, type, style, function (51, 50, 67, etc.) pickup, current multiplier, time dial, and delay. For multi-function units, list all devices being used. Include the CT and/or PT ratios for each function.

10. Arc Flash Risk Assessment:

- a. The results of the Arc Flash Risk Assessment shall include, but is not limited to the following:
  - 1) Summary of the findings of the arc flash risk assessment.
  - 2) Table indicating worst case scenario of all buses evaluated. At the top of the table, a reference to table H.3(b) of NFPA 70E for PPE required shall be included. Table shall include but is not limited to the following:
    - a) Arcing fault magnitude.
    - b) Protective device clearing time.
    - c) Duration of arc.
    - d) Arc flash boundary.
    - e) Working distance.
    - f) Incident energy.
  - 3) Table detailing all busses evaluated and all scenarios with the corresponding incident energies. The worst case scenario shall be highlighted for each bus.
  - 4) Table for each scenario's results of all busses evaluated. At the top of the table, a reference to table H.3(b) of NFPA 70E for PPE required shall be included. Table shall include but is not limited to the following:
    - a) Arcing fault magnitude.
    - b) Protective device clearing time.
    - c) Duration of arc.
    - d) Arc flash boundary.
    - e) Working distance.

11. Incident Energy Deficiencies and Code Violations:

- a. Section shall include detailed accounts of all deficiencies and code violations noted while performing the study.

12. Recommendations:

- a. Section shall include detailed accounts of all recommendations Consultant suggests to improve the system, including recommendations for incident energy reduction.

13. Report Appendix A – Data Collection Forms:

- a. All data collection forms used in the study shall be affixed in Appendix A

14. Report Appendix B – Photographs:

- a. Photographs of all equipment as detailed in Data Collection paragraph shall be affixed in Appendix B

1.06 SKM FILES

- A. The software database and library used to model the power system shall be submitted in native file format including all updates to the library necessary to complete the model. The database files submitted shall be compatible with the version of SKM software owned by UPRR.

1.07 QUALITY ASSURANCE

- A. The studies shall be in conformance with the NFPA and ANSI Standards, and IEEE recommended practices detailed in this specification.
- B. The Consultant is responsible for compliance with all performance specifications in this standard. Any deviations must be explained in detail and documentation provided. Consultant shall list assumptions used in completing the analysis.

1.08 SEQUENCING AND SCHEDULING

- A. Contractor shall provide a proposed timeline listing all submittal dates with proposal based on starting 30 days after proposal date.

PART 2 - PRODUCT

2.01 CONSULTANT QUALIFICATIONS

- A. The short circuit, equipment evaluation, protective device coordination and arc flash risk assessment studies shall be conducted by one of the following firms:
  - 1. AVO Electrical Engineering Services: Ryan Downey, email: ryan.downey@avoedivision.com
  - 2. Eaton Electrical Services and Systems Division: Mark Freyenberger, email: MarkAFreyenberger@Eaton.com
  - 3. Electric Power Systems: Howard Campbell, email: H.Campbell@epsii.com
  - 4. Patrick Engineering Inc: Chris Cress, email: CCress@patrickco.com
  - 5. Wilson and Company: John Harrell, email: John.Harrell@wilsonco.com

6. Zachry Engineering Corporation: Chad Wieseler, email: WieselerC@zachrygroup.com
7. TKDA: Wesley Wegner, email: wesley.wegner@tkda.com
8. North Sky Engineering: Clint Thayer, email: cthayer@northskyeng.com

## 2.02 COMPUTER ANALYSIS SOFTWARE

- A. The studies shall be completed using the latest version of the SKM System Analysis PowerTools for Windows (PTW) software program.

## 2.03 ARC FLASH LABELS

- A. Consultant shall provide a thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on the implemented overcurrent device settings and will be provided after the results of the analysis have been approved by the Union Pacific Manager of Electrical Design.
- C. The label shall include the following information, at a minimum:
  1. Equipment Name (per Drawings).
  2. Protective Device Location.
  3. Protective Device Size and Type.
  4. System Nominal voltage.
  5. Limited Approach Boundary.
  6. Restricted Approach Boundary.
  7. Arc Flash Boundary.
  8. Available Incident energy.
  9. Working distance.
  10. List of specific PPE required (per table H.3(b) of NFPA 70E).
  11. Label expiration date (5 years from issue date).
  12. UPRR Engineering Project Code, revision number and issue date.
- D. Labels shall be machine printed, with no field markings. The labels shall be printable directly from the power system software utilized for the study with a Brady PowerMark, BBP85, or GlobalMark printer to ensure that Union Pacific Railroad personnel have the option of printing the labels.
- E. Arc flash labels shall be provided in the following manner.
  1. For applicable panelboard, safety switch, or control panel, one arc flash label shall be provided.
  2. For each motor control center, one arc flash label shall be provided.
  3. For each low voltage switchboard, one arc flash label shall be provided.
  4. For each switchgear, one arc flash label shall be provided.

5. For medium voltage equipment, one arc flash label shall be provided.
  6. For pad mounted transformers, both dry type and oil filled, one arc flash label shall be provided. The side of the transformer with the highest incident energy shall be utilized to create the label.
- F. See Appendix E for examples of arc flash labels.
1. All arc flash labels shall be field installed by Onsite Personnel once written approval has been received from the Union Pacific Manager of Electrical Design.

## PART 3 - EXECUTION

### 3.01 DATA COLLECTION

- A. Onsite Personnel shall be responsible to verify all supplied information.
- B. Contractor shall ensure that all field data collection is performed by a qualified (as defined by NFPA 70E) person to ensure accurate equipment modeling.
- C. Copies of any available drawings shall be provided electronically by Union Pacific Railroad. Consultant shall create new electronic one-line diagrams.
- D. Equipment shall be visually inspected to collect the necessary nameplate data used in the analysis. Onsite Personnel shall be responsible for the visual verification of all nameplate data required for the analysis.
- E. UPRR shall provide personnel to escort Onsite Personnel to equipment locations and to open all equipment rooms, locks, etc. necessary to collect nameplate data.
- F. Onsite Personnel shall research and record existing equipment interrupting capacities.
- G. Onsite Personnel shall record all NEC and NESC violations observed during normal activities of the study.
- H. Onsite Personnel shall document all equipment whose physical condition requires attention.
- I. Onsite Personnel shall provide all the data collection necessary for the electrical system shown in Appendix A. The power system analysis shall include the utility service (including primary relaying, fusing, and/or other overcurrent protection) down through each and every overcurrent protective device, disconnect and transformer in excess of 50 volts for all systems. Equipment between 200V and 50V is to be included in the Short Circuit Analysis, Equipment Evaluation, and Protective Device Coordination Study portions of the final report but may be excluded from the Arc Flash Risk Assessment.
  1. When the project involves electrical equipment installed in existing UP electrical systems or services, the scope of the study shall include all equipment defined above as well as all upstream equipment back to the existing utility service(s). This includes UP primary systems between project location and utility service point, any other UP service drops from UP primary system may be excluded.
- J. Consultant shall obtain from the utility the normal operating service voltage levels, three-phase and single phase short circuit MVA and X/R ratio at each service point and utility overcurrent device settings.

- K. Onsite Personnel shall use data collection forms in Appendix B. If a form is needed that is not part of Appendix B, contact the Union Pacific Electrical Design Department.
- L. Onsite Personnel shall provide digital pictures of all electrical equipment being evaluated. Pictures shall be taken after arc flash labels have been applied.
  - 1. All pictures shall have a minimum 8 megapixel resolution.
- M. Vendor providing Onsite Personnel shall be responsible for any qualified escorting, supervision, or equipment necessary to complete all associated on-site work (i.e. data collection, label installation, etc.) for all equipment including overhead equipment and wiring.

### 3.02 SYSTEM MODELING

- A. Provide a list of all assumptions to the Union Pacific Manager of Electrical Design. The Union Pacific Railroad Electrical Design Department shall review, discuss and request any changes to assumptions before the system model is run.
- B. Equipment names used in the modeling software shall be identical to the naming convention shown in the project drawings.
- C. Consultant shall refer to Appendix C for SKM symbol selection. If a symbol is needed that isn't included, contact UPRR electrical design department.
- D. The Union Pacific Railroad - { YARD NAME } may have multiple operating conditions, including, but not limited to, generation on/off, shutdown, bus-ties, start-up, emergency operation, etc. Consultant shall discuss facility operation with designated Union Pacific Railroad personnel - { YARD NAME } to determine the possible operating modes of the system. Each of the operating modes shall be documented and modeled in the software in order to determine the worst-case arc flash hazard and associated parameters for the electrical equipment.
- E. The software shall model each operating mode in a manner such that each mode is a scenario or change case from the base case. Modifications to the base case model shall automatically update all scenarios to eliminate the necessity to store complete databases for each condition, providing for a manageable file.
- F. Project files shall be self-contained and have all necessary information to describe the one-line, system data, settings, and analysis information. Files shall be easily transferable to any site via email or disk and operable with no setting changes to the database file. Output files shall be as required to be run on Union Pacific Railroad SKM software.
- G. Lumped motor groups for MCC's shall be modeled per IEEE standards. Where motor list data is not available, single lumped groups may be modeled per IEEE-141 "Red Book".
- H. Each motor greater than 40 HP shall be modeled individually.
- I. All analysis of the system shall be run utilizing the normal system voltage, as well as the minimum and maximum voltage for the given nominal voltage per IEEE-141 "Red Book" Chapter 3 Table 3-1 Range A. Each of the voltage level scenarios shall be documented and modeled in the software in order to determine the worst-case arc flash hazard and associated parameters for the electrical equipment.

- J. If exact conductor length is not known, utilize the best engineering judgment length.
- K. All protective device equipment shall be modeled based on the actual nameplate data including manufacturer, type, style, trip device, and actual settings. Generic substitutions or assumptions shall not be allowed unless data cannot be field verified. All assumptions shall be documented in the report.
- L. All relay data shall be modeled based on the actual nameplate data including manufacturer, type, style, trip device, and actual settings. Generic substitutions or assumptions shall not be allowed unless data cannot be field verified. All assumptions shall be documented in the report.
- M. All overcurrent relay types for the distribution system shall be modeled on the one-line diagram (and database) including phase and ground overcurrent, differential, residual, ground neutral, etc. to establish a complete and detailed system model where protective device data can be easily modified and updated by the facility and all data is available for a comprehensive protective device coordination study if required in the future.
- N. Relay models shall depict the actual connection requirements.
- O. Multi-function relays shall have all their overcurrent devices modeled in a single device and shall be able to accept multiple CT's.
- P. All equipment modeled must have a corresponding one-line diagram symbol. The symbol shall be linked to easily see all equipment, its associated data, to be able to link documents to the equipment as a data repository, etc. and to see problems clearly on the one-line drawing.
- Q. All system modeling shall conform to accepted modeling practices as outlined in IEEE-399 "Brown Book". Consultant may provide more advanced modeling techniques where compliance with the specification is maintained.

### 3.03 SHORT CIRCUIT ANALYSIS

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.
- B. Actual Transformer impedances shall be used. Transformer design impedances shall only be used where actual impedance is illegible.
- 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 three-phase and unbalanced faults at each:

1. Electric utility's supply termination point.
  2. Incoming switchgear.
  3. Unit substation primary and secondary terminals.
  4. Low voltage switchgear.
  5. Motor control centers.
  6. Standby generators and automatic transfer switches.
  7. Branch circuit panelboards.
  8. 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.

### 3.04 EQUIPMENT EVALUATION

- A. Evaluate equipment and protective devices and compare short circuit ratings. Equipment shall be evaluated using actual transformer impedances.
- B. Determine adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short circuit stresses.
- C. Notify Union Pacific Manager of Electrical Design, in writing, of existing circuit protective devices improperly rated for the actual calculated available fault current.

### 3.05 PROTECTIVE DEVICE COORDINATION STUDY

- A. Protective device coordination time current curves (TCC) shall be displayed on log-log scale graphs. The TCC shall be printed in color on 8 1/2" x 11 IN sized paper – full size portrait mode.
- B. Include on each TCC graph a complete title.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. For low voltage systems, TCCs shall be developed for both phase and ground protective devices. The TCC shall show the largest feeder/motor protective device in the MCC or panel up through the switchgear/switchboard feeder breaker, transformer secondary main, primary fuse, and medium voltage feeder breaker. For secondary switchboards serving large loads or a wide variety of loads that may affect upstream coordination, additional TCCs may be required.
- E. For medium voltage systems, TCCs shall be developed for both phase and ground protective devices. The TCC should show the largest feeder/motor protective device in the lineup up through the switchgear/transformer secondary main, unit substation primary fuse, and medium voltage feeder breaker.
- F. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- G. 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 voltage recloser trip coil settings and clearing curves.
  4. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
  5. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
  6. Transformer full-load current, magnetizing inrush current and ANSI through-fault protection curves.
  7. Conductor damage curves.
  8. Ground fault protective devices, as applicable.
  9. Pertinent motor starting characteristics and motor damage points, where applicable.
  10. Pertinent generator short circuit decrement curve and generator damage curve.
  11. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- H. Provide adequate time margins between device characteristics such that the selective operation is provided, while providing proper protection.
- I. Provide a protective device coordination study per the Submittals Section for the Existing/Default Configuration. If the Existing/Default configuration does not provide adequate selective coordination, a recommended configuration shall be developed based on the fusing criteria shown in Appendix D to provide the best selective coordination and protection.
1. During the review, Union Pacific Railroad will decide whether the final report will be based on the existing configuration, the recommended configuration, or a combination of both.
  2. Contractor shall implement the recommended settings if the Union Pacific chooses to utilize any or all recommended settings.
  3. The arc flash risk assessment shall be based upon the determined configuration above.
- J. A settings table shall be developed to summarize the settings selected/existing for the protective devices. The table shall include the following:
1. Device identification.
  2. For low voltage breakers, the circuit breaker manufacturer, type, and style, sensor rating, long-time, short-time, instantaneous settings, and time bands. For breakers with ground fault capability, the pickup and time delay.
  3. Fuse manufacturer, type, style, and rating.
  4. Protective relay manufacturer, type, style, function (51, 50, 67, etc.) pickup, current multiplier, time dial, and delay. For multi-function units, list all devices being used. Include the CT and/or PT ratios for each function.

### 3.06 ARC FLASH RISK ASSESSMENT

- A. The arc flash risk assessment shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E-2015, Annex D.4, under the following conditions:
1. Voltages in the range of 208 V - 15 kV, 3 phase.
  2. Power system operating frequencies of 50 or 60 Hz.
  3. 3 phase bolted fault current in the range of 700A - 106kA.
  4. Grounding of all types and ungrounded.
  5. Equipment enclosures of commonly available sizes.
  6. Gaps between electrical conductors in the range of 13 mm - 152 mm.
  7. Fault involving 3 phases.
- B. All three phase arc flash hazard calculations, within the conditions stated in the Arc Flash Risk Assessment paragraph shall be performed with the arc flash study module in the SKM PowerTools for Windows software under the IEEE std. 1584-2002 heading.
- C. Arc flash risk assessments of systems encountered outside the conditions listed, shall be performed per the following procedures to derive the incident energy, utilizing the bolted fault current output from the unbalanced/Single-Phase Study Module:
1. Single phase systems with voltages <1000V shall utilize equations specified by IEEE 1584.
  2. Single phase systems with voltages >1000V, shall utilize the following equation.

$$E=2.142 \times 10^6 V I_{bf} (t/D^2)$$

(IEEE std. 1584-2002 recognizes this model for calculating incident energy of single phase systems. This model will provide conservative results.)  
(For voltages over 15kV, arcing fault and bolted fault current are considered equal. NFPA 70E-2015 Edition)

- D. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (i.e. switchboards, switchgear, motor control centers, panelboards, busways, and splitters) where work could be performed on energized parts.
- E. The arc flash risk assessment shall include all significant locations rated 200 volts and above, including single phase equipment, where work could be performed on energized parts.
- F. Safe working distances shall be based upon the calculated arc flash boundary considering incident energy of 1.2 cal/cm<sup>2</sup>.
- G. 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 fault protection should not be taken into consideration when determining the clearing time when performing incident energy calculations.

- H. 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 with 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 (above 40hp) to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- I. 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 and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- J. 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.
- K. 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.
- L. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location. The calculation should utilize the fastest device to compute the incident energy for that corresponding location, including utility overcurrent protective devices.
- M. Arc Flash calculations shall be based on the assumption that all circuit breakers will have a clearing time of 2 seconds.
  - 1. Exception #1: If a fuse upstream of a circuit breaker will trip prior to 2 seconds at the arcing current of the bus the circuit breaker is protecting, set the clearing time of the circuit breaker to the fuse clearing time. Include a list of all circuit breakers that have had their clearing times adjusted within the report.
  - 2. Exception #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, the maximum clearing time based on the specific location shall be utilized.

N. Maximum clearing time for all other protective devices shall be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.

1. Exception #1: Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, the maximum clearing time based on the specific location shall be utilized.

### 3.07 FIELD QUALITY CONTROL

- A. The contractor shall ensure that all changes to device settings determined per Protective Device Coordination Study are implemented prior to final approval of power system analysis report.

**END OF SECTION**

## **APPENDIX A - ELECTRICAL DISTRIBUTION SYSTEM TO BE EVALUATED**

## **APPENDIX B - DATA COLLECTION FORMS**

## UTILITY DATA COLLECTION

### Equipment Name/ID:

(The consultant shall fill in the appropriate areas with information collected during field studies.)

### Source of Electrical Power

(In the space provided, indicate if the local utility company is providing the electrical service, or if the facility is being served from Union Pacific Railroad power lines.)

\_\_\_\_\_  
(Utility company name or UPRR)

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(City, state, zip)

\_\_\_\_\_  
(Telephone number)

Operating Service Voltage (normal): \_\_\_\_\_ kV

3Ø short circuit (MVA & x/r ratio): \_\_\_\_\_

1Ø short circuit (MVA & x/r ratio): \_\_\_\_\_

3Ø fault current (maximum / available): \_\_\_\_\_ kA

Single line-to-ground fault current (maximum / available): \_\_\_\_\_ kA

Available system impedance: \_\_\_\_\_

### NOTES:

\_\_\_\_\_  
(Collected by) (Date)

\_\_\_\_\_  
(Company name)

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(City, state, zip)

## TRANSFORMER DATA COLLECTION

Equipment Name/ID:

(The consultant shall fill in the appropriate areas with information collected during field studies.)

Source of Electrical Power

(In the space provided, indicate if the local utility company is providing the electrical service, or if the facility is being served from Union Pacific Railroad power lines.)

\_\_\_\_\_  
(Utility company name or UPRR)

Transformer manufacturer / type: \_\_\_\_\_

Transformer voltage (primary / secondary): \_\_\_\_\_

Transformer rating: \_\_\_\_\_ kVA

Transformer load ratings (primary / secondary): \_\_\_\_\_ amps

Transformer impedance rating: \_\_\_\_\_

Transformer x/r ratio: \_\_\_\_\_

Transformer phase connection(s): \_\_\_\_\_

Grounding type: \_\_\_\_\_

Working distance / clearances: \_\_\_\_\_

Obstructions that will prevent exiting the flash protection boundary in 2 seconds (Y/N): \_\_\_\_\_

Transformer location: \_\_\_\_\_

NOTES:

\_\_\_\_\_  
(Collected by) (Date)

\_\_\_\_\_  
(Company name)

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(City, state, zip)

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## GENERATOR DATA COLLECTION

Equipment Name/ID:

(The consultant shall fill in the appropriate areas with information collected during field studies.)

Source of Electrical Power

(In the space provided, indicate if the local utility company is providing the electrical service, or if the facility is being served from Union Pacific Railroad power lines.)

\_\_\_\_\_  
(Utility company name or UPRR)

Generator manufacturer / type: \_\_\_\_\_

Generator voltage (primary / secondary): \_\_\_\_\_

Generator rating: \_\_\_\_\_ kW

Generator impedance rating: \_\_\_\_\_

Generator x/r ratio: \_\_\_\_\_

Generator grounding type: \_\_\_\_\_

Working distance / clearances: \_\_\_\_\_

Obstructions that will prevent exiting the flash protection boundary in 2 seconds (Y/N): \_\_\_\_\_

Generator location: \_\_\_\_\_

NOTES:

\_\_\_\_\_  
(Collected by) (Date)

\_\_\_\_\_  
(Company name)

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(City, state, zip)

## CABLE DATA COLLECTION

Equipment Name/ID:

(The consultant shall fill in the appropriate areas with information collected during field studies.)

Source of Electrical Power

(In the space provided, indicate if the local utility company is providing the electrical service, or if the facility is being served from Union Pacific Railroad power lines.)

\_\_\_\_\_  
(Utility company name or UPRR)

Cable manufacturer / insulation type: \_\_\_\_\_

Cable voltage: \_\_\_\_\_

Cable size: \_\_\_\_\_

Cable length: \_\_\_\_\_ FT

Age of cable (approximate): \_\_\_\_\_ YRS

Source End Equipment ID: \_\_\_\_\_

Load End Equipment ID: \_\_\_\_\_

NOTES:

\_\_\_\_\_  
(Collected by) (Date)

\_\_\_\_\_  
(Company name)

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(City, state, zip)

## PROTECTIVE DEVICE DATA COLLECTION

Equipment Name/ID:

(The consultant shall fill in the appropriate areas with information collected during field studies.)

Source of Electrical Power

(In the space provided, indicate if the local utility company is providing the electrical service, or if the facility is being served from Union Pacific Railroad power lines.)

\_\_\_\_\_  
(Utility company name or UPRR)

Device manufacturer / type: \_\_\_\_\_

Device voltage: \_\_\_\_\_

Device amperage rating: \_\_\_\_\_ amps

Device delay curves: \_\_\_\_\_ (attach if applicable)

Device delay settings: \_\_\_\_\_ (attach if applicable)

Device minimum melt: \_\_\_\_\_ (attach if applicable)

Device maximum clear: \_\_\_\_\_ (attach if applicable)

Device fault clearing time: \_\_\_\_\_

Device peak let thru current: \_\_\_\_\_ amps

Device pickup (tap) setting: \_\_\_\_\_

Device Interrupting Rating: \_\_\_\_\_ amps

Protective device location: \_\_\_\_\_

Obstructions that will prevent exiting the flash protection boundary in 2 seconds (Y/N): \_\_\_\_\_

NOTES:

\_\_\_\_\_  
(Collected by) (Date)

\_\_\_\_\_  
(Company name)

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(City, state, zip)

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## EQUIPMENT DATA COLLECTION

Equipment Name/ID:

(The consultant shall fill in the appropriate areas with information collected during field studies.)

Source of Electrical Power

(In the space provided, indicate if the local utility company is providing the electrical service, or if the facility is being served from Union Pacific Railroad power lines.)

\_\_\_\_\_  
(Utility company name or UPRR)

Equipment manufacturer / type: \_\_\_\_\_

Equipment voltage: \_\_\_\_\_

Equipment rating: \_\_\_\_\_

Equipment impedance rating: \_\_\_\_\_

Equipment x/r ratio: \_\_\_\_\_

Equipment phase / connections: \_\_\_\_\_

Type of enclosure: \_\_\_\_\_

Equipment grounding type: \_\_\_\_\_

Working distance / clearances: \_\_\_\_\_

Obstructions that will prevent exiting the flash protection boundary in 2 seconds (Y/N): \_\_\_\_\_

Equipment location: \_\_\_\_\_

NOTES:

\_\_\_\_\_  
(Collected by) (Date)

\_\_\_\_\_  
(Company name)

\_\_\_\_\_  
(Address)

\_\_\_\_\_  
(City, state, zip)

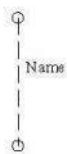
## APPENDIX C - SYMBOLOGY

When the system is modeled in SKM Power Tools for Windows the following symbols shall be used as specified below. If deviations or other symbols required shall not be used without written approval from the Union Pacific Railroad Manager of Electrical Design.

### BUS



### CABLES



Primary Distribution



Overhead Secondary Distribution



Below Grade Conductors

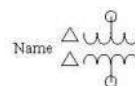


Above Grade In Conduit Secondary Conductors

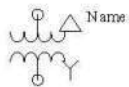
### TRANSFORMERS



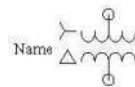
Single Phase Transformer



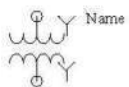
Delta-Delta 3 Phase Transformer



Delta-Wye 3 Phase Transformer

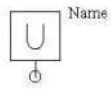


Wye-Delta 3 Phase Transformer

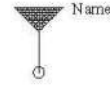


Wye-Wye 3 Phase Transformer

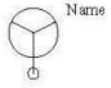
## SOURCES



Feed from Utility



Feed from Yard Distribution

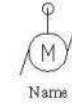


Generator Feed

## LOAD



Synchronous Motor

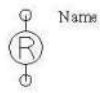


Induction Motor



Non-Motor Load

## PROTECTIVE DEVICE



Recloser



Non-Fused Switch



Medium Voltage Fuse



Medium Voltage Circuit Breaker



Low Voltage Fuse



Low Voltage Fused Switch

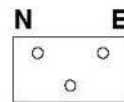


Low Voltage Circuit Breaker

## MISCELLANEOUS EQUIPMENT



UPS



Transfer Switch

## **APPENDIX D – FUSE INFORMATION**

All fusing shall be based on the information found in this Appendix, any deviation from this appendix must be approved by the UPRR Manager Electrical Design

### **A. Fuses 600V and less**

1. All fuses over 600A shall be Low-Peak, Time-Delay, Current-Limiting Class L fuses.
2. All service disconnect fuses under 600A shall be Low-Peak, Dual-Element, Time-Delay Current-Limiting Class RK1 fuses.
3. All non-service disconnect fuses under 600A shall be Dual-Element, Time-Delay, Current-Limiting Class RK5.
4. Approved Manufactures
  - a. Cooper Bussmann
  - b. Littelfuse
  - c. Ferraz Shawmut

### **B. Overhead Equipment Medium Voltage Fuses**

1. All overhead medium voltage equipment shall use “T” Speed Fuse links.
2. All transformer primary fuses shall be based on the selection sheets in this Appendix.
3. Approved Manufactures
  - a. Cooper Power Systems
  - b. S&C
  - c. Hubbell Chance

### **C. Pad Mount Equipment Medium Voltage Fuses**

1. All pad mount medium voltage equipment shall use Dual Element and/or Dual Sensing Bay-O-Net fuses.
2. All transformer primary fuses shall be based on the selection sheets in this Appendix.
3. Approved Manufactures
  - a. Cooper Power Systems
  - b. Hubbell Chance



## **TYPE K, T, 200, & QA FUSE LINKS**

Fuse link ratings recommended in these tables will carry the full load of the transformer continuously and will open in five minutes when the transformer load is approximately three times full load. Smaller or larger fuse link ratings may be used to give the desired correlation of protection and continuity of service, These tables are to be used as a guide until a more detailed study can be made.

### **SINGLE-PHASE**

Single-Phase Table is used for all single-phase, three-phase "WYE" and outside legs of open delta connected transformers. Do not fuse neutral.

### **THREE-PHASE**

Three-Phase Table is used for closed Delta and common legs of open Delta connected transformers. Use fuse size recommended for largest transformer connected to lead under consideration.

Refer to single-phase table for "WYE" and open Delta connected transformers.

TM

**Kearney™ Type K or T Fuse Link Ratings for Single-Phase Transformer Installations Three-Phase “WYE” and Outside Legs of Open Delta**

KVA RATING	RATED LINE VOLTAGE (kV)								
	2.4	4.16	4.8	7.2	7.62	12	13.2	14.4	22.9
3	2	1	1	1	1	1	1	1	1
5	3	2	2	1	1	1	1	1	1
7.5	6	3	2	2	1	1	1	1	1
10	6	3	3	2	2	1	1	1	1
15	8	6	6	3	3	2	2	2	1
25	15	8	8	6	6	3	3	3	2
37.5	25	12	10	8	8	6	3	3	3
50	30	15	15	10	10	6	6	6	3
75	50	25	25	15	15	8	8	8	6
100	65	30	30	20	20	12	10	10	6
150	100	50	50	30	30	20	15	15	10
167	100	65	50	30	30	20	20	15	10
200	140	65	65	40	40	25	20	20	12
250	140	80	80	50	50	30	25	25	15
333	140	100	100	65	65	40	40	30	20
500	200	140	140	100	100	65	50	50	30

**Kearney™ Type K or T Fuse Link Ratings for Three-Phase Individual Transformer Sizes In Closed Delta and Common Legs of Open Delta**

KVA RATING	RATED LINE VOLTAGE (kV)									
	2.4	4.16	4.8	7.2	8.32	12	12.47	13.2	14.4	22.9
3	3	2	2	1	1	1	1	1	1	1
5	6	3	3	2	2	1	1	1	1	1
7.5	8	6	3	3	2	2	2	1	1	1
10	10	6	6	3	3	2	2	2	2	1
15	15	8	8	6	6	3	3	3	3	2
25	25	15	12	8	6	6	6	6	3	3
37.5	40	25	20	12	10	18	10	6	6	3
50	50	30	25	15	15	10	10	10	8	6
75	80	50	40	25	25	15	15	15	12	8
100	100	65	50	30	30	20	20	20	15	10
150	140	100	80	50	50	30	30	30	25	15
167	140	100	80	65	50	30	30	30	30	20
200	200	100	100	65	65	40	40	40	30	20
250	200	140	100	80	80	50	50	50	40	25
333	200	140	140	100	100	65	65	65	65	40
500	–	200	200	140	140	100	100	100	80	50

## Cooper Dual Sensing Bay-O-Net

### Single-Phase Transformer (Phase-to-Ground) Applications

Transformer kVA	Transformer Primary Voltage (kV)										
	2.4	4.16	4.8	7.2	7.62	8.32	12.0	12.47	13.2	13.8	14.4
5	C03	C03	C03	C03	C03	C03	C03	C03	C03	C03	C03
10	C05	C05	C03	C03	C03	C03	C03	C03	C03	C03	C03
15	C08	C05	C05	C03	C03	C03	C03	C03	C03	C03	C03
25	C10	C08	C08	C05	C05	C05	C03	C03	C03	C03	C03
37.5	C12	C10	C08	C08	C08	C08	C05	C05	C05	C05	C05
50	C12	C10	C10	C08	C08	C08	C05	C05	C05	C05	C05
75	C14	C12	C12	C10	C10	C10	C08	C08	C08	C08	C08
100	C14	C12	C12	C10	C10	C10	C08	C08	C08	C08	C08
167	C18	C14	C14	C12	C12	C12	C10	C10	C10	C10	C10
250	–	C16	C18	C14	C14	C14	C12	C12	C12	C12	C12
333	–	C18 <sup>a</sup>	C18	C14 <sup>a</sup>	C14	C14	C12	C12	C12	C12	C12
500	–	–	–	C18	C18	C18	C14	C14	C14	C14	C14

### Three-Phase Transformer (Phase-to-Phase) Applications

Transformer kVA	Transformer Primary Voltage (kV)									
	2.4	4.16	4.8	8.32	12.0, 12.47	13.2	13.8, 14.4	20.8b,d	22.9b,d	24.9b
45	C10	C08	C08	C05	C03	C03	C03	C03	C03	C03
75	C12	C10	C10	C08	C05	C05	C05	C03	C03	C03
112.5	C14	C12	C10	C08	C08	C08	C08	C05	C05	C05
150	C14	C12	C12	C10	C08	C08	C08	C05	C05	C05
225	C18	C14	C14	C12	C10	C10	C10	C08	C08	C08
300	C18	C14	C14	C12	C10	C10	C10	C08	C08	C08
500	–	C18	C18	C14	C12	C12	C12	C10	C10	C10
750	–	C18 <sup>a</sup>	C18 <sup>a</sup>	C18	C14	C14	C14	C12 <sup>a</sup>	C12	C12
1000	–	–	–	C18	C14 <sup>a</sup>	C14 <sup>a</sup>	C14 <sup>a</sup>	C12 <sup>a</sup>	C12	C12
1500	–	–	–	–	C18 <sup>c</sup>	C18 <sup>c</sup>	C18 <sup>c</sup>	C14	C14	C14

## Cooper Dual Element Bay-O-Net


### Single-Phase Transformer (Phase-to-Ground) Applications

Transformer kVA	Transformer Primary Voltage (kV)										
	2.4	4.16	4.8	7.2	7.62	8.32	12.0	12.47	13.2	13.8	14.4
5	C03	C03	C03	C03	C03	C03	C03	C03	C03	C03	C03
10	C05	C04	C04	C03	C03	C03	C03	C03	C03	C03	C03
15	C07	C05	C05	C03	C03	C03	C03	C03	C03	C03	C03
25	C09	C06	C06	C04	C04	C04	C03	C03	C03	C03	C03
37.5	C11	C09	C08	C06	C06	C06	C05	C05	C04	C04	C04
50	C12	C09	C09	C07	C07	C07	C06	C06	C05	C05	C05
75	C14	C12	C11	C09	C09	C09	C07	C06	C06	C06	C06
100	–	C12	C12	C09	C09	C09	C09	C09	C07	C07	C07
167	–	–	–	C12	C12	C12	C11	C11	C09	C09	C09
250	–	–	–	C14	C14	C14	C12	C12	C11	C11	C11
333	–	–	–	–	–	–	C12	C12	C12	C12	C12

### Three-Phase Transformer (Phase-to-Phase) Applications

Transformer kVA	Transformer Primary Voltage (kV)									
	2.4	4.16	4.8	8.32	12.0, 12.47	13.2	13.8, 14.4	20.8a,b	22.9a,b	24.9a
45	C09	C07	C07	C04	C03	C03	C03	C03	C03	C03
75	C12	C09	C09	C06	C04	C04	C04	C03	C03	C03
112.5	C14	C11	C09	C07	C06	C06	C06	C05	C04	C04
150	–	C12	C12	C09	C07	C07	C07	C06	C05	C05
225	–	C14	C14	C11	C09	C09	C09	C07	C06	C06
300	–	–	–	C12	C09	C09	C09	C09	C07	C07
500	–	–	–	C14	C12	C12	C12	C11	C09	C09
750	–	–	–	–	C14	C14	C14	C12	C11	C11
1000	–	–	–	–	–	–	–	C14	C12	C12

## APPENDIX E - SAMPLE ARC FLASH LABEL

	
<h1>WARNING</h1>	
<h2>ARC FLASH &amp; SHOCK HAZARD</h2>	
<h3>APPROPRIATE PPE REQUIRED</h3>	
<small>Do not open covers without appropriate personal protective equipment. Failure to comply may result in injury or death. Required Arc-rated PPE ratings shall meet or exceed the available incident energy shown below. See NFPA 70E table H.3(b) for more information</small>	
<b>Flash Protection</b> Working Distance: Available Incident Energy: Flash Protection Boundary:	<b>Shock Protection</b> System Nominal Voltage: Limited Approach Boundary: Restricted Approach Boundary:
<small>Required PPE: Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall and/or arc flash suit; Arc-rated arc flash suit hood; Arc-Rated gloves; Arc-rated jacket, parka, or rainwear; Hard Hat; Arc-rated hard hat liner; Safety glasses or goggles; Hearing protection; Arc-rated gloves, Leather footwear</small>	
Equipment Name: Label Issue Date: Label is not valid after:	Protective Device Location: Protective Device Size & Type: UP Engineering Project Code:

Sample Arc Flash Label for less than 40 cal/cm<sup>2</sup>.  
Required PPE list reflects >12cal/cm<sup>2</sup>.  
Provide incident energy level specific list per table  
H.3(b) for each label.



# DANGER

## ARC FLASH & SHOCK HAZARD

### Appropriate PPE Required

De-energize this equipment at upstream device before opening covers. Failure to comply may result in injury or death.  
Required Arc-rated PPE ratings shall meet or exceed the available incident energy shown below.

See NFPA 70E table H.3(b) for more information

#### Flash Protection

Working Distance:

Available Incident Energy:

Flash Protection Boundary:

#### Shock Protection

System Nominal Voltage:

Limited Approach Boundary:

Restricted Approach Boundary:

Required PPE: Arc-rated long-sleeve shirt and arc-rated pants or arc-rated coverall and/or arc flash suit; Arc-rated arc flash suit hood; Arc-Rated gloves; Arc-rated jacket, parka, or rainwear; Hard Hat; Arc-rated hard hat liner; Safety glasses or goggles; Hearing protection; Arc-rated gloves, Leather footwear

Equipment Name:

Label Issue Date:

Label is not valid after:

Protective Device Location:

Protective Device Size & Type:

UP Engineering Project Code:

Sample Arc Flash Label for greater than 40 cal/cm<sup>2</sup>.

## **SECTION 27 11 13 - COMMUNICATIONS ENTRANCE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Communications entrance.

#### **1.02 REFERENCED STANDARDS**

- A. National Electrical Code (NEC).
- B. National Electrical Safety Code (NESC).
- C. UPRR Telecom Building Construction Best Practices (latest edition)

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. The service entrance facility shall be provided and installed according to the manufacturers recommended installation practices for hand holes and maintenance holes, whichever the owner specified.
- B. Install two (2) 4 IN inside diameter PVC conduits extending from the Telecommunications Closet / Equipment Room to the Service Box.
  1. Install two (2) 1-1/4 IN and one (1) 1 IN innerduct within these conduits. Innerduct material shall be as follows: Premier Corrugated HDPE manufactured from High Density Polyethylene (HDPE) and shall be placed inside of the conduit. This lightweight product offers maximum flexibility, and allows for installation in small or restricted areas. Corrugated duct is available in 1 IN and 1-1/4 IN and is orange in color.
  2. For conduits identified as fiber trunk pathways, the innerducts shall be a MaxCell product. The 4 IN 3-Cell product is designed to hold larger backbone cables up to 1.34 IN diameter in each cell. Up to two packs can be placed in a 4 IN conduit.
    - a. Only one 3-cell pack is required.
      - 1) Standard color is green.
      - 2) Color-coded pull tapes are pre-installed.
      - 3) Factory lubricated.
- C. A tracer wire is required in all installations using non-conductive conduits.
- D. The total number of bends in a conduit section run shall not exceed two (2) 90 bends or equivalent of sweeps and radius bends. Each bend shall have a minimum radius in accordance with existing standards.

- E. Encase conduit(s) in concrete (2,500 PSI) where, minimum 36 IN depth cannot be attained, conduits pass under roads, driveways, or bend points are subject to movement. When crossing under UPRR tracks follow instructions in UPRR web site under Real Estate and crossings. When terminating at a pole, clamp the conduit(s) rigidly to the field side of the pole at a 90-degree separation from power.
- F. Conduits terminating inside of a building shall be installed so that the conduit extends 10 cm (4 IN) (Above Finished Floor [AFF]) beyond the surface from which it emanates. Conduits shall be plugged with mechanical-type seals to ensure that foreign matter does not enter the building.
- G. The ends of metallic conduit shall be reamed, bushed, and grounded according to NEC and NESC.
- H. All conduits shall have a non-corrosive pull rope installed.
- I. Installation shall include a detectable orange warning tape placed 18 IN above the conduit. The warning tape shall be located at a minimum of 12 IN below grade.
- J. Additional details and instructions are available in item C of the Referenced Standards for this section.

**END OF SECTION**



## **SECTION 31 11 00 - CLEARING AND GRUBBING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Removal and disposal of all trees, stumps, undergrowth, brush, trash, grass, weeds, roots, concrete, debris, or other objectionable materials within the limits of the excavation, embankment, borrow, and other areas as shown on the plans and Contract Documents.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 31 24 13 – Excavation, Embankments and Other Fills

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION**

#### **3.01 GENERAL**

- A. The designated areas shall be cleared except certain areas as directed by the Engineer for preservation. Areas designated for preservation shall be carefully protected from abuse, marring or damage during construction operations.
- B. All holes remaining after clearing and grubbing shall be backfilled and compacted as directed by the Engineer and the entire area bladed to provide drainage, except, in areas to be immediately excavated, the Engineer may direct that the holes not be backfilled.

#### **3.02 EXCAVATIONS**

- A. Areas that are to be excavated and hauled into embankments shall be cleared and grubbed of all objectionable material to the full depth and width of the completed excavation. Areas that are to be excavated and wasted shall not be cleared unless specifically requested by the Engineer. Roots or other vegetation existing below the finished surface of excavated sections shall be removed to a depth of 2 FT below the finished surface. There will be no allowance for any grubbing required below such finished surface. All such grubbing below the finished surface shall be considered incidental to clearing and grubbing, and shall be included in the bid item cost for clearing and grubbing.

#### **3.03 BORROW PITS**

- A. Areas required for borrow sites and material sources must be cleared and grubbed, except for designated trees and shrubs, to prevent such objectionable material being used in construction.

### 3.04 EMBANKMENTS

- A. All areas that will be beneath embankments shall be free from all vegetation and roots to a minimum depth of 2 FT below the ground surface.
- B. All rubbish shall be removed in embankment areas.

### 3.05 OTHER DESIGNATED AREAS (SUCH AS STAGING AND STORAGE AREAS)

- A. Designated portions of the right-of-way other than excavations, borrow areas, and embankments shall be cleared off level with ground surface by cutting and removal of all trees (standing or fallen), stumps, undergrowth, brush, vines, roots, and other vegetation, trash, or objectionable materials so that no obstruction will interfere with close machine or hand mowing of cleared areas. Cleared areas shall be left smooth and free of obstructions that will impound water.

### 3.06 TOPSOIL

- A. Topsoil shall be stockpiled as necessary for capping of slopes and ditch bottoms. See Section 31 14 14.

### 3.07 DISPOSAL

- A. All cleared and grubbed material shall be disposed of off property unless otherwise directed by Engineer, and shall comply with Federal, State and Local regulations. Pieces of rail, broken ties, and rubble within the grading limits are to be removed off of railroad property in a legal proper manner. This shall be incidental to the clearing and grubbing bid item.
- B. Material being disposed of shall not be burned either on or off Railroad property.
- C. No material will be disposed of in the grading footprint.
- D. Large trees and shrubs may be shredded into mulch and used for capping slopes and ditch bottoms, as approved and directed by the Engineer.
- E. Unless otherwise stated in the special provisions, all merchantable timber will be the property of the Contractor.

### 3.08 LIMITS OF WORK

- A. Trees or other growth outside the limits for clearing and grubbing shall be preserved and protected from damage during construction operations. If rare or endangered plants or artifacts are encountered during construction, work shall stop in the vicinity of the find, and the Contractor shall notify the Engineer of said find.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 MEASUREMENT

- A. "Clearing and Grubbing" will be measured by the acre or bid as a lump sum.
- B. If a bid item for "Clearing and Grubbing" is not included, payment for this work will be considered as incidental to the unit price for grading.

#### 4.02 PAYMENT

- A. Clearing and grubbing shall be paid for at the contract unit price per acre cleared and grubbed within the grading limits. This price shall be full compensation for furnishing all labor, materials, tools, equipment, supplies, supervision, and incidentals necessary for clearing, grubbing, and disposal of the resulting materials.
- B. Areas outside the grading limit, such as borrow areas, staging areas, and material storage areas are not included. Clearing and grubbing for these areas are incidental to their respective bid items.
- C. Pieces of rail, broken ties, and rubble within the grading limits are to be removed off of railroad property in a legal proper manner. This shall be incidental to the clearing and grubbing bid item.

**END OF SECTION**

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## **SECTION 31 14 14 - TOPSOIL - STOCKPILE AND PLACING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Roadbed slopes, both in excavation and embankment sections, and any disturbed soils that will not support plant life and/or will cause or allow soil erosion shall be covered with 6 IN of top soil at the completion of the grading operation or the project.
- B. Areas which have soils which are suitable for use as topsoil, at the completion of the project, shall be cleared of all vegetation, brush, rocks that are larger than 2 IN, and any other debris on the surface, which is part of the Clearing and Grubbing Section 31 11 00.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 43 26 – Testing Laboratory Services
- B. Section 31 11 00 – Clearing and Grubbing
- C. Section 31 24 13 – Excavation, Embankments and Other Fills
- D. Section 31 25 10 – Slope Protection and Erosion Control
- E. Section 32 92 19 – Seeding

### **PART 2 - PRODUCT**

#### **2.01 MATERIAL**

- A. Topsoil:
  - 1. Topsoil consisting of friable, fertile soil of loamy character, containing an amount of organic matter normal to the region, capable of sustaining healthy plant life, and reasonably free from subsoil, roots, heavy or stiff clay, stones larger than 2 IN in greatest dimension, noxious weeds, sticks, brush, litter and other deleterious matter.
  - 2. Obtain topsoil from sources within the project limits, or provide imported topsoil obtained from sources outside the project limits, or both.

### **PART 3 - EXECUTION**

#### **3.01 REMOVAL AND STOCKPILING OF TOPSOIL.**

- A. The top 6 IN of suitable topsoil, or the soil that complies with the requirements for topsoil to any depth within the template for the excavation area will be removed and stockpiled during construction.
- B. Stockpiles shall be shaped or graded to maintain drainage and protect the topsoil material from being over wetted which will require time to disk, roll and dry back to moisture requirements for compaction of embankment.

- C. After construction, the topsoil will be placed on slopes, trouble areas and ditches as specified by the Engineer.
- D. See Section 32 92 19 or the Schedule of rates and prices for seeding, should it be required.
- E. Care shall be taken not to damage any area in the process of moving the topsoil from the stockpile to the final location.
- F. The stockpile shall be wetted to control dust.
- G. The Contractor shall check with the Engineer, the drawing, and the Specifications for the origin, the stockpile location, and the areas which will require topsoil.

#### **PART 4 - MEASUREMENT AND PAYMENT**

##### **4.01 MEASUREMENT**

- A. Removing from the excavation areas, the hauling and stockpiling, the protecting of the stockpile from the elements, and the hauling and placing of the topsoil, with compaction as required in Section 31 24 13, and the redressing of slopes and areas involved.

##### **4.02 PAYMENT**

- A. Stockpiling of Topsoil is to be paid for at the unit of Cubic Yard. This price includes the following:
  - 1. The removal from the excavation area.
  - 2. The hauling to and placing in the stockpile.
  - 3. The maintaining of the stockpile.
  - 4. The hauling and placing of the topsoil in areas requiring topsoil, as designated by the Engineer.
  - 5. The care and repair of areas disturbed while moving, placing, and compacting the topsoil.
- B. If there is no Stockpiling of Topsoil bid item, Stockpiling of Topsoil shall be incidental to the embankment or excavation bid item.

#### **END OF SECTION**

## **SECTION 31 22 19 - FINISH GRADING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Roadbed shall be finished to the lines and grades shown on the Drawings and as staked. Finished Roadbeds shall be protected from damage from all causes by the Contractor until accepted by the Railroad.

#### **1.02 ALIGNMENT AND GRADE**

- A. The finished Grading and Borrow Areas shall conform to the alignment and grade set forth in the Drawings. The Engineer shall furnish control for line and grade and sufficient information for the Contractor to set the required construction stakes.

#### **1.03 SLOPE STAKES**

- A. Slope stakes will be set by the Contractor in accordance with the typical sections and cross sections on the Drawings. The Engineer shall use his judgment or soil tests to determine the stability of the materials encountered, and if the physical properties of the materials encountered necessitates changing the slopes after an excavation has been completed. The Engineer may require the Contractor to reset the slope stakes and to steepen, flatten, or bench the slopes. The reasonable costs of re-setting stakes in this case shall be borne by the Railroad. The Contractor shall maintain and preserve all stakes and other marks established until authorized by the Engineer to remove them. If the Contractor removes or destroys such stakes or marks before receiving authorization from the Engineer the replacing of such stakes or marks shall be the Contractor's responsibility.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 4 - MEASUREMENT AND PAYMENT**

#### **4.01 PAYMENT**

- A. All finish grading labor, material and equipment used shall be incidental to the grading service item.
- B. If Proposal & Bid Form contains a finish grading service item, all labor, material and equipment used for finished grading shall be incidental to that service item.

### **END OF SECTION**

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## **SECTION 31 23 10 - EXCAVATION AND FILL FOR BUILDINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Excavation for building foundations.
2. Excavation for slabs-on-grade and paving.
3. Excavation for site structures.
4. Site Filling: Placement of structural fill to raise site elevations and stabilize foundations.

##### **B. This section does not apply to the construction of mainline and/or yard track projects.**

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 00 - Submittals and Substitutions.
- B. Section 01 45 00 - Quality Control.
- C. Section 01 43 26 - Laboratory And Field Testing Services.
- D. Section 31 23 24 – Backfill for Buildings.
- E. Section 31 23 17 – Trenching for Buildings.

#### **1.03 REFERENCED STANDARDS**

- A. ANSI/ASTM D698 (Standard Proctor) - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, using 5.5 LB Rammer and 12 IN drop.
- B. ASTM D2922 - Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (shallow depth).
- C. Code of Federal Regulations Occupational Safety and Health Administration (OSHA) Title 29-Labor, Part 1926.

#### **1.04 FIELD MEASUREMENTS**

- A. Verify that survey benchmark and intended elevations for the work are as indicated.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

- A. Section 31 23 24 – Backfill for Buildings.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Identify known underground, above ground, and aerial utilities. Stake and flag locations.
- B. Protect above and below grade utilities that are to remain.
- C. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
- D. Prepare subgrade.

### 3.02 EXCAVATION

- A. Take special precautions as required preserving condition and integrity of existing structures. Special precautions would include sheeting, shoring, bracing, etc.
- B. Excavate subsoil required to accommodate building foundations, slabs-on grade, and paving.
- C. Scarify the exposed soil to an additional depth of 6 IN; adjust the soil moisture by adding water or dryer so the soil moisture content is within 3 percent of the optimum moisture content.
- D. Compact the subgrade soils to at least 98 percent Standard Proctor maximum dry density (ASTM D698 as in Reference A).
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- F. Use precaution during final excavation to subgrade level to prevent disturbance and remolding of subgrade material. Hand trim excavation as required. Remove loose material.
- G. Remove lumped subsoil, boulders, and rock up to 1/3 CU YD measured by volume.
- H. Notify the Engineer's Field Representative of unexpected subsurface conditions or hazardous materials encountered. Discontinue affected work in area until notified to resume work.
- I. Correct unauthorized excavation. Unauthorized excavation performed by the Contractor will be corrected at the Contractor's expense. If a party other than the Contractor directed the unauthorized excavation then the expense to correct the unauthorized excavation will be covered by that party.
- J. Correct areas over-excavated by error in accordance with Section 31 23 24 - Backfill. Any over-excavation performed by the Contractor will be corrected at the Contractor's expense. If the Owner directed the over-excavation then the expense to correct the overexcavation will be covered by the Owner.
- K. It is the Contractor's responsibility to comply with applicable State and Federal regulations on excavation, shoring, and trenching.

### 3.03 FILL COURSE PLACEMENT

- A. Fill areas to contours and elevations with unfrozen materials.

- B. Place the material in 8 IN loose lifts and compact to 98 percent Standard Proctor density (ASTM D698) using a vibratory roller.
- C. Inaccessible areas should be compacted using hand equipment in 4 IN loose lifts.
- D. Maintain optimum moisture content ( $\pm 3$  percent) of all fill materials to attain required compaction density.
- E. If subgrade material or previously placed subsoil fill has deteriorated due to weather exposure, scarify the top 2 IN of material to establish an acceptable interface prior to placing any additional fill.
- F. Slope grades away from buildings a minimum of 2 IN in 10 FT, unless noted otherwise. Grade site to promote drainage for surfaces that are to remain exposed for an extended period of time to prevent water accumulation and subsequent softening.
- G. Make grade changes gradual. Blend slope into level areas and match existing paving that will remain.
- H. Remove surplus fill materials from site or dispose of in designated disposal areas.

#### 3.04 FIELD QUALITY CONTROL

- A. Field inspection will be performed under provisions of Section 01 43 26.
- B. The final surface should be smooth and uniform and should conform to the required cross section and established grade. Tolerance for the finished surface:  $\pm 1/10$  FT. Tolerance for the finished surface under paved areas:  $\pm 1/2$  IN.
- C. Compaction testing will be performed in accordance with ASTM D2922 and Section 01 43 26.
- D. Provide for visual inspection of bearing surfaces.

#### 3.05 PROTECTION

- A. Protect excavations by methods required, preventing cave-in or loose soil from falling into excavation.
- B. Remove water which enters excavations.
- C. Protect soil adjacent to and beneath existing foundation from freezing.
- D. It is the Contractor's responsibility to comply with applicable State and Federal regulations in protecting open excavations.

**END OF SECTION**

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## **SECTION 31 23 17 - TRENCHING FOR BUILDINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Excavated trenches for utilities.
2. Compacted bedding under fills over utilities to subgrade elevations.
3. Backfilling and compaction.

##### **B. This section does not apply to the construction of mainline and/or yard track projects.**

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 00 - Submittals and Substitutions.
- B. Section 01 45 00 - Quality Assurance and Control.
- C. Section 01 43 26 - Laboratory And Field Testing Services.
- D. Section 03 30 00 - Cast-In-Place Concrete.
- E. Section 31 23 10 - Excavation and Fill For Buildings.
- F. Section 31 23 24 – Backfill For Buildings.

#### **1.03 REFERENCED STANDARDS**

- A. ANSI/ASTM D698 (Standard Proctor) -Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, using 5.5-pound Rammer and 12-inch drop.
- B. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and other Gravity-Flow Applications.
- C. ASTM D2922 - Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (shallow depth).
- D. Code of Federal Regulations Occupational Safety and Health Administration Title 29- Labor, Part 1926, Subpart P - Excavations, Trenching, and Shoring.

#### **1.04 SUBMITTALS**

- A. Section 01 33 00 - Submittal Procedures.
- B. Certification that the Contractor's shoring methods conform to the requirements of OSHA and other applicable codes.

#### **1.05 FIELD MEASUREMENTS**

- A. Verify that survey benchmark and intended elevations for the work are as shown on drawings.

## PART 2 - PRODUCTS

### 2.01 FILL MATERIALS

- A. Types B, C, and flowable fill materials as specified in Section 31 23 24.

### 2.02 BED MATERIALS

- A. Type B or C material as specified in Section 31 23 24. Bedding must be free of particle larger than 1 inch in diameter.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify fill materials to be reused are acceptable.

### 3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
- C. Protect above and below grade utilities which are to remain.
- D. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with Type B fill and compact to density equal to or greater than requirements for subsequent backfill material.

### 3.03 EXCAVATION

- A. Excavate subsoil required for connection to existing utilities.
- B. Cut trenches sufficiently wide to enable installation of utilities and allow inspection.
- C. Excavation shall not interfere with normal 45 degree bearing splay of foundations.
- D. Remove rocks to a minimum clearance of 8 IN around the bottom and sides of pipe, conduit, and duct.
- E. Hand trim excavation. Remove loose material.
- F. Keep trenches dewatered.
- G. Correct unauthorized excavation in accordance with Section 31 23 24 and as specified in Section 31 23 10.
- H. Correct areas over-excavated by error in accordance with Section 31 23 24 and as specified in Section 31 23 10.
- I. Stockpile excavated material in area designated on site.

### 3.04 BEDDING

- A. Support pipe and conduit, if necessary, during placement and compaction of bedding fill, according to design drawings.
- B. Bedding material shall provide continuous support for pipe between joints.

### 3.05 BACKFILLING

- A. Reference Section 31 23 24 for general backfilling materials and instructions.
- B. Backfill trenches to proper contours and elevations with unfrozen materials.
- C. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- D. Sheeting and bracing may not be left in place unless written permission has been received from the Engineer.
- E. Employ a placement method that does not disturb or damage conduit in trench. Place lifts equally on each side of conduit to maintain balanced loading on pipe wall.
- F. Comply with ASTM D2321, Class II, for backfill around HDPE piping. Work fill material underneath haunches of pipe with a shovel and hand tamp under haunches to provide firm, uniform support of pipe. Place remaining backfill in continuous layers not exceeding 6 inches compacted depth and compact to the following schedule:
  - 1. Under foundations or slabs-on-grade - 98 percent Standard Proctor.
  - 2. Under paved areas, parking areas or sidewalks - 98 percent Standard Proctor.
  - 3. All other areas - 85 percent Standard Proctor.
- G. Backfill around sides and top of rigid pipe with Type B or Type C fill, tamped in place in 6 IN loose lifts and compacted to 95 percent Standard Proctor Density at ( $\pm 3$  percent) of optimum moisture content.
- H. Allow 24 HRS minimum cure time for concrete encasements prior to backfilling.

### 3.06 TOLERANCES

- A. Top Surface of Backfilling Under Paved Areas:  $\pm 1/2$  IN from required elevations.
- B. Top Surface of General Backfilling:  $\pm 1$  IN from required elevations.

### 3.07 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 45 00. Testing will be done at a rate of 1 test per 100 FT of trench length.
- B. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM D698 and with Section 01 43 26.
- C. Compaction testing will be performed in accordance with ASTM D2922 and with Section 01 43 26.
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.

### 3.08 PROTECTION OF FINISHED WORK

- A. Protect finished work.
- B. Recompact fill disturbed by vehicular traffic.

## END OF SECTION

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## **SECTION 31 23 19 - DEWATERING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. If water is encountered during trenching and excavating operations, remove or lower by means of one of the following dewatering systems as required to permit preparation of a satisfactory pipe bed or structural subgrade, free from water.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 31 24 13 – Excavation, Embankment and Other Fills
- B. Section 33 42 00 – Culverts

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

#### **3.01 WELL POINTS AND PUMPS**

- A. This dewatering system requires the use of individually cased wells and pumps, connecting pipelines and continuous operation in order to permit preparation of a satisfactory pipe bed or structural subgrade.

#### **3.02 CASED WELLS AND PUMPS**

- A. This dewatering system requires the use of individually cased wells and pumps, connecting pipelines and continuous operation in order to permit preparation of a satisfactory pipe bed or structural subgrade.

#### **3.03 DISCHARGE**

- A. Water from dewatering operations shall be discharged to the existing drainage course and shall be approved by Owner, Engineer and appropriate regulatory agency.

#### **3.04 PERMITS**

- A. Secure the necessary Water Rights permit from the Federal, State or Local or other appropriate regulatory agency prior to dewatering activity.

#### **3.05 DURATION**

- A. Continue dewatering until there is no danger of structure displacement due to buoyancy

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 PAYMENT

- A. All dewatering labor, material and equipment used shall be incidental to the corresponding earthwork service item.
- B. If Proposal & Bid Form contains a dewatering service item, all labor, material and equipment used for dewatering shall be incidental to that service item.

**END OF SECTION**

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## **SECTION 31 23 24 - BACKFILL FOR BUILDINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Building perimeter backfilling to subgrade elevations.
2. Backfilling.
3. Fill under paving.
4. Consolidation and compaction.
5. Fill for over-excavation and unauthorized excavation.
6. Section does not include excavation and preparation for foundation construction.

##### **B. This section does not apply to the construction of mainline and/or yard track projects.**

#### **1.02 RELATED REQUIREMENTS (SECTIONS):**

- A. Section 01 33 00 - Submittals.
- B. Section 01 45 00 - Quality Assurance and Control.
- C. Section 01 43 26 - Laboratory And Field Testing Services.
- D. Section 03 30 00 - Cast-In-Place Concrete.
- E. Section 31 23 10 - Excavation and Fill For Buildings.
- F. Section 31 23 17 - Trenching For Buildings.

#### **1.03 REFERENCED STANDARDS**

- A. ASTM C127 - Test Method for Specific Gravity and Absorption of Coarse Aggregate.
- B. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- C. ASTM C618 - Fly Ash and Raw or Calcinated Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
- D. ANSI/ASTM D698 (Standard Proctor) - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, using 5.5 LB Rammer and 12 IN drop.
- E. ASTM D2922 - Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (shallow depth).
- F. ASTM D2321 - Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe.
- G. ASTM D2487 - Classification of Soils for Engineering Purposes.
- H. ASTM D4318 - Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

#### 1.04 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures.
- B. Samples: Submit a 10 LB sample of each type of fill, in airtight containers, to testing laboratory. For each type of fill to be used, one moisture-density curve (ASTM D698), sieve analysis, and Atterberg limit tests (liquid limit, plastic limit, and plasticity index according to ASTM D4318) shall be performed. The results of the tests shall be submitted to the Engineer for approval prior to starting any fill operations.
- C. Submit flowable fill mix design with laboratory tests verifying compliance with these specifications.

#### PART 2 - PRODUCTS

##### 2.01 FILL MATERIALS

- A. Type A - Coarse aggregate road base.
- B. Type B - Sand: Natural river or bank sand; washed: free of silt, clay, loam, friable or soluble materials, or organic matter; graded in accordance with ANSI/ASTM C136, within the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 4	100
No. 40	30 to 50

- C. Type C - Excavated subsoils: Properly sampled, tested, and approved for reuse. Material is to be homogeneous and free of organic material or lumps and stones larger than 1 IN DIA.
- D. Type D - Stabilized Soil: Homogeneous mixture of ASTM C618 Class C fly ash, soil, and water.
- E. Flowable Fill: Blend of ASTM C618 Class C fly ash, cement, and water. Sand may be added as a filler. Flowable fill mixtures shall be proportioned to meet the following requirements:
  - 1. Twenty-eight day compressive strength of the fill material shall be greater than 75 LBS/SQ IN, but less than 175 LBS/SQ IN, when cured and tested as standard concrete cylinders.
  - 2. Workability shall be such that the mixture flows easily into all voids and crevices of an excavation with minimal mechanical agitation or dispersion. Flowability shall be such that the wet mixture is self-leveling. The mixture should have a slump of approximately 10 IN.
  - 3. Shrinkage of the fill material shall be no more than 1/8 IN/FT of fill depth.
- F. Coarse Aggregate Fill: Washed stone; free of shale, clay friable material, and debris; graded in accordance with ASTM D2487 Group Symbol Coarse "GP".
- G. Fly Ash: ASTM C618 Class C Fly Ash.

- H. Final fill course in unpaved or unsurfaced areas shall be topsoil capable of establishing vegetative ground cover.
- I. Concrete: Lean Concrete conforming to Section 03 30 00.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Verify fill materials to be reused are acceptable to Engineer, and test materials to establish compaction requirements.

#### 3.02 PREPARATION

- A. Generally, compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with Type A fill or Type C fill, as appropriate, and compact to 98 percent Standard Proctor density.
- C. Prior to placement of aggregate base course material at paved areas, compact subsoil to 98 percent of its maximum dry density (Standard Proctor) within  $\pm 3$  percent of optimum moisture content determined in accordance with ANSI/ASTM D698.

#### 3.03 FILLING AND BACKFILLING

- A. Backfill areas to contours and elevations with unfrozen materials. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- B. Granular Fill: Place and compact materials in continuous layers not exceeding 8 IN loose depth.
- C. Soil Fill: Unless otherwise noted, place and compact material in continuous layers not exceeding 8 IN loose depth for structural backfill. All backfill shall be compacted to 98 percent Standard Proctor density.
- D. Install and compact a 6 IN thickness of well-graded crushed stone with maximum 6 percent fines beneath building slabs.
- E. Comply with ASTM D2321 for backfill around HDPE and other flexible piping in trenches.
- F. Employ a placement and compaction method that does not disturb or damage utilities in trenches.
- G. Maintain optimum moisture content ( $\pm 3$  percent) of backfill materials to attain required compaction density.
- H. Slope grades away from building, minimum 2 IN in 10 FT, unless noted otherwise.
- I. Make grade changes gradual. Blend slope into level areas.
- J. Remove surplus backfill materials from site and dispose of in designated disposal areas.
- K. Fill for overexcavation or unauthorized excavation shall be compacted engineered fill, as specified in Section 31 23 10.

### 3.04 TOLERANCES

- A. Top Surface of Backfilling Under Paved Areas:  $\pm 1/2$  IN from required elevations.

### 3.05 FIELD QUALITY CONTROL

#### A. Grading/Embankment:

1. In at-grade and fill areas, after clearing and grubbing, and prior to fill placement, exposed subgrade shall be moisture conditioned to within the range of 2 percent below to 3 percent above the optimum moisture content, and compacted in place to a dense and unyielding condition and to a minimum of 95 percent of the modified proctor (ASTM D1557) maximum dry density for the exposed subgrade material.
  2. All materials testing shall be paid for by the Contractor and is part of Grading/Embankment.
  3. The compacted subgrade surface shall then be proofrolled with a fully loaded, tandem axle, 10 CU YD dump truck or equivalent proposed by the Contractor and will be incidental to Grading/Embankment.
  4. In areas to be excavated, the exposed excavated surface shall be proofrolled as described above for at grade and fill areas, after finished subgrade elevation is achieved.
  5. Any subgrade area identified as being loose, soft, or yielding during proofrolling shall either be further compacted or subexcavated and replaced with properly compacted native soils or imported fill. Care shall be taken during proofrolling and subgrade preparation to minimize disturbance to subgrade soils and adjacent supporting soils which will remain in place. The final prepared subgrade surface shall be sloped to promote positive drainage.
  6. Subgrade within a distance of 20 FT from the outside edge of and along the length of culverts shall be compacted to a minimum of 100 percent of the modified Proctor (ASTM D1557) maximum dry density.
- B. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM D698, and Section 01 43 26.
  - C. Compaction testing will be performed in accordance with ASTM D2922 and Section 01 43 26.
  - D. Frequency of Tests: Perform at least 1 test per 1,000 SQ FT per lift, unless otherwise noted by the Engineer. Minimum 2 tests per lift.
  - E. If tests indicate work does not meet specified requirements, remove work, replace, and retest.
  - F. Proof roll compacted fill surfaces under slabs-on-grade and site paving with smooth drum roller (5-ton minimum weight) to expose soft or weak areas of soil. Rework loose or soft areas to attain firm, uniform surface.
  - G. Final density of reworked areas must equal or exceed density of adjacent material.

### 3.06 PROTECTION OF FINISHED WORK

- A. Protect finished work under provisions of Sections 01 18 13.



- B. Scarify and recompact fills subjected to vehicular traffic.

## **PART 4 - MEASUREMENT AND PAYMENT**

### **4.01 MEASUREMENT**

- A. Measurement of borrow material is to be made at the source by topographical surveying methods and equipment as approved by the Owner. The contractor shall coordinate measurement method operations, so as to leave the excavated areas in a condition that will permit the taking of original and final surveying as necessary for accurate determination of quantities. The frequency and intervals of surveying operations by Contractor shall be agreed upon amongst Owner and Contractor. Owner will conduct verification surveys alongside Contractor forces for comparison of quantities at the Owner's convenience. Owner will determine the quantities by excavated volume (EV) of the excavation material in its original position. The limits for quantity determinations will not extend beyond the authorized grading sections set forth by the Owner.

### **4.02 PAYMENT**

- A. Partial payment for Borrow shall be determined by Owner estimates of borrow material excavated and placed or wasted via methods of load counts, approximate percent complete, Contractor survey, and/or Owner verification survey. Final payment for Borrow shall be made from final Contractor survey of all borrow areas utilized on the project and verified with a final Owner survey. Borrow shall be paid on a unit price basis for CY (EV) of Borrow Material excavated and placed into the work, or excavated to waste. Payment for borrow shall be compensation in full for furnishing, hauling, and placing the material as specified, including final compacting and finishing operations and any wasting operations.

**END OF SECTION**

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## **SECTION 31 23 26 - COMPACTION CONTROL AND TESTING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. How compacted fill shall be constructed and tested for determination of degree of compaction and moisture content. The Contractor shall acquire and pay for all testing. This shall include but is not limited to subgrade, subballast, and concrete.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. 01 43 26 Laboratory and Field Testing Services
- B. 31 24 13 Excavation, Embankments and Other Fills

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION**

#### **3.01 PLACEMENT AND COMPACTION OF EMBANKMENT**

##### **A. Lift Thickness:**

1. The Contractor shall provide sufficient compaction equipment to properly place and compact the material being used to construct the Embankment. Equipment used for towing shall not be considered as compaction equipment. The material used to construct the Embankment shall be placed in successive horizontal lifts. Each lift shall extend the full width of the Embankment before another lift is started. Each layer shall be adjusted for moisture content, if required, and shall be thoroughly mixed by diskings or other means approved by the Engineer. Each lift shall be leveled before compacting and shall be compacted by distributing the travel of the compaction equipment uniformly over the entire length and width of the Embankment.

##### **B. Compaction Equipment:**

1. Only equipment that is appropriate for the material being constructed shall be used for compaction. During Embankment construction, continuous use of approved compaction equipment is mandatory. If at any time, the Contractor has not furnished sufficient compaction equipment to compact the materials being used to construct the Embankment, then placement of such Embankment materials shall be reduced accordingly. Since the number of pieces of equipment required for compaction depends on the type and quantity of embankment material being placed, the Contractor shall carefully estimate the rate at which embankment material is placed for the construction equipment available to achieve uniform fill compaction.

C. Frozen Materials:

1. Embankment material requiring water for density control shall be placed only when temperature is above freezing. No frozen material shall be placed in Embankments. Sustained periods of freezing that induce frost into the previously placed embankment material or embankment material being placed shall be cause for the suspension of construction of the Embankment.

D. Operating Heavy Equipment Over Embankment:

1. When moving over previously compacted Embankments, the Contractor's heavy earth moving equipment shall be operated over the entire area of such Embankment in order to avoid uneven compaction of such Embankment.

E. Definitions and Terms:

1. Compaction - The process of mechanically stabilizing a material by increasing its density within a range of acceptable moisture contents. "Degree of Compaction" is expressed as a percent of maximum density obtained by the test procedure described in ASTM D1557, Test Method for Determining Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 FT-LBF/FT<sup>3</sup> (2,700 Kn-m/m<sup>3</sup>)).
2. Density in place- Field testing to determine the density and degree of compaction of fill in place shall be determined in accordance with ASTM D2922, Density of Soils and Soil-Aggregate in Place by Nuclear Methods; or other methods approved by the Engineer and/or Soils Engineer.

3.02 DENSITY REQUIREMENTS

A. Excavation:

1. Scarifying Subgrade:

- a. In cut sections, the Contractor shall scarify the top 6 IN of material below the top of existing ground, after cut has been completed, adjust moisture content, and compact such scarified material to not less than 95 percent of maximum density.

2. Excavation in Rock Cut Areas:

- a. In cut sections where the material to be excavated is in rock or solid rock the Contractor shall excavate 12 IN below the finished subgrade elevation as shown on the Drawings and shall replace such excavation with embankment material approved by the Engineer. Finished subgrade level is defined as the bottom-of-subballast level. This 12 IN shall be compacted to not less than 95 percent of the maximum dry density (ASTM D1557).

B. Embankment:

1. Scarifying, Adjusting Moisture Content and Compaction:

- a. After the required clearing, the resultant subgrade for embankments shall be prepared by scarifying the top 6 IN layer of existing ground, adjusting the moisture content of the scarified materials if required to comply with the project moisture content specifications, and compacting the scarified materials to not less than 95 percent of maximum density (ASTM D1557).

- b. Less Than 3 FT of Fill:
  - 1) The embankments which are to be 3 FT or less in height shall be compacted for their full depth to a density not less than that equal to 95 percent of the soils maximum dry density.
- c. More Than 3 FT of Fill:
  - 1) Fills having heights greater than 3 FT shall have the upper 3 FT compacted as stated immediately above with the fill constructed at depths more than 3 FT below finished grade uniformly compacted to a density equal to not less than 90 percent of the soils maximum dry density, or as otherwise specified by the Engineer or Soils Engineer for the project.
- d. Soil compaction and moisture content shall be “determined” with a nuclear density meter in accordance with ASTM D2922, or other method approved by the Soils Engineer. Soil compaction shall be computed using ASTM D1557, or another method approved by the Soils Engineer.

C. Bridges and Culverts:

- 1. When back-filling at the culverts, the Contractor shall be required to attain 100 percent of maximum density, by modified proctor (ASTM D1557), within 20 FT of the culvert.
- 2. When back-filling at bridges, the Contractor shall be required to attain 100 percent of maximum density, by modified proctor (ASTM D1557), within 100 FT of the bridge abutment.

### 3.03 MOISTURE AND DENSITY CONTROL

- A. Unless otherwise shown on the Drawings, or designated by the Engineer, embankment and those portions of cut sections which are not in rock or solid rock shall be constructed with moisture and density control. Unless otherwise directed by the Engineer, the moisture content of the soil at the time of compaction shall be at the optimum moisture content or within zero and six (6) percentage points above the soils optimum moisture content as determined by ASTM D1557. Locations and the frequency of tests will be determined by the Engineer. Moisture content for sand and gravel materials should be near the optimum moisture content to facilitate compaction of these cohesionless materials.
- B. The application of water to embankment or borrow materials shall be done with sprinkling equipment consisting of tank trucks, pressure distributors, or other equipment designed to apply water uniformly and in controlled quantities and at variable widths. Mobile sprinkling equipment shall have adequate tractive power and shall be equipped with controls operated from the driver's seat to control the rate of water flow. The Contractor shall be required to furnish sufficient water equipment to ensure proper moisture content of all materials. Watering of embankments shall be done in such a manner that pools of water will not develop. Watering and fill placement operations shall be performed in such a manner that the compacted materials have a uniform moisture content that complies with the Engineer and Soils Engineers moisture requirements for the project.

### 3.04 MINIMUM FREQUENCY OF TESTING

- A. For density control of embankment, culvert and bridge backfill, subballast, road base, and hot mix asphalt pavements, a sufficient number of tests should be taken to ensure that the specified results are obtained. The frequency of testing will vary with the project, the placement operation, and the material being used. For a project where compaction is relatively easy to obtain, the material is reasonably uniform and the compacting methods are consistent, a minimum number of tests are needed for acceptance. The minimum frequency of test needed under the relatively ideal conditions follow. Most operations will require more tests for proper control. Each lift must meet compaction requirement prior to placing a succeeding lift of material.

<b>Material</b>	<b>Test Type</b>	<b>Frequency</b>
Embankment	Moisture and Density	1 test per 2000 SY on each lift but no greater than 1000' spacing on each lift for narrow grading operations
Culvert, Bridge and Other Structural Backfill	Moisture and Density	1 test per 200 CY of material
Road Base	Moisture and Density	1 test per 1000 SY on each lift but no greater than 500' spacing on each lift for narrow grading operations

**END OF SECTION**

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## **SECTION 31 24 13 – EXCAVATION, EMBANKMENTS AND OTHER FILLS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Removal of excavation, the placement of embankment and other fills, and the classification of soils to meet the requirements of construction shown on the drawings, described in the contract documents, and stated in the Specifications.
2. The work shall be conducted so that the terrain outside the grading limits will not be disturbed except where approved by the Engineer.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Section 31 78 00 – Blasting**

#### **1.03 QUALITY ASSURANCE**

##### **A. Requirements:**

1. Comply with government agencies having jurisdiction.
2. Comply with the directions of the Railroad Engineer, Geotechnical Engineer, and independent testing laboratory.

#### **1.04 DEFINITIONS**

##### **A. The following terms shall be interpreted as follows:**

1. Borrow Area - The source, other than required roadbed excavation, where material(s) has been dug for use as fill for embankment and construction at other locations on the project.
2. Embankment (Fill) - A raised structure of soil, soil aggregate, sand, gravel, or rock; or any mixture thereof that is to be (1) used as the subgrade or foundation materials for track or other roadbeds, building(s), or other facilities; and (2) constructed to perform safely and satisfactorily under proposed train, vehicle, embankment, building and/or other proposed loading conditions.
3. Excavation (Cut) - Soil or material to be removed and used as fill for construction of a roadbed embankment or foundation for other structures or facilities; or to be disposed of properly.
4. Subexcavation -Excavation required below finished subgrade level as part of correcting unsuitable subsurface conditions.
5. Grading Area - The limits (surface) within a designated set of boundaries which includes where both excavations (cuts), embankments (fills), and fills for facilities other than track will be performed.
6. Lift - A layer (or course) of uncompacted embankment material placed on top of suitable natural subgrade or previously prepared embankment fill.

7. Nominal Maximum Size - The maximum U.S. sieve size upon which material is retained.
8. Roadbed - The bed or foundation that supports road surfacing or a track section (i.e., subballast, ballast, ties and rails).
9. Subgrade - The upper roadbed materials that underlie and support subballast; ballast; track structure (i.e., ties and rails); road surfacing (i.e., aggregate or pavement) materials, and the floor within the lowest level of a structure.
10. Unsuitable Material - Earthen and rock subgrade, foundation, borrow, or manufactured materials that do not possess the required strength, stability, and/or consolidation properties to safely and satisfactorily support proposed train or other facility loading conditions.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

#### A. EXCAVATED MATERIALS

1. Excavatability - The ease or difficulty, and means of excavating materials that are to be obtained from cut sections or borrow areas for a project will not be established for the Contractor. The Contractor shall be responsible for determining the methods necessary for excavation and handling of materials based on his interpretation of site conditions, geotechnical reports (if available), or other information sources.
2. Unsuitable Soil Materials:
  - a. The contractor shall remove and dispose of unsuitable and/or contaminated materials at a defined location on the property, at other locations shown on the plans, or as directed by the Engineer.
  - b. When project site restrictions mandate, the Contractor shall dispose of excess waste materials off the project site. These waste materials shall be legally disposed of at acceptable waste sites. Contaminated waste materials shall be disposed of at landfills approved to handle and store such materials without causing harm to the environment.
  - c. Topsoil shall be excavated during the performance of the clearing and grubbing operations for the project. The excavated topsoil materials shall either be stockpiled for later use as top dressing in grassed areas, wasted at locations directed by the Engineer, or used as part of the construction of the outer portions of embankments outside the track, road or other facilities load-bearing area(s). See Section 31 14 14 for Topsoil – Stockpile and Placing.
3. Suitable Materials:
  - a. Suitable materials shall be used for embankment or other fill construction.
  - b. Excess suitable materials, not used for embankment construction, are to be disposed of in a legal manner as follows: (1) at a designated location(s) within the project limits, (2) at other locations shown on the plans, (3) at a location(s) approved by the Engineer, or (4) at an approved landfill location(s).

4. Rock Materials:

- a. Rock is considered to be material requiring blasting or the use of heavy construction breakage equipment (such as a D-8 or larger bulldozer and/or 6,000 FT LBS or greater breakage equipment) as part of excavation. Rock shall include all materials in ledges, bedded deposits, and cemented and conglomerated deposits exhibiting the physical characteristics and difficulty of removal that requires removal using systematic drilling and blasting or as determined by the project engineer or geotechnical engineer. The fact that blasting may be resorted to by the Contractor shall not, of itself, entitle the material to be classified as "rock". Material that the Contractor encounters during excavation shall be uncovered and the Engineer notified so that the Engineer can classify the material. Materials from rock excavation which are to be used for embankment and fill construction shall be processed so as to produce a well-graded material which has a nominal maximum size as defined by the project Engineer or Geotechnical Engineer.

B. EMBANKMENT AND FILL MATERIALS

1. Embankment material (fill) is suitable earthen and/or rock that are excavated from on-site and/or off-site borrow areas, and considered suitable for use during construction based on their strength and consolidation properties, and approval by the Railroad's Engineer, Geotechnical Engineer, and/or an independent soils testing laboratory.
2. Embankment material shall be relatively free of organic materials, and not contain environmentally harmful or noxious substances.
3. Import fill or off site borrow material supplied by the Contractor shall meet specifications for: 1) granular fill, 2) random fill, 3) an inorganic lean clay having a maximum liquid limit of 45 and a maximum plasticity index of 15, 4) a clayey sand, or 5) pit run sand. Imported borrow materials, other than listed above, that are proposed for use as compacted fill on a project will require approval of the UPRR's Geotechnical Engineer prior to being used on the project.
4. Embankment and fill materials shall be identified and "classified" as follows:
  - a. Fine Grained Materials:
    - 1) Clayey Soils - Clay soils shall consist of soils having 50 percent or more by dry weight passing the No. 200 U.S. Standard sieve, that can be made to exhibit plasticity (cohesive/putty-like properties) within a range of water contents, and that exhibit considerable strength when air dry. For classification purposes, a clay is the fine-grained portion of a soil which exhibits a plasticity index equal to or greater than 4, and for which a plot of plasticity index versus liquid limit for the soil falls on or above the "A" line on the Unified Soil Classification chart. Clays with Liquid Limits above 50 are considered suitable for use as embankment materials when approved for selective placement by the Geotechnical Engineer and/or when chemically treated to reduce undesirable plasticity characteristics and associated soil properties.

- 2) Silty Soils – Silty soils shall consist of soils having 50% or more by dry weight passing the No. 200 U.S. Standard sieve, that can not be made to exhibit plasticity (cohesive/putty-like properties) within a range of water contents – and that are nonplastic or very slightly plastic and exhibits little or no strength when air dry. For classification purposes, a silt is the fine-grained portion of a soil which exhibits a plasticity index less than 4, and for which a plot of plasticity index verses liquid limit for the soil falls below the “A” line of the Unified Soil Classification chart. Silty soils can become unstable when saturated. As a result, silty soils are only considered suitable for use as embankment and general compacted fill construction when approved for selective placement by the Geotechnical Engineer. Silty materials are predominantly extremely fine sand particles that are best compacted using vibratory construction equipment.
- b. Coarse Grained Materials:
- 1) Sands – Sandy materials consist of granular materials having 50 percent or more by dry weight retained between the No. 200 and No. 4 U.S. Standard sieves. Sandy materials are generally visible to the human eye.
  - 2) Granular Materials – Coarse grained soil material with more than 50 percent dry weight retained on the No. 200 U.S. Standard sieve, and which exhibit no characteristics of cohesiveness or plasticity.
  - 3) Gravels – Gravelly materials consist of granular materials having 50 percent or more by dry weight retained between the No. 4 and 3 IN U.S. Standard sieve.
  - 4) Cobbles – Cobbles consist of rock materials having 50 percent or more by dry unit weight retained between the 3 IN and 10 IN U.S. Standard sieves.
  - 5) Boulders – Boulders consist of rock materials having 50 percent or more by dry unit weight having a diameter greater than 10 IN.
  - 6) Cinders – Cinders consist of a porous by product that routinely is the residual of partially burnt coal. Cinders have the potential for degradation (reduction in volume) when subject to freeze-thaw action and heavy loadings.
- c. Stone:
- 1) Material. “B” Stone shall comprise of naturally-occurring limestone, dolomite, quartzite, or granite. Stone must be hard, durable, angular in shape, resistant to weathering and shall be free of cracks, seams, expansive materials or other defects that would cause accumulated deterioration from exposure to climatic conditions.
  - 2) The material shall meet, in addition to the Specifications, the following quality requirements:
    - a) The approval of some “B” Stone from a particular source shall not be construed as constituting the approval of all riprap taken from that source.

- b) The Engineer shall be the sole judge of “B” Stone quality and sources of material.
- c) “B” Stone may be rejected on the basis of visual examination, regardless of laboratory tests and/or service records.
- d) Tests to which the materials may be subjected include specific gravity, abrasion, absorption, soundness, freezing and thawing and such other tests as may be considered necessary.

	TEST	REQUIREMENT
Specific Gravity	(ASTM C127)	2.65 Min.
Absorption	(ASTM C127)	2.0% Min. – 8.0% Max.
Soundness, 5 cycles Mg S04	ASTM C88)	2.0% Min. – 15.0% Max.
Abrasion	(AASHTO)	50% Max.

- 3) Gradation. All “B” Stone to be loaded and quarried shall conform to the following gradation unless otherwise specified or as shown on the plans:

- a) Nominal 8 IN size:
  - (1) 100 percent passing the 10 IN screen.
  - (2) 100 percent retained on the 6 IN screen.
- b) Gradation compliance is determined by visual inspection, monitored by the Engineer. The Engineer may designate the material as too fine or too coarse.

d. Rock:

- 1) Rock shall include all material in ledges, bedding deposits, cemented and conglomerate deposits which exhibit physical characteristics and difficulty of removal without systematic drilling and blasting, or as determined by the Engineer. The fact that blasting may be resorted to by the Contractor shall not, in itself, entitle the material to be classified as rock.

5. “Types” of embankment (fill) materials shall be identified as follows:

- a. Select Fill Material – The plasticity index of select fill material (as determined in accordance with ASTM D4318) shall not exceed 15. Select materials shall be limited to sand and gravel materials that possess minimal expansive properties and that meet the following criteria:

Liquid Limit Passing the No. 200 Sieve	Maximum Allowable Percent
(Test Method ASTM D 4318)	(Test Method ASTM D 1140)
Greater than 50	30%
Between 30 and 50	40%
Less than 30	50%

- b. Random Fill Materials – Random fill materials are defined as those non-organic cohesive soils, cohesionless soils, combined cohesive and cohesionless soils, and rock materials that possess the minimal required physical strength, consolidation and other characteristics, after placement and compaction, that are required to provide a stable and safe embankment and foundation for the project. Depending upon the physical properties required to provide a stable embankment and fill, routine materials consisting of, but not limited to, clayey silts (CL-ML), lean clays (CL), sandy lean clays (CL), clayey sands (SC), silty sands (SM), sands and gravely sands (SP & SW), sandy gravels and gravels (GP and GW), rock, and combinations of these materials may prove satisfactory embankment materials. Highly plastic clayey (CH) soils may possess the physical properties required to perform satisfactorily as part of embankment and foundation construction but are routinely either buried within the fill or chemically stabilized prior to placement and compaction to reduce undesirable physical characteristics associated with encountering water. Random fill materials shall be defined by the Railroad and/or Geotechnical Engineers for the project.
- c. Rock Fill – Rock fill shall consist only of sound, durable rock from solid rock excavation containing not more than 20 percent by weight which passes through a 1/2 IN sieve. Mixtures of boulders and silt will not be considered as rockfill. The maximum nominal size of rock shall be 24 IN or as specified by the Engineer or Geotechnical Engineer for the project.
- d. Cinder Fills - Cinder fills are subject to degradation when subject to forces such as frost action, heavy loading, etc. Such degradation can result in a reduction in the mass of the material resulting in settlement of the overlying fill and facilities. Cinder fills shall not be constructed within the load bearing zone under tracks and other structural facilities. Materials containing more than 25 percent cinders should be either wasted or uniformly blended with cohesive soil such that the blended material contains no more than 25 percent cinders. The soil/cinder blended material can be used to construct those portions of either the embankment or fill sections located within either the track or structure loading areas when approved by the Railroad and/or Geotechnical Engineers on the project.

#### C. SOURCES OF EMBANKMENT

- 1. If the quantity of materials required for construction of Embankments and fills exceeds the quantity of materials removed from excavation necessary to complete the project, additional Embankment material will first be obtained by widening cuts. If widening cuts does not provide the necessary embankment, then borrow areas, either on-site or off-site, will be used.
  - a. WIDENING CUTS – The Contractor shall widen cuts in the Grading Area or widen cuts in the vicinity of the project. The Contractor shall consult with the Engineer to determine the location of cuts in the vicinity of Grading Area and to determine the volume of such cuts which are to be widened. Cuts shall be widened in such a manner as to be at least as stable as the original cut, provide adequate drainage for the Roadbed, and retain the same slope lines as the original cut.

- b. BORROW AREAS - Borrow Areas within the Right-of-Way, if available, or from Borrow Areas outside of the Right-of-Way, provided by the Contractor, shall be required to complete the embankment. All borrow areas shall be cleared and grubbed (see Section 31 11 00, Clearing and Grubbing). Materials must be tested by an independent testing laboratory and/or approved by the Engineer prior to placement.

## 2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. The contractor shall examine the areas and conditions under which work of this section will be performed, and correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.
- B. Access - The contractor shall maintain access to adjacent areas and facilities at all times, unless approved or directed by the Engineer.
- C. Drainage - All grading shall be performed in a manner and sequence that will provide proper drainage at all times.
- D. Signs – All signs, with the exception of safety related signs (whistle posts, stop signs, etc.) located in the construction area shall be removed, protected, and replaced in the proper locations, as directed by the Engineer. Safety related signs shall be maintained in their original location until such time they are to be relocated as directed by the Engineer. This shall be incidental to the grading.
- E. Signal foundations, or other concrete, will be removed to an elevation of 2 FT below finished subgrade. Signal foundations will not be removed until new signals have been turned over to operations.
- F. Haul – Transporting excavated or embankment material, whether on-site or off-site, shall be considered incidental to the grading work. Vehicles and equipment used for hauling shall be sufficient in number and capacity to meet the project schedule. The contractor shall route the hauling equipment over the grade in such a manner as to maintain uniform compaction across the grade and minimize damage to completed work.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Before grading begins, the area shall be cleared and grubbed. See Section 31 11 00 - Clearing and Grubbing. The Contractor shall perform all grading as shown on the Drawings, as specified herein, or as otherwise staked in the field. This Work shall consist of excavating the material from roadbed areas or the Borrow Areas, and placing the material as embankment, shaping and sloping as necessary for the construction, preparation and completion of roadbeds, facilities, and other earthwork.

### 3.02 EXCAVATION

- A. Perform excavation of every type of material encountered within the limits of the work to the lines, grades, and elevations indicated on the plans and specified herein.

- B. Excavation as Embankment - The Contractor shall excavate all materials, including rock and common materials, which must be removed to accomplish the excavation as shown on the Drawings. All excavated materials will be used in the formation of Embankments, Roadbeds, and other earthwork so long as such excavation material is satisfactory for such use.
- C. Disposition of Excavated Materials - The Contractor shall utilize all satisfactory excavated materials in the formation of embankment. Where excess excavation materials or unsatisfactory material exists, such materials will be disposed of in areas on the right of way approved by the Engineer or off the right of way in a legal and proper manner. If the contractor disposes material off of the right of way, it shall be at the Contractor's expense and liability.
- D. Scarifying Subgrade - In cut sections, the Contractor shall scarify the top 6 IN of material below the Subgrade, adjust the moisture content, and recompact such scarified material.
- E. Proofrolling - After the site has been stripped, and/or excavated to the rough subgrade elevation, the exposed subgrade should be proofrolled prior to placement of any structural fill to identify any soft, disturbed, or unstable areas. Unstable or otherwise unsuitable soils, which are revealed by proofrolling and which cannot be adequately densified in-place, should be remediated under the direction of the Engineer. If required, the methods of stabilization typically include over-excavation and replacement, a lift of crushed stone materials, a geosynthetic over the soft soils, or chemical stabilization with lime. Appropriate remediation methods shall be determined in consultation with the Engineer.
- F. Excavation in Solid Rock Areas - In cut sections where the material to be excavated is solid rock, the Contractor shall excavate 12 IN below finished track subgrade elevations as shown on the Drawings and shall replace such excavated 12 IN of solid rock with embankment material approved by the Engineer.
- G. Blasting - No blasting will be allowed without sufficient advanced notice given to the Engineer. This time will permit the safe and continuous operation of the Railroad. See section 31 78 00 Blasting.
- H. Ditches and Slopes - The Contractor shall construct intercepting "V" ditches on the uphill side of cut slopes as directed by the Engineer. The ditches are to be 2 FT deep with 3:1 side slope.
- I. Over Excavation – The Contractor shall not excavate below the design finished grade elevation without the Engineer's prior approval. Materials that are excavated below design finished grade elevation, prior to obtaining prior approval of the Engineer, shall be reconstructed to design grade with materials designated by the Engineer and at the Contractor's expense.



- J. Subexcavation - The Contractor shall inform the Engineer when unsuitable subgrade and foundation materials are encountered. Unsuitable subgrade and foundation materials shall be removed and replaced with compacted fill placed in accordance with recommendations provided by the Soils Engineer. Subexcavation that is unplanned should be quantified and the information provided to the Engineer. Subexcavation shall include suitable material for backfill, unless otherwise specified. Other considerations in lieu of subexcavation may include surcharging, or the use of geosynthetic fabric and/or geogrid in combination with a granular materials, both of which must be specified and approved by the project Engineer and/or Geotechnical Engineer prior to their installation. Geotextile/filter fabric shall be extra heavy nonwoven geotextile meeting the requirements found in Table 1-10-2 of the AREMA Manual. Geogrid shall be Tensar BX 1100 or an approved equivalent. Quantities are estimated to establish a unit price. Payment will be for square yards as installed and approved.
- K. Soil Treatment or Modification – The treatment of soils using lime, fly ash, or other additives may be used when specified, or as directed by the project Engineer and/or Soils Engineer. See section 31 32 14 - Lime Stabilization.
- L. Borrow Areas - Except as otherwise permitted, borrow pits and other excavation areas shall be excavated in such a manner as will afford adequate drainage. After borrowing operations are completed, areas shall be left in a neat, orderly condition with uniformly shaped slopes not steeper than 2 FT horizontal on 1 FT vertical. Borrow areas of fine grained material subject to wind erosion and blowing shall be stabilized or seeded. The Contractor shall ensure that the excavation of material from any source results in minimum detrimental effects on natural environmental conditions.

### 3.03 EMBANKMENT AND FILL CONSTRUCTION

#### A. Earth Fill:

- 1. Embankments and fills shall be constructed and compacted as shown on the plans, in these specifications, in the special provisions, or as directed by the Engineer. Embankments shall be constructed in lifts containing only that amount of material that can be compacted uniformly throughout its entire depth when utilizing the compaction construction equipment available on the project. Compaction shall be accomplished by sheeps foot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Earth fills shall be uniformly compacted to the densities specified by the project Engineer or Soils Engineer for the project using methods and equipment best suited for the materials.
- 2. Each successive lift or layer shall be carefully leveled and completely and uniformly compacted over the full width of the embankment before a succeeding layer is placed. Embankments built of soil material or material consisting of gravel or small pieces of rock 6 IN or less in maximum dimension shall be placed and compacted until the required degree of compaction is obtained thoroughly and uniformly throughout the layer. No stones larger than 3 IN in diameter will be permitted within the top 12 IN of the finished grade elevation.

#### B. Rock Fill:

1. Embankments built of materials comprised predominantly of rock larger than 6 IN in maximum nominal size dimension shall be constructed by placing the material in layers not exceeding the maximum size of the rock present, but in no case shall the thickness of layers exceed 24 IN, unless approved by the Engineer.
  2. Rock fill shall be placed using procedures that form a dense, well-graded mass of stone with a minimum of voids. The rock fill lifts shall extend the full width of the roadbed or fill area. When directed by the project Engineer or Geotechnical Engineer (1) the bottom, sides and top of the rock fill shall be covered with geosynthetic fabric or (2) the voids shall be filled with finer cohesive or coarse grained materials to prevent migration of finer materials located around the rock fill into the voids, thereby avoiding settlement and/or loss of the finished subgrade profile.
- C. Preparation of Foundations for Embankments:
1. General – Following required clearing and grubbing, the foundation and subgrade for the proposed embankments and fills shall be prepared by scarifying the top 6 IN layer of existing ground, adjusting the moisture content of the scarified material and compacting the scarified soils in accordance with the project specifications.
  2. Benching Of Fill Into Existing Slopes – Slopes that are steeper than four horizontal to one vertical (4.0H:1.0V) and to receive embankment and fill materials shall be benched (stepped) to tie the existing and constructed materials. The base of each step shall be cut as nearly horizontal as possible and the face of each step cut no steeper than 1.0H:1.0V to allow fill placed adjacent to the vertical cut to be compacted in its entirety to the degree specified for the project. Benching operations should be performed so as to avoid undermining of any adjacent existing tracks or structures. Steps cut into the slope shall not be allowed to remain unsupported overnight.
- D. Grading During Freezing Conditions - With the approval of the Engineer, the Contractor may construct embankment and fill materials during freezing weather. The Contractor shall not place any embankment or fill materials on frozen ground, or use frozen materials for embankment or fill construction. Fill materials that are placed must be completely compacted before freezing. The placing of fill shall stop if the materials freeze before the required compaction is obtained. Frozen materials must be removed at the Contractor's expense before filling operations resume.
- E. Topsoil - Topsoil placed shall be compacted with at least two complete coverages over the area with a multiple wheel, pneumatic-tired roller designed for use in the compaction of earth fills.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 MEASUREMENT

- A. Cross sections provided shall be considered Pay Quantities for grading. The quantities are calculated to neat line of the cross sections with no allowance for shrinkage, clearing and grubbing, or topsoil stripping and placement. Adjustments to pay quantities will not be considered after commencement of grading. If the Contractor disputes the accuracy of the plan quantities, the Contractor shall pay for the cost to perform measurements and calculations of the quantities.

- B. Subexcavation quantities, which are estimated, shall be measured and approved by the Engineer. Backfill is to be included unless there is a separate bid item.

**END OF SECTION**

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## **SECTION 31 32 14 - SOIL STABILIZATION - LIME**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Requirements:**

1. The Primary requirement of this Specification is to secure a completed course of treated subgrade material containing a uniform lime mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent embankment. It shall be the responsibility of the Contractor to regulate the sequence of his work, to use the proper amount of lime, maintain the work and rework the courses as necessary to meet the above requirements.

#### **1.02 QUALITY ASSURANCE**

##### **A. Certification and verification:**

1. If lime is furnished in trucks, the Contractor shall be required to furnish to the Railroad weight tickets on each truck load for verification of the actual tonnage installed on the roadbed.
2. When Type A Hydrated lime is furnished in bags, each bag shall bear the manufacturer's certified weight and the Contractor shall verify, to the Railroad, the number of bags along with the weight of each bag actually used on the project.
3. Type B Commercial Lime Slurry, the distributor truck shall be equipped with a sampling device.
4. Type C Quicklime to be used only when conditions require it and approved by the Engineer. Placement shall be in accordance with the State Highway specifications for the state in which the work is being performed.

#### **1.03 DELIVERY AND STORAGE**

- A. Hydrated lime in bags shall be stored and handled in closed weatherproof containers until immediately before distribution on the roadbed.
- B. Hydrated lime in bags shall be stored in weatherproof building with adequate protection from ground dampness.

#### **1.04 PREPARATION OF SUBGRADE**

- A. The roadbed shall be constructed and shaped to conform to the typical sections, lines and grades as shown on the plans or as established by the Engineer.

- B. If the Contractor elects to use a cutting and pulverizing machine that will remove the subgrade material accurately to the secondary grade and pulverize the material at the same time, he will not be required to expose the secondary grade nor windrow the material. However, the Contractor shall be required to roll the subgrade, as directed by the Engineer, before using the pulverizing machine and correct any soft areas that this rolling may reveal. This method will be permitted only where a machine is provided which is capable of cutting to the full depth of the stabilized layer in one pass. It must also ensure that the material is cut uniformly to the proper grade to a smooth surface over the entire width of the cut. The machine shall be of such design that a visible indication is given at all times that the machine is cutting to the proper depth.
- C. In lieu of using the cutting and pulverizing machine, the Contractor shall excavate and windrow the material to expose the secondary grade. Any wet or unstable materials below the secondary grade shall be corrected, as directed by the Engineer, by scarifying, adding lime, compacting, or by other methods until satisfactory stability is obtained. When this method is used the mixing and compaction shall be done in maximum 6 IN lifts.

#### 1.05 PULVERIZATION

- A. The existing pavement or base material shall be pulverized or scarified so that 100 percent passes the 2 IN sieve.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. The lime and lime slurry being furnished under the terms of this specification shall, in addition to all other requirements, also meet the following chemical and physical requirements.
  1. Type A Hydrated Lime, dry powdered material consisting essentially of calcium hydroxide.
  2. Type B Commercial Lime Slurry, a liquid mixture of essentially hydrated lime solids and water in slurry form.
  3. Lime shall conform to following requirements:

CHEMICAL COMPOSITION	TYPE	
	A	B
Active lime content, % by weight $\text{Ca(OH)}_2 + \text{CaO}$	90.0 min <sup>1</sup>	87.0 min <sup>2</sup>
Unhydrated lime content, % by weight CaO	5.0 max	
Free water content, % by weight H <sub>2</sub> O :	5.0 max	
SIZING		
Wet Sieve, as % by weight residue retained:		
No. 6	0.2 max	0.2 max <sup>2</sup>
No. 30	4.0 max	4.0 max <sup>2</sup>

Notes:

1. Maximum 5.0% by weight CaO shall be allowed in determining total active lime content.
2. MAXIMUM SOLIDS CONTENT OF SLURRY.

### PART 3 - EXECUTION

#### 3.01 SAFETY

- A. Precautions should be taken, including but not limited to, dust masks; eye protection; and protective clothing. Lime will not be spread on windy days. The Contractor will comply with all Federal, State and local regulations governing this type of work.

#### 3.02 APPLICATION

A. Restrictions and requirements:

1. Lime shall be spread only on that area where the first mixing operations can be completed during the same day.
2. Hydrated lime shall be added, at the percentage specified on the plans, as a percentage of the dry weight of the soil.

B. Dry placing method:

1. The lime shall be spread by an approved spreader or by bag distribution or as directed by the Engineer.
2. Lime shall be distributed at a uniform rate and in such a manner as to reduce the scattering of lime by the wind to a minimum. Lime shall not be applied when wind conditions, in the opinion of the Engineer, are such that blowing lime becomes objectionable to traffic or adjacent property owners. A motor grader shall not be used to spread the lime.
3. The material shall be sprinkled as directed by the Engineer.

C. Slurry Placing:

1. Where Type A Hydrated Lime is specified and slurry placement is to be used, the Type "A" Hydrate shall be mixed with water to form a slurry of the solids content designated by the Engineer. The distribution truck shall be equipped with an agitator that will keep the lime and water in a uniform mixture.
2. Type B Commercial Lime Slurry shall be delivered to project in slurry form at or above the minimum dry solids content approved by the Engineer. The distribution of lime at the rates shown on the plans or approved by the Engineer shall be attained by successive passes over a measured section of roadway until the proper lime content has been secured.

#### 3.03 MIXING

- A. This process will be the same for both methods.

- B. The material and lime shall be thoroughly mixed by approved road mixers or other approved equipment, and the mixing continued until, in the opinion of the Engineer, a homogenous friable mixture of material and lime is obtained, such that when all nonslaking aggregates retained on the 3/4 IN sieve are removed, the remainder of the material shall meet the following requirements when tested from the roadbed in the roadbed condition by the laboratory sieves:

Minimum passing 1 - 3/4 IN sieve	100 percent
Minimum passing 0 - 3/4 IN sieve	85 percent

- C. The soil-lime mixture shall be sprinkled during the mixing operation to obtain a moisture content at least 5 percent above optimum.
- D. During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of 6 HRS or more, or has had excessive loss due to washing or blowing will not be accepted for payment.
- E. Hydrated lime mixing and pulverizing shall not be started until the temperature is greater than 40 DegF in the shade, and rising.
- F. After initial mixing, the lime-treated layer should be shaped to the approximate section and compacted lightly prior to curing in order to minimize evaporation loss. The mixture may be left to cure for one to four days or the mixing continued until the above sieve requirements are met.
- G. When shown on the plans or approved by the Engineer, the pulverization requirement may be waived when the material contains a substantial quantity of aggregate.

### 3.04 COMPACTION

A. Definitions:

1. Ordinary Compaction - The Soils shall be sprinkled and rolled as directed by the Engineer. All irregularities, depressions or weak spots which develop shall be corrected immediately by scarifying the areas affected, adding or removing material as required and reshaping and recompacting by sprinkling and rolling. The surface of the course shall be maintained in a smooth condition, free from undulations and ruts, until other work is placed thereon or the work is accepted.
2. Density Control - The course shall be sprinkled as required and compacted to the extent necessary to provide the density specified in the Railroad's Earthwork Specification 31 24 13 and Compaction Control and Testing Specification 31 23 26. In addition to the above, the full depth of material shown on the plans shall be compacted to the extent necessary to remain firm and stable under construction equipment. After such section is completed, tests as necessary will be made by the testing laboratory, see section 01 43 26. If the material fails to meet the testing requirements, it shall be reworked as necessary to meet these requirements. Should the material, due to any reason or cause, lose the required stability, density and finish before the next course is placed or the work is accepted, it shall be reprocessed and refinished at the cost of the Contractor.



### 3.05 FINISHING, CURING AND PREPARING FOR SURFACING

- A. After the final layer, course, or lift of the lime treated subgrade, subbase, or base has been compacted, it shall be brought to the required lines and grades in accordance with the typical sections. The completed sections shall then be finished by rolling as directed by the Engineer, with a pneumatic tire or other suitable roller sufficiently light to prevent hair line cracking.
- B. The Completed section shall be moist-cured for a minimum of 7 days before further lifts are added or any traffic is permitted, unless otherwise directed by the Engineer. In cases where subgrade treatment sets up sufficiently to prevent objectionable damage from traffic, such lifts may be opened to construction and/or access traffic, and may be covered by other courses the day following compaction, unless otherwise directed by the Engineer. If the plans provide for the treated material to be sealed or covered by additional courses of material, such seal or courses shall be applied after final mixing and compaction is completed, unless otherwise directed by the Engineer.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 MEASUREMENT

- A. Lime will be paid for at the unit price bid per ton (of 2000 LBS) for Type "A" Hydrated Lime.
- B. Lime treated Subgrade (Ordinary Compaction), or Lime treated subgrade (Density Control), of the depth specified will be paid for at the unit price bid per square yard. The unit price bid shall be full compensation for all correction of secondary subgrade, for loosening, mixing, pulverizing, spreading, sprinkling, rolling, drying, furnishing and application of lime, shaping, and maintaining, for all manipulations required, for all hauling, and freight involved, for all tools, equipment, materials, labor, and for all incidentals necessary to complete the work.

**END OF SECTION**

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## **SECTION 31 35 20 - SLOPE PROTECTION AND EROSION CONTROL**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. General information required in connection with slopes and dust control.
2. Installing silt fence and ditch checks for controlling stormwater erosion during construction as shown on the plans or designated by the Engineer.
3. This work shall consist of furnishing, placing, and removal of silt fence and ditch checks in accordance with these Specifications at locations shown in the plans or designated by the Engineer.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

#### **2.01 GENERAL**

- A. Only products on the respective State Department of Transportation's Approved Products List will be allowed for use on this project, unless specified elsewhere in these specifications or on the Plans.
- B. Material for hold down stakes shall be wood or other degradable material. Metallic stakes will not be allowed.

### **PART 3 - EXECUTION**

#### **3.01 FILTER FABRIC**

- A. Height of silt fence shall not exceed 36 IN.
- B. Posts shall be spaced a maximum of 10 FT apart when using standard strength filter fabric with wire fence backing and spaced a maximum of 6 FT apart when using extra strength filter fabric. Posts shall be driven a minimum of 12 IN into the ground.
- C. A trench shall be excavated approximately 4 IN deep x 4 IN wide along the line of posts and upslope from the barrier.
- D. When standard strength filter fabric is used, a wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy duty wire staples at least 1 IN long, tie wires or hog rings. The wire shall extend into the trench a minimum of 2 IN and shall not extend more than 36 IN above the original ground surface.
- E. The standard strength filter fabric shall be stapled or wired to the fence and 8 IN of the fabric shall be extended into the trench. The fabric shall not extend more than 36 IN above the original ground surface.

- F. When extra strength filter fabric and closer post spacing are used, the wire mesh support fence may be eliminated. In such a case, the filter fabric shall be stapled or wired directly to the posts and 8 IN of the fabric shall be extended into the trench. The fabric shall not extend more than 36 IN above the original ground surface.
- G. The trench shall be backfilled and the soil compacted over the filter fabric.
- H. Inspection shall be frequent and repair or replacement shall be made promptly as needed or as directed by Engineer. Silt fences shall be replaced every 6 months and removed when the seeding has been established or as directed by the Engineer.
- I. Sediment deposits shall be removed periodically as directed by Engineer or when depth reaches 1/3 height of silt fence.

### 3.02 STRAW BALE DITCH CHECKS

- A. Straw bales shall be placed in a single row, lengthwise, oriented perpendicular to the contour, with ends of adjacent bales tightly abutting one another.
- B. All straw bales shall be either wire-bound or plastic tied. Straw bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales.
- C. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a straw bale and the length of the proposed barrier to a minimum depth of 4 IN. After the straw bales are staked and chinked, the excavated soil shall be backfilled against the barrier. Backfill soil shall conform to the ground level on the downhill side and shall be built up to 4 IN against the uphill side of the barrier.
- D. Each bale shall be securely anchored by at least two stakes driven through the bale. The first stake in each bale shall be driven toward the previously laid bale to force the bales together. Stakes shall be driven deep enough into the ground to securely anchor the bales.
- E. The gaps between straw bales shall be chinked (filled by wedging) with straw to prevent water from escaping between the bales.
- F. The barrier shall be extended to such a length that the bottoms of the end straw bales are higher in elevation than the top of the lowest middle bale to assure that sediment-laden runoff will flow either through or over the barrier but not around it.
- G. Sediment deposits shall be removed after each storm event or when depth reaches 1/3 height of straw bales to prevent sediments from reaching further downstream via a channel.
- H. Inspection shall be frequent and repair or replacement shall be made promptly as needed or as directed by Engineer. Straw bales should be replaced every 3 months and removed when the seeding has been established or as directed by the Engineer.

### 3.03 SLOPES AND PROTECTION OF FINISHED WORK

- A. Construction and Protection:

1. The Contractor shall be responsible for developing, implementing and maintaining a Storm Water Pollution Prevention Plan. If permits are included, the Contractor must adhere to all of the conditions set forth in the permit, and the Contractor must keep a copy of the permit and SWPPP onsite at all times. UPRR has provided silt fence and stabilized construction exit details. The Contractor shall use best management practices to ensure that a proper plan is developed and followed. The Contractor shall submit a SWPPP to the Engineer for review and approval 14 days prior to the start of activities impacted by the plan. This plan shall be approved and implemented prior to the start of any grading, and cost shall be incidental to grading unless there are separate bid items. The Contractor shall submit the Notice of Intent for the NPDES permit, as well as the Notice of Termination, unless it is provided by the Railroad. If the permit is provided by the Railroad, a Transfer of Ownership form, if available, shall be completed by the Contractor and the permit shall be transferred to the Contractor. The Contractor shall be responsible for maintaining the SWPPP for the duration of the project. This shall include, but not limited to, re-staking loose hay bales, adjusting and re-staking silt fence, mucking out accumulated silt and other items as necessary to maintain the system.
2. Silt fence is normally the first item constructed, especially on import fill projects. Silt fence may be offset from toe of slopes as directed by the Engineer.
3. All reasonable precautions shall be taken to preserve the character of the material outside of the theoretical slope lines. The slope shall be finished to the lines and grades furnished by the Engineer. All loose materials shall be removed from the slopes and all materials, whether solid or loose, projecting more than one foot outside of the theoretical slope line as staked, shall be removed by the Contractor.
4. The Contractor shall not widen cuts or benches without the prior approval of the Engineer. Widened cut slopes or benches, if approved, must be constructed as follows:
  - a. In such a manner as to be at least as stable as the original cut slopes or benches.
  - b. To provide adequate drainage for the Roadbed.
  - c. In accordance with these Specifications and in the same manner as if such widened cut slopes or benches had been originally contemplated by these Specifications and the Drawings.
5. Care shall be taken to ensure drainage is diverted along or away from the toe of the slope during construction to eliminate water pockets and toe saturation. All operations shall be conducted such that proper drainage shall be provided at all times, especially at the close of work shift or before anticipated rain.

### 3.04 DUST AND WIND EROSION CONTROL

- A. As the Work progresses, all finished grades and finished slopes both in excavation and Embankments must be protected from damage by application of water as necessary until the Work has been completed. The Contractor will be required to maintain all excavations, embankments, stockpiles of material sources, haul roads, permanent access roads, plant sites, waste areas, borrow areas, and all other work areas inside or outside of the physical boundaries of the work, free from dust or other materials which would violate federal, state or local air pollution standards or which would cause a hazard or nuisance to people in the vicinity of the Work. Approved temporary methods of dust control, including sprinkling, chemical treatment, light bituminous treatment or similar methods will be permitted. Sprinkling must be repeated at such intervals as to keep all potential sources of dust wet at all times, and the Contractor must provide sufficient sprinkling equipment to comply with this requirement at no expense to the Railroad.
- B. Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify the surface, reshape, and compact to the required density prior to further construction.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 PAYMENT

- A. The Storm Water Pollution Prevention Plan will be paid for as a lump sum. Approved installations will be paid for at the contract unit price per 50 percent initial installation, percentage payments each month determined by length of contract and a final payment of 10 percent for bid item "SWPPP".
- B. Straw bales and silt fence, if provided as separate bid items, shall be paid for at the Contract Unit Price. Silt fence and straw bales are estimated quantities in order to establish a unit price. The Contractor will be paid for the actual amount used.

### END OF SECTION

## **SECTION 31 35 26 - SECONDARY CONTAINMENT SYSTEMS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Secondary containment membrane, geotextile fabric, and accessories required for leak-proof liners under tracks, tanks, and other structures and above grade containment.
- B. Furnish all labor materials, tools, equipment and services for all Secondary Containment System as indicated in accordance with the provisions of the Contract Documents. This includes coordination with all trades and all associated work not specifically indicated.
- C. Although such work may not be specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure, and complete installation.

#### **1.02 REFERENCED STANDARDS**

##### **A. ASTM International (ASTM):**

1. D751, Standard Test Methods for Coated Fabrics.
2. D1117, Standard Guide for Evaluating Nonwoven Fabrics.
3. D5641, Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber
4. E96, Standard Test Methods for Water Vapor Transmission of Materials.
5. E515, Standard Test Method for Leaks Using Bubble Emission Techniques.

#### **1.03 SUBMITTALS**

##### **A. Submit as specified in Section 01 33 00.**

##### **B. Submittal data shall include, but not be limited by, the following:**

1. Product samples of all materials to be used in project, including liners and fabrics. Each sample shall be approximately 8 IN x 10 IN in size with clear designation of product.
2. Specification sheet giving full details of minimum physical properties and test methods used, site seaming methods and a list of similar projects completed in which the manufactured materials have been successfully used.
3. Shop drawings of the proposed panel layout and the location and direction of seams. Seams shall be labeled either field or factory. Details shall be included to show the termination of the panels at the perimeter of lined areas, the methods of sealing around penetrations, and methods of anchoring.
4. Sub-grade certification as required in Paragraph 3.01.

5. All field test results.
  6. Records of all repairs and results of repair testing.
  7. Warranty
- C. The manufacturer shall provide the Contractor with complete written instructions for the storage, handling, installation, and seaming of the liner in compliance with this specification. Contractor shall forward a copy of this information to the Engineer.
  - D. In order to qualify as an approved synthetic liner, the Contractor shall submit lining material samples and a specification sheet to the Engineer for approval prior to construction.

#### 1.04 QUALITY ASSURANCE

- A. A manufacturer's authorized installation contractor shall install the geomembrane liner per the written instructions of the manufacturer.

### PART 2 - PRODUCTS

#### 2.01 GEOMEMBRANE LINER

- A. Above grade liners shall be Petrogard VI – No Substitutions Accepted.
- B. Below grade liners shall be Petrogard X – No Substitutions Accepted.

#### 2.02 GEOTEXTILE FABRIC

- A. Geotextile fabric shall be provided as cover for all buried geomembrane liners, and indicated on drawings.
- B. Geotextile fabric shall be nonwoven fabric consisting of only continuous chains of polymeric filaments or yarns of polyester formed into a stable network by needle punching. The fabric shall be inert to commonly encountered chemicals, and hydrocarbons; shall be resistant to mildew, rot, ultraviolet light, insects, and rodents; and shall have a minimum fabric weight of 16 OZ/SQ YD per ASTM D1117.
- C. The filter fabric shall be provided in rolls wrapped with protective covering to protect the fabric from mud, dirt, dust, and debris.
- D. For abovegrade applications, the geotextile fabric will be placed in between the liner and the surface.
- E. For belowgrade applications, the geotextile fabric will be placed in between the liner and the subgrade and a second layer on top of the liner.

#### 2.03 NON-SKID WALKWAYS

- A. Provided non-skid walkways as noted on drawings that are compatible with respective Petrogard liner product or other installed liner system if existing.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION AND PREPARATION

- A. Area Subgrade Preparation:

UP General Specifications

SECONDARY CONTAINMENT SYSTEMS

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1. Surfaces to be lined should provide firm, unyielding foundation for the membrane with no sudden, sharp or abrupt changes or breaks in grades and shall be sloped as specified in the contract drawings. Usually no object larger than USCS sand and (SP) should remain on subgrade in order to protect against puncture. The subgrade should be uniformly compacted to ensure against settlement.
  2. Contractor shall certify in writing that the surface on which the membrane is to be installed is acceptable before commencing work.
- B. Geotextile fabric shall be used under the liner to compensate for irregular subgrades or where added protection of liner necessary. Fabric is required on top of the liner for below grade applications.

### 3.02 INSTALLATION

- A. Field fabrication of liner will not be allowed. On-site modification of liner material shall be laid out and overlapped by a minimum of 4 IN prior to welding if applicable. Extreme care shall be taken by the installer in the preparation of the area to be welded. The area to be welded shall be cleaned and prepared according to procedures identified by material fabricator. All seams will be electronically welded in factory or heat-fused on the jobsite.
- B. No “fish mouths” shall be allowed within the seam area. Where “fish mouths” occur, the material shall be cut, overlapped, and an overlap heat weld shall be applied. All welds on completion of the work shall be tightly bonded. Any membrane area showing injury due to excessive scuffing, puncture or distress from any cause, shall be replaced or repaired with an additional section of liner material.
- C. The liner shall be installed per the written instructions of the manufacturer.
- D. In areas where wind is prevalent, lining should be started from upwind side of containment and proceed downwind. The leading edge of the liner should be secured at all times with sandbags or other methods sufficient to hold liner down during high winds. Sandbags or tires may be used as required to hold down liner during and after installation.
- E. Equipment or other items shall not be dragged across surface of liner. All installers walking on the liner must have soft-soled shoes.
- F. Lining material should fit as closely as possible around inlets, outlets, and other penetrations. Any penetration must be sealed with approved sealing methods. Any lining attached to concrete should be made with a mechanical anchor. Manufacturer of liner shall submit anchorage details for approval.
- G. All seams to be vacuum box tested and results recorded and given to the engineer for review. All defects found are to be repaired and vacuum box tested after repairs. Installer shall retain all records of all repairs and the results of repair testing and submit to the engineer for review.

### 3.03 GUARANTEE

- A. The liner shall be warranted to maintain its integrity in this installation for twelve (12) years. A copy of the warrantee shall be submitted to the owner upon acceptance of installation.

**END OF SECTION**

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## **SECTION 31 37 00 - RIP RAP**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Riprap furnished, hauled, and placed by the Contractor to the locations and of the types shown on the drawings and as directed by the Engineer.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Standard Drawing 680000 - Round Steel Pipe Culverts
- B. Section 31 24 13 – Excavation, Embankments and Other Fills
- C. Section 33 42 00 - Culverts
- D. Section 40 05 39 – Reinforced Concrete Pipe

#### **1.03 QUALITY ASSURANCE**

- A. Sections covering Responsibilities and Duties include, but are not necessarily limited to, General Requirement Specification, Section 00 07 00.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIAL REQUIREMENTS**

##### **A. Material:**

1. Riprap shall be hard, durable, angular in shape, resistant to weathering and shall be free of cracks, seams, expansive materials or other defects that would cause accumulated deterioration from exposure to climatic conditions.

##### **B. The material shall meet, in addition to the Specifications, the following quality requirements:**

1. The approval of some riprap from a particular source shall not be construed as constituting the approval of all riprap taken from that source.
2. The Engineer shall be the sole judge of riprap quality and sources of material.
3. Rip rap may be rejected on the basis of visual examination, regardless of laboratory tests and/or service records.

4. Tests to which the materials may be subjected include specific gravity, abrasion, absorption, soundness, freezing and thawing and such other tests as may be considered necessary.

TEST	REQUIREMENT
Specific Gravity (ASTM Designation C127)	2.65 Minimum
Absorption (ASTM Designation C127)	8.0% Maximum
Soundness, 5 cycles Mg S04 (ASTM Designation C88)	2.0% Minimum 15% Maximum

C. Requirements:

1. All riprap to be loaded and quarried shall conform to the following limitations unless otherwise specified or as shown on the plans:

RIP RAP CLASS	AVERAGE PER STONE (LBS)	DIMENSION (IN)	TYPICAL VELOCITIES (FT/S)
I	50 to 200	9 to 14	6-8
II	200 to 1,000	14 to 24	8-12
III	1,000 to 4,000	24 to 38	≥12
IV	> 4,000	> 38	Special cases

D. Requirements, Limitations, and Allowances:

1. The riprap class(es) required shall be well distributed and the entire mass of stone shall conform to the limitations specified. However, the following allowances shall be acceptable to produce the required riprap protection:
  - a. Riprap Class I - No allowances are permitted.
  - b. Riprap Class II - 15 percent of Riprap Class I.
  - c. Riprap Class III - 15 percent of Riprap Class I and 15 percent of Riprap Class II.
  - d. Riprap Class IV - 15 percent of Riprap Class I, 15 percent of Riprap Class II and 15 percent of Riprap Class III.
- E. The above allowances may be adjusted in the field where at the discretion of the engineer a greater or lesser percentage would be required. Individual pieces, larger than the maximum specified size may be toed in at the bottom of the riprap toe.

## PART 3 - EXECUTION

### 3.01 CONSTRUCTION METHODS

- A. Riprap shall be placed in such a manner as:
  - 1. To produce a compact mass of rock which shall provide adequate embankment protection and erosion control.
  - 2. To avoid segregation of the various sizes of rock.
- B. Placement of Stones:
  - 1. Individual stones shall be tightly in contact with other stones in order to produce the least possible amount of void spaces.
  - 2. All material going into riprap protection shall be so placed and distributed that there will be no large accumulations of either the larger or smaller sizes of stone.
  - 3. Rearranging of individual stones by mechanical equipment or by hand may be required to the extent necessary to obtain a reasonably well graded distribution of stone sizes.
  - 4. The Contractor shall maintain the riprap protection until accepted. Material displaced by any cause shall be replaced at no additional cost to the Railroad.
- C. Sources:
  - 1. The sources proposed for use by the Contractor shall be selected in advance, and approval of a source by the Engineer may depend upon laboratory test data, visual examination and service records.
  - 2. If such records are not available, such as in the case of newly opened quarries, the materials shall be subject to tests considered necessary by the Engineer.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 MEASUREMENT

- A. Measurement of acceptable riprap, complete in place, will be made on the basis of the area actually covered, and the volume will be computed on the basis of the measured area and the thickness specified on the plans.

### 4.02 PAYMENT

- A. The Riprap quantities measured as provided above, will be paid for at the unit prices bid per cubic yard.
- B. The Riprap of the various classifications shown above will each be bid separately.

- C. Riprap shall be included with culvert installation unless specified separately with a bid item. The cost of Riprap material and installation at the end of culverts shall be included in the unit price per foot cost of installing of the culvert.
- D. The unit price bid will include full compensation for furnishing, hauling, placing of all materials and furnishing of all labor, tools, equipment, incidental and necessary to the completion of the work.

**END OF SECTION**



## **SECTION 31 63 16 - AUGERED PRESSURE GROUTED PILING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Contractor shall furnish all labor, tools, equipment and services for the complete and correct installation of all pilings as shown in the Drawings, and Construction Documents.

#### **1.02 QUALITY ASSURANCE**

- A. The Piling Contractor shall inspect the site and related conditions prior to commencing his portion of the work.
- B. All piles shall be installed by an experienced Piling Contractor who is able to submit evidence of having a minimum of three (3) years of similar experience.
- C. The Piling Contractor shall submit to the Architect and the Engineer in writing, all applicable information as listed in Section 8, records for review and approval, in addition to the above experience record.

#### **1.03 LOCATION TOLERANCE**

- A. All finished piles shall be in the location as shown on the drawings within 3 IN from the plan center of the pile when installed from the pile cut off elevation. Deviation shall not be more than 2 percent or  $\pm 2$  IN, whichever dimension is more strict, from the plan cut off elevation.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

- A. Portland Cement – Per ASTM C150, Standard Specification for Portland Cement, Type I or Type II.
- B. Special Pozzolan – The special pozzolan, when available, shall be an approved flyash or equal: A finely powdered siliceous material which possesses the property of combining with the lime liberated during the hydration of portland cement. The special pozzolan shall contribute markedly to the later-age strength of the cement base mortar.
- C. Grouting Agent – The grouting agent shall affect the base mortar to reduce mixing water and eliminating setting shrinkage.
- D. Water – Water for cement base mortar shall be fresh, clean, and free from deleterious amounts of sewage, oil, acid, alkali, or organic matter.
- E. Fine Aggregate – Sand shall meet the requirement of the current ASTM C33, Standard Specification for Concrete Aggregates, except that the gradation shall be as herein specified. The sand shall be well graded from fine to coarse with a fineness modulus of two and three tenths to three and four tenths (2.30-3.40).

## 2.02 MIXING AND PUMPING MORTAR

- A. Only approved mixed and pumping equipment shall be used in preparing and handling the mortar. All materials shall be measured by volume or weight as they are fed into the mixer. The time of mixing shall be such as to produce a homogeneous mortar, whether mixed on the site, or obtained from a Ready-Mix plant.
- B. The cement base non-shrinkage mortar shall consist of portland cement, when available, a special pozzolan, a grouting agent, sand and water so proportioned and mixed as to produce a mortar capable of maintaining the solids in suspension without applicable water gain; which may be pumped without difficulty and which will penetrate and fill open voids in the adjacent solids. These materials shall be proportioned to produce a hardened mortar, which will achieve the design strength within twenty-eight (28 days), or if it contains a special pozzolan, within 90 days. The grout strength shall be specified to meet applicable codes for the specified pile size and capacity.
- C. A pressure gauge in good operating condition shall be located on the grout pump so that the grouting pressure may be checked by the operator, and the Engineer's representative.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. The piling shall be in the diameter and length shown on the drawings and shall be constructed in accordance with the methods specified below. Only experienced Piling Contractors will be accepted to perform the work.
- B. A continuous flight hollow shaft (minimum inside diameter of 2-1/2 IN auger shall be rotated into the underlying soil to the pre-determined tip elevation or refusal, whichever comes first. Leaving the auger in the hole, and maintaining a slow positive rotation, being injecting the specified mortar through the hollow shaft. Inject a sufficient quantity of grout to completely fill the augered hole, carefully coordinating the rate of injection as the auger is withdrawn.
- C. Protection of piles – Provide a sequence of pile installation within pile groups such that the adjacent piles are not disturbed. Do not place piles within 3 FT of adjacent piles or as soil conditions permit until set as occurred. Initial set is that time period when the grouted pile changes from being a fluid. A physical check of the adjacent pile is the most accurate way of determining when initial set has occurred.
- D. In the event non-augerable material is encountered, the obstruction shall be removed by the General Contractor, and the pile completed. An additional pile may be required at the Engineer's direction, and shall be paid for in accordance with the unit price for additional piles.
- E. APG Piles shall be poured to top of ground and the mortar may be removed to the cut-off elevation prior to initial set. If the hole will not stand open, the pile must be cut off after final set or mortar and the excavation for the pile cap has been made.
- F. Auger refusal shall be defined as an auger penetration rate of 1 FT/min or less.
- G. Upon filling of the hole, the pipe pile shall be immediately placed into the wet hole with the pipe protruding to the cut off elevation as shown on the plans.

### 3.02 FIELD QUALITY CONTROL

A. During the progress of the job, standard 2 IN compression test cubes shall be tested in accordance with ASTM C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 IN or 50 mm Cube Specimens), by a qualified commercial testing laboratory, approved by the Engineer. A minimum of one (1) set of six (6) cubes shall be made for each days work. From each set of six (6) cubes, two (2) shall be tested at three (3) days, two(2) at seven (7) days and two (2) at twenty-eight (28) days unless specified strength has already been obtained. If a special pozzolan is used, make a break two (2) additional cubes at ninety (90) days, if necessary.

#### B. RECORDS

1. Before commencing the work, the Piling Contractor shall submit to the Architect or the Engineer for approval of the following:
  - a. Sketch and/or description of pile drilling equipment to be utilized.
  - b. Complete description of method of installation.
2. Mortar design mix.
  - a. During the course of the work, the Owner's Project Testing Agency or Piling Contractor shall submit:
  - b. Load test reports, if applicable, including all test data, and a graph of load verses settlement.
  - c. A daily pile report showing the pile number and location, date placed, length of pile, and final tip elevation.

#### C. LOAD TESTS

1. Pile load tests, if required, shall be performed by the Piling Contractor and witnessed by an independent testing laboratory, paid for by the Owner. The cost of the test pile, anchor piles and all equipment necessary to perform the pile load test shall be included in the base bid. All load testing shall be performed in accordance with the method outlined in ASTM D1143, Standard Test Methods for Deep Foundations Under Static Axial Compressive Load, unless otherwise changed or revised by the Soils Engineer and / or Architect.
2. The test pile lengths shall be established either before or during the test pile installation.
3. The Engineer shall make a thorough analysis of the drilling characteristics and test results to determine the optimum production pile length.
4. The Piling Contractor shall coordinate the performance of the load tests with the testing laboratory and General Contractor. The tests may be performed, with the Engineer's approval, prior to the general excavation.

#### D. REMOVAL OF WASTE

1. Augered soil and waste grout accumulated from piling operation shall be removed continuously from the pile location.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 PAYMENT

- A. The base bid shall include the lump sum amount for installing the piling as shown on the structural plans, and if required, the amount of the pile load tests.

### 4.02 UNIT PRICES

- A. A unit price, per lineal foot, for greater lineal footage than shown on the base quantity.
- B. A unit price, per lineal foot, for lesser lineal footage than shown on the base quantity.
- C. A unit price, per pile of the estimated length, for additional piles than shown on the base quantity.
- D. A unit price, per pile of estimated length, for fewer piles than shown on the base quantity.
- E. A unit price for each additional pile load test.

**END OF SECTION**

## **SECTION 31 66 14 - AGGREGATE PIERS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Vibrated or rammed aggregate piers.

#### **1.02 REFERENCED STANDARDS**

##### **A. ASTM International (ASTM):**

1. D1194, Spread Footing Load Testing (individual column, or column groups).
2. D1143, Standard Test Method for Piles Under Static Axial Compressive Load.
3. D3689, Standard Test Method for Individual Piles Under Static Axial Tensile Load.
4. D1241, Standard Specification for Materials for Soil Aggregate Subbase, Base, and Surface.
5. D422, Standard Test Method for Particle Size Analysis.
6. C33, Standard Specification for Concrete Aggregates.

#### **1.03 DEFINITIONS**

- A. Aggregate Piers - Columns of compacted aggregate used to reinforce the ground: to increase bearing capacity; reduce settlement of a structure; or increase slope stability. The piers can be constructed with a down-hole vibrator or down-hole tamper.
- B. Down-Hole Vibrator - High-energy vibrators used to produce horizontal vibrations to consolidate aggregate and surrounding soils.
- C. Bottom Feed Vibrators - Down-hole vibrators equipped with a tremie pipe to feed aggregate to the tip of the vibrator. Used in soft or cohesionless soils where hole walls are susceptible to collapse.
- D. Down-Hole Tampers - Proprietary high-energy impact apparatus to provide vertical tamping energy through a hammer connected to a beveled tamper head.

#### **1.04 SCOPE OF WORK**

- A. The work shall consist of installation, monitoring and testing of the aggregate piers within the limits indicated on the project documents.
- B. The aggregate pier contractor shall provide all labor, materials, and equipment to accomplish the work, to include:
  1. Pre-drilling of holes as necessary and disposal or stockpiling of all spoil.
  2. Construction of the aggregate piers to the requirements of the construction documents.

- C. It shall be the aggregate pier contractor's responsibility to determine and implement the systems and criteria to ensure that the specified performance is achieved.

#### 1.05 SUBMITTALS

- A. A list of at least five previously completed projects of similar scope and purpose, to include a description of the project, relative size, and contact person with phone number.
- B. Ground improvement design based on information contained in the project geotechnical report, prepared by an engineer licensed in the state of the work to be performed.
- C. Ground improvement QA plan, as detailed in Section 3.04 of these Specifications, including work procedures and control criteria; shop drawings for review, indicating the spacing, location, and depth of the aggregate piers to achieve the required criteria; modulus test detail and setup to confirm that the installation procedure produces the pier modulus used in the design.
- D. Daily records that include: The type and size of compaction equipment; predrill auger diameter used; the identification number and depth of the pier tip for each pier; any change in subsurface conditions observed during the work; modulus test data, analysis of the data, and the concluding recommended design parameters, prepared by an engineer licensed in the state of the work.
- E. A final report documenting the observations and results of the tests. This report will certify that the bearing pressure has been achieved within settlement tolerances.
- F. A warranty document good for one year.

#### 1.06 QUALITY ASSURANCE

- A. The aggregate pier contractor shall have at least five continuous years of documented experience in aggregate piers.
- B. The aggregate pier contractor shall provide experienced management, supervisory and key personnel to implement the aggregate pier program.
- C. The Owner's third party QA representative will ensure that procedures and documentation conform to these specifications.
- D. Third party QA observation and initial testing costs shall be the responsibility of the Owner. The installing contractor shall be responsible for testing and observation costs associated with failed tests or rejected piers.

### PART 2 - PRODUCTS

#### 2.01 EQUIPMENT

- A. Down-Hole Vibrator –Piers installed by vibration shall utilize a down-hole vibrator capable of providing at least 80 HP of rated energy and a centrifugal force of 15 tons. The equipment shall include a metering device to monitor amperage usage and fluctuations during the operation of the equipment. Complete equipment specifications should be submitted to the Engineer prior to commencement of the fieldwork.

- B. Down-Hole Tamper – Piers installed by tamping shall utilize a down-hole tamper with a diameter at least 90 percent of the pre-drilled hole diameter, have beveled sides, and be long enough to reach the full depth of the pre-drilled hole. The tamper shall have a minimum rating of 1,225 FT-LB and shall apply direct downward impact energy to each lift of aggregate. A minimum tamper energy level of 490,000 FT-LBS of force per minute shall be applied by the energy source.

## 2.02 BACKFILL MATERIALS

- A. Down-Hole Vibrator Method: The backfill aggregate should consist of hard, angular to sub-angular durable rock fragments, with the majority of particles in the range of 1/8th IN to 1-1/2 IN such as ASTM C33 size No. 57, or shall be other graded aggregate selected by the installer, successfully used in the modulus test, and approved by the Project Engineer.
- B. Down-Hole Tamper Method:
  - 1. Aggregate used for piers constructed above the water table shall be Type I, Grade B in accordance with ASTM D1241, or shall be other graded aggregate selected by the installer, successfully used in the modulus test, and approved by the Project Engineer.
  - 2. For aggregate used for piers constructed below the water table, the gradation shall be the same as Type I Grade B, except that particles passing the number 40 sieve shall be eliminated. Alternately, No. 57 stone or other stone selected by the installer, and approved by the Engineer may be used.
  - 3. When type I Grade B material is used, potable water or other suitable source shall be used to increase the aggregate moisture content when required.

## PART 3 - EXECUTION

### 3.01 SITE INSPECTION

- A. Adjacent structures within 15 FT of work area shall be examined prior to initiating work to document preexisting cracks/damage, and monitored for movement during any work within 15FT of the structure. The work shall be stopped and the engineer notified if any building settlement is observed.

### 3.02 AGGREGATE PIER CONSTRUCTION

- A. The general procedures are as follows:
  - 1. Stable Ground Conditions: The following general procedures shall be followed when the pre-drilled hole remains open during construction.
    - a. Pre-drilling to the design depth will be performed with an auger diameter equal to the finished column diameter.
    - b. Down-Hole Vibrator Method: The quantity of aggregate initially added shall be such that the vibrator tip is able to penetrate to within 12 IN of the design depth. The vibrator will be raised and lowered repeatedly, such that on each re-penetration, the tip of the vibrator advances to within 12 IN of the previous penetration depth.

- c. Down-Hole Tamper Method: Following placement of the first 12 IN lift of aggregate, the tamper is to be lowered to the top of the aggregate and activated. The full energy of the impactor and weight of the excavator shall be used for at least 30 seconds per lift, and subsequent lifts shall not exceed 12 IN in thickness.
  - d. The aggregate shall be removed and replaced with fresh aggregate if cave-ins occur during the aggregate placement such that the volume of caved-in soil is greater than 10 percent of the aggregate being compacted.
- 2. Unstable Ground Conditions: The following general procedures will be followed when a pre-drilled hole will not remain open before or during pier construction.
  - a. Down-Hole Vibrator Method: If the hole will remain temporarily stable, the hole may be filled with aggregate to a level above the instability as long as the vibrator is still able to penetrate to within 1 FT of the pre-drilled depth. If the hole will not remain temporarily stable, a Bottom Feed Down-Hole vibrator may be used.
  - b. Down-Hole Tamper Method: A casing with a minimum outside diameter equal to 100 percent of the pier diameter is advanced to the full treatment depth. The first 12 IN lift of aggregate will be placed, and the tamper lowered to the top of the aggregate. The full energy of the impactor and weight of the excavator shall be used for at least 30 seconds per lift, and subsequent lifts shall not exceed 12 IN in thickness. The casing is extracted after each lift is compacted with the bottom of the casing always maintained below the top of the aggregate.
- 3. Obstructions: Aggregate piers shall be constructed within 6 IN of the design location. Obstructions encountered during excavation or drilling that will prevent installation of the aggregate piers to design depth, or cause the aggregate pier to stray from its specified location during installation shall be removed. To the extent the obstructions are shown in the geotechnical report, removal of obstructions shall be performed at no additional cost to the owner.
  - a. Obstructions include, but are not limited to, boulders, timbers, concrete, bricks, utility lines, etc., that prevent installing the aggregate piers to the required depth, or cause the aggregate pier to drift from the required locations. Dense natural rock or weathered rock shall not be deemed obstructions, and piers may be terminated short of design lengths on such materials. The aggregate pier design engineer shall be notified within 24 HRS to verify that the short piers are acceptable.

### 3.03 PERFORMANCE CRITERIA

- A. Construct appropriate aggregate piers with granular backfill material beneath all column foundations and load-bearing wall foundations to provide the following criteria upon completion:
  - 1. An allowable soil bearing capacity of 2000 psf with a maximum total settlement of 0.5 IN and a maximum differential settlement of 0.003 times the distance between adjacent columns.



- B. Aggregate piers should be constructed to a depth sufficient to satisfy the settlement criteria above. A modulus test shall be performed to verify the parameter values selected for the pier aggregate.

### 3.04 FIELD QUALITY ASSURANCE

#### A. Inspections:

1. All aggregate pier operations for test and production work including: Installation; monitoring; and logging shall be performed under the observation and documentation of the third party QA representative.
2. The QA representative will provide site observation and documentation to ensure performance of the aggregate pier work to include: pier identification; recording of pre-drill hole depth, or initial vibrator tip depth; observance of the aggregate pier installation procedures; and recording of compaction energy information.
3. A sample of the aggregate pier material should be submitted to the Engineer or third party QA firm for a grain size distribution analysis to establish suitability and conformance to this specification. The cost of which will be borne by the contractor. Certification of grain size distribution provided by the quarry may be submitted in lieu of a sample. The aggregate material shall be randomly tested throughout installation for conformance at least once per week of installation, or any time the material source changes. If the aggregate material is not produced by an established rock crushing operation with an approved QC program, then the testing frequency shall be daily. Aggregate material not conforming to the specification shall be rejected and not installed. Any piers installed using rejected material shall be at the risk of the installing contractor and undergo performance testing at the discretion of the Owner and Engineer. Piers failing the performance test shall be rejected, and costs associated with failing piers shall be the responsibility of the installing contractor.
4. The foundation bearing surface shall be compacted and firm prior to the construction of the foundation.

#### B. Modulus Test:

1. Testing to determine specification compliance will be provided by the aggregate pier contractor, and will consist of at least one modulus test of an aggregate pier. The results of the Modulus Test shall meet the following criteria to pass:
  - a. The geotechnical engineer shall approve of the location of the Modulus Test.
  - b. Deflections of the top of the test pier shall be measured by a suitable method.
  - c. Deflections at the bottom of the test pier shall be measured by means of a telltale installed at the bottom of the test aggregate pier. Performance will be deemed acceptable when, at the specified design stress, deflection at the bottom of the pier does not exceed 20 percent of the deflection at the top of the pier.
  - d. Load increments, decrements, and duration, shall be determined using ASTM D1143 as general guidelines.

- e. Surficial disturbance shall be compensated for by applying a seating load equal to 5 percent of the total load to the loaded steel plate before applying load increments.
- f. The modulus testing shall be performed as described in the Design Submittal.

### 3.05 UPLIFT TEST

- A. In addition to specifications within this section, ASTM D3689 shall be the general guide in establishing uplift load test procedures. The uplift load test will be performed as described in the Design Submittal.
- B. The Geotechnical Engineer shall approve the site location of the uplift load test.
- C. Verification that the design of the aggregate pier system is in accordance with the performance observed during the uplift load test shall be attained through information acquired during the uplift load test.

### 3.06 REJECTION OF AGGREGATE PIERS

- A. If an aggregate pier is installed in an incorrect location or exceeds the specified tolerances, the aggregate pier contractor shall replace the pier. Pier replacement may be avoided if alternate remedial procedures are approved by the Designer. Unless the rejection is caused by obstruction, refusal in rock or dense soil or errors in the project drawings, the cost of all labor, material, and testing required for the replacement shall be the responsibility of the installer.

## **END OF SECTION**

## **SECTION 31 78 00 - BLASTING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Blasting shall be used in cut sections only as necessary to loosen rock or cemented material and to reduce such rock or cemented material to sizes that can be handled by mechanical earth moving equipment.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- ##### **A. Section 31 24 13 – Excavation, Embankments and Other Fills**

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION**

#### **3.01 PREFERRED METHOD OF REMOVING ROCK**

- ##### **A. Ripping shall be the preferred method of removing rock and cemented material from cut sections and ripping shall be used whenever possible to remove rock and cemented materials from cut sections.**

#### **3.02 BLASTING**

##### **A. Qualifications:**

1. The blasting shall be performed by an experienced and properly licensed explosive engineer familiar with Railroad work and operations.

##### **B. Blasting shall be conducted in a manner that follows:**

1. Rock or other material outside of the cut section will not be disturbed.
2. The Shape of the cut section after blasting has been completed will conform as nearly as possible to the lines and grades for the cut section shown on the Drawings or established by the Engineer.
3. Excessive blasting will not be permitted. The Contractor shall stop any method of blasting which leads to overshooting or which is dangerous to public or destructive to property or natural features. Blasting shall not be used as a method of moving rock, cemented material or earth cut in a cut section.

##### **C. Removal of Overburden Prior to Blasting:**

1. Prior to blasting, the Contractor shall, in accordance with the excavation procedures set forth in Section 31 24 13 of these Specifications, remove from the cut section as much overburden as possible.
2. The Contractor shall stabilize slopes that require stabilization before proceeding with the blasting.

### 3.03 PREPARATION TO BLAST

#### A. Operations Outages:

1. Prior to blasting, the Engineer shall arrange a suitable track outage or work window to ensure there is no danger to passing trains.
2. The contractor shall ensure that the blasting can be performed in the allotted time in the track outage. This shall include any cleanup work that may be necessary prior to train movement.
3. The contractor shall ensure that any communications, electrical equipment, or weather will not interfere with the blasting operation.

#### B. Inspection:

1. The railroad track and track bed, property, and facilities shall be inspected prior to blasting

### 3.04 LIMITATIONS

#### A. The following limitations are mandatory for all blasting operations except in quarries:

1. Benches - When drilling and blasting rock cut sections, benches shall be created at intervals not to exceed 20 FT in height. This limitation does not apply to relief holes.
2. Quantity of Explosives - Explosives shall be of such quantity and shall be used in such a manner as will neither open seams nor otherwise damage rock outside the cut section.
3. Repair Damage - Should seams be opened or rock outside the cut section be otherwise damaged, the Contractor shall perform all work which, in the opinion of the Engineer, is necessary to remedy such damage.
4. Time Of Placement and Detonation - Placement and detonation of explosives shall, to the extent reasonably possible, take place during the same work shift. Explosives shall never be placed one day and left overnight for detonation on a subsequent day.
5. Blasting Along Rock Cliffs - In blasting along rock cliffs where preservation of bed rock at and below the subgrade is necessary to provide support for the full width of the subgrade, the Contractor shall reduce depths of all drill holes, reduce quantities of explosives, modify drill patterns and take other measures necessary to prevent breaking down, loosening, or otherwise damaging the supporting bed rock below the subgrade.

### 3.05 BLASTING PLANS

#### A. Prior to each blast, the Contractor shall furnish the Engineer with a plan showing:

1. The pattern and depth of all blast holes including relief holes.
2. The type of explosive used.
3. The loading pattern.
4. The sequence of the firing.
5. The plan shall show the position of all holes and relative charges.

6. The location of charges relating to engineering stations and distances from the centerline of track.
7. The plans shall show grades, lines and slopes of the cut section or as designated by the Engineer.
8. The blasting plan is for record purposes only and will not absolve the Contractor of his responsibility for using proper drilling and blasting procedures and protecting the Railroad's property.

#### 3.06 DAMAGES

- A. The railroad track and track bed, property, and facilities shall be inspected after the blasting operation.
- B. Any damages to the Railroad or other outside parties, property and facilities, are the responsibility of the blasting contractor or general contractor.

### PART 4 - MEASUREMENT AND PAYMENT

#### 4.01 MEASUREMENT

- A. Blasting shall not be measured directly for payment but shall be considered incidental to the work for which it is performed, with all costs being incorporated in the appropriate bid items for the work being performed.

#### **END OF SECTION**

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## **SECTION 32 01 13 - ASPHALT CONCRETE PAVING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Provide asphaltic concrete paving, wheel stops, speed bumps, and curbs where shown on the drawing or as stated in the bid items, and as needed for complete and proper installation.
- B. The extent of each type and thickness of Asphalt Paving is shown on the drawings or identified in the bid items.
- C. In addition to the asphalt paving courses, the items in this section include, but are not limited to:
  - 1. Sub-grade.
  - 2. Soil treatment.
  - 3. Base-Aggregate.
  - 4. Prime, tack and seal coats.
  - 5. Asphalt pavement.
- D. Patching, repairing, surface preparation - new, and repair to existing asphalt is included in this Section.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Excavating, grading and compaction required in the preparation of subgrades are specified in Section 31 24 13 and 31 23 26.
- B. Paint Striping and Marking specified in Section 32 17 23.

#### **1.03 REFERENCE STANDARDS:**

- A. ASTM: ASTM International.
- B. State Department of Transportation Standards and Specifications latest edition of the state in which the work is being done.
- C. AASHTO: American Society of State Highway Transportation Officials.

#### **1.04 SUBMITTALS**

- A. Materials Certificates: Provide copies of materials certificates signed by material producer and Contractor, certifying that each material item complies with or exceeds specified requirements.

#### **1.05 JOB CONDITIONS**

- A. Apply prime and tack coats when ambient temperature is above 50 DegF, and when temperature has not been below 35 DegF for 12 HRS immediately prior to application. Do not apply when base is wet or contains an excess of moisture.

- B. Construct asphalt concrete surface course when atmospherical temperature is above 40 DegF and rising and when sub-base is dry. Sub-base shall be placed when air temperature is above 30 DegF and rising and no frost in the existing sub-base or soil.
- C. Grade Control: Establish and maintain required line and elevations.
- D. The Contractor shall provide, erect, remove, relocate, clean, replace and maintain, if required, suitable signs, barricades, fences or other necessary traffic control devices as may be required or directed by the Engineer. Requirements of local, city, state or federal agencies shall be complied with, including all necessary permits. The Contractor will be required to coordinate his activities with the activities of the Railroad as well as others not party to the Contract.

## PART 2 - PRODUCTS

### 2.01 SUBGRADE

- A. Shall be compacted in accordance with Section 31 00 00.
- B. See the special instructions for subgrade stabilization, if required.

### 2.02 AGGREGATE BASE

- A. Unless otherwise specified, aggregate base material shall conform to sub-ballast Specifications Section 34 11 27.

### 2.03 PRIME COAT

- A. Prior to the application of the asphaltic concrete, apply a bituminous prime coat of liquid asphalt on the prepared compacted base at a rate of 0.25 GAL/SQ YD or at a rate approved by the Engineer.
- B. Apply liquid asphalt by pressure distributors.
- C. Allow sufficient time before placing the asphaltic concrete to permit the prime coat to penetrate the prepared compacted base.

### 2.04 TACK COAT

- A. Tack coat is used to promote a bond between new and existing courses.
- B. Tack coat, if required, shall be applied immediately in advance of the new surfacing.
- C. Tack coat, if required, shall be applied at very low orders of coverage to preclude the development of a slip plane between courses.

### 2.05 PRODUCT HANDLING

- A. Protect asphalt paving materials before, during and after installation, and prevent damage to the installed work of other trades. In the event of damage, immediately make repairs or replacements necessary for approval of the Engineer and at no additional cost to the Railroad.



## 2.06 ASPHALT MIX

- A. Asphalt mix shall conform to the most current State Department of Transportation Specifications in which the work is being performed. All mix designs shall be approved by the Engineer prior to placement.

## PART 3 - EXECUTION

### 3.01 INSTALLATION OF ASPHALT

- A. Asphalt installation shall conform to the most current State Department of Transportation Specifications of the State in which the work is to be performed. Installation shall be approved by the Engineer prior to installation.
- B. Surface Preparation:
  - 1. The subgrade shall conform to the design grade and cross section, be free from irregularities and compacted to specified densities.
  - 2. Remove loose material from compacted Aggregate surface immediately before applying herbicide treatment and prime coat.
  - 3. Proof-roll prepared subgrade surface to check for unstable areas and areas requiring additional compaction.
  - 4. Notify Engineer of unsatisfactory conditions. Do not begin paving work until deficient subgrade areas have been corrected and are ready to receive aggregate and paving.
  - 5. It shall be the Contractor's sole responsibility to maintain the subgrade and aggregate as prepared, and any deterioration which may develop shall be corrected at the Contractor's expense.
  - 6. When the surface is constructed on an existing bituminous surface, it shall be cleaned of all foreign material and broomed free of dust before tack coat is applied.
  - 7. When the surface is constructed on an existing concrete or brick surface, it shall be cleaned of all foreign material and broomed free of dust before tack coat is applied, with special care taken in cleaning cracks.
  - 8. Joints or wide longitudinal or diagonal cracks shall be filled with surface course material and compacted as designated by the Engineer. Filling of joints or cracks shall be considered incidental and included in the price of the paving.
  - 9. All waste material as a result of Contractor's operations and site preparation shall be disposed of by the Contractor in an approved manner.

### 3.02 TACK COAT

- A. Tack coat is the application of a very light film of asphalt to an existing paved surface prior to placing new asphalt surfacing.

### 3.03 APPLICATION OF PRIME COAT

- A. Apply prime coat at a rate of 0.25 GAL/SQ YD over the compacted aggregate base after weed killer has been applied. Apply material to penetrate and seal, but not flood, the surface and/or reduce the adhesion between the aggregate and the surfacing material. Cure and dry as long as necessary to attain penetration and evaporation of volatiles.

### 3.04 PATCHWORK ON EXISTING SURFACE

- A. If the existing surface requires patching, the defective area will be saw cut around its limits and the defective material removed. The remaining hole shall be filled with aggregate base rock material and the asphalt patch should be applied at least as thick as the surrounding asphalt. Both base and asphalt shall be compacted to a minimum density of 96 percent.

### 3.05 PLACING MIX

- A. The mix shall be placed by means of a mechanical spreader and shall spread the mix without tearing the surface. The spreader shall strike a finish that is smooth, true to cross section, uniform in density and texture and free from hollows, transverse corrugation and other irregularities. The mix may be spread and finished by hand methods only where machine methods are impractical as determined by the Engineer.
- B. The paving operations shall be maintained as continuously as possible. The speed of the spreader should be adjusted to the capacity of the plant and hauling operations. If the spreader stops for any considerable time and the mix cools below optimum viscosity of the asphalt for proper spreading and compaction and causes roughness in the finish surface and poor densification of the finish mix, the Contractor shall remove and repair that portion of the work at his own expense.
- C. Asphalt mixture shall be spread at a minimum temperature of 225 DegF. When conditions warrant, the mixture in hauling equipment shall be protected to maintain the minimum mix temperature.
- D. Place in strips not less than 10 FT wide, unless otherwise approved by the Engineer. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete base course for a section before placing surface course.
- E. Make joints between old and new pavements or between successive days' work to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

### 3.06 ROLLING

- A. Begin rolling when mixture will bear roller weight without excessive displacement.
- B. Compact mixture with hot hand-tampers or vibrating plate compactors, in areas inaccessible to rollers.
- C. Breakdown rolling: Accomplish breakdown or initial rolling immediately following rolling of joint and outside edge. Check surface after breakdown rolling and repair displaced areas by loosening and filling required, with hot material.

- D. Second rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.
- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.
- F. Patching: Remove and replace areas with foreign materials and defective areas. Cut out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness. Patch areas remaining after thickness test.

### 3.07 QUALITY CONTROL

- A. In addition to the specified testing of subgrade base material, test asphalt courses for thickness, smoothness and compaction.
- B. Thickness: In-place compacted thickness will not be acceptable if exceeding 1/2 IN greater, nor 3/8 IN less than the designated course thickness. Any areas found to be deficient in thickness will be overlaid with a minimum of 1 IN thickness, or totally removed and replaced, as determined by the Engineer, at no additional cost to the Railroad. Furnish core tests at locations designated by the Engineer, a minimum rate of one (1) test per 40,000 SQ FT of paved areas, or as directed by the Engineer.
- C. Surface Smoothness: Test finished surface of each asphalt concrete course for smoothness using a 10 FT straightedge. Surfaces will not be acceptable if the tolerances for smoothness exceed 3/8 IN in 10 FT-0 IN.
- D. Compaction: Rolling shall be continued until all roller marks are eliminated and a minimum density of 96 percent has been obtained.
- E. Prior to the seal coat, perform a flood test, if required by, and in the presence of the Engineer.
  - 1. Flood the entire paved area with water.
  - 2. If a depression is found where water ponds to a depth of 1/8 IN in 6 FT, fill and correct.
  - 3. Feather and smooth the edges of fill so that the joint between fill and surface isn't visible.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 MEASUREMENT

- A. Asphalt Paving will be paid for at the contract unit price per square yard, installed according to specifications, including grade control.
- B. Asphalt prime will be paid for at the contract unit price per square yard, installed according to specifications, and includes cleaning of surfaces.
- C. Tack will be paid for at the contract unit price per square yard, installed according to specifications.
- D. Patchwork on existing surfaces will be paid for at contract unit price per square yard, installed according to specifications, which includes disposal of defective material.

**END OF SECTION**

## **SECTION 32 01 14 - ASPHALT - CUTTING AND PATCHING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. General requirements pertaining to cutting (including excavating), and asphalt fitting and patching of the Work required to:
  - a. Make the several parts fit properly.
  - b. Uncover work to provide for installing, inspecting or both, of ill-timed work.
  - c. Remove and replace work not conforming to requirements of the Contract Documents.
  - d. Remove and replace defective work.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Documents affecting work of this Section include, but are not necessarily limited to, General conditions, Supplementary Conditions and Sections in Division 01 of these Specifications.
- B. In addition to other requirements specified, upon the Engineer's request, uncover work to provide for inspection by the Engineer of covered work, and remove samples of installed materials for testing.
- C. Do not cut or alter work performed under separate contracts without the Engineer's written permission.

#### **1.03 SUBMITTALS**

##### **A. Request for Engineer's Consent:**

1. Prior to cutting which effects structural safety, submit written request to the Engineer for permission to proceed with cutting.
2. Should conditions of the Work or schedule indicate a required change of materials or methods for cutting and patching, so notify the Engineer and secure his written permission and the required Change Order prior to proceeding.

##### **B. Notice to the Engineer:**

1. Prior to cutting and patching performed pursuant to the Engineer's instructions, submit cost estimate to the Engineer. Secure the Engineer's approval of cost estimates and type of reimbursement before proceeding with cutting and patching.
2. Submit written notice to the Engineer designating the time the Work will be uncovered to provide for the Engineer's observation.

#### 1.04 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. For replacement of items removed, use materials complying with pertinent Sections of these Specifications.

### PART 3 - EXECUTION

#### 3.01 SURFACE CONDITIONS

- A. Inspection:
  - 1. Inspect existing conditions, including elements subject to movement or damage during cutting, excavating, patching and backfilling.
  - 2. After uncovering the work, inspect conditions affecting installation of new work.
- B. Discrepancies:
  - 1. If uncovered conditions are not as expected, immediately notify the Engineer and secure directions.
  - 2. Do not proceed until unsatisfactory conditions are corrected.

#### 3.02 PREPARATION PRIOR TO CUTTING

- A. Provide required protection including, but not necessarily limited to, shoring, bracing, and support to maintain structural integrity of the Work.

#### 3.03 PERFORMANCE

- A. Perform required excavating and backfilling as required under pertinent other Sections of these Specifications.
  - 1. Perform cutting and demolition by methods which will prevent damage to other portions of the Work and provide proper surfaces to receive installation of repair and new work.
  - 2. Perform fitting and adjusting of products to provide finished installation complying with the specified tolerances and finishes.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 PAYMENT FOR COSTS

- A. The Railroad will reimburse the Contractor for cutting and patching actually performed by the Contractor at the bid price quoted in the Proposal and Bid.

**END OF SECTION**

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## **SECTION 32 12 16 - HOT MIX ASPHALT PAVING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

A. This Section includes the following:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt patching.
3. Pavement-marking paint.
4. Wheel stops.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

A. Drawings and general provisions of the contract, including General and Supplementary conditions and Division 01 Specification sections, apply to this section.

#### **1.03 SYSTEM DESCRIPTION**

A. Provide hot-mix asphalt pavement according to the materials, workmanship, and other applicable requirements of the standard specifications.

#### **1.04 SUBMITTALS**

A. Submit under provisions of Section 01 33 00.

B. Job-Mix Designs:

1. Contractor is to comply with local parking lot mix design standard.

C. Material Certificates:

1. Certificates signed by manufacturers certifying that each material complies with requirements.

#### **1.05 QUALITY ASSURANCE**

A. Installer Qualifications:

1. Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Manufacturer Qualifications:

1. Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance. The firm shall be a registered and approved paving mix manufacturer with authorities having jurisdiction or with the DOT of the state in which the Project is located.

C. Asphalt Paving Publication:

1. Comply with The Asphalt Institute's "The Asphalt Handbook," except where more stringent requirements are indicated.

#### 1.06 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
  1. Prime and Tack Coats – Minimum surface temperature of fifty degrees Fahrenheit, or fifteen and one-half degrees Celsius (50 Deg. F / 10 Deg. C).
  2. Asphalt Base Course – Minimum surface temperature of forty degrees Fahrenheit, or four degrees Celsius (40 Deg. F / 4 Deg. C) and rising at time of placement.
  3. Asphalt Surface Course – Minimum surface temperature of sixty degrees Fahrenheit, or fifteen and one-half degrees Celsius (60 Deg. F / 15.5 Deg. C) at time of placement.
- B. Pavement Marking Paint – Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 Deg. F / 4 Deg. C for oil-based materials, 50 Deg. F / 10 Deg. C for water-based materials, and not exceeding 95 Deg. F / 35 Deg. C.

### PART 2 - PRODUCTS

#### 2.01 AGGREGATES

- A. Coarse Aggregate – Sound; angular crushed stone; crushed gravel; or properly cured, crushed blast-furnace slag; complying with ASTM D692, Standard Specification for Coarse Aggregate for Bituminous Paving Mixtures.
- B. Fine Aggregate – Sharp-edged natural sand or sand prepared from stone; gravel, properly cured blast-furnace slag, or combinations thereof; comply with ASTM D1073, Standard Specification for Fine Aggregate for Bituminous Paving Mixtures. For hot-mix asphalt, limit natural sand to a maximum of 10 percent by weight of the total aggregate mass.

#### 2.02 ASPHALT MATERIALS

- A. Asphalt Cement – ASTM D3381, Standard Specification for Viscosity-Graded Asphalt Cement for Use in Pavement Construction, for viscosity-graded material.
- B. Prime Coat – Asphalt emulsion prime conforming to state DOT requirements.
- C. Tack Coat – ASTM D977, Standard Specification for Emulsified Asphalt, emulsified asphalt or ASTM D2397, Standard Specification for Cationic Emulsified Asphalt, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
- D. Water – Potable.

#### 2.03 RECYCLED ASPHALT MATERIAL

- A. Due to certain environmental concerns, the usage of recycled asphalt materials is only to be used as follows:

1. As a base beneath a new asphalt or concrete parking lot or road, or other below-grade bedding base.
  2. As stock material for new asphalt.
  3. As a patch material for damaged asphalt roads or lots, provided a tack material or bonding agent is used to hold millings together.
- B. Areas where recycled asphalt is not acceptable:
1. As a loose ballast material where the granular material is exposed to weather or stormwater.
  2. Placed as a road or lot patch filler without using a tack material or bonding agent to hold millings together.
  3. Any other application where recycled asphalt granules would be exposed to weather or stormwater run-off.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
- C. Notify the Engineer of Record in writing of any unsatisfactory conditions. Do not begin paving installation until these conditions have been satisfactorily corrected.

#### 3.02 PATCHING AND REPAIRS

- A. Patching – Saw cut perimeter of patch and excavate existing pavement section to sound base. Re-compact new subgrade. Excavate rectangular or trapezoidal patches, extending 12 IN / 300 mm into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically.
  1. Tack coat faces of excavation and allow to cure before paving.
  2. Partially fill excavation with dense-graded, hot-mix asphalt base mix and compact while still hot. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.
- B. Tack Coat – Apply uniformly to existing surfaces of previously constructed asphalt or portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 GAL/SQ YD of surface.
  1. Allow tack coat to cure undisturbed before paving.
  2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### 3.03 SURFACE PREPARATION

- A. General – Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge aggregate embedded in compacted surface or base course.
- B. Herbicide Treatment – Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
- C. Prime Coat – Apply uniformly over surface of compacted-aggregate base at a rate of 0.25 GAL/SQ YD. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure for 72 HRS minimum. Protect primed substrate from damage until ready to receive paving.

### 3.04 HOT-MIX ASPHALT PLACING

- A. Machine place hot-mix asphalt mix on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness, when compacted.
  - 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
  - 2. Place hot-mix asphalt surface course in single lift.
- B. Refer to design documents for base course, surface course and total pavement thicknesses.
  - 1. Spread mix at minimum temperature of 250 Deg. F / 121 Deg. C.
  - 2. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
  - 3. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- C. Place paving in consecutive strips not less than 10 FT-0 IN / 3m wide, except where infill edge strips or a lesser width are required. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.
- D. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove any excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.05 JOINTS

- A. Construct joints to ensure continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
  - 1. Clean contact surfaces and apply tack coat.

2. Offset longitudinal joints in successive courses a minimum of 6 IN / 150 mm.
3. Offset transverse joint in successive courses a minimum of 24 IN / 600 mm.
4. Construct transverse joints by bulkhead method or sawed vertical face method as described in the Asphalt Institute's, The Asphalt Handbook.
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

### 3.06 COMPACTION

- A. General Compaction – Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers. Complete compaction before mix temperature cools to 185 Deg. F / 85 Deg. C.
- B. Breakdown Rolling – Accomplish breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Repair surfaces by loosening displaced material, filling with hot-mix asphalt, and re-rolling to required elevations.
- C. Intermediate Rolling – Begin intermediate rolling immediately after breakdown rolling, while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt has been uniformly compacted to the following density: Average Density: 96 percent of reference laboratory density according to ASTM D5581 Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6 IN DIA Specimen), but not less than 94 percent nor greater than 100 percent.
- D. Finish Rolling – Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping – While surface is being compacted and finished trim edges of pavement to proper alignment. Bevel edges while still hot, with back of rake or smooth iron. Compact thoroughly using tamper or satisfactory method.
- F. Repairs – Remove paved areas that are defective or contaminated with foreign materials. Remove paving course over area affected and replace with fresh hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection – After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

### 3.07 INSTALLATION TOLERANCES

- A. Thickness – Compact each course to produce the thickness indicated within the following tolerances:
  1. Base Course:  $\pm 1/2$  IN /  $\pm 13$  mm.
  2. Surface Course:  $+1/4$  IN / 6 mm, no minus.

- B. Surface Smoothness – Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10 FT- 0 IN / 3m straightedge applied transversely or longitudinally to paved areas.
  - 1. Base Course: 1/4 IN / 6 mm.
  - 2. Surface Course: 1/8 IN / 3 mm.

### 3.08 PAVING MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Engineer of Record.
- B. Allow paving to cure for thirty (30) days before starting permanent pavement marking. In locations where the new pavement will be placed in service prior to (30) day cure, temporary pavement markings may be required.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of fifteen (15) mils or four tenths millimeter (0.4 mm).
  - 1. Parking lot striping: 4 IN wide.
  - 2. Color shall be white.

### 3.09 FIELD QUALITY CONTROL

- A. Testing Agency – The Contractor will engage a qualified independent testing agency to perform field inspections and tests and to prepare test reports. The Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.
- B. Additional Testing – Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.
- C. Thickness – In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D3549, Standard Test Method for Thickness and Height of Compacted Bituminous Paving Mixture Specimens.
- D. Surface Smoothness – Finished surface of hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- E. In-Place Density – Samples of un-compacted paving mixtures and compacted pavement will be secured by testing agency according to ASTM D979 Standard Practice for Sampling Bituminous Paving Mixtures.
  - 1. Reference laboratory density will be determined by averaging results from 4 samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D5581 Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6 IN DIA Specimen) and compacted according to job-mix specifications.

2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D1188 Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples or ASTM D2726 Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
  - a. One core sample will be taken for every one-thousand square yards or eight-hundred thirty-six square meters (1000 SQ YD / 836 sq. m.) or less of installed pavement, but in no case will fewer than three (3) cores be taken.
  - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D2950 Standard Test Method for Density of Bituminous Concrete in Place by Nuclear Methods and correlated with ASTM D1188, Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples or ASTM D2726 Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures.
- F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

**END OF SECTION**

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## **SECTION 32 13 00 - RIGID PAVING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Furnishing all plant, material, and equipment, and performing all labor for the manufacturing, transporting, placing, finishing, jointing, and curing of Portland Cement Concrete (PCC) pavement.

#### **1.02 PRE-QUALIFICATIONS**

- A. Contractor shall submit, along with bid, qualifications and prior projects for review by UP. UP reserves the right to reject bids from contractors who in the opinion of UP lack satisfactory experience or fail to provide documentation.

##### **B. Prior Project List:**

1. Provide evidence of the successful installation of PCC pavement on three prior projects of comparable size and application. Include multiple lift construction if project being bid requires multiple lift construction. The project listing shall include a brief description for each project, the final contract amount, the owner's name and contact information and the design engineer's name and contact information.

##### **C. Paving Personnel:**

1. Submit resumes and references for the proposed PCC Project Manager, Project Superintendent, Foreman, and Paver Operator. All are expected to have experience with a similar level of responsibility on at least 3 similar projects. Should the proposed contractor become the successful contractor, the personnel proposed in this submission shall be assigned to the project. If for some reason the proposed personnel are not available for this project, replacement personnel shall be subject to qualification by UP.

#### **1.03 REFERENCED STANDARDS**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

1. American Association of State Highway And Transportation Officials (AASHTO):
  - a. M 182, (2005; R 2009) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats.
  - b. T 26, (2008) Standard Method of Test for Quality of Water to Be Used in Concrete.

2. American Concrete Institute International (ACI):
  - a. 211.1, (1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete.
  - b. 214R, (2011) Evaluation of Strength Test Results of Concrete.
  - c. 305R, (2010) Guide to Hot Weather Concreting.
  - d. 306R, (2010) Guide to Cold Weather Concreting.
  - e. 309R, (2005) Guide for Consolidation of Concrete.
3. ASTM International (ASTM):
  - a. A1064/A1064M, (2013) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
  - b. A184/A184M, (2006; E2011) Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
  - c. A615/A615M, (2013) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
  - d. A775/A775M, (2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
  - e. C1017/C1017M, (2007) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
  - f. C1064/C1064M, (2011) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
  - g. C1077, (2011c) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
  - h. C1157/C1157M, (2011) Standard Specification for Hydraulic Cement.
  - i. C117, (2004) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing.
  - j. C123/C123M, (2012) Standard Test Method for Lightweight Particles in Aggregate.
  - k. C1240, (2012) Standard Specification for Silica Fume Used in Cementitious Mixtures.
  - l. C1260, (2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
  - m. C127, (2012) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.
  - n. C128, (2012) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate.
  - o. C131, (2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
  - p. C136, (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

- q. C138/C138M, (2013a) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete.
- r. C142/C142M, (2010) Standard Test Method for Clay Lumps and Friable Particles in Aggregates.
- s. 143/C143M, (2012) Standard Test Method for Slump of Hydraulic-Cement Concrete.
- t. C150/C150M, (2012) Standard Specification for Portland Cement.
- u. C1567, (2011) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
- v. C1602/C1602M, (2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete.
- w. C1646/C1646M, (2008a) Making and Curing Test Specimens for Evaluating Frost Resistance of Coarse Aggregate in Air-Entrained Concrete by Rapid Freezing and Thawing.
- x. C171, (2007) Standard Specification for Sheet Materials for Curing Concrete.
- y. C172/C172M, (2010) Standard Practice for Sampling Freshly Mixed Concrete.
- z. C 174, (2012) Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Cores.
- aa. C192/C192M, (2013a) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
- bb. C231/C231M, (2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- cc. C260/C260M, (2010a) Standard Specification for Air-Entraining Admixtures for Concrete.
- dd. C29/C29M, (2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate.
- ee. C294, (2012) Standard Descriptive Nomenclature for Constituents of Concrete Aggregates.
- ff. C295/C295M, (2012) Petrographic Examination of Aggregates for Concrete.
- gg. C309, (2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- hh. C31/C31M, (2012) Standard Practice for Making and Curing Concrete Test Specimens in the Field.
- ii. C39/C39M, (2012) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- jj. C40/C40M, (2011) Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.

- kk. C42/C42M, (2012) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
- ll. C494/C494M, (2012) Standard Specification for Chemical Admixtures for Concrete.
- mm. C595/C595M, (2012; E 2012) Standard Specification for Blended Hydraulic Cements.
- nn. C618, (2012) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- oo. C 642, (2013) Standard Test Method for Density, Absorption, and Voids in Hardened Concrete.
- pp. C666/C666M, (2003; R 2008) Resistance of Concrete to Rapid Freezing and Thawing.
- qq. C78/C78M, (2010) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading).
- rr. C88, (2013) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
- ss. C856, (2011) Petrographic Examination of Hardened Concrete.
- tt. C87/C87M, (2010) Effect of Organic Impurities in Fine Aggregate on Strength of Mortar.
- uu. C881/C881M, (2013) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- vv. C94/C94M, (2014) Standard Specification for Ready-Mixed Concrete.
- ww. C989/C989M, (2012a) Standard Specification for Slag Cement for Use in Concrete and Mortars.
- xx. D1751, (2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- yy. D1752, (2004a; R 2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion.
- zz. D2995, (1999; R 2009) Determining Application Rate of Bituminous Distributors.
- aaa.D3665, (2012) Random Sampling of Construction Materials.
- bbb. D4791, (2010) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
- ccc.D75, (2009) Standard Practice for Sampling Aggregates.
- ddd. E1274, (2003; R 2012) Standard Test Method for Measuring Pavement Roughness Using a Profilograph.
- 4. Concrete Plant Mixer Manufacturers Bureau (CPMB):
  - a. 100, , (2007) Concrete Plant Standards.

5. National Ready Mixed Concrete Association (NRMCA):
  - a. QC 3, (2011) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities.

#### 1.04 SUBMITTALS

- A. The Contractor shall submit documentation to the UP that verifies the following:
  1. All the materials utilized in the PCC Paving meet the specified requirements.
  2. Aggregates:
    - a. Source name and location.
    - b. Soundness loss with calculations.
    - c. Percent of Fractured Faces for the coarse aggregate.
    - d. Gradations.
    - e. Bulk saturated surface dry specific gravities.
    - f. Los Angeles wear abrasion.
    - g. Fineness modulus.
    - h. Aggregate absorption.
    - i. Aggregate correction factor.
    - j. Sand equivalent of fine aggregate.
    - k. Fine aggregate clay lumps content.
    - l. Organic impurity content, including soft fragments, coal and lignite, flat or elongated pieces, and other deleterious substances.
    - m. Whether or not the aggregate is prequalified by the State Department of Transportation.
  3. Cementitious Materials (Cement, Fly Ash, Blended Cement):
    - a. Source name and location.
    - b. Chemical and physical properties.
    - c. Whether or not the cementitious materials are prequalified by the State Department of Transportation.
  4. Admixtures:
    - a. Documentation of compliance with appropriate ASTM requirements.
  5. Concrete mixture proportions.
  6. Water/cementitious ratios.
  7. Type and amount of admixtures.
  8. Water source and location; include pH, available alkalis, and a full chemical analysis.
  9. ASR Testing.

10. Plastic Concrete Properties:

- a. Air temperature.
- b. Concrete temperature.
- c. Slump; when using super-plasticizer, document the slump before and after addition of the super-plasticizer.
- d. Unit weight.
- e. Air content.
- f. When using super-plasticizer, document the measured air content before and after adding the super-plasticizer.

11. Hardened Concrete Properties:

- a. Compressive strength tests (the average of three cylinders tested at 3 Days, 7 Days, and 28 Days).
- b. Modulus of Rupture strength tests (the average of three beams tested at 3 Days, 7 Days, and 28 Days).
- c. Expansion data from AASHTO T 303.

12. Dowel and Tie Bars, and reinforcement:

- a. Material certifications.

13. Joint Sealant:

- a. Material certifications.
- b. Manufacturer's installation instructions.

14. Curing Compound:

- a. Material certification.

B. The Contractor shall submit the following:

- 1. Quality Control Plan.
- 2. Cold Weather Procedures.
- 3. Hot Weather Procedures.
- 4. Quality Control Staff.
- 5. Laboratory Accreditation.

1.05 EQUIPMENT

- A. Equipment necessary for handling materials and performing all parts of the work shall be approved by the engineer as to design, capacity, and mechanical conditions. The equipment shall be at the jobsite sufficiently ahead of the start of paving operations to be examined thoroughly and approved.

- B. Obtain National Ready Mixed Concrete Association (NRMCA) certification of the concrete plant. The concrete plant shall be inspected by an engineer approved by the NRMCA. A list of NRMCA approved engineers is available on the NRMCA website at <http://www.nrmca.org>. All fees and costs associated with this inspection shall be paid by the Contractor. Submit a copy of the NRMCA QC Manual Section 3 Concrete Plant Certification Checklist, NRMCA Certificate of Conformance, and Calibration documentation on all measuring and weighing devices prior to uniformity testing.
- C. Locate the mixing plant within a proximity to the site to enable PCC placement within specified times.
- D. The batch plant and equipment shall conform to the requirements of ASTM C94.
- E. Mixers and Transportation Equipment
  - 1. General: Concrete may be mixed at a central plant, or wholly or in part in truck mixers. Each mixer shall have attached in a prominent place a manufacturer's nameplate showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.
  - 2. Central plant mixer: Central plant mixers shall conform to the requirements of ASTM C94. The mixer shall be examined daily for changes in condition due to accumulation of hard concrete or mortar or wear of blades. The pickup and throwover blades shall be replaced when they have worn down 3/4 IN or more. The Contractor shall have a copy of the manufacturer's design on hand showing dimensions and arrangement of blades in reference to original height and depth.
  - 3. Truck mixers and truck agitators. Truck mixers used for mixing and hauling concrete and truck agitators used for hauling central-mixed concrete shall conform to the requirements of ASTM C94.
  - 4. Nonagitator trucks: Nonagitating hauling equipment shall conform to the requirements of ASTM C94.
- F. Finishing Equipment:
  - 1. The standard method of constructing concrete pavements on UP projects shall be with an approved slip-form paving equipment designed to spread, consolidate, screed, and float-finish the freshly placed concrete in one complete pass of the machine so a dense and homogeneous pavement is achieved with a minimum of hand finishing. The paver-finisher shall be a heavy duty, self-propelled machine designed specifically for paving and finishing high quality concrete pavements. It shall weigh at least 2200 LBS/FT of paving lane width and powered by an engine having at least 6.0 HP/FT of lane width.
  - 2. On projects requiring less than 500 SQ YD of PCC pavement or requiring individual placement areas of less than 500 SQ YD, or irregular areas at locations inaccessible to slip-form paving equipment, PCC pavement may be placed with approved placement and finishing equipment using stationary side forms. Hand screeding and float finishing may only be used on small irregular areas as allowed by the Engineer.

G. Vibrators:

1. Vibrator shall be the internal type. Operating frequency for internal vibrators shall be between 8,000 and 12,000 vibrations per minute. Average amplitude for internal vibrators shall be 0.025 - 0.05 IN.
2. The number, spacing, and frequency shall be as necessary to provide a dense and homogeneous pavement and meet the recommendations of ACI 309, Guide for Consolidation of Concrete. Adequate power to operate all vibrators shall be available on the paver. The vibrators shall be automatically controlled so that they shall be stopped as forward motion ceases. The contractor shall provide an electronic or mechanical means to monitor vibrator status. The checks on vibrator status shall occur a minimum of two times per day or when requested by the Engineer.
3. Hand held vibrators may be used in irregular areas only, but shall meet the recommendations of ACI 309, Guide for Consolidation of Concrete.

H. Concrete Saws:

1. The Contractor shall provide sawing equipment adequate in number of units and power to complete the sawing to the required dimensions. The Contractor shall provide at least one standby saw in good working order and a supply of saw blades at the site of the work at all times during sawing operations.

I. Side Forms:

1. Straight side forms shall be made of steel and shall be furnished in sections not less than 10 FT in length. Forms shall have a depth equal to the pavement thickness at the edge, and a base width equal to or greater than the depth. Flexible or curved forms of proper radius shall be used for curves of 100 FT radius or less. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment. Forms with battered top surfaces and bent, twisted or broken forms shall not be used. Built-up forms shall not be used, except as approved by the Engineer. The top face of the form shall not vary from a true plane more than 1/8 IN in 10 FT, and the upstanding leg shall not vary more than 1/4 IN. The forms shall contain provisions for locking the ends of abutting sections together tightly for secure setting. Wood forms may be used under special conditions, when approved by the Engineer.

J. Pavers:

1. The paver shall be fully energized, self-propelled, and designed for the specific purpose of placing, consolidating, and finishing the concrete pavement, true to grade, tolerances, and cross section. It shall be of sufficient weight and power to construct the maximum specified concrete paving lane width as shown in the plans, at adequate forward speed, without transverse, longitudinal or vertical instability or without displacement. The paver shall be equipped with electronic or hydraulic horizontal and vertical control devices.



K. Dowel Bar Inserters:

1. A mechanical device or dowel bar inserter may be used during placement of the concrete, subject to the following requirements:
  - a. The pavement shall be placed and consolidated to full depth prior to insertion of the dowel bars.
  - b. Dowel bars shall be inserted into the plastic concrete ahead of the finishing beam or screed.
  - c. The installing device shall consolidate the concrete so that no voids exist around the dowel bars.
  - d. Dowel bars shall be located within 1 IN of the planned transverse and depth locations.
  - e. Dowel bars shall be placed within 2 IN of the planned longitudinal locations.
  - f. Dowel bars shall be parallel to the pavement surface and centerline within a tolerance of 1/2 IN per bar length.
  - g. Forward movement of the finishing beam or screed shall not be interrupted by insertion of the dowel bars.
  - h. A positive method of marking transverse joint locations shall be provided. Dowel bar location tolerances shall be randomly checked by the Engineer. Deviance from the tolerance shall result in suspension of paving operations until the problem is corrected. Significant and/or multiple deviances from dowel bar location tolerances may result in removal of the affected concrete section(s) at the Contractor's expense.

L. Curing Equipment:

1. Equipment for applying membrane-forming curing compound shall be mounted on a self-propelled frame that spans the paving lane. The reservoir for curing compound shall be constantly mechanically (not air) agitated during operation and shall contain means for completely draining the reservoir. The spraying system shall consist of a mechanically powered pump which will maintain constant pressure during operation, an operable pressure gauge, and either a series of spray nozzles evenly spaced across the lane to give uniformly overlapping coverage or a single spray nozzle which is mounted on a carriage which automatically traverses the lane width at a speed correlated with the forward movement of the overall frame. All spray nozzles shall be protected with wind screens. Calibrate the spraying system in accordance with ASTM D2995, Method A, for the rate of application required in paragraph: Membrane Curing. Any hand-operated sprayers allowed by that paragraph shall be compressed air supplied by a mechanical air compressor. If the curing equipment fails to apply an even coating of compound at the specified rate, it shall immediately be replaced.

M. Straightedge:

1. Furnish one 12 FT straightedge for each paving spreader for testing the finished surface. Straightedges shall be made available for UP use upon request. Straightedges shall be constructed of aluminum or other lightweight metal and shall have blades of box or box- girder cross section with flat bottom reinforced to ensure rigidity and accuracy. Straightedges shall have handles to facilitate movement on the pavement.

PART 2 - PRODUCTS

2.01 MATERIAL SOURCES

- A. All materials shall be obtained from the sources selected by contractor and approved by UP. Any change in materials requires resubmittal, testing and UP approval before being introduced to the project site.
- B. Obtain samples of aggregates during paving at the point of batching. Additional tests and analyses of aggregates at various stages in the processing and handling operations may be made by UP at the discretion of UP.

2.02 CEMENTITIOUS MATERIALS

A. Portland Cement:

1. Portland cement shall conform to ASTM C150/C150M, Type I or II, including the false set requirement. Low alkali cement shall be used if the proposed aggregates are found to have greater than 0.10 percent expansion when tested in accordance with the Alkali-Silica Reactivity paragraph. Submit current production mill certifications. All portland cement for the project shall be from a single source.

B. Blended Cement:

1. Blended cement shall conform to ASTM C595/C595M, Type IP or IS, including the optional requirement for mortar expansion. The pozzolan added to the Type IP blend shall be ASTM C618 Class F or Class N and shall be interground with the cement clinker. The manufacturer shall state in writing that the amount of pozzolan in the finished cement will not vary more than plus or minus 5 mass percent of the finished cement from lot to lot or within a lot. The percentage and type of mineral admixture used in the blend shall not change from that submitted for the aggregate evaluation and mixture proportioning. The requirements of Table 2 in paragraph SUPPLEMENTARY CEMENTITIOUS MATERIALS (SCM) CONTENT do not apply to the SCM content of blended cement.

C. Fly Ash:

1. Fly ash shall conform to the requirements of ASTM C618, Class F, including the optional requirements for drying shrinkage, uniformity, and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 3 percent. Class F fly ash for use in mitigating Alkali-Silica Reactivity shall have a Calcium Oxide (CaO) content of less than 13 percent and a total equivalent alkali content less than 3 percent.

D. Ultra Fine Fly Ash and Ultra Fine Pozzolan:

1. Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) shall conform to ASTM C618, Class F or N, and the following additional requirements:
  - a. The strength activity index at 28 days of age shall be at least 95 percent of the control specimens.
  - b. The average particle size shall not exceed 6 microns.

E. Ground Granulated Blast Furnace Slag:

1. Ground granulated blast furnace slag shall conform to the requirements of ASTM C989/C989M, Grade 100 or 120. Submit current mill certification and chemical composition analyses. All GGBFS for the project shall be from a single source.

F. Supplementary Cementitious Materials (SCM) Content:

1. Contractor may elect to use one of the SCMs listed in Table 2, unless the SCM is required to mitigate ASR, in which case the effective SCM shall be utilized.

TABLE 2 – SUPPLEMENTARY CEMENTITIOUS MATERIALS CONTENT

<u>Supplementary Cementitious Material</u>	<u>Minimum Content</u>	<u>Maximum Content</u>
Class N Pozzolan and Class F Fly Ash		
$\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3 > 70\%$	25%	35%
$\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3 > 80\%$	20%	35%
$\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3 > 90\%$	15%	35%
UFFA and UFP	7%	16%
GGBF Slag	40%	50%

2.03 WATER

- A. Water used in mixing or curing shall be clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product. Water will be tested in accordance with the requirements of AASHTO T 26. Water known to be of potable quality may be used without testing.

2.04 CURING MATERIALS

- A. Liquid membrane-forming compounds for curing concrete shall conform to the requirements of ASTM C309, Type 2, Class B, or Class A if wax base only.
- B. White polyethylene film for curing concrete shall conform to the requirements of ASTM C171.

- C. White burlap-polyethylene sheeting for curing concrete shall conform to the requirements of ASTM C171.
- D. Waterproof paper for curing concrete shall conform to the requirements of ASTM C171.
- E. Burlap and cotton mat used for curing shall conform to AASHTO M182.

## 2.05 AGGREGATES

- A. Locate and test the sources from which the aggregates are to be obtained. All aggregate for each nominal size group of aggregates shall be from a single aggregate source and shall meet specified quality requirements. Complete aggregate quality testing prior to performing mixture proportion studies. Furnish, separately, fine, intermediate and coarse aggregates that meet requirements of these specifications.
- B. Alkali-Silica Reactivity:
  - 1. Aggregates shall be tested for deleterious reactivity with alkalis in the cement, which may cause excessive expansion of the concrete. Separate tests of coarse and fine aggregate shall be made in accordance with ASTM C1260. If the expansion of coarse or fine aggregate test specimens, tested in accordance with ASTM C1260, does not exceed 0.10 percent at 16 days from casting (14-days of alkali solution (1N NaOH) exposure), the coarse and fine aggregates shall be accepted.
  - 2. If the expansion of any aggregate, coarse or fine, at 16 days is greater than 0.10 percent, tests of combined materials shall be made in accordance with ASTM C1567 using the aggregates, cementitious materials, and/or specific reactivity reducing chemicals in the proportions proposed for the mixture design. If the expansion of the proposed combined materials test specimens, tested in accordance with ASTM C1567, does not exceed 0.10 percent at 30 days from casting, the proposed combined materials will be accepted. If the expansion of the proposed combined materials test specimens is greater than 0.10 percent at 30 days from casting, the aggregates will not be accepted unless adjustments to the combined materials mixture can reduce the expansion to less than 0.10 percent at 30 days, or new aggregates shall be evaluated and tested.
- C. Fine Aggregate:
  - 1. Fine aggregate shall consist of natural sand, manufactured sand, or a combination of the two. Particles of the fine aggregate shall be generally spherical or cubical in shape.

2. Fine aggregate shall conform to the requirements of ASTM C33. Gradation shall meet the requirements of Table 1 when tested in accordance with ASTM C136, except as may otherwise be qualified under Section 6 of ASTM C33.

**Table 1. Gradation for Fine Aggregate (ASTM C 33)**

Sieve Designation (Square Openings)	Percentage by Weight Passing Sieves
3/8 in. (9.5 mm)	100
No. 4 (4.75 mm)	95-100
No. 8 (2.36 mm)	80-100
No. 16 (1.18 mm)	50-85
No. 30 (600 µm)	25-60
No. 50 (300 µm)	10-30
No. 100 (150 µm)	2-10

**D. Coarse and Intermediate Aggregate**

1. Coarse aggregate shall conform to the requirements of ASTM C33. Gradation, within the separated size groups, shall meet the requirements of Table 2 when tested in accordance with ASTM C136. When the nominal maximum size of the aggregate is greater than 1 in, the aggregates shall be furnished in two size groups.

**Table 2 Gradation For Coarse Aggregate  
(ASTM C 33)**

Sieve Designations (square openings)		Percentage by Weight Passing Sieves	
in	mm		
2-1/2	63	---	---
2	50.8	100	---
1-1/2	38.1	90-100	---
1	25.0	20-55	100
3/4	19.0	0-15	90-100
1/2½	12.5	---	---
3/8	9.5	0-5	20-55
No. 4	4.75	---	0-10
No. 8	2.36	---	0-5

2. Aggregates delivered to the mixer shall consist of crushed stone, crushed or uncrushed gravel, air-cooled blast furnace slag, crushed recycled concrete pavement, or a combination thereof. The aggregate shall be composed of clean, hard, uncoated particles and shall meet the requirements for deleterious substances contained in ASTM C33, Table 3, Class 4S, 4M, and 1N shall apply for the severe, moderate, and negligible weathering regions identified in Figure 1 of ASTM C33.
3. Dust and other coating shall be removed from the aggregates by washing. The aggregate in any size group shall not contain more than 8 percent by weight of flat or elongated pieces when tested in accordance with ASTM D4791. A flat or elongated particle is one having a ratio between the maximum and the minimum dimensions of a circumscribing rectangular prism exceeding 5 to 1.
4. The percentage of wear shall be no more than 40 percent when tested in accordance with ASTM C131 or ASTM C535.
5. Aggregates that have a history of D-cracking shall not be used. Prior to approval of mixture design and production of Portland cement concrete the Contractor shall submit written certification that the aggregate does not have a history of D-Cracking and that the aggregate meets the specified State requirements.
  - a. Other sources of crushed stone aggregate shall be approved if the durability factor as determined by ASTM C666 is greater than or equal to 95 and all other quality test requirements within these specifications are fulfilled. The UP will consider and reserves final approval of other State classification procedures.

E. Aggregate Material Storage:

1. Aggregate shall be stored at the site of the mixing plant, avoiding breakage, segregation, or contamination by foreign materials. Each size of aggregate from each source shall be stored separately in free-draining stockpiles. Aggregate shall remain in free-draining storage for at least 24 HRS immediately prior to use. Stockpiles shall be built on a 12 IN thick sacrificial layer that extends beyond limits of stockpile using concrete production aggregates. Do not allow loader bucket to penetrate into sacrificial layer. Asphalt millings or other materials shall not be used for a sacrificial layer. Sufficient aggregate shall be maintained at the site at all times to permit continuous uninterrupted operation of the mixing plant at the time PCC is being placed. Aggregate shall be handled to prevent segregation or degradation. The tires or tracks of vehicles used for stockpiling or moving aggregate shall be kept clean of foreign materials.
2. Aggregate Stockpiles:
  - a. Aggregates as delivered to site shall be clean and free of debris and deleterious material. Stockpiles observed to contain clay balls, dirt, organic matter, material foreign to concrete, other contamination, or material considered objectionable to UP, shall be rejected and removed from the site. Protect stockpiles from contamination by runoff water, storm water, mud, other aggregates or materials and other contaminants. Ensure stockpile base is above any run off flow or localized ponding/flooding, and slopes away from all stockpiles.

### 3. Stockpile Construction:

- a. Stockpiles shall be built to prevent segregation and degradation. Stockpiles built with end loaders shall not be higher than the maximum height of loader bucket. Conveyors shall continuously be adjusted so the maximum free-fall is 6 FT and aggregate does not roll down sides of pile. Telescoping radial stackers shall also be controlled the same as conveyors. Stockpiles built with conveyors or stackers shall build small individual cones of 6 FT height, and then build successive cones adjacent and on top. Tracked or wheeled equipment shall not operate on stockpiles.

## 2.06 ADMIXTURES

- A. The use of any material added to the concrete mix shall be approved by the Engineer. The Contractor shall submit certificates indicating that the material to be furnished meets all of the requirements indicated below. In addition, the Engineer may require the Contractor to submit complete test data from an approved laboratory showing that the material to be furnished meets all of the requirements of the cited specifications. Subsequent tests may be made of samples taken by the Engineer from the supply of the material being furnished or proposed for use on the work to determine whether the admixture is uniform in quality with that approved.
  1. Air-entraining admixtures shall meet the requirements of ASTM C260 and shall consistently entrain the air content in the specified ranges under field conditions. The air-entrainment agent and any water reducer admixture shall be compatible.
  2. Water-reducing, set retarding, and set-accelerating admixtures shall meet the requirements of ASTM C494, including the flexural strength test.
- B. Calcium chloride and admixtures containing calcium chloride shall not be used.

## 2.07 EXPANSION JOINT MATERIALS

- A. Premolded joint filler for expansion joints shall conform to the requirements of ASTM D1751 or ASTM D1752, Type II or III, as required to be compatible with the joint filler. Expansion joints shall be punched to admit the dowels where called for on the plans. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint, unless otherwise specified by the Engineer. When the use of more than one piece is required for a joint, the abutting ends shall be fastened securely and held accurately to shape by stapling or other positive fastening means satisfactory to the Engineer.
- B. Expansion joint filler shall be 3/4 IN thick, unless otherwise indicated, and shall be furnished in a single full depth piece.

## 2.08 JOINT SEALER

- A. Dow Corning 888 (ASTM D5893, Type NS) (FAA P-605 for silicone joint sealants).
- B. Dow Corning 890SL (ASTM D5893, Type SL) (FAA P-605 for silicone joint sealants).
- C. ASTM D1854 - Jet-Fuel-Resistant Concrete Joint Sealer, Hot-Applied Elastic Type.
- D. ASTM D3406 - Joint Sealants, Hot-Applied, Elastometric-Type, for Portland Cement Concrete Pavements.

## 2.09 REINFORCING

- A. All reinforcement shall be free from loose, flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce the bond with concrete. Removal of thin powdery rust and tight rust is not required. However, reinforcing steel which is rusted to the extent that it does not conform to the required dimensions or mechanical properties shall not be used.
- B. Reinforcing bars shall conform to ASTM A615/A615M, billet-steel or ASTM A996/A996M, rail and axle steel, Grade 60. Bar mats shall conform to ASTM A184/A184M. The bar members may be billet rail or axle steel.
- C. Welded Wire Reinforcement shall be deformed or smooth, conforming to ASTM A1064/A1064M, and shall be furnished in flat sheets.

## 2.10 DOWELS

- A. Dowels shall be single piece bars fabricated or cut to length at the shop or mill before delivery to the site. Dowels shall be free of loose, flaky rust and loose scale and shall be clean and straight. Dowels may be sheared to length provided that the deformation from true shape caused by shearing does not exceed 0.04 IN on the diameter of the dowel and does not extend more than 0.04 IN from the end of the dowel. Dowels shall be plain (non-deformed) steel bars conforming to ASTM A615/A615M, Grade 40 or 60; ASTM A996/A996M, Grade 50 or 60. Dowel bars shall be epoxy coated in conformance with ASTM A775/A775M. Grout retention rings shall be fully circular metal or plastic devices capable of supporting the dowel until the epoxy hardens. Dowel sleeves or inserts are not permitted.
- B. Dowel bar assemblies shall consist of a framework of metal bars or wires arranged to provide rigid support for the dowels throughout the paving operation, with a minimum of four continuous bars or wires extending along the joint line. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from rising, sliding out, or becoming distorted during paving operations.

## 2.11 TIE BARS

- A. Tie bars shall be deformed steel bars conforming to ASTM A615/A615M, or ASTM A996/A996M, Grade 60, and of the sizes and dimensions indicated. Deformed rail steel bars and high-strength billet or axle steel bars, Grade 50 or higher, shall not be used for bars that are bent and straightened during construction.
- B. Tie bars shall be epoxy coated in conformance with ASTM A775/A775M.

## 2.12 EPOXY RESIN

- A. Epoxy-resin used to anchor dowels and tie bars in pavements shall conform to the requirements of ASTM C881, Type I, Grade 3, Class C. Class A or B shall be used when the surface temperature of the hardened concrete is below 60 DegF.

## 2.13 MIX DESIGN

- A. Proportions:



1. Concrete shall be designed to achieve a 28-day flexural strength that meets or exceeds the minimum design strength. The mix shall be designed using the procedures contained in Chapter 9 of the Portland Cement Association's manual, "Design and Control of Concrete Mixtures".
2. The Contractor shall note that to ensure that the concrete actually produced will meet or exceed the acceptance criteria for the specified strength. The mix design average strength must be higher than the specified strength. The amount of overdesign necessary to meet specification requirements depends on the producer's standard deviation of flexural test results and the accuracy that that value can be estimated from historic data for the same or similar materials.
3. The minimum cementitious material (cement plus flyash, or GGBFS) shall be 517 LBS/CU YD.
4. Prior to the start of paving operations and after approval of all material to be used in the concrete, the Contractor shall submit a mix design showing the proportions and flexural and compressive strengths obtained from the concrete at 7 and 28 days. The mix design shall include copies of test reports, including test dates, and a complete list of materials including type, brand, source, and amount of cement, flyash, ground slag, coarse aggregate, fine aggregate, water, and admixtures. The fineness modulus of the fine aggregate and the air content shall also be shown. The mix design shall be submitted to the Engineer at least 14 days prior to the start of operations. The submitted mix design shall not be more than 90 days old. Production shall not begin until the mix design is approved in writing by the Engineer.
5. Should a change in sources be made, or admixtures added or deleted from the mix, a new mix design must be submitted to the Engineer for approval.
6. Flexural strength test specimens shall be prepared in accordance with ASTM C192 and tested in accordance with ASTM C78. Compressive strength test specimens shall be prepared in accordance with ASTM C192 and tested in accordance with ASTM C39. The mix determined shall be workable concrete having a slump for side-form concrete between 1 and 2 IN as determined by ASTM C143. For vibrated slip-form concrete, the slump shall be between 1/2 IN and 1-1/2 IN.
7. Before or during construction, if the source of any materials is changed, or if there is any variation in quality of materials furnished, conduct additional tests and adjust amount of cement as required to obtain the specified results.

**B. Cementitious Materials:**

1. Flyash may be used in the mix design. When flyash is used as a partial replacement for cement, the minimum cement content may be met by considering Portland cement plus flyash as the total cementitious material. The replacement rate shall be determined from laboratory trial mixes, but shall be between 20 and 30 percent by weight of the total cementitious material. If fly ash is used in conjunction with ground granular blast furnace slag the maximum replacement rate shall not exceed 10 percent by weight of total cementitious material.

2. Ground blast-furnace slag may be used in a mix design containing Type I or Type II cement. The slag, or slag plus flyash if both are used, may constitute between 25 to 55 percent of the total cementitious material by weight. If the concrete is to be used for slipforming operations and the air temperature is expected to be lower than 55 DegF the percent slag shall not exceed 30 percent by weight.

C. Admixtures:

1. Air-entraining admixture shall be added in such a manner that will insure uniform distribution of the agent throughout the batch. The air content of freshly mix air-entrained concrete shall be based upon trial mixes with the materials to be used in the work adjusted to produce concrete of the required plasticity and workability. The percentage of air in the mix shall be 5 - 7%. Air content shall be determined by testing in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag and other highly porous coarse aggregate.

D. Concrete Mix Design Laboratory:

1. The Contractor's laboratory used to develop the concrete mix design shall meet the requirements of ASTM C1077. The laboratory accreditation must be current and listed on the accrediting authority's website. All test methods required for developing the concrete mix design must be listed on the lab accreditation. A copy of the laboratory's current accreditation and accredited test methods shall be submitted to the Engineer prior to start of construction.

## PART 3 - EXECUTION

### 3.01 PREPARATION OF SUBGRADE OR SUBBASE

- A. Verify that substrate is in place, compacted as specified, finished to the specified tolerances, and free from debris, waste concrete or cement, frost, ice and standing or running water.
- B. After the underlying surface has been placed and compacted to the required density, the areas that will support the paving machine and the area to be paved shall be trimmed or graded to the plan grade elevation and profile by means of a properly designed machine. The grade of the underlying surface shall be controlled by a positive grade control system using lasers, stringlines, or guide wires.
- C. If the density of the underlying surface is disturbed by the trimming operations, it shall be corrected by additional compaction and retested at the option of the Engineer before the concrete is placed except when stabilized subbases are being constructed. If damage occurs on a stabilized subbase, it shall be corrected full depth by the Contractor.
- D. If traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately before the placement of concrete.
- E. The prepared grade shall be moistened with water, without saturating, immediately ahead of concrete placement to prevent rapid loss of moisture from concrete. The underlying surface shall be protected so that it will be entirely free of frost when concrete is placed.

### 3.02 HANDLING, MEASURING, AND BATCHING MATERIAL

- A. The batch plant site, layout, equipment, and provisions for transporting material shall assure a continuous supply of material to the work. Stockpiles shall be constructed in such a manner that prevents segregation and intermixing of deleterious materials.
- B. Aggregates that have become segregated or mixed with earth or foreign material shall not be used. All aggregates produced or handled by hydraulic methods, and washed aggregates, shall be stockpiled or binned for draining at least 12 HRS before being batched. Rail shipments requiring more than 12 HRS will be accepted as adequate binning only if the car bodies permit free drainage.
- C. Batching plants shall be equipped to proportion aggregates and bulk cement, by weight, automatically using interlocked proportioning devices of an approved type. When bulk cement is used, the Contractor shall use a suitable method of handling the cement from weighing hopper to transporting container or into the batch itself for transportation to the mixer, such as a chute, boot, or other approved device, to prevent loss of cement. The device shall be arranged to provide positive assurance that the cement content specified is present in each batch.

### 3.03 MIXING CONCRETE

- A. The concrete may be mixed at the work site, in a central mix plant or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time shall be measured from the time all materials, except water, are emptied into the drum. All concrete shall be mixed and delivered to the site in accordance with the requirements of ASTM C94.
- B. Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators, or non-agitating trucks. The elapsed time from the addition of cementitious material to the mix until the concrete is deposited in place at the work site shall not exceed 30 minutes when the concrete is hauled in non-agitating trucks, nor 90 minutes when the concrete is hauled in truck mixers or truck agitators. Retempering concrete by adding water or by other means will not be permitted. With transit mixers additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements provided the addition of water is performed within 45 minutes after the initial mixing operations and provided the water/cementitious ratio specified in the approved mix design is not exceeded, and approved by the Engineer.

### 3.04 LIMITATIONS ON MIXING AND PLACING

- A. No concrete shall be mixed, placed, or finished when the natural light is insufficient, unless an adequate and approved artificial lighting system is operated.
- B. Cold Weather:
  - 1. Unless authorized in writing by the Engineer, mixing and concreting operations shall be discontinued when a descending air temperature in the shade and away from artificial heat reaches 40 DegF and shall not be resumed until an ascending air temperature in the shade and away from artificial heat reaches 35 DegF.

2. The aggregate shall be free of ice, snow, and frozen lumps before entering the mixer. The temperature of the mixed concrete shall not be less than 50 DegF at the time of placement. Concrete shall not be placed on frozen material nor shall frozen aggregates be used in the concrete.
3. When concreting is authorized during cold weather, water and/or the aggregates may be heated to not more than 150 DegF. The apparatus used shall heat the mass uniformly and shall be arranged to preclude the possible occurrence of overheated areas which might be detrimental to the materials.
4. Concrete damaged by freezing shall be removed and replaced as directed.

C. Hot Weather:

1. During periods of hot weather when the maximum daily air temperature exceeds 85 DegF, the following precautions shall be taken.
  - a. The forms and/or the underlying surface shall be sprinkled with water immediately before placing the concrete. The concrete shall be placed at the coolest temperature practicable, and in no case shall the temperature of the concrete when placed exceed 90 DegF. The aggregates and/or mixing water shall be cooled as necessary to maintain the concrete temperature at or not more than the specified maximum.
  - b. The finished surfaces of the newly laid pavement shall be kept damp by applying a water-fog or mist with approved spraying equipment until the pavement is covered by the curing medium. If necessary, wind screens shall be provided to protect the concrete from an evaporation rate in excess of 0.2 psf per hour as determined in accordance with Figure 2.1.5 in ACI 305R, Hot Weather Concreting, which takes into consideration relative humidity, wind velocity, and air temperature.
  - c. When conditions are such that problems with plastic cracking can be expected, and particularly if any plastic cracking begins to occur, the Contractor shall immediately take such additional measures as necessary to protect the concrete surface. Such measures shall consist of wind screens, more effective fog sprays, and similar measures commencing immediately behind the paver. If these measures are not effective in preventing plastic cracking, paving operations shall be immediately stopped.

D. Temperature Management Program:

1. Prior to the start of paving operation for each day of paving, the contractor shall provide the engineer with a Temperature Management Program for the concrete to be placed to assure that uncontrolled cracking is avoided. As a minimum the program shall address the following items:
  - a. Anticipated tensile strains in the fresh concrete as related to heating and cooling of the concrete material.
  - b. Anticipated weather conditions such as ambient temperatures, wind velocity, and relative humidity.
  - c. Anticipated timing of initial sawing of joint.

### 3.05 PLACING CONCRETE

- A. The Contractor has the option of placing the concrete with either side (fixed) forms or slip-forms. At any point in concrete conveyance, the free vertical drop of the concrete from one point to another or to the underlying surface shall not exceed 3 FT. Backhoes and grading equipment shall not be used to distribute the concrete in front of the paver. Front end loaders will not be used unless the contractor demonstrates that they can be used without contaminating the concrete and base course and it is approved by the Engineer.
- B. Hauling equipment or other mechanical equipment can be permitted on adjoining previously constructed pavement when the concrete strength reaches 90% of its design strength or approved by engineer of record. Also, subgrade and subbase planers, concrete pavers, and concrete finishing equipment may be permitted to ride upon the edges of previously constructed pavement when the concrete has attained a minimum flexural strength of 400 psi.
- C. Slip-Form Construction:
  - 1. The concrete shall be distributed uniformly into final position by a self propelled slip-form paver without delay. The alignment and elevation of the paver shall be regulated from outside reference lines established for this purpose. The paver shall vibrate the concrete for the full width and depth of the strip of pavement being placed and the vibration shall be adequate to provide a consistency of concrete that will stand normal to the surface with sharp well defined edges. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms.
  - 2. The plastic concrete shall be effectively consolidated by internal vibration with transverse vibrating units for the full width of the pavement and/or a series of equally placed longitudinal vibrating units. The space from the outer edge of the pavement to longitudinal unit shall not exceed 9 IN. The spacing of internal units shall be uniform and shall not exceed 18 IN.
  - 3. The term internal vibration means vibrating units located within the specified thickness of pavement section.
  - 4. The rate of vibration of each vibrating unit shall be within 8000 to 12000 cycles per minute and the amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete along the entire length of the vibrating unit and for a distance of at least 1 FT. The frequency of vibration or amplitude shall vary proportionately with the rate of travel to result in a uniform density and air content. The paving machine shall be equipped with a tachometer or other suitable device for measuring and indicating the actual frequency of vibrations.
  - 5. The concrete shall be held at a uniform consistency. The slip-form paver shall be operated with as nearly a continuous forward movement as possible. And all operations of mixing, delivering, and spreading concrete shall be coordinated to provide uniform progress with stopping and starting of the paver held to a minimum. If for any reason, it is necessary to stop the forward movement of the paver, the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

6. When concrete is being placed adjacent to an existing pavement, that part of the equipment which is supported on the existing pavement shall be equipped with protective pads on crawler tracks or rubber-tired wheels on which the bearing surface is offset to run a sufficient distance from the edge of the pavement to avoid breaking the pavement edge.

D. Side-Form Construction:

1. Side form sections shall be straight, free from warps, bends, indentations, or other defects. Defective forms shall be removed from the work. Metal side forms shall be used except at end closures and transverse construction joints where straight forms of other suitable material may be used.
2. Side forms may be built up by rigidly attaching a section to either top or bottom of forms. If such build-up is attached to the top of metal forms, the build-up shall also be metal.
3. Width of the base of all forms shall be equal to at least 80 percent of the specified pavement thickness.
4. Side forms shall be of sufficient rigidity, both in the form and in the interlocking connection with adjoining forms, that springing will not occur under the weight of subgrading and paving equipment or from the pressure of the concrete. The Contractor shall provide sufficient forms so that there will be no delay in placing concrete due to lack of forms.
5. Before placing side forms, the underlying material shall be at the proper grade. Side forms shall have full bearing upon the foundation throughout their length and width of base and shall be placed to the required grade and alignment of the finished pavement. They shall be firmly supported during the entire operation of placing, compacting, and finishing the pavement.
6. Forms shall be drilled in advance of being placed to line and grade to accommodate tie bars where these are specified.
7. Immediately in advance of placing concrete and after all subbase operations are completed, side forms shall be trued and maintained to the required line and grade for a distance sufficient to prevent delay in placing.
8. Side forms shall remain in place at least 12 HRS after the concrete has been placed, and in all cases until the edge of the pavement no longer requires the protection of the forms. Curing compound shall be applied to the concrete immediately after the forms have been removed.
9. Side forms shall be thoroughly cleaned and oiled each time they are used and before concrete is placed against them.
10. Concrete shall be spread, screeded, shaped and consolidated by one or more self-propelled machines. These machines shall uniformly distribute and consolidate concrete without segregation so that the completed pavement will conform to the required cross section with a minimum of handwork.
11. The number and capacity of machines furnished shall be adequate to perform the work required at a rate equal to that of concrete delivery.

12. Concrete for the full paving width shall be effectively consolidated by internal vibrators without causing segregation. Internal type vibrators' rate of vibration shall be not less than 7,000 cycles per minute. Amplitude of vibration shall be sufficient to be perceptible on the surface of the concrete more than 1 FT from the vibrating element. The Contractor shall furnish a tachometer or other suitable device for measuring and indicating frequency of vibration.
13. Power to vibrators shall be connected so that vibration ceases when forward or backward motion of the machine is stopped.
14. The provisions relating to the frequency and amplitude of internal vibration shall be considered the minimum requirements and are intended to ensure adequate density in the hardened concrete.

E. Consolidation Testing:

1. The provisions relating to the frequency and amplitude of internal vibration shall be considered the minimum requirements and are intended to ensure adequate density in the hardened concrete. If a lack of consolidation of the concrete is suspected by the Engineer, additional referee testing may be required. Referee testing of hardened concrete will be performed by cutting cores from the finished pavement after a minimum of 24 HRS curing. Density determinations will be made based on the water content of the core as taken. ASTM C642 shall be used for the determination of core density in the saturated-surface dry condition. Referee cores will be taken at the minimum rate of one for each 500 CU YDS of pavement, or fraction thereof.
2. The average density of the cores shall be at least 97 percent of the original mix design density, with no cores having a density of less than 96 percent of the original mix design density.
3. Failure to meet the above requirements will be considered as evidence that the minimum requirements for vibration are inadequate for the job conditions, and additional vibrating units or other means of increasing the effect of vibration shall be employed so that the density of the hardened concrete as indicated by further referee testing shall conform to the above listed requirements.

### 3.06 STRIKE-OFF OF CONCRETE AND PLACEMENT OF REINFORCEMENT

- A. Following the placing of the concrete, it shall be struck off to conform to the cross section shown on the plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement shall be at the elevation shown on the plans. When reinforced concrete pavement is placed in two layers, the bottom layer shall be struck off to such length and depth that the sheet of reinforcing steel fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off, and screeded. If any portion of the bottom layer of concrete has been placed more than 30 minutes without being covered with the top layer or if initial set has taken place, it shall be removed and replaced with freshly mixed concrete at the Contractor's expense. When reinforced concrete is placed in one layer, the reinforcement may be positioned in advance of concrete placement or it may be placed in plastic concrete by mechanical or vibratory means after spreading.

- B. Reinforcing steel, at the time concrete is placed, shall be free of mud, oil, or other organic matter that may adversely affect or reduce bond. Reinforcing steel with rust, mill scale or a combination of both will be considered satisfactory, provided the minimum dimensions, weight, and tensile properties of a hand wire-brushed test specimen are not less than the applicable ASTM specification requirements.

### 3.07 JOINTS

- A. Joints shall be constructed as shown on the plans and in accordance with these requirements. All joints shall be constructed with their faces perpendicular to the surface of the pavement and finished or edged as shown on the plans. Joints shall not vary more than 1/2 in from their designated position and shall be true to line with not more than 1/4 IN (6 mm) variation in 10 FT (3 m). The surface across the joints shall be tested with a 10 FT (3 m) straightedge as the joints are finished and any irregularities in excess of 1/4 IN (6 mm) shall be corrected before the concrete has hardened. All joints shall be so prepared, finished, or cut to provide a groove of uniform width and depth as shown on the plans.
- B. Joint plan changes requested for construction.
- C. Construction:
  - 1. Longitudinal construction joints shall be slip-formed or formed against side forms with or without keyways, as shown in the plans.
  - 2. Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for more than 30 minutes or it appears that the concrete will obtain its initial set before fresh concrete arrives. The installation of the joint shall be located at a planned contraction or expansion joint. If placing of the concrete is stopped, the Contractor shall remove the excess concrete back to the previous planned joint.
- D. Contraction:
  - 1. Contraction joints shall be installed at the locations and spacing as shown on the plans. Contraction joints shall be installed to the dimensions required by forming a groove or cleft in the top of the slab while the concrete is still plastic or by sawing a groove into the concrete surface after the concrete has hardened. When the groove is formed in plastic concrete the sides of the grooves shall be finished even and smooth with an edging tool. If an insert material is used, the installation and edge finish shall be according to the manufacturer's instructions. The groove shall be finished or cut clean so that spalling will be avoided at intersections with other joints. Grooving or sawing shall produce a slot at least 1/8 in wide and to the depth shown on the plans.
- E. Expansion:



1. Expansion joints shall be installed as shown on the plans. The premolded filler of the thickness as shown on the plans, shall extend for the full depth and width of the slab at the joint, except for space for sealant at the top of the slab. The filler shall be securely staked or fastened into position perpendicular to the proposed finished surface. A cap shall be provided to protect the top edge of the filler and to permit the concrete to be placed and finished. After the concrete has been placed and struck off, the cap shall be carefully withdrawn leaving the space over the premolded filler. The edges of the joint shall be finished and tooled while the concrete is still plastic. Any concrete bridging the joint space shall be removed for the full width and depth of the joint.

F. Tie Bars:

1. Tie bars shall consist of deformed bars installed in joints as shown on the plans. Tie bars shall be placed at right angles to the centerline of the concrete slab and shall be spaced at intervals shown on the plans. They shall be held in position parallel to the pavement surface and in the middle of the slab depth. When tie bars extend into an unpaved lane, they may be bent against the form at longitudinal construction joints, unless threaded bolt or other assembled tie bars are specified. These bars shall not be painted, greased, or enclosed in sleeves. When slip-form operations call for tie bars, two-piece hook bolts can be installed in the female side of the keyed joint provided the installation is made without distorting the keyed dimensions or causing edge slump. If a bent tie bar installation is used, the tie bars shall be inserted through the keyway liner only on the female side of the joint. In no case shall a bent tie bar installation for male keyways be permitted.

G. Dowel Bars:

1. Dowel bars or other load-transfer units of an approved type shall be placed across joints in the manner as shown on the plans. They shall be of the dimensions and spacings as shown and held rigidly in the middle of the slab depth in the proper horizontal and vertical alignment by an approved assembly device to be left permanently in place. The dowel or load-transfer and joint devices shall be rigid enough to permit complete assembly as a unit ready to be lifted and placed into position. A metal, or other type, dowel expansion cap or sleeve shall be furnished for each dowel bar used with expansion joints. These caps shall be substantial enough to prevent collapse and shall be placed on the ends of the dowels as shown on the plans. The caps or sleeves shall fit the dowel bar tightly and the closed end shall be watertight. The portion of each dowel painted with rust preventative paint and shown on the plans to receive a debonding lubricant, shall be thoroughly coated with asphalt MC-70, or an approved lubricant, to prevent the concrete from bonding to that portion of the dowel. If free-sliding plastic-coated or epoxy-coated steel dowels are used, a lubrication bond breaker shall be used except when approved pullout tests indicate it is not necessary. Where butt-type joints with dowels are designated, the exposed end of the dowel shall be oiled.
2. Dowel bars at contraction joints may be placed in the full thickness of pavement by a mechanical device approved by the Engineer. The device shall be capable of installing dowel bars within the maximum permissible alignment tolerances. Dowels bars at longitudinal construction joints shall be bonded in drilled holes.

H. Installation:

1. All devices used for the installation of expansion joints shall be approved by the Engineer.
2. The top of an assembled joint device shall be set at the proper distance below the pavement surface and the elevation shall be checked. Such devices shall be set to the required position and line and shall be securely held in place by stakes or other means to the maximum permissible tolerances during the pouring and finishing of the concrete. The premolded joint material shall be placed and held in a vertical position; if constructed in sections, there shall be no offsets between adjacent units.
3. Dowel bars and assemblies shall be checked for position and alignment. The maximum permissible tolerances on dowel bar alignment shall be in accordance with reinforcement design. During the concrete placement operation, it is advisable to place plastic concrete directly on dowel assemblies immediately prior to passage of the paver to help maintain dowel position and alignment within maximum permissible tolerances.
4. When concrete is placed using slip-form pavers, dowels and tie bars shall be placed in longitudinal construction joints by bonding the dowels or tie bars into holes drilled into the hardened concrete. Holes approximately 1/8 IN to 1/4 IN greater in diameter than the dowel or tie bar shall be drilled with rotary-type core drills that must be held securely in place to drill perpendicularly into the vertical face of the pavement slab. Rotary-type percussion drills may be used provided that spalling of concrete does not occur. Any damage of the concrete shall be repaired by the Contractor in a method approved by the Engineer. Dowels or tie bars shall be bonded in the drilled holes using an epoxy resin material. Installation procedures shall be adequate to insure that the area around dowels is completely filled with epoxy grout. Epoxy shall be injected into the back of the hole and displaced by the insertion of the dowel bar. Bars shall be completely inserted into the hole and shall not be withdrawn and reinserted creating air pockets in the epoxy around the bar. The Contractor shall furnish a template for checking the position and alignment of the dowels.
5. Dowels and/or tie bars in a longitudinal joint shall not be less than 10 IN from a transverse joint and shall not interfere with dowels in the transverse direction.

I. Sawing of Joints:

1. Joints shall be cut as shown on the plans. The circular cutter shall be capable of cutting a groove in a straight line and shall produce a slot at least 1/8 IN wide and to the depth shown on the plans. The top portion of the slot shall be widened by sawing to provide adequate space for joint sealers as shown on the plans. Sawing shall commence as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling, or tearing and before uncontrolled shrinkage cracking of the pavement occurs. Sawing shall be carried on both during the day and night as required. The joints shall be sawed at the required spacing, consecutively in sequence of the concrete placement. Curing compound, if being used as the cure type, shall be reapplied in the initial sawcut and maintained for the remaining cure period. Curing compound shall not be applied, and used as the cure method, to any final concrete face that is to receive a sealant. All slurry and debris produced in the sawing of joints shall be removed by vacuuming and washing.

### 3.08 FINAL STRIKE-OFF, CONSOLIDATION, AND FINISHING.

#### A. Sequence:

1. The sequence of operations shall be the strike-off, floating and removal of laitance, straightedging, and final surface finish. The addition of superficial water to the surface of the concrete to assist in finishing operations will not be permitted.

#### B. Finishing at Joints:

1. The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material; it shall be firmly placed without voids or segregation under and around all load-transfer devices, joint assembly units, and other features designed to extend into the pavement. After the concrete has been placed and vibrated adjacent to the joints, the finishing machine shall be operated in a manner to avoid damage or misalignment of joints. If uninterrupted operations of the finishing machine, to, over, and beyond the joints, cause segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the screed is approximately 8 IN from the joint. Segregated concrete shall be removed from the front of and off the joint; and the forward motion of the finishing machine shall be resumed. Thereafter, the finishing machine may be run over the joint without lifting the screed, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

#### C. Machine Finishing:

1. The concrete shall be spread as soon as it is placed, and it shall be struck off and screeded by a finishing machine. The machine shall go over each area as many times and at such intervals as necessary to give to proper consolidation and to leave a surface of uniform texture. Excessive operation over a given area shall be avoided. When side forms are used, the tops of the forms shall be kept clean by an effective device attached to the machine, and the travel of the machine on the forms shall be maintained true without lift, wobbling, or other variation tending to affect the precision finish. During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed for its entire length. When in operation, the screed shall be moved forward with a combined longitudinal and transverse shearing motion, always moving in the direction in which the work is progressing, and so manipulated that neither end is raised from the side forms during the striking-off process. If necessary, this shall be repeated until the surface is of uniform texture, true to grade and cross section, and free from porous areas.

D. Hand Finishing:

1. Hand finishing methods will not be permitted, except under the following conditions: in the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade; in areas of narrow widths or of irregular dimensions where operation of the mechanical equipment is impractical. Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used. A second screed shall be provided for striking off the bottom layer of concrete when reinforcement is used.
2. The screed for the surface shall be at least 2 FT longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and shall be constructed either of metal or of other suitable material covered with metal. Consolidation shall be attained by the use of suitable vibrators.

E. Floating:

1. After the concrete has been struck off and consolidated, it shall be further smoothed and trued by means of a longitudinal float using one of the following methods:
  - a. Hand Method. Long-handled floats shall not be less than 12 FT in length and 6 IN in width, stiffened to prevent flexibility and warping. The float shall be operated from foot bridges spanning but not touching the concrete or from the edge of the pavement. Floating shall pass gradually from one side of the pavement to the other. Forward movement along the centerline of the pavement shall be in successive advances of not more than one-half the length of the float. Any excess water or laitance in excess of 1/8 IN thick shall be removed and wasted.

- b. Mechanical method. The Contractor may use a machine composed of a cutting and smoothing floats, suspended from and guided by a rigid frame and constantly in contact with, the side forms or underlying surface. If necessary, long-handled floats having blades not less than 5 FT in length and 6 IN in width may be used to smooth and fill in open-textured areas in the pavement. When the crown of the pavement will not permit the use of the mechanical float, the surface shall be floated transversely by means of a long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating, any excess water and laitance in excess of 1/8 IN thick shall be removed and wasted. Successive drags shall be lapped one-half the length of the blade.

F. Straight-edge Testing and Surface Correction:

- 1. After the pavement has been struck off and while the concrete is still plastic, it shall be tested for trueness with a Contractor furnished 16 FT straightedge swung from handles 3 FT longer than one-half the width of the slab. The straightedge shall be held in contact with the surface in successive positions parallel to the centerline and the whole area gone over from one side of the slab to the other, as necessary. Advancing shall be in successive stages of not more than one-half the length of the straightedge. Any excess water and laitance in excess of 1/8 IN thick shall be removed from the surface of the pavement and wasted. Any depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the smoothness requirements as stated in the pavement design documents. Straightedge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straightedge and until the slab conforms to the required grade and cross section. The use of long-handled wood floats shall be confined to a minimum; they may be used only in emergencies and in areas not accessible to finishing equipment.

3.09 SURFACE TEXTURE

- A. The surface of the pavement shall be finished with either a brush or broom, burlap drag, or artificial turf finish for all newly constructed concrete pavements. It is important that the texturing equipment not tear or unduly roughen the pavement surface during the operation. Any imperfections resulting from the texturing operation shall be corrected to the satisfaction of the Engineer.
- B. Brush or Broom Finish:
  - 1. If the pavement surface texture is to be a type of brush or broom finish, it shall be applied when the water sheen has practically disappeared. The equipment shall operate transversely across the pavement surface, providing corrugations that are uniform in appearance and approximately 1/16 IN in depth.
- C. Burlap Drag Finish:

1. If a burlap drag is used to texture the pavement surface, it shall be at least 15 OZ/SQ YD To obtain a textured surface, the transverse threads of the burlap shall be removed approximately 1 FT from the trailing edge. A heavy buildup of grout on the burlap threads produces the desired wide sweeping longitudinal striations on the pavement surface. The corrugations shall be uniform in appearance and approximately 1/16 IN in depth.

D. Artificial Turf Finish:

1. If artificial turf is used to texture the surface, it shall be applied by dragging the surface of the pavement in the direction of concrete placement with an approved full-width drag made with artificial turf. The leading transverse edge of the artificial turf drag will be securely fastened to a lightweight pole on a traveling bridge. At least 2 FT of the artificial turf shall be in contact with the concrete surface during dragging operations. A variety of different types of artificial turf are available and approval of any one type will be done only after it has been demonstrated by the Contractor to provide a satisfactory texture. One type that has provided satisfactory texture consists of 7,200 approximately 0.85 IN long polyethylene turf blades per square foot. The corrugations shall be uniform in appearance and approximately 1/16 IN in depth.

### 3.10 CURING

- A. Immediately after finishing operations are completed and marring of the concrete will not occur, the entire surface of the newly placed concrete shall be cured for a 7-day cure period in accordance with one of the methods below. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or lack of water to adequately take care of both curing and other requirements, shall be cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than 1/2 HR during the curing period.
- B. When a two-sawcut method is used to construct the contraction joint, the curing compound shall be applied to the sawcut immediately after the initial cut has been made. The sealant reservoir shall not be sawed until after the curing period has been completed. When the one cut method is used to construct the contraction joint, the joint shall be cured with wet rope, wet rags, or wet blankets. The rags, ropes, or blankets shall be kept moist for the duration of the curing period.
- C. Impervious Membrane Method:

1. The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place. The curing compound shall not be applied during rainfall. Curing compound shall be applied by mechanical sprayers under pressure at the rate of 1 GAL to not more than 150 SQ FT. The spraying equipment shall be of the fully atomizing type equipped with a tank agitator. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application the compound shall be stirred continuously by mechanical means. Hand spraying of odd widths or shapes and concrete surfaces exposed by the removal of forms will be permitted. When hand spraying is approved by the Engineer, a double application rate shall be used to insure coverage. The curing compound shall be of such character that the film will harden within 30 minutes after application. Should the film become damaged from any cause, including sawing operations, within the required curing period, the damaged portions shall be repaired immediately with additional compound or other approved means. Upon removal of side forms, the sides of the exposed slabs shall be protected immediately to provide a curing treatment equal to that provided for the surface.

D. Polyethylene Films:

1. The top surface and sides of the pavement shall be entirely covered with polyethylene sheeting. The units shall be lapped at least 18 IN (457 mm). The sheeting shall be placed and weighted to cause it to remain in contact with the surface and sides. The sheeting shall have dimensions that will extend at least twice the thickness of the pavement beyond the edges of the pavement. Unless otherwise specified, the sheeting shall be maintained in place for 7 days after the concrete has been placed.

E. Waterproof Paper:

1. The top surface and sides of the pavement shall be entirely covered with waterproofed paper. The units shall be lapped at least 18 IN (457 mm). The paper shall be placed and weighted to cause it to remain in contact with the surface covered. The paper shall have dimensions that will extend at least twice the thickness of the pavement beyond the edges of the slab. The surface of the pavement shall be thoroughly saturated prior to placing of the paper. Unless otherwise specified, the paper shall be maintained in place for 7 days after the concrete has been placed.

F. White Burlap-Polyethylene Sheets:

1. The surface of the pavement shall be entirely covered with the sheeting. The sheeting used shall be such length (or width) that it will extend at least twice the thickness of the pavement beyond the edges of the slab. The sheeting shall be placed so that the entire surface and both edges of the slab are completely covered. The sheeting shall be placed and weighted to remain in contact with the surface covered, and the covering shall be maintained fully saturated and in position for 7 days after the concrete has been placed.

2. Curing in Cold Weather. The concrete shall be maintained at a temperature of at least 50 DegF for a period of 72 HRS after placing and at a temperature above freezing for the remainder of the curing time. The Contractor shall be responsible for the quality and strength of the concrete placed during cold weather, and any concrete injured by frost action shall be removed and replaced at the Contractor's expense.

G. Water Method:

1. The entire area shall be covered with burlap or other water absorbing material. The material shall be of sufficient thickness to retain water for adequate curing without excessive runoff. The material shall be kept wet at all times and maintained for 7 days. When the forms are stripped, the vertical walls shall also be kept moist. It shall be the responsibility of the Contractor to prevent ponding of the curing water on the subbase.

### 3.11 PROTECTION OF PAVEMENT

- A. The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by the Contractor's employees and agents. This shall include watchmen to direct traffic and the erection and maintenance of warning signs, lights, pavement bridges, crossovers, and protection of unsealed joints from intrusion of foreign material, etc. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement replaced at the Contractor's expense. The Contractor shall have available at all times, materials for the protection of the edges and surface of the unhardened concrete. Such protective materials shall consist of rolled polyethylene sheeting at least 4 mils (0.1 mm) thick of sufficient length and width to cover the plastic concrete slab and any edges. The sheeting may be mounted on either the paver or a separate movable bridge from which it can be unrolled without dragging over the plastic concrete surface. When rain appears imminent, all paving operations shall stop and all available personnel shall begin covering the surface of the unhardened concrete with the protective covering.

### 3.12 OPENING TO TRAFFIC

- A. The pavement shall not be opened to traffic until test specimens molded and cured in accordance with ASTM C31 have attained a flexural strength of 550 psi when tested in accordance with ASTM C78. If such tests are not conducted, the pavement shall not be opened to traffic until 14 days after the concrete was placed. Prior to opening the pavement to construction traffic, all joints shall either be sealed or protected from damage to the joint edge and intrusion of foreign materials into the joint. As a minimum, backer rod or tape may be used to protect the joints from foreign matter intrusion. The pavement shall be cleaned before opening for normal operations.



### 3.13 REPAIR, REMOVAL, REPLACEMENT OF SLABS

#### A. General:

1. New pavement slabs that are broken or contain cracks shall be removed and replaced or repaired, as specified hereinafter at no cost to the owner. Spalls along joints shall be repaired as specified. Removal of partial slabs is not permitted. Removal and replacement shall be full depth, shall be full width of the slab, and the limit of removal shall be normal to the paving lane and to each original transverse joint. The engineer will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall be 4 IN (100 mm) DIA, shall be drilled by the Contractor and shall be filled by the Contractor with a well consolidated concrete mixture bonded to the walls of the hole with epoxy resin, using approved procedures. Drilling of cores and refilling holes shall be at no expense to the owner. All epoxy resin used in this work shall conform to ASTM C881, Type V.

#### B. Shrinkage Cracks:

1. Shrinkage cracks, which do not exceed 4 in in depth, shall be cleaned and then pressure injected with epoxy resin, Type IV, Grade 1, using procedures as approved. Care shall be taken to assure that the crack is not widened during epoxy resin injection. All epoxy resin injection shall take place in the presence of the Engineer. Shrinkage cracks, which exceed 4 in in depth, shall be treated as full depth cracks.

#### C. Slabs with Cracks through Interior Areas:

1. Interior area is defined as that area more than 6 IN (600 mm) from either adjacent original transverse joint. The full slab shall be removed and replaced at no cost to the owner, when there are any full depth cracks, or cracks greater than 4 IN in depth, that extend into the interior area.

#### D. Cracks Close To and Parallel To Joints:

1. All cracks essentially parallel to original joints, extending full depth of the slab, and lying wholly within 6 in either side of the joint shall be treated as specified hereinafter. Any crack extending more than 6 IN (600 mm) from the joint shall be treated as specified above in subparagraph "Slabs With Cracks Through Interior Area."
  - a. Full Depth Cracks Present, Original Joint Not Opened:
    - 1) When the original uncracked joint has not opened, the crack shall be sawed and sealed, and the original joint filled with epoxy resin as specified below. The crack shall be sawed with equipment specially designed to follow random cracks. The reservoir for joint sealant in the crack shall be formed by sawing to a depth of 3/4 IN (19 mm),  $\pm 1/16$  IN (1.6 mm), and to a width of 5/8 IN (16 mm),  $\pm 1/8$  IN (3.2 mm). Any equipment or procedure which causes raveling or spalling along the crack shall be modified or replaced to prevent such raveling or spalling. The joint sealant shall be a liquid sealant as specified. Installation of joint seal shall be as specified for sealing joints or as directed. If the joint sealant reservoir has been sawed out, the reservoir and as much of the lower saw cut as possible shall be filled with epoxy resin, Type IV, Grade 2, thoroughly tooled into the void using approved procedures.
    - 2) If only the original narrow saw cut has been made, it shall be cleaned and pressure injected with epoxy resin, Type IV, Grade 1, using approved procedures. If filler type material has been used to form a weakened plane in the transverse joint, it shall be completely sawed out and the saw cut pressure injected with epoxy resin, Type IV, Grade 1, using approved procedures. Where a parallel crack goes part way across paving lane and then intersects and follows the original joint which is cracked only for the remained of the width, it shall be treated as specified above for a parallel crack, and the cracked original joint shall be prepared and sealed as originally designed.
  - b. Full Depth Cracks Present, Original Joint Also Cracked:
    - 1) At a joint, if there is any place in the lane width where a parallel crack and a cracked portion of the original joint overlap, the entire slab containing the crack shall be removed and replaced for the full lane width and length.

E. Removal and Replacement of Full Slabs:

1. Where it is necessary to remove full slabs, unless there are keys or dowels present, all edges of the slab shall be cut full depth with a concrete saw. All saw cuts shall be perpendicular to the slab surface. If keys, dowels, or tie bars are present along any edges, these edges shall be sawed full depth 24 IN (150 mm) from the edge if only keys are present, or just beyond the end of the dowels or tie bars if they are present. These joints shall then be carefully sawed on the joint line to within 1 IN (25 mm) of the depth of the dowel or key.

2. The main slab shall be further divided by sawing full depth, at appropriate locations, and each piece lifted out and removed. Suitable equipment shall be used to provide a truly vertical lift, and approved safe lifting devices used for attachment to the slabs. The narrow strips along keyed or doweled edges shall be carefully broken up and removed using light, hand-held jackhammers, 30 LB (14 kg) or less, or other approved similar equipment.
3. Care shall be taken to prevent damage to the dowels, tie bars, or keys or to concrete to remain in place. The joint face below keys or dowels shall be suitably trimmed so that there is not abrupt offset in any direction greater than 1/2 IN (12 mm) and no gradual offset greater than 1 IN (25 mm) when tested in a horizontal direction with a 12 FT (3.6 m) straightedge.
4. No mechanical impact breakers, other than the above hand-held equipment shall be used for any removal of slabs. If underbreak between 1-1/2 and 4 IN (37 and 100 mm) deep occurs at any point along any edge, the area shall be repaired as directed before replacing the removed slab. Procedures directed will be similar to those specified for surface spalls, modified as necessary.
5. If underbreak over 4 IN (100 mm) deep occurs, the entire slab containing the underbreak shall be removed and replaced. Where there are no dowels, tie bars, or keys on an edge, or where they have been damaged, dowels of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete using procedures as specified. Original damaged dowels or tie bars shall be cut off flush with the joint face. Protruding portions of dowels shall be painted and lightly oiled. All 4 edges of the new slab shall thus contain dowels or original keys or original tie bars.
6. Placement of concrete shall be as specified for original construction. Prior to placement of new concrete, the underlying material (unless it is stabilized) shall be re-compacted and shaped as specified in the appropriate SECTION of these specifications. The surfaces of all four joint faces shall be cleaned of all loose material and contaminants and coated with a double application of membrane forming curing compound as bond breaker. Care shall be taken to prevent any curing compound from contacting dowels or tie bars. The resulting joints around the new slab shall be prepared and sealed as specified for original construction.

F. Repairing Spalls Along Joints:

1. Where directed, spalls along joints of new slabs, and along parallel cracks used as replacement joints, shall be repaired by first making a vertical saw cut at least 1 IN (25 mm) outside the spalled area and to a depth of at least 2 IN (50 mm). Saw cuts shall be straight lines forming rectangular areas. The concrete between the saw cut and the joint, or crack, shall be chipped out to remove all unsound concrete and at least 1/2 IN (12 mm) of visually sound concrete. The cavity thus formed shall be thoroughly cleaned with high-pressure water jets supplemented with compressed air to remove all loose material. Immediately before filling the cavity, a prime coat of epoxy resin, Type III, Grade I, shall be applied to the dry cleaned surface of all sides and bottom of the cavity, except any joint face. The prime coat shall be applied in a thin coating and scrubbed into the surface with a stiff-bristle brush. Pooling of epoxy resin shall be avoided. The cavity shall be filled with low slump Portland cement concrete or mortar or with epoxy resin concrete or mortar. Concrete shall be used for larger spalls, generally those more than 1/2 CU FT (0.014 m<sup>3</sup>) in size, and mortar shall be used for the smaller ones. Any spall less than 0.1 CU FT (0.003 m<sup>3</sup>) shall be repaired only with epoxy resin mortar or a Grade III epoxy resin. Portland cement concrete and mortar mixtures shall be proportioned as directed and shall be mixed, placed, consolidated, and cured as directed. Epoxy resin mortars shall be made with Type III, Grade 1, epoxy resin, using proportions and mixing and placing procedures as recommended by the manufacturer and approved by the Engineer. The epoxy resin materials shall be placed in the cavity in layers not over 2 IN (50 mm) thick. The time interval between placement of additional layers shall be such that the temperature of the epoxy resin material does not exceed 140 DegF (60 DegC) at any time during hardening. Mechanical vibrators and hand tampers shall be used to consolidate the concrete or mortar. Any repair material on the surrounding surfaces of the existing concrete shall be removed before it hardens. Where the spalled area abuts a joint, an insert or other bond-breaking medium shall be used to prevent bond at the joint face. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints, or as required to be routed for cracks. The reservoir shall be thoroughly cleaned and sealed with the sealer specified for the joints. If any spall penetrates half the depth of the slab or more, the entire slab shall be removed and replaced as previously specified.

3.14 EXISTING CONCRETE PAVEMENT REMOVAL AND REPAIR

- A. All operations shall be carefully controlled to prevent damage to the concrete pavement and to the underlying material to remain in place. All saw cuts shall be made perpendicular to the slab surface.
- B. Removal of Existing Pavement Slab:
  1. When it is necessary to remove existing concrete pavement and leave adjacent concrete in place, the joint between the removal area and adjoining pavement to stay in place, shall first be cut full depth. The pavement to be removed shall be carefully broken up and removed using hand-held jackhammers, 30 LB (14 kg) or less, or the approved light-duty equipment which will not cause stress to propagate across the joint saw cut and cause distress in the pavement which is to remain in place.

C. Edge Repair:

1. The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Areas that are damaged during construction shall be repaired at no cost to the Owner.
2. Spall Repair. Spalls shall be repaired where indicated and where directed. Repair materials and procedures shall be as previously specified in subparagraph "Repairing Spalls Along Joints."
3. Underbreak Repair. All underbreak shall be repaired. First, all delaminated and loose material shall be carefully removed. Next, the underlying material shall be recompact, without addition of any new material. Finally, the void shall be completely filled with paving concrete, thoroughly consolidated. Care shall be taken to produce an even joint face from top to bottom. Prior to placing concrete, the underlying material shall be thoroughly moistened. After placement, the exposed surface shall be heavily coated with curing compound.
4. Underlying Material. The underlying material adjacent to the edge or under the existing pavement, which is to remain in place, shall be protected from damage or disturbance during removal operations and until placement of new concrete, and shall be shaped as shown on the drawings or as directed. Sufficient material shall be kept in place outside the joint line to prevent disturbance (or sloughing) of material under the pavement that is to remain in place. Any material under the portion of the concrete pavement to remain in place, which is disturbed or loses its compaction shall be carefully removed and replaced with concrete per Engineer's recommendations. The underlying material outside the joint line shall be thoroughly compacted and moist when new concrete is placed.

3.15 CONTRACTOR QUALITY CONTROL

A. Quality Control Program:

1. When the proposed paving area is greater than 40,000 sf or a full length craneway, the Contractor shall develop a Quality Control Program in accordance with Section 01 45 00 Quality Assurance & Controls. The program shall address all elements that affect the quality of the pavement including but not limited to:
  - a. Mix Design.
  - b. Aggregate Gradation.
  - c. Quality of Materials.
  - d. Stockpile Management.
  - e. Proportioning.
  - f. Mixing and Transportation.
  - g. Placing and Consolidation.
  - h. Joints.
  - i. Dowel Placement and Alignment.
  - j. Flexural and Compressive Strength.
  - k. Finishing and Curing.

1. Surface Smoothness.

3.16 QUALITY CONTROL TESTING

- A. The Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to this specification and as set forth in the Quality Control Program. The testing program shall include, but not necessarily be limited to, tests for aggregate gradation, aggregate moisture content, slump, and air content.
- B. A Quality Control Testing Plan shall be developed as part of the Quality Control Program, and shall include the following:

1. Fine Aggregate:

- a. Gradation. A sieve analysis shall be made at least twice daily in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.
- b. Moisture Content. If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C70 or ASTM C566.

2. Coarse Aggregate:

- a. Gradation. A sieve analysis shall be made at least twice daily for each size of aggregate. Tests shall be made in accordance with ASTM C136 from randomly sampled material taken from the discharge gate of storage bins or from the conveyor belt.
- b. Moisture Content. If an electric moisture meter is used, at least two direct measurements of moisture content shall be made per week to check the calibration. If direct measurements are made in lieu of using an electric meter, two tests shall be made per day. Tests shall be made in accordance with ASTM C566.

3. Slump. Four slump tests shall be performed for each lot of material produced. One test shall be made for each subplot. Slump tests shall be performed in accordance with ASTM C143 from material randomly sampled from material discharged from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.
4. Air Content. Four air content tests, shall be performed for each lot of material produced. One test shall be made for each subplot. Air content tests shall be performed in accordance with ASTM C231 for gravel and stone coarse aggregate and ASTM C173 for slag or other porous coarse aggregate, from material randomly sampled from trucks at the paving site. Material samples shall be taken in accordance with ASTM C172.
5. Four unit weight and yield tests shall be made in accordance with ASTM C138. The samples shall be taken in accordance with ASTM C172 and at the same time as the air content tests.

C. Control Charts:

1. The Contractor shall maintain linear control charts for fine and coarse aggregate gradation, slump, and air content.
2. Control charts shall be posted in a location satisfactory to the Engineer and shall be kept up to date at all times. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and suspension Limits, or Specification limits, applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable causes before they occur. If the Contractor's projected data during production indicates a potential problem and the Contractor is not taking satisfactory corrective action, the Engineer may halt production or acceptance of the material.
3. The control charts shall include:
  - a. Fine and Coarse Aggregate Gradation. The Contractor shall record the running average of the last five gradation tests for each control sieve on linear control charts. Specification limits shall be superimposed on the Control Chart for job control.
  - b. Slump and Air Content. The Contractor shall maintain linear control charts both for individual measurements and range (that is, difference between highest and lowest measurements) for slump and air content in accordance with the following Action and Suspension Limits.

#### Control Chart Limits

Control Parameter	Individual Measurements		Range Suspension Limit
	Action Limit	Suspension Limit	
Slip Form:			
Slump	+0 to -1 in (0-25 mm)	+0.5 to -1.5 in (13-38 mm)	+/- 1.5 in (38 mm)
Air Content	+/- 1.2%	+/- 1.8%	+/- 2.5%
Fixed Form:			
Slump	+ 0.5 to -1 in (13-25 mm)	+1 to -1.5 in (25-38 mm)	+/- 1.5 in (38 mm)
Air Content	+/- 1.2%	+/- 1.8%	+/- 2.5%

The individual measurement control charts shall use the mix design target values as indicators of central tendency.

D. Corrective Action:

1. The Contractor Quality Control Program shall indicate that appropriate action shall be taken when the process is believed to be out of control. The Contractor Quality Control Program shall detail what action will be taken to bring the process into control and shall contain sets of rules to gauge when a process is out of control. As a minimum, a process shall be deemed out of control and corrective action taken if any one of the following conditions exists.
  - a. Fine and Coarse Aggregate Gradation. When two consecutive averages of five tests are outside of specification limits, immediate steps, including a halt to production, shall be taken to correct the grading.
  - b. Fine and Coarse Aggregate Moisture Content. Whenever the moisture content of the fine or coarse aggregate changes by more than 0.5 percent, the scale settings for the aggregate batcher and water batcher shall be adjusted.
  - c. Slump. The Contractor shall halt production and make appropriate adjustments whenever:
    - 1) one point falls outside the Suspension Limit line for individual measurements or range.  
OR
    - 2) two points in a row fall outside the Action Limit line for individual measurements.
  - d. Air Content. The Contractor shall halt production and adjust the amount of air-entraining admixture whenever:
    - 1) one point falls outside the Suspension Limit line for individual measurements or range.  
OR
    - 2) two points in a row fall outside the Action Limit line for individual measurements.
  - e. Whenever a point falls outside the Action Limits line, the air-entraining admixture dispenser shall be calibrated to ensure that it is operating correctly and with good reproducibility.

E. Contractor Quality Control Staff:

1. All Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) certified in the following grade (or shall have written evidence acceptable to UP of having completed similar qualification programs):
  - a. CQC personnel responsible for inspection of concrete paving operations: ACI Concrete Transportation Inspector.
  - b. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I.
  - c. Laboratory Testing Technicians: ACI Concrete Strength Testing Technician and Laboratory Testing Technician, Grade I or II.

F. Laboratory Accreditation:



1. Laboratory and testing facilities shall be provided by and at the expense of the Contractor. The laboratories performing the tests shall be accredited in accordance with ASTM C1077, including ASTM C1260. The accreditation shall be current and shall include the required and optional test methods, as specified throughout this Specification.

G. Reports:

1. All results of tests conducted at the project site shall be reported on the same day tested and shall be delivered to UP. These requirements do not relieve the Contractor of the obligation to report failures immediately to UP. Such reports of failure and the action taken shall be confirmed in writing in the routine reports. UP has the right to examine all Contractor quality control records at any time.

3.17 QUALITY ASSURANCE

- A. UP may sample and test aggregates and concrete during construction and inspect production and placement facilities and equipment to determine compliance with the specifications as specified herein and as otherwise considered appropriate. Provide facilities and labor as may be necessary for procurement of representative test samples. Testing performed by UP will not relieve the Contractor from the quality control testing requirements specified.

**END OF SECTION**

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## **SECTION 32 13 13 - CEMENT CONCRETE PAVEMENT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Exterior cement concrete pavement for the following:
  - a. Driveways and roadways.
  - b. Parking aprons and Drop Slabs.
  - c. Curbs and gutters.
  - d. Walkways.
  - e. Equipment Pads.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 31 00 00 - "Earthwork" for subgrade preparation, grading, and subbase course.
- C. Section 07 92 00 - "Joint Sealants" for joint sealants within concrete pavement and at isolation joints of concrete pavement with adjacent construction.
- D. Section 03 30 00 - "Cast-in-Place Concrete" for general building applications of concrete.
- E. 03 20 00 - "Concrete Reinforcement" for exterior cement pavement requiring reinforcement.
- F. Soils Report: The Owner has provided a Soils Report for this project which contains specific recommendations for Concrete Pavement Design Sections. All portions of this report, including recommendations for subgrade stabilization, preparation, and Pavement Design are considered to be part of this specification.

#### **1.03 SUBMITTALS**

- A. Product Data: For each type of manufactured material and product indicated.
- B. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

#### **1.04 QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

- B. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
- C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant and each aggregate from one source.
- D. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by the requirements of the Contract Documents.
- E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.

#### 1.05 PROJECT CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

### PART 2 - PRODUCTS

#### 2.01 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.
  - 1. Use flexible or curved forms for curves of a radius 100 FT or less.
- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

#### 2.02 STEEL REINFORCEMENT

- A. Plain-Steel Welded Wire Fabric: ASTM A185, fabricated from as-drawn steel wire into flat sheets.
- B. Deformed-Steel Welded Wire Fabric: ASTM A497, flat sheet.
- C. Reinforcement Bars: ASTM A615/A615M, Grade 60, deformed.
- D. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, Grade 60, deformed bars; assembled with clips.
- E. Plain Steel Wire: ASTM A82, as drawn.
- F. Joint Dowel Bars: Plain steel bars, ASTM A615/A615M, Grade 60. Cut bars true to length with ends square and free of burrs.
- G. Tie Bars: ASTM A615/A615M, Grade 60, deformed.
- H. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
  - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer coated wire bar supports.

### 2.03 CONCRETE MATERIALS

- A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.
- B. Portland Cement: ASTM C150, Type I or II.
- C. Aggregate: ASTM C33, uniformly graded, from a single source, with coarse aggregate as recommended for climate zone of project location.
- D. Water: ASTM C94.

### 2.04 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.
- B. Air-Entraining Admixture: ASTM C260.
- C. Water-Reducing Admixture: ASTM C494, Type A.
- D. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
- E. Water-Reducing and Accelerating Admixture: ASTM C494, Type E. Water-Reducing and Retarding Admixture: ASTM C494, Type D.

### 2.05 CURING MATERIALS

- A. Absorptive Cover: AASHTO M182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 OZ/SQ YD dry.
- B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B.
- F. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  1. Evaporation Retarder:
    - a. Spray-Film; ChemMasters.
    - b. Sure Film; Dayton Superior Corporation.
    - c. Eucobar; Euclid Chemical Co.
    - d. Lambco Skin; Lambert Corporation.
    - e. E-Con; L&M Construction Chemicals, Inc.
    - f. Confilm; Master Builders, Inc.

- g. Waterhold; Metalcrete Industries.
- h. SikaFilm; Sika Corporation.
- i. Finishing Aid; Symons Corporation.
- 2. Clear Waterborne Membrane-Forming Curing Compound:
  - a. Safe-Cure Clear; ChemMasters.
  - b. Day Chem Rez Cure (J-11-W); Dayton Superior Corporation.
  - c. Aqua Kure-Clear; Lambert Corporation.
  - d. L&M Cure R; L&M Construction Chemicals, Inc.
  - e. 1100 Clear; W. R. Meadows, Inc.
  - f. Resi-Chem Clear Cure; Symons Corporation.

## 2.06 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.
- B. Pavement-Marking Paint: Alkyd-resin type; ready mixed; complying with FS TT-P-115, Type I, or AASHTO M248, Type N.
  - 1. Color: Blue for handicapped requirements, red for fire lanes, yellow elsewhere.
- C. Glass Beads: AASHTO M247.

## 2.07 CONCRETE MIXES

- A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.
  - 1. Do not use Owner's field quality-control testing agency as the independent testing agency.
- C. Proportion mixes to provide concrete with the following properties:
  - 1. Compressive Strength (28 Days): 4000 psi.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
  - 3. Slump Limit: 4 IN,  $\pm 1$  IN.
    - a. Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8 IN after adding admixture to plant- or site-verified, 2 to 3 IN slump.
- D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements for concrete exposed to deicing chemicals.
- E. Air Content: 6.0 percent,  $\pm 1.5$  percent.

## 2.08 CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with requirements and with ASTM C94.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Proof-roll prepared subbase surface to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and subgrade is ready to receive pavement.
- B. Remove loose material from compacted subbase surface immediately before placing concrete.

### 3.02 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 HRS after concrete placement.
- B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

### 3.03 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.
  - 1. Apply epoxy repair coating to uncoated or damaged surfaces of epoxy-coated reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2 IN overlap to adjacent mats.

### 3.04 JOINTS

- A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.
  - 1. When joining existing pavement, place transverse joints to align with previously placed joints, unless otherwise indicated.

- B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than 1/2 HR, unless pavement terminates at isolation joints. All expansion joints shown on the Drawings and as otherwise noted are considered to be a construction joint.
1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 IN into concrete.
  2. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
  3. Provide tie bars at sides of pavement strips where indicated.
  4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
  5. Terminate Pour at all required expansion joint locations. Secure and support expansion joint material on one side by forms.
  6. Follow requirements outlined for preparation and cutting of joint bed at all construction joints as outlined in Paragraph 3.04 E. below.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
1. Locate expansion joints at intervals as indicated on the drawings.
  2. Extend joint fillers full width and depth of joint.
  3. Terminate joint filler less than 1/2 IN or more than 1 IN below finished surface if joint sealant is indicated.
  4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
  5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint- filler sections together.
  6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Contraction / Control Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints as indicated on the Drawings.
1. Locate contraction joints and construct as indicated on the Drawings.
  2. In areas where spacing of Control Joints is not specified, the following maximum spacing of control joints shall not be exceeded in either direction.
    - a. 4 IN Thick Slabs: 6 FT-0 IN.



- b. 5 IN Thick Slabs: 8 FT-0 IN.
  - c. 6 IN Thick Slabs: 10 FT-0 IN.
  - d. 8 IN Thick Slabs: 12 FT-0 IN.
  - e. Greater than 8 IN:  $\text{Depth (IN)} \times 1.5 = \text{Max. Joint Spacing (FT)}$ .
3. Make initial cut equal to 1/4 slab depth as soon as slab can be cut without damage but in no case shall initial cut be made more than 24 HRS after initial pour.
  4. Soft cut process may be used only with prior approval of the Architect and then only for the initial cut.
  5. Allow concrete pavement to cure for 28 days or until 28 day design strength can be verified by independent test reports before making second cut.
  6. Use wet cut process to cut joint for sealant bed as indicated on the Drawings.
- F. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.
1. Radius: 3/8 IN.

### 3.05 CONCRETE PLACEMENT

- A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.
- B. Remove snow, ice, or frost from subbase surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery, at Project site, or during placement.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, roding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
  1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

- H. Screed pavement surfaces with mechanical screed. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry- shake surface treatments.
- I. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.
- J. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained 85 percent of its 28-day compressive strength.

### 3.06 CONCRETE FINISHING

- A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.
- B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.
  - 1. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 IN deep with a stiff-bristled broom, perpendicular to line of traffic.

### 3.07 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot- weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 LB/SQ FT x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:
  - 1. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 IN and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

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

### 3.08 PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117 and as follows:
  1. Elevation: 1/4 IN.
  2. Thickness: +3/8 IN, -1/4 IN.
  3. Surface: Gap below 10 FT long, unleveled straightedge not to exceed 1/4 IN.
  4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 IN.
  5. Vertical Alignment of Tie Bars and Dowels: 1/4 IN.
  6. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 IN.
  7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 IN per 12 IN.
  8. Joint Spacing: 3 IN.
  9. Contraction Joint Depth: +1/4 IN, no minus.
  10. Joint Width: +1/8 IN, no minus.

### 3.09 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow concrete pavement to cure for 28 days and be dry before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
  1. If drawings indicate reflective markings broadcast glass spheres uniformly into wet pavement markings at a rate of 6 LB/GAL.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement.
- B. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods as directed.

### 3.11 REPAIRS AND PROTECTION

- A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.
- B. Drill test cores where directed by Architect when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

**END OF SECTION**

## **SECTION 32 17 23 - PAINT STRIPING AND MARKINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes:
  - 1. Providing traffic and parking lot paint marks, as indicated on the Drawings.
- B. Yellow latex paint especially formulated and manufactured for use on asphaltic concrete under traffic conditions.
- C. Cleaning: Sweep and clean surface to eliminate loose material and dust.
- D. Painting: Apply paint in two (2) coats. Allow the first coat to dry prior to applying the second coat, or as directed by the Engineer.
- E. Color: Yellow, unless otherwise specified.

### **PART 2 - PRODUCT**

#### **2.01 STRIPING PAINT**

- A. Paint for striping and markings shall be a yellow latex paint especially formulated and manufactured for use on asphaltic concrete under traffic conditions. Acceptable striping paints are:
  - 1. Lane Marking Paint #7800 Ameritone.
  - 2. "Nonreflectorized" Sherwin-William Co.

### **PART 3 - EXECUTION**

#### **3.01 EXECUTION**

- A. Apply paint with mechanical equipment to produce uniform straight lines with straight edges and a minimum of overspray. Striping and markings shall comply with site plan layout or located as directed by the Engineer. Sizes are as follows:
  - 1. Parking Lot Striping: 4 IN wide - 2 coats.
  - 2. Arrows: 18 IN high.
  - 3. Letters: 18 IN high for aisle.
  - 4. Letters: 12 IN high for speed limit painted on asphalt (see attached drawing).
  - 5. Numbers: 12 IN high.

### **PART 4 - MEASUREMENT AND PAYMENT**

#### **4.01 MEASUREMENT AND PAYMENT**

- A. Markings, including arrows, numbers or letters, will be paid for at the contract unit price per each marking applied according to Specifications.

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PAINT STRIPING AND MARKINGS

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- B. Striping will be paid for at the contract unit price per linear foot applied according to Specifications.

**END OF SECTION**

## **SECTION 32 31 10 - RIGHT OF WAY FENCES AND GATES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

##### **1. Standard Right Of Way Fence:**

- a. The extent of the Standard Right of Way fence and gates is as indicated on the drawings or as designated by the Engineer and in accordance with typical details shown on drawing 0075.

#### **1.02 SUBMITTALS**

- A. Submit manufacturer's technical data and installation instructions for all fence material, a sufficient time in advance to permit review by the Engineer, before ordering material.

#### **1.03 QUALITY ASSURANCE**

- A. Provide wire fences and gates as complete units, controlled by a single source, or approved by the Engineer, including necessary erection accessories, fittings and fastenings.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

##### **A. General:**

1. Dimensions indicated for material are outside dimensions, exclusive of coating and shall consist of all new materials unless otherwise specified herein.

##### **B. Hog Tight, Woven Wire, Steel Fabric:**

1. A 26 IN woven wire galvanized steel fabric is to be used. With 7 horizontal bars of No. 9 galvanized wire and stays on 6 IN centers. Weight is approximately 266 LBS per 20 rod roll.

##### **C. Posts:**

1. Line Posts: Use painted studded tee steel fence posts 7 FT-0 IN long, with anchor plate, spaced as shown on drawing 0075.
2. Corner Post: Use 6 IN DIA by 9 FT-0 IN with 5 percent solution penta treated wood posts or 7 IN x 9 IN second hand wood ties.
3. Brace Panel Posts: Use 6 IN DIA by 9 FT-0 IN, with 5 percent solution penta treated wood posts or 7 IN x 9 IN second hand wood ties.
4. Horizontal Brace Posts: Brace posts shall be 4 IN DIA or 4 IN x 4 IN x 8 FT-0 IN wood with 5 percent solution penta treated horizontal braces.

- 5. Gate Posts: Use 7 IN x 9 IN x 9 FT second hand ties. Each side of gate shall have a brace panel constructed to support gate.
- D. Barbed Wire: Barbed wire shall be two-strand 12.5 galvanized wire, twisted, with 14-gauge 4-point barbs spaced not more than 5 IN center to center. Metal and finish to match fabric (galvanized).
- E. Diagonal Tie Wire: Use double number 8 galvanized steel wire twisted.
- F. Wire Clips: Use 12 gauge galvanized wire clips.
- G. Wire Staples: Use 1.5 IN 9 gauge galvanized steel wire staples.
- H. Gates: Gate frames shall be constructed of 1.625 IN DIA steel tube with .066 IN wall. Rails shall be high strength 16 gauge s-bend shape. Stays shall be roll-formed 12 gauge welded in pairs. Latch shall be double pine 1/2 IN x 1 IN steel with lock and saddle horse type handle. Hinge shall be full wrap omega style 1/4 IN steel with bottom in fixed position and top will adjust vertically 5 IN between rails.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. General: Do not begin installation and erection until timely notice has been given to the Engineer. The area along the fence line shall be cleared enough to permit proper construction. Any clearing required for fence construction shall be incidental to the fence construction bid item.

### **PART 4 - MEASUREMENT AND PAYMENT**

#### **4.01 MEASUREMENT**

- A. Fencing shall be measured by the linear foot of fence constructed, excluding gates. Gates shall be measured as each gate, complete in place.

#### **4.02 PAYMENT**

- A. Fence shall be paid for at the unit price bid per linear foot.
- B. Gates shall be paid for at the lump sum price bid per each gate.
- C. The price shall be full compensation for furnishing, fabricating and installing all materials, preparation, hauling, including all labor, tools, equipment and incidentals necessary to complete the work. Excavation, backfilling, disposal of surplus material and clean-up is also included.

### **END OF SECTION**



## **SECTION 32 31 13 - CHAIN LINK FENCING AND GATES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Description:**

1. The extent of chain link fence and gates is indicated on the drawings, in the bid items, or as designated by the Engineer.

##### **B. Quality Assurance:**

1. Provide chain link fence and gates, including all erection accessories, fittings, and fastenings as complete units, which are called for in the specifications and approved by the Engineer.

##### **C. Submittals:**

1. Submit under provisions of Section 01 33 00.
2. Submit manufacturer's technical data and installation instructions for all fence material. Submit data early enough to permit review and approval by the Engineer before ordering material.

##### **D. Comply with provisions of shop drawings as noted.**

### **PART 2 - PRODUCTS**

#### **2.01 GENERAL**

- ##### **A. Dimensions indicated for posts, roll formed and H Section, are outside dimensions, exclusive of coatings.**

#### **2.02 MANUFACTURER**

##### **A. Subject to compliance with requirements, provide products of one of the following:**

1. Allied Tube and Conduit Corp.
2. American Fence Corp.
3. Anchor Fence, Inc.
4. Cyclone Fence - A Div. of U.S. Diversified Group or other approved source

#### **2.03 STEEL FABRIC:**

- ##### **A. Fabric: No. 9-gauge or 0.148" coated steel wire size, 2" mesh fabric 60" and under knuckled both selvages, for fabric 72" or over, bottom selvage knuckled and the top selvage twisted and barbed.**
- ##### **B. Furnish one-piece fabric widths.**
- ##### **C. Fabric Finish: Galvanized, ASTM A 392, Class II, with not less than 2.0 oz. zinc per square foot of surface.**

## 2.04 GENERAL FITTINGS AND POSTS.

### A. Accessories:

1. Steel Framework, General:
  - a. Galvanized steel, ASTM A 120 or KA 123, with not less than 1.8 oz. zinc per square foot of surface.
2. Fittings and Accessories:
  - a. Galvanized, ASTM A 153, with zinc weights per Table I.
3. End, Corner, and Pull Posts:
  - a. Minimum sizes and weights as follows:
    - 1) 2.875" O.D. steel pipe, 5.79 lbs. per lin. ft.
4. Line Posts:
  - a. Space 10' o.c. maximum, unless otherwise indicated, of following minimum size and weight:
    - 1) 2.375" O.D. steel pipe, 3.65 lbs. per lin. ft.
    - 2) 2.25" x 1.70" H Section line posts, 3.26 lbs. P.L.F.
5. Gate Posts:
  - a. Furnish posts for supporting 12'-6" nominal gate leaf, as follows:
    - 1) 6.625" O.D. pipe post, 18.97 lbs. per lin. ft.
6. Tension Wire:
  - a. 7-gauge, coated coil spring wire, metal and finish to match fabric.
7. Wire Ties:
  - a. 11-gauge galvanized steel or 11 gauge aluminum wire, to match fabric core material.
8. Top and Brace Rails:
  - a. Use 1.626" O.D. pipe as top rail for brace, and truss to line post.
9. Truss Rod:
  - a. Use 0.375" diameter rod and adjustable tightener.
10. Stretcher Bars:
  - a. One-piece lengths equal to full height of fabric, with minimum cross section of 3/16" x 3/4".
11. Stretcher Bar Bands:
  - a. Space not over 15" o.c. to secure stretcher bars to end, corner, pull and gate posts.
12. Barbed Wire:
  - a. Three-strand, 12-1/2 gauge wire, with 14 gauge 4 point barbs spaced not more than 5" o.c.; metal and finish to match fabric, if required.

13. Barbed Wire Supporting Arms:

- a. Capable of withstanding 250 lbs. of downward pull at the outermost end.

14. Fence Slats (If Required):

- a. Manufacturer: P.D.S. Division of AB Plastics, Inc.
- b. Type: Tubular shaped plastic, to fit fencing mesh size for vertical installation.
- c. Color of slats will be selected by the Engineer.

2.05 GATES:

A. Swing Gates:

1. Manually Operated:

- a. Gate Hardware: Provide hardware and accessories for each gate, galvanized per ASTM A 153.
- b. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180 degree gate opening. Provide 1-1/2 pair of hinges for each leaf.
- c. Latch: Forked type or plunger-bar type to permit operation from either side of gate, with padlock eye as integral part of latch.
- d. Keeper: Provide keeper which automatically engages gate leaf and holds it in open position until manually released.
- e. Make perimeter frames of min. 1.90" O.D. pipe.

2. Double Swing gates.

- a. Provide gate stops for double gates, consisting of mushroom-type flush plate with anchors, set in concrete, and designed to engage center drop rod or plunger bar.
- b. Include locking device and padlock eyes as integral part of latch, permitting both gate leaves to be locked with single padlock.

B. Sliding Gates:

1. Sliding Gates Manual:

- a. Provide manufacturer's standard heavy-duty inverted channel track, ball bearing hanger sheaves, supports, guides, stays, bracing, hardware, and accessories as required. Provide for locking with padlock.

2. Sliding Gates Automatic:

- a. "Electrical gate opener" provide manufacturer's standard heavy-duty inverted channel track, ball bearing hanger, guides, sheaves, support, stays, bracing, hardware, and accessories as required and controlled by a single source.
- b. NOTE: These gates may be single or double gates, which will be called out in the bid item.

C. Concrete:

1. Provide concrete consisting of Portland cement, ASTM C 150, aggregates ASTM C 33, and clean water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 3,000 psi, using a min. of 5 sack cement per C.Y. 1" maximum size aggregate, maximum 3" slump and 2% to 4% entrained air.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General:

1. Do not begin installation and erection before asphalt paving under fence area is completed. If fence is not on asphalt, the area along the fence line shall be cleared to permit proper construction. Any clearing required for fence installation is incidental to fence construction bid item.

B. Excavation:

1. Drill or hand-excavate (using post-hole digger) holes for posts to diameters and spacing indicated, in firm, undisturbed, and/or compacted soil. Excavate holes for each post to minimum diameter of not less than four times largest cross-section of post.

C. Setting Posts:

1. Center and align post 3' above bottom of excavation. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations. Unless otherwise indicated, extend concrete footings 2" above grade, and trowel to a crown to shed water.

D. Center Rails:

1. Provide center rails where indicated. Install in one piece between posts, and flush with post on fabric side, using special offset fittings where necessary.

E. Post Brace Assemblies:

1. Install braces so posts are plumb when diagonal rod is under tension. Manufacturer's standard adjustable brace at end and gate posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric.

F. Tension Wire:

1. Install tension wires through post cap loops before stretching fabric, and tie each post cap with not less than 6 gauge galvanized wire. Fasten fabric to tension wire using 11 - gauge galvanized steel hog rings, spaced 24" o.c. Install tension wire at top and bottom of fence fabric.

G. Fabric:

1. Leave approximately 1" above top of asphalt or ground and bottom selvage, unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released. Install plastic slats in areas shown on drawings, if required.

H. Stretcher Bars:

1. Thread through or clamp to fabric 4" o.c., and secure to posts with metal bands spaced 15" o.c. Provide one stretcher bar for each gate and end post, and two for each corner and pull post, except where fabric is integrally woven into post.

I. Barbed Wire:

1. Pull wire taut and install securely to extension arms, and secure to end post or terminal arms in accordance with manufacturer's instructions.

J. Barbed Wire Supporting Arms:

1. Manufacturer's standard barbed wire supporting arms, metal and finish to match fence framework, with provision for anchorage to posts and attaching three rows of barbed wire to each arm. Supporting arms may be either attached to posts or integral with post top weather cap, and must be capable of withstanding 250 lbs. downward pull at outermost end. Single 45 degree arm; for three strands barbed wire, one for each post and vertical arm installation.

K. Tie Wires:

1. Use U-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons or clothing. Tie fabric to line posts, with wire tie spaced 12" o.c. Tie fabric to rails and braces, with wire ties spaced 24" o.c. Tie fabric to tension wires, with hog rings spaced 24" o.c.

L. Fasteners:

1. Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Pen ends of bolts or score threads to prevent removal of nuts.

3.02 GATES:

A. Installation and Fabrication:

1. Install gates plumb, level, and secure for full opening without interference. Install ground set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.
2. Fabrication: Fabricate perimeter frames of gates from metal and finish to match fence framework. Assemble gate frames by welding or with special fittings and rivets for rigid connection, providing security against removal or breakage connections. When welding or damage occurs, repair finish so as to protect from rust. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware, and accessories. Space frame members maximum of 8' apart, unless otherwise indicated.

3. Provide same fabric as for fence. Install fabric with stretcher bars at vertical edges, and at top and bottom edges. Attach stretcher bars to gate frame at not more than 15" o.c.
4. Install diagonal cross-bracing, consisting of 3/8" diameter adjustable length truss rods on gates to ensure frame rigidity, without sag or twist.
5. Extend end members of gate frames 1'-0" above top member, and prepare to receive three strands of wire. Provide necessary clips for securing wire to extensions.

#### **PART 4 - MEASUREMENT AND PAYMENT**

##### **4.01 MEASUREMENT**

- A. Chain Link or Cyclone Fencing shall be measured by the linear foot of fence which is a certain height constructed per specifications and excluding gates.
- B. Gates for Chain Link or Cyclone fencing shall be measured as each type, a certain height and width of gate, complete in place as per specifications.

##### **4.02 PAYMENT**

- A. Chain Link Fence shall be paid for at the contract unit price per linear foot.
- B. Gates for Chain Link Fence shall be paid for at the contract lump sum price per each gate for a certain type, height and width.

##### **4.03 GENERAL**

- A. Security fence systems will sometimes have noise detectors. These systems hang on the fence and also pick up noise from the fence. Care shall be taken to install the fence in a manner that caps, arms, braces, wire and posts do not set off a noise sensitive system.
- B. Gates, Support arms for barbed wire, the barbed wire, razor wire, and fence slats will be included in the Bid Items if they are required and noted.

#### **END OF SECTION**

## **SECTION 32 31 56 - WIRE FENCES (DEER PROOF)**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. The extent of the "Deer Proof" fence and gates is as indicated on the drawings or as designated by the Engineer.

#### **1.02 SUBMITTALS:**

- ##### **A. Submit manufacturer's technical data and installation instructions for all fence material, a sufficient time in advance to permit review by the Engineer, before ordering material.**

#### **1.03 QUALITY ASSURANCE:**

- ##### **A. Provide wire fences and gates as complete units, controlled by a single source, or approved by the Engineer, including necessary erection accessories, fittings and fastenings.**

#### **1.04 MATERIALS**

##### **A. General:**

1. Dimensions indicated for material are outside dimensions, exclusive of coatings.

##### **B. Steel Fabric:**

1. A woven wire galvanized steel fabric is to be used. Fabric may be furnished in two-piece widths with prior approval of the Engineer. The top and bottom wire widths to be of 10-gauge galvanized steel wire. Intermediate wires and stays to be of 12.5-gauge galvanized steel wire. The bottom fabric is to have horizontal wires with gradually increasing spacing, starting narrowest at the bottom, up to but not more than 6 - 8 IN. Vertical stays are to be spaced at 6 IN. Where two piece fabric widths are used, the fabrics shall be connected by use of 11 - gauge galvanized steel hog rings on 18 - 24 IN centers.

##### **C. Posts:**

1. Line Posts: Use painted studded tee steel fence posts 10 FT long, with anchor plate, spaced on 25 FT centers. Approximate weight of 1.33 LBS/FT. Splicing of posts will not be allowed.
2. Corner Posts: Use 8 IN DIA or 8 IN by 8 IN penta or CCA treated wood posts 12 FT long, set in concrete.
3. Brace Panel Posts: Use 6 IN DIA or 6 IN by 6 IN penta or CCA treated wood posts 12 FT long. Brace panels to be spaced not more than 650 FT apart.
4. Horizontal Brace Posts: Brace posts shall be 2.5 IN DIA galvanized steel posts. Approximate weight of 3.79 LBS/FT.

5. Gate Posts: Gate posts shall be 4 IN DIA galvanized steel posts 12 FT long with top cap, set in concrete. Approximate weight of 9.36 LBS/FT.

D. Barbed Wire:

1. Barbed wire shall be two-strand 121.5 gauge wire, twisted, with 14 gauge 4-point barbs spaced not more than 5 IN center to center. METAL AND FINISH TO MATCH FABRIC (galvanized).

E. Top Wire:

1. Top wires shall be two-strand 12.5 gauge galvanized twisted barbless wire with metal and finish to match fabric.

F. Diagonal Tie Wire:

1. Use two strand 9 gauge galvanized steel wire.

G. Wire Clips:

1. Use 10 gauge galvanized wire clips on approximately 12 IN centers on the fabric and to each tension and barbed wire.

H. Wire Staples:

1. Use 1.5 IN 9 gauge galvanized steel wire staples.

I. Gates:

1. Gate frames shall be constructed of 1.875 IN DIA galvanized steel pipe with approximate weight of 1.89 LBS/FT, except the vertical hinge side which shall be constructed of 1.875 IN DIA galvanized steel pipe with approximate weight of 2.50 LBS/FT. Gate frame shall be covered with the same fabric and wires as the fence.

J. Miscellaneous Fittings and Accessories:

1. These shall be galvanized steel of good commercial quality and design and approved by the Engineer before ordering.

## PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. General:

1. Do not begin installation and erection until timely notice has been given to the Engineer. The area along the fence line shall be cleared enough to permit proper construction. Any clearing required for fence construction shall be incidental to the fence construction bid item.

B. Excavation:

1. Drill or hand-excavate (using post hole digger) holes for posts to spacing indicated, in firm, undisturbed, or compacted soil. Excavate holes for each post to a minimum diameter of 16 - 24 IN.



C. Setting Posts:

1. Fence posts shall be spaced at the intervals and set to the depth shown on the plans. Check each post for vertical and top alignment. Metal line posts may be driven in place providing such driving does not damage the posts. Posts must be set to the desired depth and tops of posts not cut off to height. 8 IN wood corner posts and 4 IN galvanized gate posts shall be set in concrete. Place concrete around posts and vibrate or tamp for consolidation. Extend concrete 2 IN above grade and trowel to a crown to shed water. Metal line posts that will not drive in and 6 IN wood brace posts shall be backfilled in 4 IN layers with each layer thoroughly tamped. Corner posts shall be braced in both directions and end and gate posts shall be braced in one direction. Brace panels will also be installed at all grade breaks as directed by the Engineer. At all grade depressions where stresses tend to pull the posts out of the ground, the fencing shall be snubbed or guyed at the critical point by means of a double 9 gauge galvanized wire connected to each horizontal line of barbed and top wire and to the top and bottom wire of the fabric. This shall be connected to a deadman of sufficient weight to hold the fence down.

D. Fabric:

1. Leave fabric approximately 2 IN above the top of ground level. Pull fabric taut and tie or staple to posts. Install and anchor so that fabric remains in tension after pulling force is released. Existing cross fences shall be connected, if required, to the new fence. Where this occurs, a braced corner post shall be installed.

E. Barbed and Top Wire:

1. Pull wire taut and tie or staple to the posts such that it remains tight. Install the barbed wire 1 IN above the top of ground level. Install one top wire 1 IN from the top of the post and the other midway between it and the top of the fabric.

F. Horizontal Brace Post:

1. The horizontal brace post shall be installed 6 FT above the ground on brace panels and fastened with a no. 60 spike on wood posts or the proper fitting n galvanized steel posts.

G. Diagonal Tie Wires:

1. Wires shall be securely fastened to posts and provide rigidity to brace panels.

H. Gates:

1. Fabricate perimeter frames of gates from metal as described above. Assemble gate and frames by welding or with special fittings and rivets for rigid connection and provide security against removal or breakage of connections. When welding or damage occurs, repair finish so as to protect from rust. Provide horizontal and vertical members to ensure proper gate operation and attachment of fabric, hardware and accessories. Provide same fabric for gate as the fence. Stretch fabric on frame and securely fasten. Install diagonal cross-bracing, consisting of 3/8 IN DIA adjustable length truss rods on gate to ensure frame rigidity without sag or twist. Extend end members of gate frame above and below the fabric a sufficient distance to attach barbed and top wires. Provide necessary clips for securing wire to extensions. Provide end caps on top of vertical members. Provide hinges to suit gate size, non lift-off type, and permit 180 degree gate opening. Latch shall be forked type or plunger bar type to permit operation from either side. Latch shall have padlock eye as integral part of latch. Provide keeper which automatically engages gate leaf and holds it in an open position until manually released. Where double gates are used, provide gate stops for double gates, consisting of mushroom-type flush plate with anchors, set in concrete, and designed to engage center drop rod as integral part of latch, permitting both gate leaves to be locked with a single padlock. Padlocks will be applied by the owner.

**PART 4 - MEASUREMENT AND PAYMENT**

**4.01 MEASUREMENT**

- A. Fencing shall be measured by the linear foot of fence constructed, excluding gates. Gates shall be measured as each gate, complete in place.

**4.02 PAYMENT**

- A. Fence shall be paid for at the unit price bid per linear foot.
- B. Gates shall be paid for at the lump sum price bid per each gate.
- C. The price shall be full compensation for furnishing, fabricating and installing all materials, preparation, hauling, including all labor, tools, equipment and incidentals necessary to complete the work. Excavation, backfilling, disposal of surplus material and clean-up is also included.

**END OF SECTION**

## **SECTION 32 32 23 - SEGMENTAL RETAINING WALLS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Single depth segmental retaining walls without soil reinforcement.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- ##### **A. Section 31 00 00 - "Earthwork" for excavation for segmental retaining walls.**

#### **1.03 PERFORMANCE REQUIREMENTS**

- ##### **A. Structural Performance:** Engineering design shall be based on vehicle loads, loads due to soil pressures resulting from grades indicated and determined according to "NCMA's "Design Manual for Segmental Retaining Walls."
- ##### **B. Drainage:** Provide drainage system capable of preventing accumulation of storm water behind segmental retaining wall.

#### **1.04 PRECONSTRUCTION TESTING**

- ##### **A. Preconstruction Testing Service:** Engage a qualified testing agency to perform the following preconstruction testing:
1. Test soil backfill materials for coefficient of friction according to ASTM D5321.

#### **1.05 SUBMITTALS**

##### **A. Action Submittals:**

##### **1. Shop Drawings:**

- a. Indicate assembly dimensions, locations of structural members, connections, attachments, wall system dimensions, layout, general construction details, method of installation, sizes, and locations from datum, and design loads.
    - 1) Provide drawings signed and sealed by a professional engineer licensed in the state where the work is to be built.
  - b. Standard manufacturer's installation drawings alone will not constitute a Shop Drawing submittal and will be disapproved.
  - c. Any deviation from the plans and specifications shall be noted with a "cloud" and state if it affects other trades or not. All deviations shall be subject to approval.
  - d. No product shall be delivered to the site prior to Shop Drawing approval.
2. Product Data: For each type of product indicated.
  3. Samples: For each color and texture of concrete unit required.

##### **B. Informational Submittals:**

1. Preconstruction test reports.
2. Field quality-control reports.

## PART 2 - PRODUCTS

### 2.01 SEGMENTAL RETAINING WALL UNITS

- A. Concrete Units: ASTM C1372, Normal Weight, except that units shall not differ in height more than  $\pm 1/16$  IN from specified dimension.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide Redi-Rock 6 FT-0 IN Standard Batter Wall, 41 IN Series Blocks or comparable product by a licensee of one of the following:
    - a. Allan Block Corporation.
    - b. Anchor Wall Systems, Inc.
    - c. GeoWestern, Inc.
    - d. ICD Corporation.
    - e. Keystone Retaining Wall Systems, Inc.; a Contech company.
    - f. Risi Stone Systems; a division of Rothbury International.
    - g. Rockwood Retaining Walls, Inc.
    - h. Tensar Earth Technologies, Inc.
    - i. Versa-Lok Retaining Wall Systems; a division of Kiltie Corporation.
  2. Provide units that comply with requirements for freeze-thaw durability.
  3. Provide units that interlock with courses above and below by means of integral lugs or lips.
- B. Color: As indicated by manufacturer's designations.
- C. Shape and Texture: Provide units matching basic shape, dimensions, and face texture indicated by referencing manufacturer's pattern designation.

### 2.02 INSTALLATION MATERIALS

- A. Pins and Clips: Product supplied by segmental retaining wall unit manufacturer for use with units provided, made from nondegrading polymer reinforced with glass fibers.
- B. Cap Adhesive: Product supplied or recommended by segmental retaining wall unit manufacturer for adhering cap units to units below.
- C. Leveling Base: Comply with requirements in Section 31 00 00 - "Earthwork" for base material and drainage fill.
- D. Soil Fill: Comply with requirements in Section 31 00 00 - "Earthwork" for satisfactory soils.
- E. Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent.

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SEGMENTAL RETAINING WALLS

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1. Apparent Opening Size: No. 70 to 100 sieve, maximum; ASTM D4751.
  2. Minimum Grab Tensile Strength: 110 LB; ASTM D4632.
- F. Subdrainage Pipe: Comply with requirements in Section 33 40 10 - "Storm Drainage."

## PART 3 - EXECUTION

### 3.01 RETAINING WALL INSTALLATION

- A. General: Place units according to NCMA's "Segmental Retaining Wall Installation Guide" and segmental retaining wall unit manufacturer's written instructions.
  1. Lay units in running bond.
  2. Form corners and ends by using special units.
- B. Leveling Base: Place and compact base material to thickness indicated and with not less than 95 percent maximum dry unit weight according to ASTM D698.
- C. First Course: Place first course of segmental retaining wall units for full length of wall. Place units in firm contact with each other, properly aligned and level.
  1. Tamp units into leveling base as necessary to bring tops of units into a level plane.
- D. Subsequent Courses: Remove excess fill and debris from tops of units in course below. Place units in firm contact, properly aligned, and directly on course below.
- E. Cap Units: Place cap units and secure with cap adhesive.

### 3.02 FILL PLACEMENT

- A. General: Comply with requirements in Section 31 00 00 - "Earthwork," NCMA's "Segmental Retaining Wall Installation Guide," and segmental retaining wall unit manufacturer's written instructions.
- B. Fill voids between and within units with drainage fill. Place fill as each course of units is laid.
- C. Place, spread, and compact drainage fill and soil fill in uniform lifts for full width and length of embankment as wall is laid. Place and compact fills without disturbing alignment of units. Where both sides of wall are indicated to be filled, place fills on both sides at same time. Begin at wall and place and spread fills toward embankment. above bottom of wall, whichever is greater.
  1. Compact reinforced-soil fill to not less than 95 percent maximum dry unit weight according to ASTM D698.
    - a. In areas where only hand-operated compaction equipment is allowed, compact fills to not less than 90 percent maximum dry unit weight according to ASTM D698.
  2. Compact nonreinforced-soil fill to comply with Section 31 00 00 - "Earthwork."
  3. Place drainage geotextile against back of wall and place layer of drainage fill at least 12 IN wide behind drainage geotextile to within 12 IN of finished grade. Place another layer of drainage geotextile between drainage fill and soil fill.

- D. Place a layer of drainage fill at least 12 IN wide behind wall to within 12 IN of finished grade. Place a layer of drainage geotextile between drainage fill and soil fill.
- E. Wrap subdrainage pipe with filter fabric and place in drainage fill as indicated sloped not less than 0.5 percent to drain.
- F. Place impervious fill over top edge of drainage fill layer.

### 3.03 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Comply with requirements in Section 31 00 00 - "Earthwork" for field quality control.
  - 1. In each compacted backfill layer, perform at least 1 field in-place compaction test for each 30 FT or less of segmental retaining wall length.

**END OF SECTION**

## **SECTION 32 90 10 - LANDSCAPING FOR BUILDINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This Section includes the following:
  - 1. Trees.
  - 2. Shrubs.
  - 3. Ground covers.
  - 4. Plants.
  - 5. Lawns.
  - 6. Topsoil and soil amendments.
  - 7. Fertilizers and mulches.
  - 8. Stakes and guys.
  - 9. Landscape edgings.
  - 10. This section does not apply to the construction of mainline and/or yard track projects.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Drawings and general provisions of the Contract, including General and Special Conditions apply to this Section.
- B. Section 31 00 00 - "Earthwork" for excavation, filling, rough grading, and subsurface aggregate drainage and drainage backfill.
- C. Section 31 11 00 - "Clearing and Grubbing" for protection of existing trees and planting, topsoil stripping and stockpiling, and site clearing.

#### **1.03 SUBMITTALS**

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product certificates signed by manufacturers certifying that their products comply with specified requirements.
  - 1. Manufacturer's certified analysis for standard products.
  - 2. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
  - 3. Label data substantiating that plants, trees, shrubs, and planting materials comply with specified requirements.

- C. Certification of grass seed from seed vendor for each grass-seed mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
  - 1. Certification of each seed mixture for sod, identifying sod source, including name and telephone number of supplier.
- D. Samples of each of the following:
  - 1. Edging materials and accessories to verify color selected.
- E. Maintenance instructions recommending procedures to be established by Owner for maintenance of landscaping during an entire year. Submit before expiration of required maintenance periods.

#### 1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
  - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that landscaping is in progress.
- B. Provide quality, size, genus, species, and variety of trees and shrubs indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."
- C. Measurements: Measure trees and shrubs according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 IN above ground for trees up to 4 IN caliper size, and 12 IN above ground for larger sizes. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip-to-tip.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.
- B. Seed: Deliver seed in original sealed, labeled, and undamaged containers.
- C. Sod: Harvest, deliver, store, and handle sod according to the requirements of the American Sod Producers Association's (ASPA) "Specifications for Turfgrass Sod Materials and Transplanting/Installing."
- D. Trees and Shrubs: Deliver freshly dug trees and shrubs. Do not prune before delivery, except as approved by Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy natural shape. Provide protective covering during delivery. Do not drop trees and shrubs during delivery.
  - 1. Immediately after digging bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting.



2. Handle balled and burlapped stock by the root ball.
- E. Deliver trees, shrubs, ground covers, and plants after preparations for planting have been completed and install immediately. If planting is delayed more than 6 hours after delivery, set planting materials in shade, protect from weather and mechanical damage, and keep roots moist.
  1. Heel-in bare-root stock. Soak roots in water for 2 HRS if dried out.
  2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
  3. Do not remove container-grown stock from containers before time of planting.
  4. Water root systems of trees and shrubs stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

#### 1.06 PROJECT CONDITIONS

- A. Utilities: Determine location of above grade and underground utilities and perform work in a manner which will avoid damage. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Architect before planting.

#### 1.07 COORDINATION AND SCHEDULING

- A. Coordinate installation of planting materials during normal planting seasons for each type of plant material required.

#### 1.08 WARRANTY

- A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Warrant the following living planting materials for a period of one year after date of Substantial Completion, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, abnormal weather conditions unusual for warranty period, or incidents that are beyond Contractor's control.
  1. Trees.
  2. Shrubs.
  3. Ground covers.
  4. Plants.
- C. Remove and replace dead planting materials immediately unless required to plant in the succeeding planting season.
- D. Replace planting materials that are more than 25 percent dead or in an unhealthy condition at end of warranty period.

- E. A limit of one replacement of each plant material will be required, except for losses or replacements due to failure to comply with requirements.

## PART 2 - PRODUCTS

### 2.01 TREE AND SHRUB MATERIAL

- A. General: Furnish nursery-grown trees and shrubs conforming to ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully-branched, healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
- B. Grade: Provide trees and shrubs of sizes and grades conforming to ANSI Z60.1 for type of trees and shrubs required. Trees and shrubs of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Label each tree and shrub with securely attached, waterproof tag bearing legible designation of botanical and common name.
- D. Label at least 1 tree and 1 shrub of each variety and caliper with a securely attached, waterproof tag bearing legible designation of botanical and common name.

### 2.02 SHADE AND FLOWERING TREES

- A. Shade Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, conforming to ANSI Z60.1 for type of trees required.
  - 1. Branching Height: 1/3 to 1/2 of tree height.
  - 2. Branching Height: 1/2 of tree height.
- B. Small Trees: Small upright or spreading type, branched or pruned naturally according to species and type, and with relationship of caliper, height, and branching recommended by ANSI Z60.1, and stem form as follows:
  - 1. Form: Single stem.
  - 2. Form: Multi-stem, clump, with 2 or more main stems.
  - 3. Form: Multi-stem, shrub, with multiple stems.
- C. Provide balled and burlapped trees.
- D. Provide bare-root trees.
- E. Provide balled and burlapped trees except where bare-root trees are indicated.
  - 1. Container-grown trees will be acceptable in lieu of balled and burlapped trees subject to meeting ANSI Z60.1 limitations for container stock.

### 2.03 DECIDUOUS SHRUBS

- A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
- B. Provide balled and burlapped deciduous shrubs.

- C. Provide bare-root deciduous shrubs.
- D. Provide balled and burlapped deciduous shrubs except where bare-root deciduous shrubs are indicated.
  - 1. Container-grown deciduous shrubs will be acceptable in lieu of balled and burlapped deciduous shrubs subject to meeting ANSI Z60.1 limitations for container stock.

#### 2.04 CONIFEROUS EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, coniferous evergreens, of type, height, spread, and shape required, conforming to ANSI Z60.1.
- B. Provide balled and burlapped coniferous evergreens.
  - 1. Container-grown coniferous evergreens will be acceptable in lieu of balled and burlapped coniferous evergreens subject to meeting ANSI Z60.1 limitations for container stock.

#### 2.05 BROADLEAF EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, broadleaf evergreens, of type, height, spread, and shape required, conforming to ANSI Z60.1.
- B. Provide balled and burlapped broadleaf evergreens.
  - 1. Container-grown broadleaf evergreens will be acceptable in lieu of balled and burlapped broadleaf evergreens subject to meeting ANSI Z60.1 limitations for container stock.

#### 2.06 GROUND COVERS AND PLANTS

- A. Provide ground covers and plants established and well rooted in removable containers or integral peat pots and with not less than the minimum number and length of runners required by ANSI Z60.1 for the pot size indicated.

#### 2.07 GRASS MATERIALS

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with the Association of Official Seed Analysts' "Rules for Testing Seeds" for purity and germination tolerances.
  - 1. Seed Mixture: Provide seed of grass species and varieties, proportions by weight, and minimum percentages of purity, germination, and maximum percentage of weed seed as indicated on The Drawings.
- B. Sod: Certified turfgrass sod complying with ASPA specifications for machine-cut thickness, size, strength, moisture content, and mowed height, and free of weeds and undesirable native grasses. Provide viable sod of uniform density, color, and texture of the following turfgrass species, strongly rooted, and capable of vigorous growth and development when planted.
  - 1. Species: Provide sod of grass species and varieties, proportions by weight, and minimum percentages of purity, germination, and maximum percentage of weed seed as indicated on Schedules at the end of this Section.

## 2.08 TOPSOIL

- A. Topsoil: ASTM D5268, pH range of 5.5 to 7, 4 percent organic material minimum, free of stones 1 IN or larger in any dimension, and other extraneous materials harmful to plant growth.
  - 1. Topsoil Source: Reuse surface soil stockpiled on the site. Verify suitability of surface soil to produce topsoil meeting requirements and amend when necessary. Supplement with imported topsoil when quantities are insufficient. Clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
  - 2. Topsoil Source: Import topsoil from off-site sources. Obtain topsoil from naturally well-drained sites where topsoil occurs at least 4 IN deep; do not obtain from bogs or marshes.
  - 3. Topsoil Source: Amend existing surface soil to produce topsoil. Supplement with imported topsoil when required.

## 2.09 SOIL AMENDMENTS

- A. Lime: ASTM C602, Class T, agricultural limestone containing a minimum 80 percent calcium carbonate equivalent, with a minimum 99 percent passing a No. 8 sieve and a minimum 75 per-cent passing a No. 60 sieve.
  - 1. Provide lime in the form of dolomitic limestone.
- B. Aluminum Sulfate: Commercial grade, unadulterated.
- C. Sand: Clean, washed, natural or manufactured sand, free of toxic materials.
- D. Perlite: Horticultural perlite, soil amendment grade.
- E. Peat Humus: Finely divided or granular texture, with a pH range of 6 to 7.5, composed of partially decomposed moss peat (other than sphagnum), peat humus, or reed-sedge peat.
- F. Peat Humus: For acid-tolerant trees and shrubs, provide moss peat, with a pH range of 3.2 to 4.5, coarse fibrous texture, medium-divided sphagnum moss peat or reed-sedge peat.
- G. Sawdust or Ground-Bark Humus: Decomposed, nitrogen-treated, of uniform texture, free of chips, stones, sticks, soil, or toxic materials.
  - 1. When site treated, mix with at least 0.15 LB of ammonium nitrate or 0.25 LB of ammonium sulfate per cubic foot of loose sawdust or ground bark.
- H. Manure: Well-rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.
- I. Herbicides: EPA registered and approved, of type recommended by manufacturer. Water: Potable.

## 2.10 FERTILIZER

- A. Bonemeal: Commercial, raw, finely ground; minimum of 4 percent nitrogen and 20 percent phosphoric acid.

- B. Superphosphate: Commercial, phosphate mixture, soluble; minimum of 20 percent available phosphoric acid.
- C. Slow-Release Fertilizer: Granular fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
  - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

#### 2.11 MULCHES

- A. Organic Mulch: Organic mulch, free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
  - 1. Type: Shredded hardwood.
- B. Asphalt Emulsion Tackifier: Asphalt emulsion, ASTM D977, Grade SS-1, nontoxic and free of plant growth- or germination-inhibitors.
- C. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application, nontoxic and free of plant growth- or germination-inhibitors.

#### 2.12 WEED-CONTROL BARRIERS

- A. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, 4.8 OZ/SQ YD.

#### 2.13 EROSION-CONTROL MATERIALS

- A. Fiber Mesh: Biodegradable twisted jute or spun-coir mesh, 0.92 LB/SQ YD minimum, with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, 6 IN long.

#### 2.14 STAKES AND GUYS

- A. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, redwood, or pressure-preservative-treated softwood, free of knots, holes, cross grain, and other defects, 2 by 2 IN by length indicated, pointed at one end.
- B. Guy and Tie Wire: ASTM A 641, Class 1, galvanized-steel wire, 2-strand, twisted, 0.106 IN DIA.
- C. Hose Chafing Guard: Reinforced rubber or plastic hose at least 1/2 IN DIA, black, cut to lengths required to protect tree trunks from damage.
- D. Flags: Standard surveyor's plastic flagging tape, white, 6 IN long.

#### 2.15 LANDSCAPE EDGINGS

- A. Steel Edging: ASTM A569, rolled edge, standard steel edging, fabricated in sections with loops stamped from or welded to face of sections approximately 30 IN apart to receive stakes.
  - 1. Edging Size: 3/16 IN wide by 4 IN deep.
  - 2. Stakes: Tapered steel, 15 IN long.
  - 3. Accessories: Standard tapered ends, corners, and splicers as required.

4. Finish: Standard paint finish; color selected by Architect.
5. Finish: ASTM A525, G 90 zinc coated with standard paint finish; color selected by Architect.
6. Accessories: Manufacturer's standard connecting clips or plugs.

#### 2.16 MISCELLANEOUS MATERIALS

- A. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's instructions.
- B. Trunk-Wrap Tape: Two layers of crinkled paper cemented together with bituminous material, 4 IN wide minimum, with stretch factor of 33 percent.

### PART 3 - EXECUTION

#### 3.01 EXAMINATION

- A. Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of work of this Section. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### 3.02 PREPARATION

- A. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, and secure Architect's acceptance before the start of planting work. Make minor adjustments as may be required.

#### 3.03 PLANTING SOIL PREPARATION

- A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
- B. Mix soil amendments and fertilizers with topsoil at rates indicated. Delay mixing fertilizer if planting does not follow placing of planting soil within a few days.
  1. A "Planting Soil Amendments Schedule" is included at the end of this Section.
- C. For tree pit or trench backfill, mix planting soil before backfilling and stockpile at site.
- D. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of top-soil and mix thoroughly before planting.
  1. Mix lime with dry soil prior to mixing fertilizer. Prevent lime from contacting roots of acid-tolerant plants.
  2. Apply phosphoric acid fertilizer, other than that constituting a portion of complete fertilizers, directly to subgrade before applying planting soil and tilling.

#### 3.04 LAWN PLANTING PREPARATION

- A. Limit subgrade preparation to areas that will be planted in the immediate future.
- B. Loosen subgrade to a minimum depth of 4 IN. Remove stones larger than 1-1/2 IN in any dimension and sticks, roots, rubbish, and other extraneous materials.

- C. Spread planting soil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen.
  - 1. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.
  - 2. Allow for sod thickness in areas to be sodded.
- D. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare soil as follows:
  - 1. Remove and dispose of existing grass, vegetation, and turf. Do not turn over into soil being prepared for lawns.
  - 2. Till surface soil to a depth of at least 6 IN. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 IN of soil. Trim high areas and fill in depressions. Till soil to a homogenous mixture of fine texture.
  - 3. Clean surface soil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
  - 4. Remove waste material, including grass, vegetation, and turf, and legally dispose of it off the Owner's property.
- E. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1 IN in any dimension, and other objects that may interfere with planting or maintenance operations.
- F. Moisten prepared lawn areas before planting when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- G. Restore prepared areas if eroded or otherwise disturbed after fine grading and before planting.

### 3.05 GROUND COVER AND PLANT BED PREPARATION

- A. Loosen subgrade of planting bed areas to a minimum depth of 6 IN. Remove stones larger than 1 IN in any dimension and sticks, roots, rubbish, and other extraneous materials.
- B. Spread planting soil mixture to depth required to meet thickness, grades, and elevations shown, after light rolling and natural settlement. Place approximately 1/2 the thickness of planting soil mixture required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil mixture.
- C. Till soil in beds to a minimum depth of 8 IN and mix with specified soil amendments and fertilizers. Remove soil to a minimum depth of 8 IN and replace with prepared planting soil mixture.

### 3.06 EXCAVATION FOR TREES AND SHRUBS

- A. Pits and Trenches: Excavate with vertical sides and with bottom of excavation slightly raised at center to assist drainage. Loosen hard subsoil in bottom of excavation.
  - 1. Bare-Root Trees and Shrubs: Excavate at least 12 IN wider than root spread and deep enough to allow setting of roots on a layer of planting soil and with collar set at same grade as in nursery, but 1 IN below finish grade, unless otherwise indicated.
    - a. Setting Layer: Allow 3 IN of planting soil.
  - 2. Balled and Burlapped Trees and Shrubs: Excavate approximately 1-1/2 times as wide as ball diameter and equal to ball depth, plus the following setting layer depth:
    - a. Setting Layer: Allow 3 IN of planting soil.
  - 3. Container-Grown Trees and Shrubs: Excavate to container width and depth, plus the following setting-layer depth:
    - a. Setting Layer: Allow 3 IN of planting soil.
  - 4. Where drain tile is shown or required under planted areas, excavate to top of porous backfill over tile.
- B. Dispose of subsoil removed from landscape excavations. Do not mix with planting soil or use as backfill.
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
  - 1. Hardpan Layer: Drill 6 IN DIA holes into free-draining strata or to a depth of 10 FT, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub pits.
- E. Fill excavations with water and allow to percolate out, before placing setting layer and positioning trees and shrubs.

### 3.07 PLANTING TREES AND SHRUBS

- A. Set balled and burlapped stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.
  - 1. Place stock on setting layer of compacted planting soil.
  - 2. Remove burlap and wire baskets from tops of balls and partially from sides, but do not remove from under balls. Remove pallets, if any, before setting. Do not use planting stock if ball is cracked or broken before or during planting operation.
  - 3. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.



- B. Set container-grown stock plumb and in center of pit or trench with top of ball raised above adjacent finish grades as indicated.
  - 1. Carefully remove containers so as not to damage root balls.
  - 2. Place stock on setting layer of compacted planting soil.
  - 3. Place backfill around ball in layers, tamping to settle backfill and eliminate voids and air pockets. When pit is approximately 1/2 backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing and tamping final layer of backfill.
- C. Set bare-root stock on cushion of planting soil. Spread roots without tangling or turning toward surface, and carefully work backfill around roots by hand. Puddle with water until backfill layers are completely saturated. Plumb before backfilling, and maintain plumb while working backfill around roots and placing layers above roots. Remove injured roots by cutting cleanly; do not break.
  - 1. Set collar 1 IN below adjacent finish grades, unless otherwise indicated.
- D. Dish and tamp top of backfill to form a 3 IN high mound around the rim of the pit. Do not cover top of root ball with backfill.
- E. Wrap trees of 2 IN caliper and larger with trunk-wrap tape. Start at base of trunk and spiral cover trunk to height of first branches. Overlap wrap, exposing half the width, and securely attach without causing girdling. Inspect tree trunks for injury, improper pruning, and insect infestation and take corrective measures required before wrapping.

### 3.08 TREE AND SHRUB PRUNING

- A. Prune, thin, and shape trees and shrubs according to standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Architect, do not cut tree leaders; remove only injured or dead branches from flowering trees. Prune shrubs to retain natural character. Shrub sizes indicated are size after pruning.

### 3.09 TREE AND SHRUB GUYING AND STAKING

- A. Upright Staking and Tying: Stake trees of 2 through 5 IN caliper. Stake trees of less than 2 IN caliper only as required to prevent wind tip-out. Use a minimum of 2 stakes of length required to penetrate at least 18 IN below bottom of backfilled excavation and to extend at least 72 IN above grade. Set vertical stakes and space to avoid penetrating balls or root masses. Support trees with 2 strands of tie wire encased in hose sections at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
- B. Guying and Staking: Guy and stake trees exceeding 14 FT and more than 3 IN caliper unless otherwise indicated. Securely attach no fewer than 3 guys to stakes 30 IN long, driven to grade. Attach flags to each guy wire, 30 IN above finish grade.

### 3.10 PLANTING GROUND COVER AND PLANTS

- A. Space ground cover and plants as indicated.
- B. Space ground cover and plants not more than 24 IN apart.

- C. Dig holes large enough to allow spreading of roots, and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

### 3.11 MULCHING

- A. Mulch backfilled surfaces of planted areas and other areas indicated.
- B. Weed-Control Barriers: Install the following weed-control barriers according to manufacturer's recommendations, before mulching. Completely cover area to be mulched, lapping edges a minimum of 6 IN.
  - 1. Material and Seam Treatment: Composite fabric with seams pinned.
- C. Organic Mulch: Apply the following average thickness of organic mulch and finish level with adjacent finish grades. Do not place mulch against trunks or stems.
  - 1. Thickness: 3 IN.

### 3.12 HYDROSEEDING NEW LAWNS

- A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.
  - 1. Mix slurry with nonasphaltic tackifier.
  - 2. Apply slurry uniformly to all areas to be seeded in a 1-step process. Apply mulch at the minimum rate of 1500 LB per acre dry weight but not less than the rate required to obtain specified seed- sowing rate.
  - 3. Apply slurry uniformly to all areas to be seeded in a 2-step process. Apply first slurry application at the minimum rate of 500 LB per acre dry weight but not less than the rate required to obtain specified seed-sowing rate. Apply slurry cover coat of fiber mulch at a rate of 1000 LB per acre.

### 3.13 SODDING NEW LAWNS

- A. Lay sod within 24 HRS of stripping. Do not lay sod if dormant or if ground is frozen.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
  - 1. Lay sod across angle of slopes exceeding 1:3.
  - 2. Anchor sod on slopes exceeding 1:6 with wood pegs spaced as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within 2 HRS of planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 IN below the sod.

### 3.14 INSTALLATION OF EDGINGS

- A. Wood Headers: Install wood headers or edgings where indicated. Anchor with wood stakes spaced up to 36 IN apart, driven at least 1 IN below top elevation of header or edging. Use 2 galvanized nails per stake to fasten headers and edging; length as needed to penetrate both members and provide 1/2 IN clinch at point. Predrill stakes when needed to avoid splitting.
- B. Steel Edging: Install steel edging where indicated according to manufacturer's recommendations. Anchor with steel stakes spaced approximately 30 IN apart, driven below top elevation of edging.
- C. Plastic Edging: Install plastic edging where indicated according to manufacturer's recommendations. Anchor with steel stakes spaced approximately 24 IN apart, driven through upper base grooves of edging.

### 3.15 INSTALLATION OF MISCELLANEOUS MATERIALS

- A. Apply antidesiccant using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.
  - 1. When deciduous trees or shrubs are moved in full-leaf, spray with antidesiccant at nursery before moving and again 2 weeks after planting.

### 3.16 CLEANUP AND PROTECTION

- A. During landscaping, keep pavements clean and work area in an orderly condition.
- B. Protect landscaping from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

### 3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of it off the Owner's property.

### 3.18 SEED MIXTURES SCHEDULE

- A. Refer to Landscape Plan for Seed Mixtures for each area.

## **END OF SECTION**

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## **SECTION 32 92 19 - SEEDING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Preparing and seeding of disturbed areas of roadbed slopes, ditch bottoms, and areas shown within the grading limits on the plans. Disturbed areas outside the grading limits shall be seeded at the contractor's expense.
2. This work shall consist of furnishing and placing seed, fertilizer and mulch in accordance with these Specifications at locations shown in the plans or designated by the Engineer.

#### **1.02 MATERIAL REQUIREMENTS**

- ##### **A.**
- Seeding, fertilizing and mulching shall be in accordance with the state DOT specifications. Rates of application and seed mixtures shall be based on location of construction and planting time of the year, subject to the approval of the Engineer. The Contractor shall coordinate with the UPRR Engineer as to when seeding shall be done.

##### **B.**

### **PART 2 - PRODUCTS**

#### **2.01 EQUIPMENT**

##### **A. General:**

##### **1. .**

The Contractor shall furnish equipment in satisfactory working condition, and in sufficient quantity to perform the work as specified. The equipment shall be on the project site and approved by the Engineer before work on the corresponding item begins.

##### **B. Grass Seed Drilling**

1. Grass should be seeded with a grass drill equipped with double coulter furrow openers with depth bands and press wheels (preferred) or drag chains. Seed should be planted 1/4 to 3/4 inch deep.

##### **C. Broadcast Seeding**

1. In areas inaccessible to a drill, seed may be broadcasted. Broadcast seed must be covered by harrowing with spike tooth harrow, dragging a chain, raking or other suitable equipment. Seed shall be broadcast at a fifty percent (50%) or higher rate.

##### **D. Corrugated Roller Seeder**

1. The seeder shall be equipped with corrugated roller wheels mounted on tandem axles. The roller wheels shall be spaced on approximately two inch (2") centers and shall place the seed at a depth of one-quarter inch (1/4") to one-half inch (1/2"). The seeder shall be equipped with two (2) separate planter boxes and planting mechanisms, which will plant clean, fine seed and large, chaffy seed simultaneously. The seeder shall weigh approximately one-hundred twenty-five to two-hundred fifty pounds per lineal foot (125-250 lbs./lineal ft.) of rolling width.

E. Hydraulic Hydro-Seeder

1. The seeder shall be capable of mixing and applying seed, commercial fertilizer, stabilizing emulsion and tackifiers, or any combination thereof, with fiber and water. Seeders shall have built-in continuous agitation system of sufficient operating capacity to produce and apply a homogeneous mixture.
2. This equipment shall be factory designed and built with sufficient pump capacity to apply specified quantities. The tank shall hold a minimum of one-thousand (1000) gallons and be equipped with a mechanical agitation system with an operating capacity sufficient to suspend and homogeneously mix the seed and water. The delivery hoses shall be big enough to prevent clogging and be equipped with spray nozzles that will provide even distribution on seeding areas.
3. The equipment shall be mounted on a traveling unit which may be either self-propelled or pulled, capable of getting the tank and nozzles within sufficient proximity of the area to be seeded without the wheels operating on the seeding area.

### PART 3 - EXECUTION

#### 3.01 CONSTRUCTION METHODS

A. Notice:

1. The Contractor shall notify the engineer at least 48 HRS in advance of the time he intends to begin work and shall not proceed with such work until permission to do so has been granted by the engineer.

B. Weather:

1. Seeding operations shall be performed only during the periods of favorable weather. Seeding shall not be done before or during hot, dry weather except by express permission of the engineer. No work shall be performed during excessively windy weather or when the ground is frozen, excessively wet or untillable.

C. Bed Preparation:

1. Not more than five days prior to the sowing of the seed, the seedbed shall be prepared by loosening the soil to a depth of not less than 2 IN by disking, harrowing, raking or by other approved means. Repeated disking, harrowing or similar means may be required to provide a satisfactory seedbed. Disking, harrowing and raking shall be longitudinal on all slopes. If needed, the seedbed shall be compacted.

D. Weeding:

1. Existing weed stubble and small weeds shall be cut and partially incorporated into the soil during the seedbed preparation work. All other growth of vegetation that interface with seeding operations shall be removed.

E. Preserving Plants:

1. Extreme care shall be exercised to avoid injury to trees and shrubs that have been designated by the Engineer to be preserved.

F. Fertilizer:

1. Shall be uniformly applied to all areas requiring seeding.

G. Establishing Ground Cover

1. Contractor shall be responsible for establishing a minimum of 80% ground cover from the seed planted on all disturbed areas as determined by visual estimation of the Engineer. Reseeding or other measures may be necessary for the Contractor to meet this requirement, even if failure is due to weather. The Contractor shall submit aerial photography of the seeded area documenting the ground cover condition.
2. The Contractor shall remove silt fence when seeding is established.

3.02 PLANTING METHODS

A. General:

1. All seed shall be sown at the specified rate. When several species are specified and cannot be combined due to different characters such as size, weight, hulled, the seed shall be planted separately to obtain the specified seeding rates. Equipment shall not be operated on areas where rutting or slippage would mar the soil surface.

B. Methods:

1. Grass Drill Seeding Method:

- a. The seed shall be planted with a grass seed drill conforming to Section 2.01 b  
1. All drilling shall conform to the contour of area.

2. Hand Broadcasting Method:

- a. Hand broadcasting shall not be used except in areas that are too small or inaccessible to accommodate the specified equipment.

3. Corrugated Roller Seeder Method:

- a. The seed shall be distributed to conform to Section 2.01 d 1 which has been adjusted to accurately apply the proper amount.

#### 4. Hydraulic and Hydro-Seeder Methods:

- a. The seeding shall consist of mixing and applying seed, commercial fertilizer and stabilizing emulsion, or any combination thereof, with fiber and water. The materials and quantities thereof to be mixed with water will be specified in the special provisions. The quantity of water shall be as needed for the application. Except that when stabilizing emulsion is specified, the ratio of total water to total stabilizing emulsion in the mixture shall be as recommended by the manufacturer of the emulsion, but shall not exceed 6 GAL of water for each 5 LBS of stabilizing emulsion solids specified. Tanks shall be of a size that is appropriate to the size of the seeding area.

### 3.03 METHODS OF MULCHING

- A. The Contractor shall apply the protective mulch within 48 HRS after sowing the seed, unless otherwise directed by the engineer. The mulch shall be applied with mulch blowing machine or other approved methods.
- B. Immediately following the spreading of the mulch on the seeding areas, the material shall be anchored to the soil by "Cat Walking" with a bulldozer, a V-type wheel land packer, a soil erosion mulch tiller, or other suitable equipment which will secure the mulch firmly to form a soil binding mulch, or by the use of a chemical tackifier.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 MEASUREMENT

- A. Seeding will be measured by the ACRE as shown in the bid items. If the area is small, it may be measured in square yards.

### 4.02 PAYMENT

- A. Payment for seeding will be at the contract unit bid per acre. Includes preparing the soil, purchasing and sowing of seed, mulching, fertilizing, tacking, watering, erosion protection and caring for the area until the contract is complete, or the growing season is over, or if placed late in the year, until the seed has germinated in the spring of the following year. Water used in connection with seeding is considered incidental to the job.
- B. Final payment for seeding will be released when 80% ground cover has been established and aerial photography of the seeded area documenting the ground cover condition has been approved by the Engineer.

### 4.03 METHOD

- A. The method of applying seed, emulsion, tackifier, water, equipment, and all things required in seeding shall be considered as included in the price for seeding.
- B. If the method of seeding is not stated in the bid item or elsewhere in the Contract Documents, hydroseeding shall be the method used.

## END OF SECTION



## **SECTION 33 01 50 - ABOVEGROUND PETROLEUM STORAGE TANK CLEANING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Requirements for cleaning Union Pacific Railroad's aboveground diesel fuel storage tanks.
- B. The Contractor shall provide all project coordination, supervision, labor, materials, equipment and supplies necessary to clean the tanks. Specific information for each tank or group of tanks can be obtained from the Railroad.
- C. The Work requires confined space entry and The Contractor shall certify his workers are properly trained in Confined Space Entry. Anyone entering the tank shall use appropriate personal protection and safety equipment.

#### **1.02 REFERENCED STANDARDS**

##### **A. American Petroleum Institute (API):**

1. 2015, Cleaning Petroleum Storage Tanks.
2. 2207, Preparing Tank Bottoms for Hot Work.

##### **B. Occupational Safety and Health Administration (OSHA):**

1. 29 CFR 1910.146, Permit Required for Confined Spaces.

#### **1.03 SUBMITTALS**

##### **A. Submit copies of the following:**

1. One (1) copy of written Confined Space Entry Program outlining procedures for preventing unauthorized entry, identifying and evaluating hazards, testing, and monitoring conditions, training, rescue, and safe entry. Confined space entry program shall meet the requirements of 29 CFR 1910.146.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION**

#### **3.01 TANK ISOLATION**

- A. The Contractor shall provide all necessary materials and equipment to properly isolate the storage tank from the piping and power supply prior to beginning the Work. This may include the removal of valves and installation of blind flanges or other methods to ensure complete tank lockout.
- B. Care shall be taken to ensure that all fuel spillage is properly contained and transported to the designated waste disposal location. The Contractor shall be responsible for the cost associated with the cleanup of all fuel spills.

- C. All fuel being transferred in this matter must be filtered using a ten (10) micron diesel fuel filter. It is the Contractor's responsibility to ensure the fuel filter is kept clean and operating per the manufacturer's specifications.

### 3.02 RECLAIMED FUEL TRANSFER

- A. Before any fuel is transferred out of the tank, the Contractor shall stick the tank bottom to determine the approximate quantity of reclaimable fuel remaining in the tank and notify the Engineer.
- B. The Contractor shall provide the necessary piping connections, pumps, meters, filters and other required equipment for transferring and filtering usable fuel left in the tank into a Railroad provided tank or other location as specified for each site.
- C. All fuel being transferred in this manner must be filtered through a ten (10) micron diesel fuel filter. It is the contractor's responsibility to ensure the fuel filter is kept clean and operating per the manufacturer's specifications.

### 3.03 WASTE OIL REMOVAL

- A. All "off-spec" diesel fuel and water remaining in the tank after acceptable fuel is recovered shall be considered waste oil. The Contractor shall collect the waste oil and dispose of as indicated on the Site Data Sheet.

### 3.04 SLUDGE REMOVAL

- A. The Contractor shall collect and dispose of all bottom sludge as indicated on the Site Data Sheet.
- B. The disposal method and location shall be acceptable to all Federal, State, and Local governing agencies, including the Environment Protection Agency (EPA), and meet current requirements of the Resource Conservation and Recovery Act of 1981 (RCRA).

### 3.05 CLEANING AND VAPOR FREEING

- A. Cleaning of the tanks shall be conducted in accordance with the requirements of API Publication 2015 – Cleaning Petroleum Storage Tanks and publication 2207 – Preparing Tank Floors for Hot Work using high pressure steam or water.
- B. The Contractor shall provide all toxicity tests, reports, labor, safety equipment, washing equipment, pumps, electrical power supply, and material and equipment necessary to clean interior tank surfaces and provide atmospheres suitable for cutting and/or welding to conduct API 653 tests.
- C. If an internal tank lining is present, notify the Engineer and proceed with removing all loose liner material during tank cleaning. All tank wash water shall be collected by the Contractor and disposed of to the location as specified.

- D. The Contractor shall test for hydrocarbon vapors with an industry standard vapor indicator. The values obtained shall comply with the American Conference of Governmental Industrial Hygienists (ACGIH) and NFPA (National Fire Protection Association) standard 325M - Fire Hazard Properties of Flammable Liquids, Gasses, and Volatile Solids and NIOSH (National Institute for Occupational Safety and Health) published acceptable lower flammability limit (LFL). Vapor concentration shall be less than 10 percent of LFL.
  - E. Wash water shall be collected and transported to the designated disposal area as indicated on the Site Data Sheets.
  - F. The Contractor shall at all times have adequate fire extinguishing equipment and ventilation fans on hand and ready for use. The Contractor's employees shall properly extinguish cigars, cigarettes, and other smoking materials before entering the work area.
- 3.06 INSPECTION
- A. The tank interior shall be free of oils, dirt, debris, and excess water at the bottom, in the sump(s), and a minimum of 8 FT-0 IN up the shell wall after cleaning.

**END OF SECTION**

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## **SECTION 33 01 51 - ABOVEGROUND PETROLEUM STORAGE TANK INSPECTION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

**A. Section Includes:**

1. Requirements for “out-of-service” inspections of Union Pacific Railroad’s API-650 aboveground fuel storage tanks located at various sites.
- B. See the Tank Data Sheet to be provided by the Railroad for known information on specific tanks to be inspected.

#### **1.02 REFERENCES**

**A. American Petroleum Institute (API):**

1. 650, Welded Steel Tanks for Oil Storage.
2. 653, Tank Inspection, Repair, Alteration and Reconstruction.

**B. American Society for Non-Destructive Testing, Inc (ASNT).**

#### **1.03 SUBMITTALS**

**A. Submit copies of the following:**

1. One (1) copy of written Confined Space Entry Program outlining procedures for preventing unauthorized entry, identifying and evaluating hazards, testing and monitoring conditions, training, rescue and safe entry for both “Permit-Required” and “Non Permit-Required” confined spaces.
2. One (1) preliminary copy of inspection results or recommendations for items found NOT to comply with minimum API-653 standards. Results or recommendations shall be delivered or faxed to the engineer for review prior to demobilizing from the site.
3. Three (3) copies of the final inspection report shall be delivered within three (3) weeks after the inspection pit.

#### **1.04 QUALITY ASSURANCE**

- A. Tank inspectors shall be certified in accordance with API-653 – Aboveground Storage Tank Inspection Certification and shall be knowledgeable with all governing regulations and codes concerning petroleum storage tanks. An ASNT Level II individual certified in the required testing methods shall supervise the on-site inspection. An ASNT Level III individual certified in the required testing methods shall review and approve all test results and sign all report documents.**

## PART 2 - PRODUCTS

### 2.01 INSPECTION REPORT

- A. A preliminary hand-written summary of the tank inspection shall be given or faxed to the Engineer prior to demobilizing from the site. This summary shall indicate conditions that preclude the tank from immediate service or that may limit continued service to less than ten (10) years, and recommendations for repairs.
- B. In addition to the requirements of API-653, the final inspection report shall include be limited by, the following:
  - 1. Inspection summary and recommendations for repairs (include nameplate data).
  - 2. A general description of the inspected tank and all results of the visual inspection.
  - 3. A complete schedule and location sketch of all tank equipment and nozzles which includes:
    - a. Manufacturer, model number, serial number, and function of equipment.
    - b. Size and location of equipment or nozzle.
  - 4. Plan sketches and tables of the floor and roof showing thickness readings and their location.
  - 5. Detail of floor showing internal elevations, edge settlement and external elevation readings.
  - 6. Color pictures of equipment, inspection items and conditions such as:
    - a. Tank equipment and accessories.
    - b. Internal piping and gauge equipment.
    - c. General pictures of internal floor and shell condition, and external shell and roof condition.
    - d. Other notable inspection findings.
- C. The report shall be spiral bound with a heavy plastic windowed cover and back. The first page shall have the Title, which includes the tank number (example TNKD-9805) and a picture of the tank façade.
- D. Provide consecutive page numbering, a Table of Contents, and tabs required to make the report organized and easy to follow.
- E. Pictures shall be printed or photocopied to standard letter sized paper (8.5 x11 IN) and bound within the report.

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. The Contractor shall inspect the interior and exterior of the out-of-service storage tanks, including all appurtenances, in accordance with API-653 – Tank Inspection, Repair, Alteration and Reconstruction.

- B. The inspection shall include, but not limited to, the following:
1. An exterior visual inspection of the tank to ascertain the apparent general condition of any foundation, shell deformation, paint condition, shell or shell appurtenance deterioration or other indication of a possible problem. Visual inspection shall also include 100 percent inspection of the shell-to-bottom weld to look for pitting, cracks, etc. and sump welds.
  2. Interior visual inspection to ascertain the general condition of the internal gauging equipment, structural members, roof supports, shell appurtenances, sumps and coating system (if applicable).
  3. Provide a 100 percent magnetic flux leakage inspection, to the extent possible, of floor plates to check for underside corrosion of tank bottom. Indicate areas which could not be scanned by equipment.
  4. Ultrasonic Thickness Testing:
    - a. The floor plates shall have a minimum of three (3) reading taken per plate. Location selected to provide a uniform distribution. In addition, areas that exhibit pitting or loss of material shall be scanned (B-scan, electronic "coupon") to determine the extent and magnitude of material loss.
    - b. The shell plate readings are to be taken 6 IN above the floor, 36 IN apart and a minimum of three (3) points for each shell course along ladders or stairs. In addition, areas that exhibit pitting or loss of material shall also be tested for minimum plate thickness.
    - c. Provide a minimum of three (3) ultrasonic reading per plate of the tank roof to document general roof integrity. The test sites to be selected to provide a uniform distribution or areas showing extensive deterioration.
  5. Vacuum test all floor plate bottom welds, and other floor areas that exhibit excessive pitting.
  6. Inspect level gauges, floats, and other accessible tank appurtenances such as manufacturer, model number, serial number, function, location of tank, etc.
  7. Document all field information on all tank appurtenances such as manufacturer, model number, serial number, function, location on tank, etc.
  8. Internal floor elevations shall be taken along the eight (8) radial lines (N, NE, E, SE, etc.) at an interval no more than 15 FT apart from the center to the shell.
  9. External bottom extension elevations shall be taken along the eight (8) radial lines to check for external settlement.
  10. External elevation readings along the shell to check for excessive edge settlement.

**END OF SECTION**

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## **SECTION 33 05 23 - PIPE UNDER CROSSING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Construction and placement of pipe and casings under railroad crossings.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. UPRR Contract Section.**

##### **B. Section 00 07 00 - General Requirements.**

##### **C. Section 31 24 13 - Roadway Excavation and Embankment.**

##### **D. Section 31 23 26 - Compaction Control and Testing.**

##### **E. Section 40 05 03 - Piping Materials and Methods – Steel Pipe.**

#### **1.03 SUBMITTALS**

##### **A. Shop Drawings**

1. See Section 01 33 00.
2. Product technical data including:
  - a. Acknowledgement that products submitted meet requirements of standards referenced.
  - b. Manufacturer's installation instructions.
  - c. Compliance with submittal requirements of authority or agency having jurisdiction over undercrossing.

##### **B. Operation and Maintenance Manuals:**

1. See Section 01 33 00.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

##### **A. Casing Pipe:**

1. Structural grade steel.
2. Minimum yield strength of 35,000 psi or greater as required by the permits.
3. Wall Thickness:
  - a. Minimum of 1/4 IN or greater as required by permits
4. Diameter:
  - a. Minimum of 4 IN or larger than outside diameter of the carrier pipe's jointing system

## PART 3 - EXECUTION

### 3.01 INSTALLATION

#### A. General:

1. Install undercrossing to meet requirements of authority or agency having jurisdiction over the undercrossing.
2. Observe work requirements stipulated in any permit condition.
3. Consult Contract Drawings for limitation of construction Right-Of-Way.

#### B. Special Requirements:

1. If installation of crossing is by jacking or dry boring, the following will be required unless more requirements are specified by the authority or agency having jurisdiction over the crossing.
  - a. Diameter of the hole:
    - 1) Not exceeding diameter of casing by more than 1-1/2 IN.
  - b. Pressure grout all voids outside the casing, including abandoned or misaligned holes.
  - c. Fill void between carrier pipe and casing wall with blow sand. Install watertight grouted plug minimum of 1 FT-0 IN deep at both ends.
  - d. Undercrossing casing:
    - 1) Full lengths.
    - 2) Weld pressure tight.
  - e. After casing is installed, band wood blocks 120 degrees apart to each length of carrier pipe to prevent displacement and pull pipe into place. Pipe must be straight and centered in casing when in place.
  - f. Coordinate connections to system with authority or agency having jurisdiction over the crossing.

**END OF SECTION**

## **SECTION 33 05 24 - PIPE BURSTING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. The Contractor and their Subcontractor(s) shall furnish all labor, materials, tools, equipment, and services for all pipe bursting applications as indicated in accord with Division 01 and the Contract Documents.
- B. Coordinate and obtain permits from local utilities as required.

#### **1.02 QUALITY ASSURANCE**

- A. The Contractor shall take reasonable care to avoid disturbing other utilities, structures and surface features. In the event that damage is sustained, the Contractor shall repair or replace, at the request of the Railroad or Owner of the damaged utility, those areas at the Contractor's expense.
- B. The Contractor shall bear the costs of all excavations to relieve hydraulic pressure from adjacent structures, utilities, or to provide retrieval of pipe bursting equipment, either due to the course of work or accidental loss, equipment rental, or materials to prevent damage.
- C. The Contractor shall submit shop drawings, technical data, or demonstrate to the satisfaction of the Engineer the process to be used during pipe bursting or pipe splitting operations.

#### **1.03 SAFETY**

- A. The Contractor, Subcontractor(s), and their subordinate employees are required for follow all safety rules and regulations in accord with the Occupational Safety and Health Organization (OSHA) and Union Pacific Railroad (UPRR).

#### **1.04 CONTRACTOR QUALIFICATIONS**

- A. The Contractor and their Subcontractor(s) shall have a minimum of five (5) years experience with pipe bursting technology.
- B. The Contractor and their Subcontractor(s) shall provide verification of qualifications to the Railroad. The Contractor shall furnish background information on key personnel to allow the Railroad to ensure they have adequate experience.

#### **1.05 CONSTRUCTION RECORDS**

- A. The Contractor shall keep and provide at the request of the Railroad, the Engineer, and their Representatives the following documents during the pipe bursting or pipe splitting process:
  - 1. Pre-construction survey.
  - 2. As-built conditions.
  - 3. Construction Logs.

4. Materials installed.
5. Extent and causes of delays.
6. Locations of effected areas.
7. Unusual problems or conditions encountered.

## 1.06 SUBMITTALS

### A. Construction Documents:

1. The Contractor shall provide submittals that show the method of construction and restoration of existing service connections. These shall include:
  - a. Detailed drawings and a written description of the entire construction procedure to install pipe, bypass flow, and reconnection to service connections.
  - b. A methodology statement to explain the operation of all pipe bursting or pipe splitting equipment. Include details for:
    - 1) The bursting tool (based on technique used).
    - 2) The protective sleeve (if used).
    - 3) The winching unit.
  - c. In the event a lubricant is used, any environmental implications regarding its use and migration away from the pipe alignment shall be brought to the attention of the Engineer or their representative.
  - d. Material Safety Data Sheets (MSDS) on materials used during pipe bursting or pipe splitting operations.
2. The Contractor shall submit written information including shop drawings, technical reports and methodology reports explaining the temporary diversion for the pipeline. The Contractor shall verify the capacity and durability of pumps, pipes, hoses and all appurtenances are able to handle all necessary flows while the pipeline is out of service. Continuous service of connections to the line during the execution of the Work shall be the responsibility of the Contractor, including clean-up, repair and property damage cost and claims due to bypassing failures.

## PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

## PART 3 - EXECUTION

### 3.01 CONSTRUCTION

#### A. Service Excavations:

1. The Contractor shall flush all pipes with water, to be collected at the end of the pipe run and remove and dispose of in a legal manner, all deleterious matter ejected.

2. All service connections to be excavated and disconnected prior to pipe bursting. Temporary bypasses are to be installed to allow use of all service connections. Excavate above and below the pipe to reduce humps in main piping during the bursting.

B. Insertion and Reception Pits:

1. All pits should be prepared and shored in an approved manner. For all static rod and cable pull machines, the machine shall be properly braced to resist the horizontal force necessary for the bursting operation. This may require the pit or manhole to have a thrust block with proper structural capabilities. Inadequate structural capacity of the pit wall or thrust block to resist the pull or push forces can cause wall deformation or failure and surface heave near the wall. Sudden movements of jacking rigs, and cable pull systems can raise safety concerns for the contractor and bystanders.
2. For replacement of gas and water lines, service pits can be expanded and used for the insertion and reception pits.
3. After pipe bursting, the Contractor is to restore the connections to original or better condition.
4. Different pipe bursting systems have different requirements in terms of the space required in the reception pit. Some systems may be able to operate within existing manholes and others may need to excavate a pit for the pulling frame. The Contractor is to determine what pipe bursting method is to be used. At the end of the Project, the contractor is to restore existing manholes or fill reception pits to original or better condition.
5. The insertion pit must be large enough to allow the pipe to be inserted. For continuous HDPE pipes, this means that the pipe must be able to be fed from the surface into the existing pipe alignment without overstressing the pipe in bending. Manufacturer's guidelines on minimum bending radius need to be closely adhered to. Instead of creating a long insertion pit, it is sometimes possible to create a pipe entry path using an impact mole or similar device. This is then expanded using the pipe bursting expansion head and the pipe is fed through this new hole to the level of the pipe being replaced.
6. The Contractor is to apply all confined space safety procedures apply as appropriate. Entry and exit holes from existing manholes shall be enlarged to ensure the structural integrity of the manhole. The sewer manhole invert may need modification to allow tool passage. In cases of large upsizes or when dealing with large diameter pipe, and where surface conditions allow, complete replacement of manholes may be the simplest and least expensive option. This also can be beneficial in that a complete new system results.

C. Equipment Installation:

1. When the winch and pulling cables are used to pull the bursting tool through the pipe, the winch is placed in a reception pit, and the cable pulled through the pipe and attached to the front of the bursting unit in an insertion pit. The winch helps to ensure the directional stability in keeping the unit on the line of the existing pipe. The winch must supply sufficient cable in one continuous length so that the pull may be continuous between winching points. The winch, cable and cable drum shall be provided with a safety cage and supports so that it may be operated safely without injury to persons or property.
2. When rigid pulling rods are used instead, they are threaded from the reception pit through the existing pipe until the pipe insertion is reached. The rods are then attached to the bursting head.
3. Equipment used to perform the work shall be located away from buildings so as not to create noise impact. Provide a silent engine compartment with the winch to reduce machine noise as required to meet local requirements.
4. Lubrication may be used as recommended by the manufacturer. Under no circumstances shall the pipe be stressed beyond its elastic limit.

D. Reconnection of Services and Annular Space Sealing:

1. The newly installed pipe shall be left to cool for the manufacturer's recommended time, however not less than 4 HRS, prior to any reconnection of service lines, sealing of the annular space in the manhole wall or backfilling of the insertion pit.
2. Following the relaxation period, the annular spaces in the manhole wall shall be sealed. Sealing is extended a minimum of 8 IN into a manhole wall in such a manner as to form a smooth, watertight joint. Ensuring a proper bond between the PVC or PE pipe replacement pipe and the poured manhole wall joint is critical.
3. Service connections can be reconnected to the new pipe with specially designed fittings by various methods. The saddles, made of a material compatible with that of the pipe, are connected to the pipe to create a leak-free joint. Different types of fused saddles (electrofusion saddles, conventional fusion saddles) are installed in accordance with manufacturer's recommended procedures. Connection of new service laterals to the pipe also can be accomplished by compression-fit service connections. Installation procedures and equipment are to follow manufacturer's installation instructions. After testing, and inspection to ensure that the service meets all required specifications of the service line, the pipeline returns to service.

E. TESTING OF THE REPLACEMENT PIPE

1. All replacement pipe shall be pressure tested after installation to ensure proper installation. In accordance with Section 40 05 03 Subsection 3.04, Paragraph C, Pressure Piping Pneumatic/Soap Test. Pressure test to be performed before and after lateral connections are restored.

2. If pressure testing cannot be performed, the Contractor shall provide closed circuit television inspection as a post-production method to determine if the pipeline has been installed as required and all joints have been properly finished.
  - a. CCTV system shall have a rotating lens camera with an articulating head. Each joint shall be scanned 360 degrees.
  - b. The camera shall operate in 100 percent humidity conditions.
  - c. Lighting for the camera shall minimize relative glare.
  - d. Lighting and camera quality shall be suitable to provide clear, in-focus picture of the entire periphery of the pipe for all conditions encountered during the Work.
  - e. Focal distance shall be adjustable through a range from 3 IN to infinity.
  - f. The remote reading footage counter shall be accurate to 1 percent over the length of the particular section being inspected.
  - g. The camera, television monitor, and other components of the color video system shall be capable of producing a minimum of 350 line resolution.
  - h. Documentation consisting of color video tape and a written report detailing the condition of the mainline and joints shall be submitted to the Engineer for approval prior to final payment.

**END OF SECTION**

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## **SECTION 33 05 25 - HORIZONTAL DIRECTIONAL DRILLING**

### **PART 1 - GENERAL**

#### **1.01 PREFACE**

- A. The American Railway Engineering and Maintenance-of-Way Association (AREMA) has assigned a working committee to develop a recommended railroad industry practice for Horizontal Directional Drilling (HDD – hereafter) under railroad Rights-of-Way. These interim guidelines are issued by the Union Pacific Railroad (UPRR) pending completion of the AREMA recommended practice, at which time UPRR will review and determine whether to adopt it.

#### **1.02 SCOPE**

- A. All pipelines proposed for installation under UPRR Right-of-Way and trackage using HDD. Fiber optics installation under the jurisdiction of the UPRR Information Technologies (IT) Department with 10 IN or smaller diameter casing pipe shall follow the guidelines outlined in the current version of the “Fiber Optic Engineering, Construction and Maintenance” Standard Manual.

#### **1.03 DIRECTIVES**

- A. For all liquid or gas pipelines, only steel pipe may be installed under tracks or UPRR Right-of-Way utilizing HDD. The pipe may be used as a carrier pipe or a casing pipe. Plastic carrier pipe, if used, must be installed in a steel casing.
- B. For fiber optics (not under the jurisdiction of UPRR IT Department) or electrical installations, plastic (PVC or HDPE) pipe may be used as a conduit.
- C. For all liquid or gas installations or for nominal pipe sizes exceeding 6 IN DIA, minimum cover (measured from base of rail to top of pipe) shall be 2 FT-6 IN regardless of product. For fiber optics or electrical installations, with casing/conduit nominal size of 6 IN or less, minimum cover shall be 1 FT-6 IN. Applicant submittal shall include actual planned depth of pipe under each railroad track.
- D. Applicant must provide pipe specifications. Pipe must specify AREMA recommendations and all applicable government and industry regulations.
- E. Applicant must provide qualifications of drilling contractor including specific instances of previous successful experience in drilling under sensitive surface facilities.

#### 1.04 PRE-DRILLING REQUIREMENTS

- A. The contractor must submit an Installation Plan that describes the anticipated rig capacity, the proposed equipment and the method for advancing the borehole through expected soil conditions, angles, depth and exact location of the exit ditch, the pilot hole diameter, the proposed reaming plan, including the number and diameter of pre-reams/back-reams and the diameter of the final reamed borehole, and contingency equipment and plans for dealing with soil conditions that a soil engineer could reasonably expect to be encountered at the proposed HDD installation site. The Installation Plan will also address the anticipated hours of operation during the HDD borehole drilling and installation process, the minimum number of personnel and their responsibilities on-duty and on-site during all HDD drilling operations.
- B. The Contractor must provide a detailed Fracture Mitigation (frac-out) Plan including method of monitoring and capturing the return of drilling fluids with particular attention to prevention of inadvertent escape of drilling fluids where they could undermine the railroad tracks.
- C. Establish a Survey Grid Line and provide a program of monitoring and documenting the actual location of the borehole during drilling operations.

#### 1.05 RIGHT-OF-WAY SAFETY REQUIREMENTS

- A. A railroad observer and an applicant inspector are required to monitor the ground, ballast, and track for movement during the drilling, reaming, and pullback processes. All work within the Railroad Right-of-Way must be coordinated with the Railroad Flagger. The installation process and all train movement must be immediately stopped if movement is detected. The damaged area must be immediately stopped if movement is detected. The damaged area must be immediately reported to the Railroad and immediately repaired subject to Railroad review and approval. The installation process must be reviewed and modified as required before the installation may proceed. Applicant must pay Railroad's expenses for review, observation of installation and flagging.
- B. Upon completion of the HDD installation work, the contractor shall provide an accurate as-built drawing of the installed HDD segment. As-built drawings will include both horizontal and profile plans.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**

## **SECTION 33 05 26 - MECHANICAL IDENTIFICATION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Identification and labeling of above ground piping, valves and equipment, ductwork, above ground tank connections, and above ground storage tanks.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 09 90 01-Painting and Coatings
- B. Section 09 97 50 – Tank and Pipe Coatings for Fuel and Oil Systems

#### **1.03 REFERENCED STANDARDS**

- A. ASME A13.1 - Scheme for the Identification of Piping System.
- B. UPRR Fuel Standard 003-16 – AST Labeling

#### **1.04 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.
- B. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- C. Shop drawings required by this Section include, but are not limited by, the following:
  1. Schedule of pipe;
  2. Tank and valve label designations.
- D. Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- E. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Subject to compliance with requirements, provide mechanical identification materials of one of the following:
  1. Allen Systems, Inc.
  2. Brimar Industries, Inc.
  3. Brady (W.H.) Company, Signmark Division.
  4. Industrial Safety Supply Company, Inc.
  5. Seton Name Plate Corp.

6. Craftmark Identification Systems.
7. Approved Equal.

## 2.02 IDENTIFICATION

### A. Aboveground Piping:

1. Color: Conform to ASME A13.1.
2. Provide product identification as listed in this section for all aboveground piping. Paint and stenciled lettering, or metal tags with stamped 1/4 IN minimum letter height. Secure tags with chains which are suitable for the environment.
3. For piping or pipe covering with an outside diameter of less than 3/4 IN, provide metal tags with stamped 1/4 IN minimum letter height. Secure tags with chains which are suitable for the environment.
4. Label the containment pipe of double wall piping per the carrier pipe contents.
5. The length of the color field and the letter size as listed in this section.
6. Color shall conform to ASME A13.1.

### B. Underground Piping:

1. Underground Pipe Marker Tape: Bright colored plastic ribbon tape, minimum 6 IN (150 mm) wide by 4 mil (0.10 mm) thick, continuously imprinted to indicate piping service, manufactured for direct burial service.
2. Underground Metallic Detection Tape: Bright colored plastic ribbon tape, minimum 6 IN (150 mm) wide by 4 mil (0.10 mm) thick, metallic film bonded to tape, continuously imprinted to indicate piping service, manufactured for direct burial service.

### C. Valves and Equipment:

1. Provide 19-gage (1-1/2 IN) polished brass valve tags with stamp-engraved piping system abbreviation in 1/4 IN high letters and sequenced valve numbers 1/2 IN, and with a 5/32 IN hole for fastener.
2. Equipment shall be identified with paint stencil or other approved method with designation as shown on drawings, or as directed by engineer.

### D. Ductwork:

1. Provide manufacturer's standard laminated plastic, color coded duct markers. Conform to ANSI A13.1 color code.
2. Nomenclature: Direction of air flow, Duct service (supply, return, exhaust, etc.).

### E. Aboveground Tank Connections:

1. Paint and stencil lettering as indicated on drawings.
2. Legend designation shall be upper case, block type letters with appropriate background color.

### F. Aboveground Tanks:

1. Tank labeling including NFPA Hazardous Material identification shall be per UPRR Fuel Standard 003-16-AST Labeling..

G. Caution Signs:

1. Aluminum, 0.04 IN (1.0 mm) thick, baked enamel finish; plastic face bonded to 20 gauge galvanized steel backing.
2. Minimum size: 10 IN (250 mm) wide by 7-inch (175 mm) high. Heading: "CAUTION"; In yellow letters on black background.

H. Oxy-Acetylene System Signage:

1. Signage shall meet the requirements of NFPA 51.
2. Oxygen manifold:
  - a. The following sign shall be conspicuously posted at each manifold:

**LOW-PRESSURE MANIFOLD —  
DO NOT CONNECT  
HIGH-PRESSURE CYLINDERS.  
MAXIMUM PRESSURE — 350 PSIG.**

- b. Gages on oxygen regulators shall be marked "USE NO OIL."
3. Station outlets shall be clearly marked to indicate the name of the gas in the connected pipe.
  4. Signs clearly establishing the location and identity of section shutoff valves shall be provided.
  5. Piping shall be painted and labeled in accordance with this Specification.
- I. Systems to be identified include, but are not limited by, the following:

Product/System	Label Wording	Color of Pipe	Color of Letters
Diesel fuel (DF)	DIESEL FUEL	White	Black
Industrial water (IW)	INDUSTRIAL WATER	White	Black
Retention Tank	RETENTION TANK	White	Black
Soap (SO)	SOAP	White	White/ Color field: Green
Compressed air (CA)	COMPRESSED AIR	Blue	White
Potable water (PW)	POTABLE WATER	Green	White
Domestic Cold Water (DCW)	DOMESTIC COLD WATER	Green	White
Domestic Hot Water (DHW)	DOMESTIC HOT WATER	Yellow	Black
Domestic Hot Water Recirculating (DHWR)	DOMESTIC HOT WATER RECIRCULATING	Yellow	Black
Sanitary Sewer (SAN)	SANITARY	Yellow	Black
Vent (V)	VENT	Yellow	Black

<b>Product/System</b>	<b>Label Wording</b>	<b>Color of Pipe</b>	<b>Color of Letters</b>
Natural Gas (G)	NATURAL GAS	Yellow	Black
Acetylene (ACT)	ACETYLENE	Yellow	Black
Non-Potable water (NPW)	NON-POTABLE WATER	Green	White
Tempered water (TW)	TEMPERED WATER	Green	White
Radiator water (RW)	RADIATOR WATER	Green	Black
Toilet waste vacuum (TWV)	TOILET WASTE VACUUM	Green	Yellow
Oxygen (OX)	OXYGEN	Green	White
Lube oil (LO)	LUBE OIL	Gray	Black
Compressor oil (CO)	COMPRESSOR OIL	Gray	Black
Journal oil (JO)	JOURNAL OIL	Gray	Black
Drain/Used oil (DO)	DRAIN OIL	Gray	Black
Reclaim oil (RO)	RECLAIM OIL	Gray	Black
Toilet Fill/Toilet chemical (TC)	TOILET CHEMICAL	Yellow	Black
Fire protection water (FW)	FIRE PROTECTION WATER	Red	White
Fire protection foam (AFFF)	FIRE PROTECTION FOAM	Red	White

***Note: If piping is insulated, use colored band over insulation.***

J. The length of the color field and the letter size:

<b>Pipe or Outside diameter</b>	<b>Length of Color field</b>	<b>Size of Letters</b>
3/4 to 1 1/4 IN	8 IN	1/2 IN
1 1/2 to 2 IN	8 IN	3/4 IN
2 1/2 to 6 IN	12 IN	1 1/4 IN
8 to 10 IN	24 IN	2 1/2 IN
Over 10 IN	32 IN	3 1/2 IN

## 2.03 FLOOR STRIPING / PHYSICAL HAZARDS

- A. A safety yellow stripe shall be used to mark physical hazards such as striking against, stumbling, falling, tripping and “caught-between”. These include building columns in areas of forklift usage, edges of elevated platforms, nosing of stair treads, equipment pits, and projection into a walk/work area or other area where a person needs to be warned of a possible hazard.

- B. In an area with a moving hazard, the entire involved area should be provided with border and diagonal stripping. The width of the stripe to be determined by intent of warning. Recommended is a minimum 4 IN stripe for most instances with 1 to 2 IN for stair tread nosing.
- C. Items such as pipe bollards, handrails, building or structural columns shall be painted safety yellow.
- D. Building or structural columns shall be painted safety yellow to a height of 10 FT off of finished floor.
- E. Walkways shall be painted with a 4 IN white border with 4 IN diagonal stripes.

#### 2.04 CAUTION SIGNS

- A. Aluminum, 0.04 IN (1.0 mm) thick, baked enamel finish; plastic face bonded to 20 gauge galvanized steel backing.
- B. Minimum size: 10 IN (250 mm) wide by 7 IN (175 mm) high. Heading: "CAUTION"; In yellow letters on black background.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Clean surface to receive label or paint. Surface must be free of oil, grease, dust, dirt, or other substances which would affect adhesion. Refer to Section 09 90 01 for surface preparation and painting requirements.
- B. Install label or stencils only after coating system is complete and dry.
- C. Stencils shall be carefully applied and removed to insure a neat and legible legend.

#### 3.02 LOCATIONS

- A. Locate piping labels and banding on piping near connections to equipment, on both sides of wall or grade penetrations, at intervals not to exceed 50 FT. Legends shall be visible from normal line of vision.
- B. Identify all mechanical equipment shown on Drawings or specified in this Division, including but not limited to the following:
  - 1. Pumps.
  - 2. Plumbing equipment.
  - 3. Air compressors.
  - 4. Air dryers.
  - 5. Compressed air pressure regulators.
  - 6. Refrigerant compressors and condensers.
  - 7. Furnaces.
  - 8. Unit heaters.
  - 9. Fans.

10. Control dampers.
11. Fire or smoke dampers.
12. Thermostats.
13. Control panels and switches.”

### 3.03 CAUTION SIGN INSTALLATION

- A. Install with corrosion resistant mechanical fasteners.
- B. Provide signs printed with the message "EMERGENCY EQUIPMENT - DO NOT CLOSE VALVE" where indicated on Drawings and at the following locations:
  1. Shut-off valves on water supply to emergency showers and emergency eye wash stations.

### 3.04 TAG INSTALLATION

- A. Install tags with self-locking nylon ties or zinc plated steel jack chain.
- B. Use tags to identify mechanical equipment or components that are too small or have surfaces that prevent secure nameplate installation, including but not limited to the following:
  1. Control valves.
  2. Isolation valves.
  3. Control devices.
  4. Instrumentation devices.

### 3.05 EQUIPMENT IDENTIFICATION

- A. All equipment such as controls, relays, gauges, etc.; and handling units, pumps, water heaters, air compressors, air dryers, compressed air pressure regulators, refrigerant compressors and condensers, unit heaters, supply fans, fire dampers, control panels and switches, thermostats, exhaust fans, filters, reheat coils, dampers, etc.; shall have nameplates or plastic tags listing name, function, and drawing symbol. Do not label exposed equipment in public areas. Provide tags for all mechanical equipment and components that are too small or have surfaces that prevent secure nameplate installation such as control valves, isolation valves, control devices, and instrumentation devices.
  1. Plastic Nameplates: Laminated three-layer phenolic with engraved black, 1/4 IN minimum letters on light contrasting background.
  2. Aluminum Nameplates: Black enamel background with natural aluminum border and engraved letters furnished with two mounting holes and screws.
  3. Plastic Tags: Minimum 1-1/2 IN square or round laminated three-layer phenolic with engraved, 1/4 IN minimum black letters on light contrasting background.
  4. Brass Tags: Brass background with engraved black letters. Tag size minimum 1-1/2 IN square.
- B. Fasten nameplates or plastic tags with stainless steel self-tapping screws or permanently bonding cement.



- C. Mechanical equipment shall carry a permanent label installed by the manufacturer stating that the equipment complies with the requirements of Standard 90.1.

**END OF SECTION**

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## **SECTION 33 31 20 - SANITARY LIFT STATIONS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Sanitary lift stations.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to Work of this section.

#### **1.03 REFERENCED STANDARDS**

- A. UL and NEMA Compliance: Provide electric motors and components which are listed and labeled by Underwriters Laboratories and comply with NEMA standards.

#### **1.04 SUBMITTALS**

- A. Submit as specified in Section 01 33 00 - Submittals and Substitutions.
- B. Product Data: Submit manufacturer's pump specifications, installation and start-up instructions, and accurate pump characteristic performance curves with selection points clearly indicated.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to pumps. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
- D. Maintenance Data: Submit maintenance data and parts lists of each type of pump, control, and accessory, including troubleshooting maintenance guide. Include this data, product data, and wiring diagrams in maintenance manual in accordance with requirements of Division 01.

### **PART 2 - PRODUCTS**

#### **2.01 SANITARY WASTE GRINDER PUMPS**

- A. General: Provide complete duplex submersible grinder type sanitary type lift pump station capable of pumping sanitary sewage from the support building and waste vacuum station, of size and capacity indicated on the drawings. Manufacturer of the duplex grinder type sanitary lift pump station shall include duplex submersible type pumps, movable breakaway fittings with stainless steel guide rails, stainless steel pump brackets, stainless steel pipe nipples, stainless steel elbows, stainless steel hardware with cast iron check valves, lifting cables, level controls, NEMA-3R duplex control panels and fiberglass basin. Grinder type sanitary lift pump station shall be furnished as a complete factory assembled package.

- B. Pump: Unit shall be submersible, grinder, vertical discharge design. Volute shall be cast iron ASTM A48, Class 30.
- C. Impeller: Ten (10) Vane vortex with pump out vanes on back side, dynamically balanced, ISO G6.3, 85-5-5-5 bronzecast iron ASTM A48, class 30 impeller.
- D. Shredding Ring: Shall be hardened 440C stainless steel, Rockwell C-55.
- E. Cutter: Shall be hardened 440C stainless steel, Rockwell C-55.
- F. Seal Plate: Cast iron ASTM A48, class 30.
- G. Shaft: Type 416 stainless steel shaft.
- H. Square Rings: Buna-N.
- I. Seal: Tandem mechanical, oil-filled reservoir. The rotating face shall be carbon and stationary face shall be ceramic. The elastomer shall be Buna-N. The hardware is to be 300 stainless steel.
- J. Motor: Motor shall be NEMA B – Single phase torque curve, completely oil filled, squirrel cage induction with class B insulation, dual-voltage, 208/230 VAC, single-phase, 3450 RPM. Upper bearing shall be single row, ball bearing, oil lubricated, radial and thrust load. Motor housing shall be cast iron ASTM A48, class 30. Motor provided with moisture sensor, temperature sensor, and 25 FT-0 IN long power cord, pressure grommet for sealing and strain relief.
- K. Basin: The basin for Sanitary Lift Stations shall be constructed of fiberglass. Sized for (see drawings for basin depth) duplex pump installation with 3 IN ballast support flange, stainless steel discharge hub, adapter/inlet hub, steel cover with black asphalt coating, 3 IN bug-free vent, lockable hinged access door, with stainless steel hinges and hardware.
- L. Rail Guide System: 304 stainless steel “C” channel.
- M. Breakaway Fitting: Heavy duty, cast iron stationary.
- N. Junction Box: NEMA 6 rated with cable grips for direct burial cable.
- O. Ball Valves: PVC full port design, true union. Supply with 3/8 IN DIA stainless steel extension handles.
- P. Movable Sub-Assembly – including the following items:
  - 1. Check Valve – Cast iron body with plug, natural rubber ball.
  - 2. Pump brackets – Shall be 304 stainless steel.
  - 3. Movable – Cast iron.
  - 4. Discharge Piping – Stainless steel.
  - 5. Level controllers – pressure switch level controllers to automatically cycle pumps on, off, and provide high level alarm position.

6. Control panel – Furnish and install one complete duplex pump control panel in a NEMA 3R rated enclosure. The panel to provide short circuit protection and line disconnect. The panel shall incorporate circuit breakers with through inner door operating handles, tamper-proof door, inner door, run lights, start delays, and magnetic starters with ambient compensated quick trip overloads, alternator, and HOA selector switches, 115 volt control transformer with fused secondary aodn on winding thermal overloads in series with contractor coils, moisture sensor relays with warning lights, temperature sensor relays, with warning lights, and high-level and alarm bell with silencer.
- Q. Available Manufacturers – Subject to compliance with requirements, manufacturers offering submersable type sump pumps which may be incorporated in the work include, but are not limited to:
1. ABS, Inc.
  2. Barnes Pump, Inc.
  3. Myers Pumps, Inc.
  4. Weil Pump Co.
  5. Weinman Pump LFE Corp.; Fluids Control Division.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION OF PUMPS

- A. General – Install pumps where indicated on drawings, in accordance with the manufacturer’s published installation instructions, complying with recognized industry practices to ensure that pumps comply with requirements and serve intended purposes.
- B. Support – Install pumps with anchor bolts poured in place. Set and level pump, grout under pump with non-shrink grout.
- C. Electrical Wiring – Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer’s wiring diagrams submittal to the Electrical Installer.

### END OF SECTION

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## **SECTION 33 37 17 - ABOVE GROUND WEIR BOXES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Design, fabrication, and installation of a single-wall reinforced polyester fiberglass weir box. The weir box will be used to measure water flow.
  2. Weir box shall be approximately 40 IN long by 16 IN wide by 16 IN deep.
- B. Box shall be manufactured of 100 percent resin and glass-fiber reinforcement, with no sand fillers and no exposed glass fibers.

#### **1.02 REFERENCED STANDARDS**

- A. Manufacturer shall be able to provide documentation that the weir box has been built to the requirements of Underwriters Laboratories Standards.

#### **1.03 SUBMITTALS**

- A. Submit as specified in Division 01.
- B. Shop drawings required by this Section include, but are not limited by, the following:
1. Weir box and plate including all accessories and appurtenances.
  2. Calibration chart indicating the water height and gallons per minute of flow.

#### **1.04 QUALITY ASSURANCE**

- A. Box manufacturer shall be in the business of manufacturing weir boxes and weir plates.

### **PART 2 - PRODUCTS**

#### **2.01 FIBERGLASS WEIR BOX AND WEIR PLATE**

- A. Weir Box Requirements: Box to be molded in one piece of reinforced polyester fiberglass with 1/4 IN minimum wall thickness. Wetted surfaces shall have smooth white gel-coat finish; exterior surfaces shall have a gel-coat finish for UV protection and reinforcing ribs to prevent distortion during shipment, installation and operation. Weir box shall be self supporting and require no external supporting structure during installation and operation. There shall be provided anchor clips permanently attached to the weir box exterior. Clips shall have holes for securing weir box to foundation.
- B. Inlet and Outlet Connections: There shall be provided an inlet and outlet connection at each end of the weir box. The connections shall be fiberglass flat face pipe flanges for 4 IN line size with a bolt circle and diameter to match standard 125 LB flange dimensions.

- C. Weir Plate: The box shall be supplied with a V Notch weir plate. The weir plate shall have a notch angle of 45 degrees and a notch depth of 6 IN for a 50 GPM flow rate. The weir plate shall be fabricated from 304 stainless steel. The plate shall have a minimum thickness of 1/4 IN with a smooth upstream face and reinforcing on the downstream side as required. The V Notch stainless steel weir plate shall be a machined notch with a sharp upstream face and the notch shall be at a 90 degree angle with respect to the upstream face of the plate. The notch shall have a 1/16 IN long bevel, and a downstream chamfer of 45 degrees. The weir box shall be supplied with an angle with holes drilled to match those of the weir plate to allow mounting of the plate.
- D. Depth Gauge: There shall be supplied with the weir plate a 316 stainless steel depth gauge to be mounted upstream of the weir plate at a distance at least 3 times the depth of the weir notch. The gauge shall be supplied with elongated holes to allow the elevation of the gauge to be adjusted up or down 1/4 IN. The gauge shall be set at an elevation such that the gauge zero is exactly even with the bottom of the weir plate's V Notch. The depth markings on the gauge shall be laser cut through the gauge for long term durability. The markings shall be in units of feet by 1/10th and 1/100th of a foot.

## 2.02 WEIR BOX ACCESSORIES

- A. Riser: Weir box shall have a 12 IN DIA by 24 IN tall riser section with bolt down top and a 304 stainless steel 3/4 IN NPT connector for transducer wiring.
- B. Ultrasonic Transducer Mounting Bracket: There shall be supplied with the weir box, an elevation adjustable bracket fabricated from 316 stainless steel piping and fittings with a 1 IN female NPT connector for the transducer. All fasteners shall be stainless steel.
- C. Lid: Weir box shall have a fiberglass hinged lid with a stainless steel handle and stainless steel hinges to cover box upstream of riser section.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Weir box shall be installed according to manufacturer's current installation instructions.

### **END OF SECTION**



## **SECTION 33 39 13 - MANHOLES AND COVERS FOR BUILDINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Modular precast concrete manhole sections for sanitary sewer application with tongue-and-groove joints, covers, anchorage, and accessories. Manholes for electrical application are not covered in this section.

##### **B. This section does not apply to the construction of mainline and/or yard track projects.**

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 00 - Submittals and Substitutions.
- B. Section 01 45 00 - Quality Assurance and Control.
- C. Section 03 20 00 - Concrete Reinforcement.
- D. Section 03 30 00 - Cast-In-Place Concrete.
- E. Section 31 23 24 - Backfill.

#### **1.03 REFERENCED STANDARDS**

- A. ASTM A48 - Gray Iron Castings.
- B. ASTM C478 - Precast Reinforced Concrete Manhole Sections.
- C. AASHTO HS20-44.
- D. OSHA - CFR 29.

#### **1.04 SUBMITTALS FOR REVIEW**

- A. Section 01 33 00 - Submittal Procedures.
- B. Shop Drawings: Indicate manhole locations, elevations, piping, sizes and elevations of penetrations, and installation details.
- C. Product Data: Provide manhole covers, component construction, features, configuration, dimensions, and accessories.

#### **1.05 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 5 years experience.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Manhole Sections: Reinforced precast concrete in accordance with ASTM C478. Minimum concrete strength: 5,000 LBS/SQ IN. Use joint sealant as provided and instructed by Manufacturer to make manhole watertight.

### 2.02 COMPONENTS

- A. Lid and Frame: Cast iron construction, machined flat bearing surface, removable lid with a Type I pick hole; AASHTO HS20-44 load rating; lid molded with "SANITARY SEWER" or other appropriate utility lettering on top surface.
- B. Manhole Steps: Non-corrosive steps of rubber encased steel or galvanized steel, installed to withstand 400 LBS vertical load and 1,000 LBS pullout. Place steps to allow access straight down one wall of manhole. Steps shall comply with OSHA requirements for fixed ladders.
- C. Pipe Penetration Sealing: Positive seal gasket system as manufactured by Press Seal Gasket Corporation.

### 2.03 CONFIGURATION

- A. Shaft Construction: Concentric with eccentric cone top section; lipped male/female joints; blockouts to receive pipe of size and location shown on drawings. Use precast concrete adjusting rings to attain grade elevation if necessary. Limit height of adjusting rings to 12 IN.
- B. Shape: Cylindrical, with integral precast concrete base.
- C. Clear Inside Dimensions: 48 IN DIA.
- D. Design Depth: As indicated.
- E. Clear Lid Opening: 26 IN DIA.
- F. Pipe Entry: Provide openings sized and located for pipes as indicated on drawings.
- G. Floor Concrete: 5,000 LBS/SQ IN concrete mix, using pea gravel aggregate.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify items provided by other sections of work are properly sized and located.
- B. Verify that built-in items are in proper location and ready for roughing into work.
- C. Verify excavation for manhole is correct.

### 3.02 PREPARATION

- A. Coordinate placement of inlet and outlet pipe.

### 3.03 PLACING MANHOLE SECTIONS

- A. Excavate to subgrade as indicated. Verify that subgrade is stable. Compact subgrade. Protect excavation from water damage during construction.
- B. Place and compact 6 IN thickness of well-graded crushed stone with maximum 6 percent fines beneath manholes and structural fill around the sections, in maximum 6 IN lifts, to 98 percent Standard Proctor.
- C. Accurately place manhole base section to line and grade. Install subsequent sections with sealant to form watertight joints.
- D. Install pipes as indicated.
- E. Invert Channels: Formed in fresh concrete floor, smooth and semi-circular to conform to pipes; large radius turns. Slope floor to channels between 1 and 2 IN/FT. Broom finish floor.
- F. Backfill around manhole in 6 IN lifts, compacting to 98 percent Standard Proctor. Use pipe embedment material to elevation 6 IN above top of pipes. Clean excavated material may be used to within 6 IN of finish grade. Use topsoil up to finish grade unless manhole is located beneath paved area. Insure that final grade will slope away from manhole cover.

**END OF SECTION**

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## **SECTION 33 40 10 - STORM DRAINAGE FOR BUILDINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Pipe and fittings.
2. Encasement for piping.
3. Manholes.
4. Cleanouts.
5. Non-pressure transition couplings.
6. Expansion joints.
7. Stormwater inlets.
8. Pipe outlets.

B. This section does not apply to the construction of mainline and/or yard track projects.

#### **1.02 SUBMITTALS**

##### **A. Action Submittals:**

1. Product Data: For each type of product indicated.
2. Shop Drawings:
  - a. Manholes: Include plans, elevations, sections, details, frames, and covers.
  - b. Stormwater Inlets: Include plans, elevations, sections, details, frames, covers, and grates.

#### **1.03 PROJECT CONDITIONS**

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

### **PART 2 - PRODUCTS**

#### **2.01 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS**

- A. Pipe and Fittings: ASTM A74, Service class.
- B. Gaskets: ASTM C564, rubber.

- C. Calking Materials: ASTM B29, pure lead and oakum or hemp fiber.
- 2.02 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS
- A. Pipe and Fittings: ASTM A888 or CISP 301.
  - B. Heavy-Duty, Shielded Couplings:
    - 1. Description: ASTM C1277 and ASTM C1540, with stainless-steel shield; stainless-steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.
- 2.03 DUCTILE-IRON, CULVERT PIPE AND FITTINGS
- A. Pipe: ASTM A 716, for push-on joints.
  - B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.
  - C. Compact Fittings: AWWA C153, for push-on joints.
  - D. Gaskets: AWWA C111, rubber.
- 2.04 PE PIPE AND FITTINGS
- A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M252M, Type S, with smooth waterway for coupling joints.
    - 1. Silttight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with tube and fittings.
    - 2. Soiltight Couplings: AASHTO M252M, corrugated, matching tube and fittings.
  - B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M294M, Type S, with smooth waterway for coupling joints.
    - 1. Silttight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.
    - 2. Soiltight Couplings: AASHTO M294M, corrugated, matching pipe and fittings.
- 2.05 PVC PIPE AND FITTINGS
- A. PVC Corrugated Sewer Piping:
    - 1. Pipe: ASTM F949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
    - 2. Fittings: ASTM F949, PVC molded or fabricated, socket type.
    - 3. Gaskets: ASTM F477, elastomeric seals.
- 2.06 CONCRETE PIPE AND FITTINGS
- A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C76.
    - 1. Bell-and-spigot ends and gasketed joints with ASTM C443, rubber gaskets.
    - 2. Class III for all pipe 42 IN and smaller.
    - 3. Class IV for all pipe 48 IN and larger.

## 2.07 NONPRESSURE TRANSITION COUPLINGS

- A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
  - 1. For Concrete Pipes: ASTM C443, rubber.
  - 2. For Cast-Iron Soil Pipes: ASTM C564, rubber.
  - 3. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
  - 4. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings:
  - 1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
- D. Shielded, Flexible Couplings:
  - 1. Description: ASTM C1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
- E. Ring-Type, Flexible Couplings:
  - 1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

## 2.08 EXPANSION JOINTS

- A. Ductile-Iron Flexible Expansion Joints:
  - 1. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250 psig minimum working pressure and for offset and expansion indicated.

## 2.09 CLEANOUTS

- A. Cast-Iron Cleanouts:
  - 1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
  - 2. Top-Loading Classification(s): Heavy Duty.
  - 3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A74, Service class, cast-iron soil pipe and fittings.
- B. Plastic Cleanouts:
  - 1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

## 2.10 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105.

## 2.11 MANHOLES

- A. Standard Precast Concrete Manholes:

1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: 48 IN minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
4. Base Section: 6 IN minimum thickness for floor slab and 4 IN minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
5. Riser Sections: 4 IN minimum thickness, and lengths to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
7. Joint Sealant: ASTM C990, bitumen or butyl rubber.
8. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
9. Steps: Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 1/2 IN steel reinforcing rods encased in ASTM D4101, PP wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12 to 16 IN intervals.
10. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, 6 to 9 IN total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

- B. Manhole Frames and Covers:

1. Description: Ferrous; 24 IN ID by 7 to 9 IN riser with 4 IN minimum width flange and 26 IN DIA cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
2. Material: ASTM A536, Grade 60-40-18 ductile iron unless otherwise indicated.

## 2.12 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 350/350R, and the following:
  1. Cement: ASTM C150, Type II.
  2. Fine Aggregate: ASTM C33, sand.



3. Coarse Aggregate: ASTM C33, crushed gravel.
4. Water: Potable.
- B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
  1. Reinforcing Fabric: ASTM A185/A185M, steel, welded wire fabric, plain.
  2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.
- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
  1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
    - a. Invert Slope: 2 percent through manhole.
  2. Benches: Concrete, sloped to drain into channel.
    - a. Slope: 4 percent.
- D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
  - a. Reinforcing Fabric: ASTM A185/A185M, steel, welded wire fabric, plain.
  - b. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.

#### 2.13 STORMWATER INLETS

- A. Curb Inlets: Made with vertical curb opening of materials and dimensions according to utility standards.
- B. Gutter Inlets: Made with horizontal gutter opening of materials and dimensions according to utility standards. Include heavy-duty frames and grates.
- C. Combination Inlets: Made with vertical curb and horizontal gutter openings of materials and dimensions according to utility standards. Include heavy-duty frames and grates.

#### 2.14 PIPE OUTLETS

- A. Head Walls: Reinforced concrete, with apron and tapered sides.

### PART 3 - EXECUTION

#### 3.01 EARTHWORK

- A. Excavation, trenching, and backfilling are specified in Section 31 00 00 - "Earthwork."

### 3.02 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, non-pressure drainage piping according to the following:
  - 1. Install piping pitched down in direction of flow.
  - 2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
  - 3. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  - 4. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  - 5. Install ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
  - 6. Install PE corrugated sewer piping according to ASTM D2321.
  - 7. Install PVC sewer piping according to ASTM D2321 and ASTM F1668.
  - 8. Install non-reinforced-concrete sewer piping according to ASTM C1479 and ACPA's "Concrete Pipe Installation Manual."
  - 9. Install reinforced-concrete sewer piping according to ASTM C1479 and ACPA's "Concrete Pipe Installation Manual."

### 3.03 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, non-pressure drainage piping according to the following:
  - 1. Join hub-and-spigot, cast-iron soil piping with gasketed joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
  - 2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
4. Join ductile-iron culvert piping according to AWWA C600 for push-on joints.
5. Join ductile-iron piping and special fittings according to AWWA C600 or AWWA M41.
6. Join corrugated PE piping according to ASTM D3212 for push-on joints.
7. Join PVC corrugated sewer piping according to ASTM D2321 for elastomeric-seal joints.
8. Join non-reinforced-concrete sewer piping according to ASTM C14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
9. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
10. Join dissimilar pipe materials with non-pressure-type flexible couplings.

#### 3.04 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
  1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
  2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
  3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
- B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 IN deep. Set with tops 1 IN above surrounding earth grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

#### 3.05 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C891.
- C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.
- D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 IN above finished surface elsewhere unless otherwise indicated.

#### 3.06 STORMWATER INLET AND OUTLET INSTALLATION

- A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

- B. Construct riprap of broken stone, as indicated.
- C. Install outlets that spill onto grade, anchored with concrete, where indicated.
- D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated. Construct energy dissipaters at outlets, as indicated.

### 3.07 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

### 3.08 CONNECTIONS

- A. Make connections to existing piping and underground manholes.
  - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6 IN overlap, with not less than 6 IN of concrete with 28-day compressive strength of 3000 psi.
  - 2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 IN of concrete with 28-day compressive strength of 3000 psi.
  - 3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 IN of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 IN of concrete for minimum length of 12 IN to provide additional support of collar from connection to undisturbed ground.
    - a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    - b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
  - 4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

### 3.09 IDENTIFICATION

- A. Materials and their installation are specified in Section 31 00 00 - "Earthwork." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
  - 1. Use warning tape or detectable warning tape over ferrous piping.
  - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

### 3.10 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 IN of backfill is in place, and again at completion of Project.
  - 1. Submit separate reports for each system inspection.
  - 2. Defects requiring correction include the following:
    - a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
    - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    - d. Infiltration: Water leakage into piping.
    - e. Exfiltration: Water leakage from or around piping.
  - 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  - 4. Re-inspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
  - 1. Do not enclose, cover, or put into service before inspection and approval.
  - 2. Test completed piping systems according to requirements of authorities having jurisdiction.
  - 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 HRS advance notice.
  - 4. Submit separate report for each test. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
    - a. Exception: Piping with soil tight joints unless required by authorities having jurisdiction.
    - b. Option: Test plastic piping according to ASTM F1417.
    - c. Option: Test concrete piping according to ASTM C924.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

**END OF SECTION**

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## **SECTION 33 41 20 - CURED IN PLACE PIPE LINER**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. The work necessary to clean, furnish and install, complete and in-place, Cured-In-Place-Piping (hereby known as CIPP) liner for rehabilitation of underground drainage and piping systems as shown on the drawings and specified herein.
- B. The Contractor shall provide all materials, labor, equipment, and services necessary for the installation of CIPP and air testing of the completed pipe repairs.

#### **1.02 RECORD OF CLEANING**

- A. Preliminary cleaning and video logging of pipe will be performed. A video record (either VHS tape or Digital format) of the cleaning operations will be sent for review to Union Pacific Railroad (hereby known as the Railroad). If no video record was performed, the Contractor is to perform a video record of pipe showing pipe condition as cleaned, and present to the Railroad before installation of the liner.

#### **1.03 QUALIFICATIONS**

- A. The CIPP lining contractor shall be either employees of the lining system manufacturer or certified and satisfactorily trained by the lining system manufacturer that such a company is fully trained and is a licensed installer of their lining system.
- B. Manufacturers:
  1. Insituform Technologies, Inc., Chesterfield, MO; 800-234-2992.
  2. Inliner Technologies, Paoli, IN; 812-723-0704.

#### **1.04 REFERENCED STANDARDS**

- A. The following references are part of this specification. In case of conflict between the requirements of this specification and those of the listed documents, the requirements of this specification shall prevail. The latest edition of the following references shall be used:
  1. ASTM International (ASTM):
    - a. D790, Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics.
    - b. D903, Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
    - c. D2990, Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.
    - d. D5813, Cured-In-Place Thermosetting Resin Sewer Pipe.

- e. F1216, Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
- f. F1743, Rehabilitation of Existing Pipelines and Conduits by Pulled-In-Place Installation of Cured-In-Place Thermosetting Resin Pipe (CIPP).

## 1.05 SUBMITTALS

### A. Action Submittals:

- 1. Resin manufacturer specifications, properties, installation guidelines, details, sketches, and other pertinent information for the CIPP pipe liner installation to work. All materials provided shall be fully in accordance with the requirements of the reference specifications specified above. Refer to section 01 33 00 for submittal compliance.
- 2. Analysis of design criteria and calculations for CIPP thickness based on ASTM F1216, Appendix XI.
- 3. Pre-construction closed circuit TV video.

### B. Certification:

- 1. Certified copies of Manufacturing Quality Control (MQC) test reports on the physical and chemical resistance properties of resin.
- 2. Certified copies of test reports on CIPP samples obtained during installation.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

#### A. Flexible Tube:

- 1. The flexible tube shall be one or more layers of woven or non-woven material - fiberglass, and/or polyester fiber, polypropylene composite, nylon, Kevlar, or a combination thereof manufactured under quality controlled conditions set by the manufacturer. Tube shall be sized such that it will provide a tight fit within existing pipe with the required thickness following curing of the resin.
- 2. The length of the tube shall be as necessary to span the distance between catch basins. Allowance shall be provided for stretching or shrinkage due to installation pressures and expansion.

#### B. Resin:

- 1. Resin shall produce a cured tube resistant to corrosion and abrasion from sand, silt, and other solid materials carried by stormwater.
- 2. The resin system shall be manufactured by a company selected by the CIPP supplier. Resin shall be polyester, vinyl ester, or epoxy resins.
- 3. The resin shall have physical characteristics which allow it to adhere to both wet and dry substrates.



## 2.02 CURED PIPE PROPERTIES

A. The CIPP shall meet the minimum post-curing structural properties listed below:

1. Flexural Strength (ASTM D790): 4,500 psi.
2. Flexural Modulus of Elasticity (ASTM D790): 300,000 psi.

## 2.03 CURED PIPE THICKNESS

A. The CIPP shall have minimum post-curing thicknesses as follows:

Nominal Pipe Diameter	Cured Pipe Thickness	
	Partially Deteriorated	Fully Deteriorated
IN (mm)	IN (mm)	IN (mm)
4 (101.6)	0.05 (1.3)	0.09 (2.3)
6 (152.4)	0.08 (2.1)	0.14 (3.6)
8 (203.2)	0.11 (2.8)	0.19 (4.8)
10 (254.0)	0.14 (3.6)	0.23 (5.8)
12 (304.8)	0.16 (4.1)	0.28 (7.1)
14 (355.6)	0.19 (4.8)	0.32 (8.1)
16 (406.4)	0.22 (5.6)	0.37 (9.4)
18 (457.2)	0.25 (6.4)	0.41 (10.4)

B. The criteria for determination of minimum thickness after curing include the following:

1. The Engineer is to determine if the existing pipe system is partially or fully deteriorated.
2. Existing piping system is assumed to have an ovality of 2 percent in circumference.
3. CIPP is subjected to an assumed full soil load of 120 LBS/CU FT.
4. CIPP is subjected to traffic line loads as calculated by AASHTO Standard Specifications for Highway Bridges, HS-20-44 Highway Loading.
5. Modulus of soil reaction for pipe zone backfill material is 1000 psi.
6. CIPP is subject to a groundwater elevation 6 FT above invert of the pipe.
7. Long-term flexural strength and long-term flexural modulus of elasticity for CIPP is equivalent to 50 percent of the initial flexural strength and initial flexural modulus of elasticity, respectively, as measured in accordance with ASTM F790.
8. Minimum factor of safety is 2.0.

C. The CIPP thickness shall be within –5 percent and +10 percent of minimum thickness.

1. Thickness shall be measured using calibrated calipers.

## PART 3 - EXECUTION

### 3.01 DELIVERY, STORAGE, AND HANDLING

- A. Tube impregnated with resin at the factory shall be transported, installed, and cured prior to expiration of the manufacturer's recommended shelf life.
- B. Impregnated tube shall be stored and transported under refrigerated, ultraviolet light-free conditions.
- C. No cuts, tears, or abrasions shall occur during handling. In the event the material is damaged, the damaged tube shall be immediately removed from the project site.

### 3.02 CLEANING AND INSPECTION

- A. The Contractor shall clean the entire pipe system to remove all accumulated debris that will interfere with the installation of CIPP. The Contractor shall be responsible for storage, handling, and disposal of debris removed from the pipeline. The Contractor is responsible for selecting the cleaning method.
- B. Water generated during cleaning operations shall be decanted from the vacuum truck and discharged to an Owner-designated location. Solids accumulated during stormwater line cleaning will be temporarily stockpiled onsite in a lined containment area. Water draining from solids will flow to catch basins tied to the IWWTP. The solids will be recovered and no solids or residual water will infiltrate underlying soils.
- C. The Contractor is responsible for the transportation and disposal of the solids at an approved waste facility. The Contractor is to provide documentation of solids disposal to the Owner.
- D. The lined containment structure may be used as a decontamination station should contaminated materials be encountered during operations.
- E. The Contractor shall perform a closed circuit television inspection immediately prior to installation of CIPP. System shall be clean, with pipe conditions adequate for installation of CIPP. A copy of the VHS video tape (or digital media) shall be submitted to the Engineer for review and approval prior to liner installation.

### 3.03 PREPARATION

- A. The Contractor shall provide flow diversion through bypass pumping or plugging of upstream pipe as necessary to keep work area free of running water. All water shall be contained as noted above in Article 3.02.

### 3.04 INSTALLATION

- A. Resin Impregnation:
  - 1. Thoroughly saturate flexible tube prior to installation. Catalyst system or additives compatible with the resin and flexible tube shall be as recommended by the manufacturer.
  - 2. Handle the resin impregnated flexible tube to retard or prevent resin setting until it is ready for insertion.

B. Insertion:

1. Insert flexible tube through an existing catch basin using procedure approved by the manufacturer.
2. The addition of water, air, or steam pressure shall be adjusted to cause the impregnated flexible tube to invert from catch basin to catch basin, holding the tube tight against the host sewer pipe.

C. Curing:

1. Following insertion, apply suitable heat source with a water or steam recirculation system capable of delivering hot water uniformly throughout the section to achieve a consistent cure of the resin. Curing temperatures and duration shall be as recommended by the manufacturer.
  2. The heat source shall be fitted with suitable monitors to gauge the temperature of incoming and outgoing water or steam supply. Addition gauges shall be placed between impregnated tube and invert of the original pipe at manholes to monitor outside liner temperatures during resin curing process. A standby heat source shall be at the site, ready for service in case of breakdown.
  3. Heating shall continue uninterrupted until the desired temperature is achieved. Temperatures at both ends shall be measured and recorded. The initials of the Engineer shall be obtained on curing logs. Initial cure may be considered completed when exposed portions of the flexible tube pipe take a hard set and temperatures are adequate, as recommended by the manufacturer.
- D. Cool the CIPP in accordance with the manufacturer's instructions. Do not release internal pressure in a way that can create a vacuum and damage the CIPP.
- E. The finished CIPP shall be continuous and free from visual defects such as foreign inclusions, dry spots, pinholes, de-lamination, and wrinkles larger than 2 percent of the diameter. Any section of lining with such defects shall be removed and replaced at no additional cost to the Owner.

3.05 MANHOLES AND CATCH BASINS

- A. The CIPP shall make a tight seal at the manhole and catch basin openings with no angular gaps. Sealing shall be performed in accordance with the manufacturer's recommendations.

3.06 LATERAL REINSTATEMENT

- A. Contractor shall reconnect laterals at locations shown on the Drawings and identified during pre-installation cleaning.

3.07 FIELD TESTING

- A. Obtain samples of cured liner according to ASTM F1216 for flexural properties and analyze according to ASTM D790. Analysis shall be performed by an independent laboratory acceptable to the Owner. Submit the report to the Engineer.
- B. A sample of cured liner from the testing above shall be subject to delamination tests by aggressively prying and separation into layers with a knife or sharp-edged instrument. No separation shall be included in the report above.

- C. Wall thickness of samples shall be determined in accordance with ASTM F1743.
- D. Contractor to pressure test pipe system to ensure proper liner installation. Pipe to maintain minimum 5 PSI for ten (10) minutes.

3.08 POST-INSTALLATION INSPECTION

- A. The Contractor shall submit to the Engineer a color VHS video tape (or color digital media) showing the as-constructed conditions of the system.
- B. Correction of failed CIPP or CIPP deemed defective from post-installation television inspection or test reports for structural values, thickness, etc., shall be repaired at no extra cost to the Owner. Method of repair shall be in accordance with the Manufacturer's recommendations, or as approved by the Engineer.

**END OF SECTION**

## **SECTION 33 42 00 - CULVERTS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Corrugated Aluminum Alloy Pipe (CAAP), Corrugated Steel Pipe (CSP) AND Corrugated Structural Plate Pipe (CPP).

##### **B. Description:**

1. These Pipe Culvert Specifications cover the assembly and installation of (a) CSP, (b) CPP and (c) CAAP, each hereinafter referred to as "pipe culverts." Pipe culverts shall be assembled and installed in accordance with these Specifications and Chapter 1, Part 4 of the current AREMA Specifications for Culvert installation and the Union Pacific Railroad Company's Engineering Culvert Pipe Standard Drawings 680000, 680010 and 680030. The most restrictive provisions shall govern when there are differences in the requirements.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Section 00 07 00 - General Conditions**

##### **B. Section 31 37 00 – Rip Rap**

#### **1.03 REFERENCED STANDARDS**

##### **A. STD DWG 680000 – Round Pipe Culverts**

##### **B. STD DWG 680010 – End Treatments for Culverts**

##### **C. STD DWG 680030 – Structural Plate Pipe Culverts**

## PART 2 - PRODUCTS

### 2.01 PIPE CULVERT MATERIAL

- A. All pipe culverts will be furnished with annular corrugations. The exposed ends of all corrugated pipes shall be square. Pipe culvert material, if any, furnished by the Contractor, must meet the standards for pipe culverts set forth in Chapter 1, Part 4 of the current AREMA Specifications and the Union Pacific Railroad Company's Engineering Culvert Pipe Standard Drawings 680000, 680010 and 680030 or as required and approved by the Engineer. 3 IN x 1 IN annular corrugations shall be used for all CMP pipes with 36 IN DIA and larger, 2-2/3 IN x 1/2 IN or 3 IN x 1 IN annular corrugations shall be used for 30 IN DIA CSP pipes. 3 IN x 1 IN annular corrugations shall be used for all CAAP pipes. 6 IN x 2 IN annular corrugations and a Minimum of 4 bolts per foot for all SPP pipes. Bolts and nuts shall be per the current AREMA Specifications, chapter 41, part 4. Minimum gage requirements are specified in UPRR Engineering Culvert Pipe Standards. All CMP culverts under the railroad shall be aluminized and double-riveted. Any deviations of these Specifications are to be submitted to the Engineer for approval prior to starting construction.
- B. All flared end sections furnished by the Contractor must meet the standards for pipe culverts set forth in Chapter 1, Part 4 of the current AREMA Specifications. Flared end sections shall match the annular corrugations and gage of the adjacent pipe culvert. Any deviations of these Specifications are to be submitted to the Engineer for approval prior to starting construction.

## PART 3 - EXECUTION

### 3.01 HANDLING OF PIPE CULVERT MATERIAL

- A. The Contractor shall handle pipe culverts and the pipe culvert material carefully in order to prevent damage, including, but not limited to, distortion of the pipes, injury to bituminous and other pipe culvert coatings. Pipe culverts shall never be dragged over the ground, but shall be handled with skids, rolling slings, or cranes. The Contractor shall promptly repair, to the satisfaction of the Engineer, any damage to the pipe culvert or pipe culvert material. In the event such damaged pipe culverts or pipe culvert material cannot be repaired to the satisfaction of the Engineer, replacement pipe culverts or pipe culvert material must be provided by the Contractor at his expense.

### 3.02 EXCAVATION AND LOCATION

- A. Preparation for the culvert bedding shall be included in the culvert installation or extension cost and shall include all necessary clearing and grading necessary to place the bedding material, as well as placement and compaction of aggregate base bedding. The Contractor may use CLSM, for the culvert bedding. Any ditching required, unless there is a bid item for ditching, shall be incidental to the culvert installation. Culvert bedding preparation is included in the cost per foot and will not be classified as subexcavation.

- B. If any shoring is required for culvert work, it shall be incidental to the service item. Shoring plans must conform to the General Shoring Requirements (dwg.# 710000), and must be stamped by a P.E. in the state where the work is to be performed. The shoring plan is to be submitted to the UPRR Structures Design Group for review and approval.
- C. Pipe culverts shall be placed at the location, elevation and alignment shown on the Drawings.
- D. Culvert Pipe Excavation and Embankment:
  - 1. The Contractor shall perform all pipe culvert excavation. Prior to pipe culvert excavation, embankment must be constructed to a height no less than 2 FT above the top of the proposed pipe culvert. When embankment is placed, alternate methods may be used if approved by the Engineer. Pipe culvert excavations shall be wide enough to permit thorough compaction of the backfill under and around the pipe culvert as required by paragraph "laying culvert pipe" Sub-Section 3.06.B of this Section. The base width of the pipe culvert excavation shall not exceed the external width of the pipe culvert plus:
    - a. 12 IN on each side for pipes less than 48 IN DIA.
    - b. 18 IN on each side for pipes 54 - 78 IN DIA.
    - c. 24 IN on each side for pipes 84 IN DIA or larger.
- E. Protection of Foundation and Bedding:
  - 1. Unless soft soil is encountered in which case Sub-Section 3.03.B "Soft Soil Condition" shall govern. Pipe culvert excavation shall be deep enough to permit compliance with the foundation and bedding requirements for pipe culverts. Care shall be taken to assure drainage is diverted away from the pipe bed during preparation. Any damage to or deterioration of pipe bedding prior to installation shall be repaired by the Contractor at no expense to the Railroad.
- F. The Contractor shall comply with all current and applicable Federal, State, local rules, and regulations governing the safety of men and materials during pipe culvert excavation, installation and backfilling operations. The Contractor shall observe requirements of the Occupational Safety and Health Administration relating to excavations, trenching and shoring as set forth in Title 29, Part 1926, Subpart Paragraph P, Sections 1926.650 through 1926.653, Code of Federal Regulations, and any subsequent revisions.

### 3.03 FOUNDATION, BEDDING, AND COMPACTION

- A. Pipe culverts shall be placed at the flowline grade and elevation established by the Engineer on a uniform bed of stable earth or granular material such as gravel or sand, and such bedding shall be compacted to not less than 100 percent of maximum density determined by ASTM D1557 with moisture content adjusted. The compacted bed shall contain the camber required by the Engineer or as covered by these Specifications, Sub-Section 3.04. The compacted bed shall also be shaped to fit the bottom one-third (1/3) of round pipe culvert or shaped to fit the entire bottom of pipe arch culvert. Where the granular material is used for bedding, the ends of the pipe culvert in embankment shall be sealed to prevent leaking and infiltration of water along the pipe culvert. Such sealing can often be accomplished by blanketing the ends of the pipe culvert embankment with well tamped clay. In all cases, ends of pipe culverts shall be protected by riprap as outlined in the UPRR Engineering Culvert Pipe Standards.
- B. Soft Soil Conditions:
  - 1. Where the flowline grade crosses soft areas of soil which will not provide a suitable uniform foundation for the pipe culvert bed, the Contractor shall excavate 18 IN below the flowline grade for a width equal twice the outside width of the pipe culvert. Prior to backfilling, the Engineer shall inspect the excavation and the Contractor shall perform any additional excavation beneath 18 IN of the flowline grade which may be required by the Engineer; provided, however, that the expense of any such additional excavation beneath 18 IN of the flowline grade shall be considered extra work. Upon completion of the excavation, the Contractor will backfill such excavation with granular material which shall be compacted and formed as described above.
- C. Rock:
  - 1. When the flowline grade passes over rock, the Contractor shall excavate such rock to a depth which is at least 12 IN below the flowline grade. Excavations in rock shall maintain sufficient area so that the pipe culvert will not rest on rock at any point. The Contractor will backfill excavation in rock with granular material which shall be formed as described above.

### 3.04 CAMBER

- A. Camber shall be placed in all culverts where it is anticipated that the culvert will settle as the result of high embankment construction or compressible foundation soils below the culvert bedding. Unless otherwise specified by the Engineer, all culverts shall be cambered in accordance with the following:
  - 1. In no case shall the culvert be cambered so high in the center that water will be pocketed at the inlet end of the pipe.
  - 2. Culverts resting on rock foundation need not be Cambered. Refer to Sub-Section 3.03.C.
  - 3. Embankments up to 8 FT high (measured base of rail to flowline) require a 1-1/2 IN camber.
    - a. Embankments 8 FT to 12 FT high require a 2-1/2 IN camber.
    - b. Embankments 12 FT to 24 FT high require a 4 IN camber.



- c. Embankments 24 FT to 36 FT high require a 6 IN camber.
- B. The above camber standards, based on the height of embankments, may be adjusted in the field, where at the discretion of the Engineer a greater or lesser amount of camber should be built into pipe to adjust for soil conditions encountered at the site. For fills higher than 36 FT, the Chief Engineer will provide the camber requirements.

### 3.05 RIPRAP PROTECTION

- A. Both the inlet and outlet ends of all culverts shall be protected by riprap, concrete headwall, or as shown on the Drawings. Riprap shall be installed per detail on Drawing 680000, or as shown on the Plan.

### 3.06 INSTALLATION

- A. Assembly of Culvert Pipe:
  - 1. Pipe culverts will generally be joined using 2 FT wide corrugated metal connecting bands. The inside of corrugated connecting bands and the outside of pipe culverts to be joined by corrugated connecting bands shall be kept clean and free of all dirt or gravel to ensure that the corrugations on the connecting bands and the pipe culvert fit snugly as the connecting bands are tightened. They should be tapped with a mallet or hard rubber hammer to ensure a tight joint. Connecting bands for 48 IN or less coated culvert pipe shall be 2 FT wide, two pieced type, connecting bands and the outside surface of the culvert pipe under the connecting band often need be lubricated with fuel oil or similar solvent to allow the connecting bands to be drawn firmly into place.
  - 2. Corrugated structural plate pipe shall be assembled in accordance with the manufacturer's detailed assembly instructions. Bolts shall be tightened progressively uniformly, starting at one end of the corrugated structural plate pipe after all plates are in place. Tightening shall be repeated to ensure all bolts are tight.
  - 3. When a power wrench is used for tightening bolts, the Contractor shall check the tightening of the bolts with one handed structural or socket type torque wrench. Bolts shall be torqued uniformly to a minimum of 100 FT LB and a maximum of 300 FT LB or as specified in the manufacturer's detailed assembly instructions.
  - 4. Where field cutting of culvert pipes is required, the Contractor shall make saw cuts. Torch burning will not be permitted.

B. Laying Culvert Pipe:

1. Each pipe culvert shall be laid true to the flowline grade. The minimum gradient for any pipe culvert shall be 0.5 percent unless indicated otherwise on the Plans, or as directed by the Engineer. If two or more pipe culverts are to be laid parallel to each other, such parallel pipe culverts shall be spaced per Drawing 6800000 and to permit thorough compaction of the backfill as required by Sub-Section 3.07. Parallel culverts shall be separated by a distance of at least one-half (1/2) of the nominal diameter of the pipe culverts or one-third (1/3) the span width of pipe arch culverts but not less than 12 IN, nor does it in any case need to exceed 48 IN. Riveted corrugated metal pipe culverts must be placed with the inside circumferential laps pointing downstream. The Contractor shall cover exposed metal on the surface of any bituminous coated pipe culvert before backfilling is commenced. Such exposed metal must be covered with material which is approved by the Engineer and which includes:
  - a. Fiber Bonded Bituminous (composite) coating ASTM A825 (steel only).
  - b. Polymeric Coating - ASTM A762 or AASHTO M245 (steel only).
  - c. Galvanized - AASHTOM218 or Aluminum (Type 2) - AASHTO M274 (steel only).
  - d. Asphaltic Coating - AASHTO M190 (steel and aluminum) (only 3 and 4 for structural plate pipe).
  - e. Such material shall be applied to a thickness of approximately 1/16 IN.

C. Special Installation Conditions:

1. Strutting:
  - a. All pipe culverts with a nominal diameter of 48 IN or greater shall be provided with a five (5) percent vertical elongation. Field strutting shall be required only on very large structural steel pipes (10 FT or greater). Strutting shall be removed immediately after installation and backfill are complete. In all cases, strutting may be required if specifically stated in the Request for Bids

3.07 BACKFILLING AND COMPACTION

- A. Backfill materials shall be placed simultaneously on both sides of the pipe culvert in uniform layers not to exceed 6 IN in thickness. For multiple pipes, the backfill shall be placed simultaneously in uniform 6 IN layers between and outside of pipes. Each successive layer shall be compacted, in accordance with the Railroad's Specifications 31 24 13 through 31 35 20, and to not less than 100 percent of maximum density as determined by ASTM D1557 with moisture content adjusted if necessary, and each 6 IN layer shall be properly compacted before the next layer is placed.
- B. Backfilling shall be started and completed as quickly as possible after the pipe culvert has been assembled and placed on its bed.
- C. Where granular material is used for backfill, the ends of the pipe culvert embankment shall be sealed with well tamped clay to prevent leaking and infiltration of water along the pipe culvert.

- D. Where compaction may be difficult to obtain due to space constraints or other factors, the Contractor may, with the approval of the Engineer, utilize Controlled Low-Strength Concrete Fill Material (CLSM), commonly called flowable fill, as backfill material to a point one foot above the top of the culvert per Drawing 680000.
- E. Pipe Protection:
  - 1. Materials used to complete the embankment over the pipe culvert should be essentially the same as the material used for the pipe culvert backfill and should be placed and compacted in the same manner as pipe culvert backfill materials are placed. Such material must be used to complete the embankment at least to a height over the top of the pipe culvert equal to the nominal diameter of the pipe culvert, or if the height of the completed embankment over the top of the pipe culvert is less than the nominal diameter of the pipe culvert then such material must be used to complete the embankment. The pipe culvert must be protected from damage during the entire construction period, especially if heavy compaction equipment is used. Heavy construction equipment shall not be operated over the pipe culvert until it has been covered with compacted backfill material to a depth of 24 IN.

### 3.08 RETIGHTENING OF BOLTS

- A. As soon as possible after completion of the embankment over corrugated structural plate pipes, all bolts in the corrugated structural pipe must be retightened to the standards set forth in Sub-Section 3.06.A.3. Such retightening must be started at one end of the pipe culvert and all bolts must be tightened progressively through the length of the pipe culvert.

### 3.09 PREPARATION OF EXISTING PIPE CULVERTS

- A. The Contractor shall remove existing headwalls and the ends of damaged culverts that are to be extended. The Contractor shall also verify the culvert size prior to ordering material for the culvert extension. All culverts in the project limits are to be cleaned by the Contractor unless they are to be removed or plugged and filled.
- B. The Contractor shall use Controlled Low-Strength Concrete Fill Material (CLSM) per Drawing 680000, with an unconfined compressive strength of between 50 and 300 PSI, for filling culverts that are to be plugged and filled.
- C. Culverts that are to be removed become the property of the Contractor and must be removed from Railroad property, unless otherwise noted.

## PART 4 - MEASUREMENT AND PAYMENT

- A. The number of linear feet of pipe culvert installed will be determined by measuring the installed pipe culvert along its longitudinal axis and shall be paid for on the unit price bid per linear foot of pipe installed.
- B. The cost of RIP RAP is to be included in the price per linear foot of pipe.
- C. Included in the above LF cost is the removal and disposal of 18 IN of unsuitable material and the installation of 18 IN of bedding.
- D. Below the 18 IN, removal and replacement of bedding material is considered extra work and shall be paid on the Cubic Yard basis.

- E. The number of flared end sections will be measured and paid for at the contract unit price bid per each flared end section acceptably installed.
- F. No additional payment will be made for the use of CLSM, or flowable fill, as backfill around culverts, but shall be considered subsidiary to the cost of the culvert pipe.

**END OF SECTION**

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## **SECTION 33 42 16 - REINFORCED CONCRETE BOX CULVERTS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Furnishing of material, construction and curing of, and/or extension of reinforced concrete box culverts, hereinafter referred to as "concrete boxes". Concrete boxes shall be constructed in accordance with this Specifications, the design drawings and Chapter 8 Part 16, reinforced concrete box culverts and Chapter 29 Part 3, Damp proofing, of the current American Railway Engineering and Maintenance of Way Association (AREMA) Specifications.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Documents affecting the work of this Section include, but are not necessarily limited to Division 01, General conditions of these Specifications.

#### **1.03 HANDLING OF CONCRETE BOX MATERIALS**

- A. All material used in the construction of concrete boxes shall be handled carefully in a workmanlike manner to avoid damage and/or contamination. Reinforcing steel reduced in section or with bends or kinks not shown on the plans shall not be used.
- B. In the event materials are damaged and/or contaminated and cannot be repaired to the satisfaction of the engineer, replacement of such material must be provided by the Contractor at his expense.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

##### **A. Concrete Box Material:**

1. Concrete box material shall meet the standards set forth in Chapter 8 Part 16 of the current AREMA Specifications. Reinforcing steel shall conform to ASTM A615, Grade 60. The minimum 28 day compressive strength of concrete shall be 4,000 psi.
- B. Reinforcing steel, fabricated to shapes and dimensions shown, shall be placed where indicated on the Drawings or where required to carry out the intent of the Plans.
- C. Damp-proofing materials shall meet the standards set forth in Chapter 29, Part 3 of the current AREMA MANUAL.

## PART 3 - EXECUTION

### 3.01 EXCAVATION AND LOCATION

- A. Concrete box culverts shall be placed at the location, elevation and alignment as shown on the Drawings. The Contractor shall preserve all stakes established until authorized by the Engineer to remove them. Additional layout required will be the responsibility of the Contractor and he alone shall be responsible for restoring any points destroyed.
- B. The Contractor shall perform all concrete box embankment and excavation. Excavations shall be made wide enough to permit thorough compaction of backfill around the concrete box culverts. Care shall be taken to ensure that methods used in excavation will not reduce the stability of the material adjacent to the excavation.
- C. If soft soil conditions are encountered, Sub-Section 3.02 shall govern. Excavation shall be deep enough to permit compliance with the foundation requirements set forth in Sub-Section 3.03.

### 3.02 SOFT SOIL CONDITIONS

- A. For concrete boxes, where the soil encountered will not provide a suitable uniform foundation, the Contractor shall excavate 18 IN below the foundation grade and at least 1 FT beyond the horizontal limits of the structure on all sides. The Engineer shall inspect the excavation and the Contractor shall perform any additional excavation required to obtain a stable foundation. The Contractor will backfill these areas with granular material formed as required in Sub-Section 3.06.
- B. Protection of Foundations and Bedding:
  - 1. Unless soft soil conditions are encountered, in which case Sub-Section 3.02 shall govern, concrete box excavation shall be deep enough to permit compliance with the foundation and bedding requirements for the concrete boxes. Care shall be taken to ensure drainage is diverted away from the concrete box bedding during preparation. Any damage or deterioration shall be repaired by the Contractor at no expense to the Railroad.
- C. Trenching:
  - 1. The Contractor shall comply with all current applicable Federal, State and local rules and regulations governing the safety of men and materials, during concrete box excavation, installation, and backfilling operations. The Contractor shall comply with all requirements of the Occupational Safety and Health Administration relating to excavations, trenching and shoring as set forth in Title 29,, Part 1926, Subpart Sections 1926.650 through 1926.653, Code of Federal Regulations, and any subsequent revisions. The contractor shall also comply with the Railroad's Chief Engineer's instruction bulletin 124.0 Trenching Safety Rules and Shoring Standards. Where there is a conflict between the two standards, the more restrictive will apply.



### 3.03 FOUNDATION, BEDDING, AND COMPACTION

- A. Concrete boxes shall be placed at the flowline, with grade and elevation established by the Engineer. The concrete box culverts shall be placed on a uniform bed of stable earth or granular material such as sand or gravel, and such bedding shall be compacted to not less than 100 percent of maximum density, and with moisture content at the optimum moisture content or within -4 percentage points of optimum moisture content as determined by ASTM D1557 and field density in place test D 1556. The compacted bed shall contain the camber required by the drawings, by the Engineer, or as covered by Section 33 42 00. The compacted bed shall be shaped to fit the bottom of the box and shall conform to the entire bottom of the box. Where granular material is used for bedding, ends of the concrete box excavation shall be sealed to prevent leaking and infiltration of water along the concrete box. Such sealing can often be accomplished by blanketing the ends of the concrete box embankment with well tamped clay.

### 3.04 ROCK

- A. When the concrete box foundation is resting entirely on rock or other hard foundation material, the foundation shall be freed from all loose material, cleaned and cut to a firm surface. Excavation in rock or other hard material shall be made as near as practicable to the size required to properly construct the concrete box.

### 3.05 COMPRESSIBLE AND INCOMPRESSIBLE

- A. Where the material encountered at the foundation grade is found to be partially rock or incompressible material and partially a soil or material that is compressible but otherwise satisfactory for the foundation the incompressible material shall be removed for a depth of 6 IN below the foundation grade and backfilled with a material similar to the compressible foundation used for the rest of the concrete box.

### 3.06 CONSTRUCTION

- A. All work shall be constructed on a reasonably dry foundation material. The Contractor shall, at his expense, perform all bailing, pumping, and draining to protect the area and provide this condition. Should the Contractor's operation damage the foundation, the Contractor shall restore the foundation to its previous condition at the Contractor's expense. All cleanup and removal of temporary facilities shall be the Contractor's responsibility.
- B. Each concrete box shall be constructed true to the following grade. The minimum gradient for any concrete box shall be 0.2 percent, unless shown otherwise on the plans, or as directed by the Engineer. If two or more concrete boxes are to be constructed parallel to each other, such parallel concrete boxes shall be spaced to permit thorough compaction of the backfill as required by Sub-Section 3.07. Parallel box culverts shall be separated by a distance of at least one-half of the nominal height of the concrete boxes but not less than 48 IN.
- C. Installation including, but not limited to forms, construction joints, curing and all that is required or incidental to the proper construction of the concrete box culvert shall be done in accordance with Chapter 8 of the AREMA Specifications.

### 3.07 BACKFILLING AND COMPACTION

- A. Backfill shall not be placed until the top slab has been in place for at least four (4) days or the concrete has attained at least 85 percent of its required strength.
- B. Backfill materials shall be placed simultaneously on both sides of the concrete box in uniform layers not exceeding 6 IN in thickness. For multiple boxes, the backfill shall be placed simultaneously in uniform layers between and outside of the boxes. Each successive layer shall be compacted to not less than 100 percent of maximum density as determined by ASTM D1557, with moisture content adjusted, if necessary. Each 6 IN layer shall be properly compacted before the next layer is placed.
- C. Special care must be taken to obtain adequate compaction along the side walls of the concrete box; however. Where the concrete box is placed in a confined area, making it difficult to obtain adequate compaction along the sides of the concrete box through tamping, special backfill material consisting of fine dry sand shall be used and shall be compacted by vibrating. Compaction shall be accomplished by rodding the special backfill material with a power vibrator. The special backfill material shall be compacted by vibrating the material until compaction can be obtained in a conventional manner.
- D. All backfilling material placed around and adjacent to culverts to a point at least one foot above the top of the pipe culvert shall consist of sand-gravel material containing less than 15 percent material passing the No. 200 sieve.
- E. Where sand-gravel material is used for backfill, the ends of the concrete box embankment shall be sealed with well tamped clay to prevent leaking and infiltration of water along the concrete box.
- F. Where compaction may be difficult to obtain due to space constraints or other factors, the Contractor may, with the approval of the Engineer, utilize Controlled Low-Strength Concrete Fill Material (CLSM), commonly called flowable fill, as backfill material to a point one foot above the top of the culvert. Unless specified or shown elsewhere in the plans the CLSM shall meet the requirements for flowable fill of the respective Department of Transportation.
- G. Box Culvert Protection:
  - 1. Materials used to complete the embankment over the concrete box should be essentially the same as the materials used for the concrete box backfill and should be placed and compacted in the same manner as concrete box backfill materials are placed. The concrete box must be protected from damage during the entire construction period, especially if heavy compaction and/or construction equipment is used. Heavy equipment shall not be operated over the concrete box until it has been covered with compacted backfill material to a depth of at least 24 IN.

### 3.08 REMOVAL OF EXISTING HEADWALLS OR CULVERTS IN PREPARATION FOR EXTENSION OF EXISTING CONCRETE BOXES

- A. The Contractor shall remove that portion of the existing apron, curtain, toe, head or wingwalls, and/or culverts or arches that interferes in whole or in part as shown on the Drawings, or stated in the Specifications, and shall perform all work that is required to extend, adapt, or reconstruct the existing concrete boxes, including required excavation and backfilling. Except as otherwise provided for in this Specification, the Contractor will determine the method of extending existing concrete box structures by consulting with the Engineer.
- B. When extending a structure, dowel bars are to be placed as shown on the drawings for the box or into holes drilled into the face of the existing box at locations to match the horizontal steel of the new concrete box extension. Dowels shall be 18 IN long and set with an epoxy adhesive. A sufficient amount of epoxy should be used to ensure a strong bond between the dowels and dowel holes. Dowel holes shall be drilled and cleaned.
- C. Care shall be taken to prevent uneven settlement at the joint between the existing and the extension. The face of the existing box shall be prepared to ensure a tight bond at the connection.

### 3.09 RIPRAP PROTECTION

- A. Both the inlet and outlet ends of all concrete box culverts shall be protected by riprap, concrete headwall, or as shown on the Drawings. Riprap shall be installed as shown on the Plan.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 MEASUREMENT AND PAYMENT

- A. The number of linear feet of concrete box installed will be determined by measuring the installed concrete box along its longitudinal axis and shall be paid for by the contract unit price per linear foot of box installed per the Specifications.
- B. The cost of riprap required per Engineering Standard drawings, is to be included in the price of the concrete box culvert.
- C. Included in the cost of the concrete box culvert is the 18 IN of bedding, removal and disposal of the excavated unsuitable soil and the replacement of that soil with acceptable bedding.
- D. Below 18 IN, the bedding, removal, disposal and replacement of unsuitable soils will be paid for on the cubic yard "C.Y." basis.
- E. No additional payment will be made for the use of CLSM, or flowable fill, as backfill around culverts, but shall be considered subsidiary to the cost of the culvert pipe.

### END OF SECTION

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## **SECTION 33 42 20 - SMOOTH STEEL PIPE CULVERTS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Fabrication, furnishing, and installation of smooth steel pipe culverts in accordance with these special conditions, standard construction specifications and the details shown on the plans.
- B. The size, type, length, wall thickness, and location of pipe culverts will be shown on the plans or as directed by the Engineer.

### **PART 2 - PRODUCTS**

#### **2.01 MATERIALS**

- A. See Standard Plan No. 680010 for material requirements, diameter, wall thickness, and welding requirements.
- B. Fabrication and materials shall be in accordance with Chapter 1, Part 4 of the AREMA Manual for Railway Engineering except as specified otherwise.

#### **2.02 END TREATMENT**

- A. End treatments shall be provided as specified on the plans or as directed by the Engineer.
- B. Ends of smooth steel pipes shall be finished square.

### **PART 3 - EXECUTION**

#### **3.01 HANDLING**

- A. Material shall be handled to final position in such a manner as to prevent its damage. Steel pipes shall not be dropped to, or dragged over, the ground, but shall be handled with rolling slings, on skids, or with cranes.
- B. Bent or otherwise damaged steel pipes shall be straightened and repaired, if feasible and as directed by the Engineer, before being placed in final position. No extra payment will be allowed for this work unless authorized in writing by the Engineer.

#### **3.02 PIPE CONNECTIONS**

- A. Pipe connections shall be as shown on the plans or as stated in the specifications.
- B. Sections of smooth steel pipe shall be joined by complete joint penetration welds in accordance with Standard Plan No. 680010 and AWS D1.1 Structural Welding Code unless specified otherwise on the plans or by the Engineer.

### 3.03 PIPE EXTENSIONS

- A. Connection of smooth steel pipe for extensions shall be as shown on the plans or as stated in the specifications. Sections of smooth steel pipe shall be welded as specified.
- B. Prior to performing any pipe/culvert extensions, the pipe shall be cleaned out. Pipes shall be free of any obstructions that could impede the flow. The clean out of the pipe/culvert is incidental to the cost of performing the pipe extension and shall be included in the contract unit price for pipe extensions.

### 3.04 PIPE ABANDONMENT

- A. All pipes/culverts being abandoned will be plugged and filled as indicated on the plans or special conditions. No abandoned pipes will be left open, unless otherwise directed by the Engineer. The abandoned pipes will be indicated on the plans.
- B. Culverts that are to be removed become the property of the Contractor and must be removed from Railroad property, unless otherwise noted.

### 3.05 FOUNDATION PREPARATION

- A. No foundation preparation shall be required for the length of pipe installed by jacking and boring.
- B. Foundation preparation shall be performed as required by Section 33 42 00.

### 3.06 PROTECTION OF FOUNDATIONS

- A. The Contractor shall by diversion ditches, dikes, or other means, keep the foundations free of water at all times after the work is started, and until the embankment is placed over the pipe. Any channel work necessary to allow free flow through the pipe shall be completed before the embankment is placed.

### 3.07 EARTH BORING AND JACKING CULVERT PIPE

- A. General:
  - 1. Only smooth steel pipe shall be used for installation by jacking or boring.
  - 2. Pipe damaged in jacking or boring operations shall be repaired in place to the satisfaction of the Engineer. Pipe damage beyond repair shall be removed and replaced. Repair or removal and replacement of damaged pipe shall be done at the Contractor's expense.
  - 3. Excessive voids shall not be permitted in the jacking process. If voids develop during installation, or track or ballast movement exceeds 1/4 IN, stop work immediately, notify UPRR and submit a corrective action plan.

4. If the grade of the pipe at the jacking or boring end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking or boring operation and for placing end joints of the pipe. The pits shall be a minimum of 12 FT from centerline of the nearest track. Shoring for jacking pits shall comply with the Railroad's Chief Engineer's instruction bulletin 124.0 Trenching Safety Rules and Shoring Standards. Jacking pits will not be permitted in Zone A unless approved by the Engineer. Design of shoring for jacking pits shall be performed, signed and sealed by a licensed Civil Engineer in the respective State the project is located. Temporary guardrail shall be provided for protection of the pit or trench when specified by the Engineer. Excavations greater than 5 FT in depth shall be protected in accordance with OSHA Trench Safety Guidelines.
5. Where pipe is required to be installed under railroad embankments, highways, streets, or other facilities by jacking or boring methods, installation shall be made in such a manner that it will not interfere with the operation of the railroad, street, highway, or other facility, and shall not weaken or damage any embankment or structure.
6. The pits or trenches excavated to facilitate jacking or boring operations shall be backfilled immediately after the installation of the pipe has been completed.

B. Jacking:

1. Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head and suitable bracing between the jacks and the jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. Joint cushioning material of plywood or other material may be used as approved by the Engineer. Plywood cushioning material shall be 3/4 IN minimum thickness. Cushioning rings may be made up of single or multiple pieces. A suitable jacking frame or backstop shall be provided. The pipe to be jacked shall be set on guides, properly braced together, to support the section of the pipe and to direct the pipe in the proper line and grade. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. In general, the embankment material shall be excavated just ahead of the pipe, the material removed through the pipe, and the pipe forced through the embankment with jacks, into the space thus provided.
2. The excavation for the underside of the pipe, for at least one-third of the circumference of the pipe, shall conform to the contour and grade of the pipe. Over-excavation to provide not more than 1 IN of clearance may be provided for the upper half of the pipe. This clearance shall be tapered to zero at the point where the excavation conforms to the contour of the pipe. Over-excavation in excess of 1 IN shall be pressure grouted the entire length of the installation.
3. The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but shall not exceed 2 FT. This distance shall be decreased when directed by the Engineer.

4. Preferably, the pipe shall be jacked from the low or downstream end. The final position of the pipe shall not vary from the line and grade shown on the plans, or established by the Engineer, by more than 1/8 IN per 1 FT. The maximum deviation shall be  $\pm 2$  IN from the line and grade shown. The variation shall be regular and in one direction and the final flow line shall be in the direction shown on the plans.
5. The Contractor may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with inside angles or lugs to keep the cutting edge from slipping back onto the pipe.
6. Work should be done continuously to minimize the tendency of the material to "freeze" around the pipe.
7. Excavated material shall be disposed of by the Contractor, as approved by the Engineer.

C. Boring:

1. The boring shall proceed from a pit provided for the boring equipment and workmen. The location of the pit shall be approved by the Engineer. The boring shall be done mechanically either using a pilot hole or by the auger method.
2. When the pilot hole method is used, an approximate 2 IN pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored.
3. When the auger method is used, a smooth steel pipe of the appropriate diameter equipped with a cutter head to mechanically perform the excavation shall be used. Augers shall be of sufficient diameter to convey the excavated material to the work pit.
4. Excavated material shall be disposed of by the Contractor, as approved by the Engineer. The use of water or other fluids in connection with the boring operation will be permitted only to the extent necessary to lubricate cuttings; jetting will not be permitted.
5. In unconsolidated soil formations, a gel-forming colloidal drilling fluid consisting of at least 10 percent of high grade carefully processed bentonite may be used to consolidate cuttings of the bit, seal the walls of the hole, and furnish lubrication for subsequent removal of cuttings and immediate installation of the pipe.
6. Allowable variation from line and grade shall be as specified in Sub-Section 3.07.B.4.

**END OF SECTION**



## **SECTION 33 44 16 – TRENCH DRAINS FOR BUILDINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Requirements for a precast, polymer concrete drain system. No product shall be accepted unless previously approved in accordance with design criteria.
2. This section does not apply for the construction of mainline and/or yard track projects.

##### **B. Scope of Work:**

1. Furnish precast polymer concrete surface drainage system including all components and sub-components necessary to install system as shown on the drawings and as specified herein.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Drawings and general provision of contract apply to work of this section.

#### **1.03 DESIGN CRITERIA**

- A. The design of trench drains shall be in accordance with specified criteria, ASTM Standard testing procedures, and generally accepted structural design practice.
- B. The design of the polymer concrete trench system shall be the responsibility of the manufacturer and shall be approved by the UPRR Engineering Department.
- C. Design loads on the drainage systems shall range from light pedestrian use to axle loads up to 2000 LBS plus 30 percent of load for impact. Where not specified, the tolerances and dimensions called out by the manufacturer shall be considered acceptable.

#### **1.04 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Shop drawings shall be completed by the manufacturer and sent to the UPRR Engineering Department.
- C. Manufacturer's catalog data showing:
- D. Materials of construction.
- E. Dimensions, spacings and construction of trench system.
- F. Chemical resistance guide.
- G. Installation guide.

#### **1.05 QUALITY ASSURANCE**

- A. Material covered by these specifications shall be furnished by a reputable and qualified manufacture and installer of polymer concrete drainage systems.

- B. Substitution of any component or modification of system shall be made only when approved by the UPRR Engineering Department.
- C. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Materials used in the manufacture of trench drain systems shall be first-run product of the best quality and shall be free from all defects and imperfections that might affect the performance of the finished product.
- B. All materials shall be of the kind and quality specified. Where the quality is not specified, it shall be of the respective kinds and suitable for the purpose intended.
- C. Trench drain channels shall be precast polymer concrete formed with a matched metal tooling utilizing polyester resin.
- D. Precast, polymer concrete drain components will be non-sloped as shown on the approved plans.
- E. Precast, polymer concrete drain system shall be installed flush to the grade or finished surface.

### 2.02 TRENCH DRAIN CHANNELS

- A. Each system consisting of a variable number of units are precast with no slope.
- B. Channel units shall be manufactured to an external width of about 6 IN with an internal width of about 4 IN. The inside of the channels shall have vertical side walls and about 2 IN radius bottom.
- C. Channels shall be provided with tongue and groove ends and shall interlock fully and evenly with adjoining channels.
- D. Each channel shall have horizontal anchoring ribs located along the bottom of the channel as a means of mechanical engagement into the adjacent concrete. Anchoring rib must be centered and run continuously for at least 60 percent of the length of each channel. The base of the channel shall be about 4 IN wide to provide maximum load distribution.
- E. Materials used in the manufacture of the precast polymer concrete drain system shall have the properties specified in this section and test reports must be available.
  - 1. Accelerated Service:
    - a. Test Method: ASTM D756-E.
    - b. Criteria: Retains 75 percent strength at <2 percent change in weight or dimension.
  - 2. Chemical Corrosion:
    - a. Test Method: ASTM D543-7.1.

- b. Criteria: Retains 75 percent strength at <2 percent change in weight or dimension.
- 3. Water Absorbtion:
  - a. Test Method: ASTM D57.
  - b. Criteria: <1 percent.
- F. The test specimens shall show no cracking, crazing, checking, blistering, or surface pitting. Changes in color will be permitted only if the change does not indicate degradation of the material and in the opinion of the user, the change will not be detrimental to the overall appearance of the product.

## 2.03 CHANNEL GRATES

- A. All channel grates and catch basins shall be equipped with galvanized steel gratings. Gratings shall bear evenly on the channel edges and shall provide an intake cross section of approximately 10 SQ IN per linear foot.

## 2.04 ACCESSORIES

- A. Male and female end caps shall be provided where required.
- B. Transition pieces for female to female connections male to male connections shall be available and provided where specified.
- C. Catch basins shall be precast polymer concrete with galvanized steel trash buckets. Any trench drains entering catch basins shall interlock fully with tongue and groove connections. Discharge pipe shall be 6 IN DIA.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. An area must be excavated for channel placement in trenches 4 IN wider and 4 IN deeper than channel sections to accommodate channel and bedding concrete.

### 3.02 INSTALLATION

- A. The drain system shall be installed in strict accordance with manufacturer's recommendations and approved shop drawings.
- B. When indicated, proper adhesive will be used to interlock adjoining surfaces during installation.
- C. Channel placement shall begin at catch basin.
- D. Channels are placed in sequence with arrows all pointing in the same direction. Channel ends are to be interlocked with surfaces reasonably flush and even. The joints are to be unsealed unless otherwise specified. Channels are to be firmly anchored in place during installation to prevent floating and movement during placement of concrete.

## PART 4 - MEASUREMENT AND PAYMENT

**END OF SECTION**

## **SECTION 33 52 19 - FLEET FUEL STORAGE AND DISPENSING SYSTEM**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Packaged above ground fuel storage tank and dispensing system including all wiring, accessories, safety devices, structures and appurtenances required for a complete operating and approved installation.
2. Packaged diesel fuel point of dispense cabinet.
3. Diesel and Gasoline fuel dispensing systems:
  - a. Tank mounted fuel pumps.
  - b. Tank mounted dispensers.
  - c. Piping.
4. Fuel Tank Overfill / Leak Detection System.
5. Fuel Control System.
6. Diesel fuel point of dispense cabinet; only standardized equipment, compatible with diesel fuel are permitted to be used on UPRR.
7. Furnish all labor, materials, tools, equipment, and services for fuel dispensing systems as indicated, in accord with provisions of Contract Documents.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 00 - Submittals and Substitutions.
- B. Section 01 61 02 – Basic Mechanical Requirments
- C. Section 09 90 00 - Painting and Protective Coatings.
- D. Section 09 97 50 – Tank and Pipe Coatings for Fuel and Oil Systems
- E. Section 33 05 26 - Mechanical Identification.
- F. Section 40 05 03 – Piping Materials and Methods

#### **1.03 REFERENCED STANDARDS**

- A. International Fire Code (IFC):
- B. American Society of Mechanical Engineers (ASME):
  1. B16.5, Pipe Flanges and Flanged Fittings.
  2. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
  3. B16.11, Forged Steel Fittings, Socket Welding and Threaded.
- C. American Society for Testing and Materials (ASTM):
  1. A27, Standard Specification for Steel Castings, Carbon, for General Application.

2. A36, Specification for Carbon Structural Steel.
  3. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- D. National Fire Protection Association (NFPA):
1. 30, Flammable and Combustible Liquids Code.
  2. 30A, Automotive and Marine Service Station Code.
  3. 70, National Electrical Code.
- E. Underwriters Laboratories Inc. (UL):
1. UL Gas and Oil Equipment Directory.
  2. File MH7991 and MH9061, Storage of Flammable Liquids.
  3. 87, Power Operated Dispensing Devices for Petroleum Products.
  4. 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.
  5. 330, Hose and Hose Assemblies for Dispensing Flammable and Combustible Liquids.
  6. 2080, Standard for Fire Resistant Tanks for Flammable and Combustible Liquids
  7. 2085, Standard for Protected Aboveground Tanks for Flammable and Combustible Liquids.
- F. Petroleum Equipment Institute (PEI)
1. RP200: Installation of Aboveground Storage Systems
  2. RP300: Installation and Testing of Vapor Recovery Systems
  3. RP600: Overfill Prevention for ASTs
- G. UPRR Fuel Standards
1. Standard 003-015, Overfill Protection
  2. Standard 003-16, AST Labeling

#### 1.04 SUBMITTALS

- A. Submittal Procedures: See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
- B. Approval Submittals:
1. Complete detailed Drawings of equipment provided including dimensions and connection locations.
  2. Wiring and control system diagrams and piping layouts.
  3. 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.
    - a. Copy of the Certificate of Approval for all equipment and devices where required by code.

4. Exterior above ground piping Drawings (minimum scale 1/8 IN equals 1 FT) with information including:
  - a. Dimensions of piping from wall surfaces.
  - b. Centerline dimensions of piping.
  - c. Centerline elevation and size of intersecting conduit/conduit racks, or other potential interferences requiring coordination.
  - d. Location and type of pipe supports and anchors.
  - e. Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
  - f. Line slopes and air release vents.
5. Project Data:
  - a. Product technical data including:
    - 1) Acknowledgement that products submitted meet requirements of standards referenced.
    - 2) Copies of manufacturer's written directions regarding material handling, delivery, storage and installation.
    - 3) Separate schedule sheet for each piping system scheduled in this Section showing compliance of all system components.
      - a) Attach technical product data on gaskets, pipe, fittings, and other components.
6. Test Data
  - a. Submit documentation of all test data.
7. Training
  - a. Submit training materials per Section 01 61 02.
- C. Quality Assurance Submittals.
  1. Test reports.
    - a. Copies of pressure test results on all piping systems.
    - b. Copies of pressure test results on primary and secondary tanks.
    - c. Notification of time and date of piping pressure tests.
- D. Closeout Submittals:
  1. Operation & Maintenance (O&M) Manual Content: Provide O&M manual documentation as required by Division 01.
  2. Electronic copies of the manuals are sufficient for initial submittal to Railroad. One hard copy print should be provided to Railroad at completion of the project.

#### 1.05 QUALITY ASSURANCE

- A. Fuel pumps and hoses shall be listed by UL and labeled for use with gasoline or diesel, as applicable.

B. Qualifications:

1. Installer shall have successfully completed at least three (3) projects of the same scope and the same size or larger within the last 6 years.
  - a. Installer shall demonstrate specific installation experience in regard to the specific system installation to be performed.
  - b. Installer shall have taken, if applicable, manufacturer's training courses on the installation of piping, leak detection, and tank management systems and meet the licensing requirements in the project jurisdiction.

1.06 SYSTEM DESCRIPTION

- A. Coordinate with Owner for final fuel system requirements prior to selection/purchase of equipment.
- B. The Work shall include the design, fabrication and installation of the entire fuel storage and dispensing system in conformance with pertinent federal, state, and local code requirements.
  1. The completed installation shall conform to NFPA and IFC as applicable.
  2. Unattended self-service dispensing system shall comply with IFC 2204.3
- C. Obtain all applicable permits associated with the fueling facility.
- D. For gasoline systems, the work shall include but is not limited to:
  1. Install new 1,000 GAL aboveground double wall tank, and associated safety devices.
  2. Install fuel piping and associated safety devices.
  3. Install tank mounted pump package.
  4. Install tank fill box with associated piping, valves, and adapters.
  5. Install tank mounted dispenser.
  6. Install overfill / leak detection system.
- E. For diesel fuel tank systems, the work shall include but is not limited to:
  1. Install new appropriately sized aboveground double wall tank, and associated safety devices.
  2. Install fuel piping and associated safety devices.
  3. Install tank mounted pump package.
  4. Install tank fill box with associated piping, valves, and adapters.
  5. Install tank mounted dispenser.
  6. Install overfill / leak detection system.
- F. For diesel fuel point of dispense systems, the work shall include but is not limited to:
  1. Install UPRR standard point of dispense cabinet.
  2. Install pressure regulator.
  3. Install fuel piping and associated safety devices.



## 1.07 DELIVERY, STORAGE, AND HANDLING

- A. Protect equipment, piping, pipe coatings and pipe jackets during handling using method recommended by manufacturer.
  - 1. Use of bare cables, chains, hooks, metal bars or narrow skids in contact with coated pipe is not permitted.
- B. Prevent damage to equipment and pipe during transit.
  - 1. Repair abrasions, scars, and blemishes.
  - 2. If repair of satisfactory quality cannot be achieved replace damaged material immediately.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
  - 1. Fleet Fueling System:
    - a. Convault.
    - b. Containment Solutions, FUELMASTER.
    - c. Or equal.
- B. Submit requests for "or equal" substitutions in accordance with Section 01 33 00.

### 2.02 NEW ABOVEGROUND STORAGE TANK

- A. New tank shall be rectangular, above ground, fire rated, double wall vault type design
  - 1. Capacity: 1,000 GAL.
  - 2. Fuel: Gasoline.
- B. Tank shall be designed with ballistic and vehicle impact protection.
- C. Tank system shall be a standard size, standard option tank system or equal.
  - 1. Galvanized materials (zinc coated) shall not be allowed in direct contact with any fuel.
- D. The storage tank system must be provided with all safety and overfill prevention devices required by IFC 2006, NFPA 30, NFPA 30A, and local codes.
- E. Tank system shall be a factory fabricated, concrete encased storage tank with integral secondary containment, in accordance with NFPA 30 and NFPA 30A.
  - 1. Design and manufacture tank system for horizontal above ground installation.
  - 2. Primary tank:
    - a. Construct primary storage tank of single wall ASTM A36 steel in accordance with UL 142.
      - 1) Continuous welds on all exterior seams.

3. The outer surface of the primary steel tank shall be covered by a minimum of 1/4 IN thick Styrofoam insulation panels. Secondary containment:
    - a. The secondary containment shall be impervious to corrosion.
    - b. The secondary containment shall consist of a 30 mil thick, high density, polyethylene liner enclosing the steel tank and insulation material.
  4. The primary steel tank and secondary containment shall be encased by a minimum of 6 IN of 4000 psi strength, monolithically poured, reinforced concrete.
  5. Tank system shall conform to the requirements of UL 2085, bear the UL 2085 label and provide at least two (2) HRS fire protection.
    - a. No exterior enclosure shall be allowed to cover the reinforced concrete.
  6. Skid mount tank system and provide with lifting lugs which allow tank relocation.
  7. Provide the tank system with the manufacturer's standard ladder and platform assembly, except as modified herein.
    - a. Construct the assembly of structural steel and allow access to the top of the tank system.
  8. All openings shall be located in the top of tank.
    - a. Provide openings only for access, inspection, filling, emptying and venting of the tank.
- F. Tank exterior protective coating: See Section 09 97 50.
- G. Tank Piping Penetrations:
1. Pipe penetrations will enter through the top of a tank.
    - a. Drains located at the bottom of a primary storage tank will not be allowed.
  2. Provide the number of tank piping penetrations as required per Plans.
  3. Provide nylon dielectric bushings on all pipe connections to a tank.
  4. Pipe connections to a tank shall be through welded-in-place double tapered NPT couplings.
  5. Provide the termination of fill lines within a tank with an anti-splash deflector.
    - a. Fill line shall terminate within 6 IN from the bottom of the tank.
  6. Piping shall be ASTM A53 black steel construction. Minimum wall thickness shall be schedule 40.
- H. Tank Atmospheric Venting:
1. Provide pressure vacuum vent designed to provide normal venting for above ground storage tank.
  2. Pressure vacuum vent shall be:
    - a. OPW, 623V.
    - b. Morrison Brothers Figure 748.

- 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. Vent pipe and vent shall be in accordance with NFPA 30, NFPA 30A, UL 142 and UL 2085.
- 5. Vent pipe sizing shall be not less than 2 IN nominal diameter.
- 6. Discharge point shall be at least 12 FT above adjacent ground level.
- I. Tank Emergency Venting:
  - 1. Vent shall be designed to relieve only at a pressure setting above that of the normal vent.
  - 2. Emergency vent shall be:
    - a. OPW, 201 or 202.
    - b. Morrison Brothers Figure 244.
    - c. Or equal.
  - 3. Vent shall comply with NFPA 30, NFPA 30A, UL 2085 and UL 142.
  - 4. Vent capacity shall comply with NFPA 30, NFPA 30A, UL 2085 and UL 142 for the size of tank and fuel specified.
- J. Tank Overfill Prevention Device:
  - 1. Provide tank with an overfill prevention device installed at the fill port.
  - 2. Device shall stop flow of product when the tank reaches a preset warning level.
    - a. Device shall stop flow of product at 95% tank level.
  - 3. Tank overfill prevention device shall be:
    - a. OPW, 61fSTOP.
    - b. Morrison Brothers Figure 9095A.
    - c. Guillotine Fill Limiter.
    - d. Or equal.
  - 4. Overfill prevention device shall comply with NFPA 30 and NFPA 30A.
  - 5. Use adapters per manufacturer.
- K. Tank Gages:
  - 1. Provide tank with clock gage.
  - 2. Gage shall be activated by float switch.
  - 3. Gage shall be:
    - a. Morrison Brothers 818 Series.
    - b. Or equal.

4. Gage shall be accessible and viewable when the tank is filled.
  - a. Gage shall be viewable from 20 FT to 30 FT minimum.
  - b. Orientate gage facing towards tank load out location.
5. Furnish each tank with two (2) copies of calibrated charts which indicate the liquid contents in gallons for each 1/8 IN of tank depth.

## 2.03 EQUIPMENT

### A. Vehicle Refueling Pump Package and Dispenser:

1. Provide one (1) tank mounted dispenser. Dispenser can be located on side or front of tank.
2. Provide dispenser only for use with tank mounted pumps located on the aboveground storage tank.
3. Dispenser:
  - a. Gasoline.
  - b. Provide lockable nozzle via padlock.
4. Corrosion resistant cabinet.
5. Electric Register: LCD type for 999 GAL delivery with battery backed 999,999 Gal totalizer.
6. Display on front of cabinet.
7. Pulser:
  - a. Selectable pulse/gallon output: 1, 10, 100, 250, 500, or 1,000 pulses per gallon.
8. Meter: Multi-piston positive displacement meter accurate to within +/-1 percent.
9. Solenoid valve: Electrically operated 1 IN, 115 V.
10. Hose: Smooth bore, 1 IN black rubber, 12 FT long for gasoline.
  - a. Provide automatic nozzles, breakaway valves and swivels.
  - b. Automatic nozzle:
    - 1) Restrict flow when tank is full.
11. Filter and strainer: Suitable for use with gasoline.
12. Base, frame and panels designed for outdoor use to provide vibration free support and weather protection for items above.
  - a. Provide exterior finishes of stainless steel or electrostatically primed and finished with a durable non-fading baked enamel.
  - b. Color to be approved by Engineer.
13. All items UL listed for gasoline as appropriate.
14. Provide lights to illuminate product panels and register areas.
15. Provide high post mounted retractors.

16. Dispenser shall be:

- a. Gasboy,
- b. Tuthill Fill-Rite
- c. Or equal.

17. Pumps:

- a. Pump shall be self lubricating and easily removable without disconnecting discharge piping.
  - 1) 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.
- b. Pump shall be provided with check valve, air eliminator, expansion relief valve, siphon nozzle and venturi, siphon check and pressure test screw.
- c. Submersible pumps shall fit standard 4 IN NPT tank openings.
- d. Pump intake inlet shall be horizontal to prevent drawing sediment from the tank bottom into the pump inlet.
- e. Pump manifold shall be completely sealed against product leakage to the ground and water leakage to the tank.
- f. Siphon system shall include integral siphon check valve to maintain liquid level after pump has been de-energized.
- g. Submersible pump for dispensing gasoline:
- h. Flow rate: 15 GPM minimum.
  - a) 115 V.
  - b) 1/3 HP.
- i. General Description:
  - 1) Fixed speed.
  - 2) Pumps shall be Class 1, Group D Atmospheres, UL Listed for specified fuel, 1 PH., 115 V, hermetically sealed motor windings, thermal overload protection. Suitable for exposed outdoor installation.
- j. Pump materials of construction shall be suitable for the fuel pumped as specified.

B. Emergency Switch:

- 1. Provide easily accessible emergency switch within 100 FT, but not closer than 25 FT of dispenser for emergency power shut-off.

2.04 ADAPTERS, COUPLERS AND ACCESSORIES

A. Tank Fill:

1. Tight-Fit Fill Adapter

- a. Provide bronze adapter fitted with a Buna-N or Viton gasket in the API standard 4 IN size.

- 1) Adapter shall be a top seal adapter and with a tight-fit connection to prevent vapor emissions during filling.
  - a) Adapter shall be:
    - (1) OPW.
    - (2) Morrison Brothers Figure 800A.
    - (3) Or equal.
  - 2) Provide adapter with a locking cap.
    - a) The cap shall mate with the adapter and have a latching mechanism which provides a water tight seal.
    - b) The cap shall provide some type of locking provision and be easily attachable and removable.
    - c) Cap shall be:
      - (1) OPW.
      - (2) Morrison Brothers Figure 800C.
      - (3) Or equal.
2. Locking Ball Valve:
  - a. Provide a UL listed locking full port ball valve for each product fill line.
  - b. Ball valve: Forged brass body, chrome plated ball, blowout proof stem, Teflon seals, and carbon steel handle.
  - c. Ball valve shall be:
    - 1) Morrison Brothers Figure 691B.
    - 2) OPW, 21 BV (with locking handles).
    - 3) Or equal.
3. Check Valve:
  - a. Provide a swing check valve for each product fill line.
  - b. Check valves shall be constructed for use with fuel types as specified.
  - c. Check valves shall be:
    - 1) Morrison Brothers Figure 246.
    - 2) OPW, 175.
    - 3) Or equal.
4. Overfill Prevention Valve:
  - a. See Part 2.02.K of this Specification Section.
- B. Tank Fill Spill Container:
  1. Provide a UL listed tank mounted spill container with tank for use during tank filling operations.
  2. 12 gage powder coated steel construction or stainless steel.

3. Minimum capacity of 15 GAL.
4. Container shall have a pedestal mount, lockable lid, and a 1-1/2 IN drain with lockable ball valve.
  - a. Valve shall be normally closed to release spilled product into the primary steel tank.
5. Spill container shall be:
  - a. Morrison Brothers 515 series.
  - b. Pomeco/OPW, 211-RMOT.
  - c. Or equal.

C. Fuel Discharge Line Accessories:

1. External Emergency Valve:
  - a. Provide an external emergency valve in each product discharge line.
  - b. Valve shall have a fusible link. Valve shall activate and stop flow in the event of a fire.
  - c. External Emergency Valve shall be:
    - 1) Morrison Brothers Figure 346.
    - 2) OPW, 1785.
    - 3) Or equal.
2. Solenoid Valve:
  - a. Provide solenoid valve in each product discharge line.
  - b. Valve shall be normally closed and shall open upon receipt of an electronic signal from fuel control system when switched on.
  - c. Operates on 120 volts.
  - d. Enclosure shall be watertight and rated for hazardous locations – NEMA 3, 4X, 7 and 9; groups C and D.
  - e. Built-in expansion relief.
  - f. Solenoid valve shall be:
    - 1) Morrison Brothers Figure 710.
    - 2) OPW, 821.
    - 3) Or equal.
3. Expansion Relief Valve:
  - a. Provide an expansion relief valve in each product discharge line.
  - b. Valve shall be used for relief of excess pressure, product shall return back to storage tank.
  - c. Expansion relief valve shall be:
    - 1) Morrison Brothers Figure 78DI.

- 2) OPW, 82RV.
- 3) Or equal.

D. Fire extinguishers:

1. Provide a minimum of one (1) fire extinguisher per IFC 2205.5.
  - a. Minimum rating of 2-A: 20-B: C per IFC 2205.5.
2. Locate extinguisher as shown on Drawings.

E. Warning signs:

1. Provide warning signs per IFC and/or NFPA.
2. See Section 33 05 26 for additional information.

## 2.05 FUEL TANK MONITORING SYSTEM

A. Electronic Overfill / Leak Detection Panel:

1. Panel produce an audible and visual alarm in the event of a detected leak or tank overflow
  - a. Audible alarms shall be a buzzer sounding at 70 decibels or greater.
  - b. Each visual alarm shall indicate the type and location of the alarm condition.
  - c. Visual alarms shall be capable of delineating between individual alarm conditions.
2. Panel shall initiate a remote tank fill audible/visual alarm at 90 percent tank level; State of Texas mandates audible/visual alarms at 85%
  - a. Alarm device shall be located near tank fill box in view of operator.
  - b. Alarm shall be manually acknowledged by switch located at alarm.
3. Panel shall provide a means of delineating between individual alarm conditions.
4. House panel in a NEMA 4 enclosure.
5. Panel using computer memory shall be capable of maintaining current programmable information in the event of a power failure.
6. Provide panel with a manual acknowledge switch which shall be capable of deactivating the audible alarm.
  - a. The acknowledge switch shall not be capable of deactivating subsequent audible alarms unless depressed manually again for each occurrence.
  - b. Under no circumstance shall this acknowledgement switch extinguish the visual alarms until the alarm condition has been corrected.
7. Panel shall be capable of producing hardcopy printouts of all tests and/or leak notification reports.

B. Aboveground Vaulted Tanks:

1. The interstitial space of each vaulted tank shall be continuously and automatically monitored to detect breaches in the integrity of the primary tank and the exterior vaulted shell.



2. The interstitial space shall be monitored by an electric leak detector.
  - a. Sensors shall be intrinsically safe for use in Class 1, Division 1, Group D environment as defined by NFPA 70.
  - b. Sensors shall be easily removed from the tank.
  - c. Sensors shall be compatible with the electronic monitoring panel.
  - d. Sensors shall be UL listed.

#### 2.06 DIESEL FUEL POINT OF DISPENSE CABINET

- A. UPRR stock item 315-1083, Diesel Dispensing Cabinet, Snyder part number SECO-PC-DFO-M1
- B. Cla-Valve 90-50 DS.SS.SS.150s pressure reducing valve with CRA pressure reducing control

#### 2.07 OIL COMMODITY STRAINERS

- A. Strainer shall be in-line basket type strainer. The housing and flanges shall be carbon steel with a 304 stainless basket. Seals shall be Teflon and base seal shall be FKM (Viton). Maximum working pressure shall be 285 psi at 100 degrees F. Strainer shall be 40 mesh for diesel fuel oil systems; 20 mesh for all other oil commodities. Strainer shall be FMC Technologies Smith Meter 2" – 8" In-Line Series Strainer or approved equal.
- B. Body shall have a bolted cover for easy removal of the basket.
- C. Body shall include a ¾" NPT drain connection with ball valve and cam and groove connection with dust cap.
- D. Piping connections shall be in-line ANSI 150-pound raised face flanged.
- E. A 0-5 PSI, diaphragm type, differential pressure gauge shall be plumbed from the inlet port of the strainer (high pressure) to the outlet of the strainer (low pressure). The gauge body shall be 304/316 stainless steel 600 PSI minimum working pressure. Seals and diaphragm shall be FKM (Viton) elastomers. The gauge shall be connected with 1/4" diameter stainless steel tubing. Gauge shall be Mid-West Instruments model 522 or approved equal.

The gauge face shall be color coded as follows:

1. 0-3 PSI range - Green (Normal)
  2. 3.0-4.0 PSI range - Yellow (Inspect and clean)
  3. 4.0-5.0 PSI range - Red (Dirty)
- F. Instrument Tubing:
    1. Material shall be ASTM A269 Type 304 annealed stainless steel.
    2. Wall thickness shall be as required by the fittings, but not less than .049".
  - G. Fittings:
    1. Manufacturer shall be Parker-Hannifin "Ferulok" or Swagelok stainless steel bit-type tube fittings for flareless tubes."

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. The fuel storage tank and dispensing system must be installed by or under the supervision of a licensed motor fuel tank installer.
- B. The installation of the aboveground motor fuel storage tank and dispensing system must comply with the provisions of NFPA 30, NFPA 30A, IFC 2006 and local codes.
- C. Handle storage tanks with extreme care to prevent damage during placement and install in accordance with the manufacturer's installation instructions and NFPA 30 or NFPA 30A, as applicable.
- D. Inspect the exterior surface of each tank for obvious visual damage prior to the placement of each storage tank.
  - 1. Correct surface damage to a storage tank according manufacturer's requirements before proceeding with the system installation.
- E. Field Painting:
  - 1. Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory, shall be painted, piping shall be painted, and have identification markings applied as specified in Section 09 90 00.

### 3.02 TESTS

- A. Aboveground Storage Tank Tightness Tests:
  - 1. Testing shall meet the requirements of UL 142 and UL 2085.
  - 2. Pressure tests shall be performed in the presence of a Fire Department representative.
  - 3. Perform a tightness test on each aboveground storage tank.
    - a. Perform the tests prior to making piping connections.
  - 4. Tests shall be capable of detecting a 0.1 gph leak rate from any portion of the tank while accounting for effects of thermal expansion or contraction.
  - 5. Gages used in the tightness tests shall have a scale with a maximum limit of 10 psig.
  - 6. Hydrostatically pressurize test each storage tank compartment to 20 psig and monitored for a drop in pressure over a 2 HR period during which there shall be no drop in pressure in the tank greater than that allowed for pressure variations due to thermal effects.
    - a. Pneumatic test the annual space at three (3) psig.
    - b. Any test failure shall require corrective action and retest.
  - 7. Piping shall be hydrostatically tested at 100 psig and monitored for a drop in pressure over a 2 HR period during which there shall be no drop in pressure in the tank greater than that allowed for pressure variations due to thermal effects.
    - a. Any test failure shall require corrective action and retest.

- B. Manufacturer's Tank Tests:

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1. Following the tank tightness test, leak test each storage tank in accordance with the manufacturer's written test procedure if the manufacturer's test procedure is different from the tightness tests already performed.
2. Any test failure shall require corrective action and retest.

C. 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 the maximum rated capacity of the system by using several tank trucks simultaneously, if applicable.
  - a. The use of tank trucks shall be coordinated with the Project Representative prior to testing.
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 obtained from the Project Representative.
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. Each fuel meter is operating accurately.
  - d. Vent piping is clear of debris and each pressure/vacuum relief vent is operating properly.
  - e. Dispenser and nozzles are operational and perform as designed.
  - f. Fuel filtration system is operational and performing as designed.
  - g. Each safety device works properly and is tested per NFPA requirements as necessary.

D. High Liquid Level Alarm Test:

1. Each storage tank compartment shall be initially overfilled with the appropriate product in order to verify the high liquid level alarms in the remote alarm panel function as designed.
2. The initial overfill shall also verify that the storage tank overfill protection.

3.03 FLUSHING, CLEANING AND ADJUSTING

- A. Following installation and equipment testing but prior to system performance testing, the following flushing, cleaning, and adjustments shall be performed.
1. Initial System Cleaning:
    - a. Visually inspect and clean free of debris, dust, and moisture the interior of each fuel storage tank before filling. Cleaning products shall be compatible with tank material and gasoline. Verify use of cleaning material with tank manufacturer prior to use.

- 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 Fuel Supply:
- a. Following the preparations for flushing, fill each storage tank to a 25 percent capacity with the proper fuel according to the fueling system's final operational requirements.
  - b. Following the initial fuel supply, measure and record each storage tank's fuel temperature and liquid level.
    - 1) The liquid level shall be measured using a manual tank gage.
3. Dispensing Flushing:
- a. Fuel shall be pumped at the system's maximum design flow rate from a storage tank through the fuel supply piping, through dispenser, and then into an empty fuel truck or tank as supplied by the Project Representative.
  - b. Periodic samples for inspection by the Project Representative shall be taken during the flushing procedure.
    - 1) A minimum of 100 GAL shall be flushed through each hose reel nozzle.
    - 2) The flushing procedure shall be continued until the fuel being delivered is acceptable to the Project Representative.
    - 3) Each dispensing line shall be flushed in the exact same manner.
4. Disposal of Initial Fuel Supply:
- a. In the event the fuel contained in the piping system at the conclusion of the flushing operation is not considered by the Project Representative to be of satisfactory quality for the desired use, the Contractor shall be responsible for pumping out the entire fuel supply from the storage tanks and the piping system.
  - b. Disposition of the fuel removed from the system shall be the responsibility of the Contractor.
5. Initial System Adjustments:
- a. Following the flushing and cleaning operations, each system component shall be initially adjusted, if necessary, to meet the system's final operational requirements.
  - b. The Project Representative will deliver enough fuel to the storage tanks to enable the Contractor to make final adjustments to equipment and controls.
  - c. Flow rates and pressures shall be adjusted as required to meet the indicated requirements.

- d. The sequence of control for each component shall be adjusted to meet the indicated system requirements.
- e. Following the initial system adjustments, the equipment tests shall be performed in order to determine any necessary final system adjustments.

### 3.04 TRAINING

- A. Contractor shall conduct a training course for the operating staff as designated by the Project Representative.
  - 1. The training period shall consist of a total of 8 HRS 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. For additional training requirements see section 01 61 02.

**END OF SECTION**

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## **SECTION 33 56 05 - TEMPORARY CLOSURE AND RETURN TO SERVICE FOR ABOVEGROUND PETROLEUM STORAGE TANKS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Preparation of aboveground storage tanks containing diesel fuel for removal from service and temporary closure.
2. Preparation of aboveground storage tanks for diesel fuel storage for placement back in service.

##### **B. Work Furnished by Owner:**

1. Tank cleaning will be done under separate contract by the Owner.
2. Removal of tank gauging equipment associated with the Fuel Management System (FMS), if present, will be done under separate contract by the Owner.
3. Cathodic Protection System, if present, will be modified and monitored under separate contract by the Owner.
4. Tank inspections will be done under separate contract by the Owner.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 09 97 50 – Fuel and Oil – Tank and Pipe Coatings
- B. Section 33 56 10 – Aboveground Petroleum Tank Cleaning
- C. Section 33 56 15 – Aboveground Petroleum Storage Tank Inspection
- D. Section 01 61 02 - Basic Mechanical Requirements
- E. Section 40 05 03 – Piping Materials and Methods
- F. Section 26 05 00 – Electrical Basic Requirements

#### **1.03 REFERENCED STANDARDS**

##### **A. UPRR Standard Practice**

1. Aboveground Storage Tank Labeling

##### **B. National Fire Protection Association (NFPA)**

1. NFPA 30          Flammable and Combustible Liquids Code
2. NFPA 70          National Electrical Code
3. NFPA 326          Standard for the Safeguarding of Tanks and Containers for Entry, Cleaning, or Repair

##### **C. International Fire Code**

D. American Petroleum Institute (API)

1. API STD 650 Welded Tanks for Oil Storage
2. API STD 653 Tank Inspection, Repair, Alteration and Reconstruction
3. API STD 2000 Venting Atmospheric and Low-Pressure Storage Tanks
4. API STD 2015 Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks

E. Occupational Safety and Health Administration (OSHA)

1. 29CFR1910.146 Permit Required Confined Spaces

F. Local Codes and Standards as Applicable

1.04 SUBMITTALS

A. Submit as specified in Section 01 33 00.

B. Submit the following:

1. One (1) copy of written Confined Space Entry Program outlining procedures for preventing unauthorized entry, identifying and evaluating hazards, testing and monitoring conditions, training, rescue and safe entry for both "Permit-Required" and "Non Permit-Required" confined spaces.
2. Tank stabilization calculations as indicated below.
3. Submit applicable materials as required by Related Requirements (Sections).

1.05 QUALITY ASSURANCE

- A. Company specializing in performing the work of this section with minimum documented experience as outlined in Related Requirements (Sections).

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Piping materials, including blind flanges, gaskets, bolts, nuts, etc. shall be provided per section 40 05 03 Piping Materials and Methods.
- B. Coatings shall be provided per section 09 97 50 – Fuel and Oil – Tank and Pipe Coatings.
- C. Tank labeling shall be per UPRR Standard Practice, Aboveground Storage Tank Labeling.
1. "Tank Out of Service" decal, 3" letters on black background, 5" x 20", UPRR Stock Item #315-1130.
  2. Decals shall be applied using UPRR Stock Item #412-0391 spray adhesive on the tank and around the edges.
  3. Date of out of service event will be stenciled on tank
  4. Report of tank status change will be reported to the UPRR project point of contact. UPRR project POC is responsible for notifying the environmental management group for SPCC plan updates reflecting change in tank status upon completion.



## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. The Owner will remove all fuel from the tank and perform tank cleaning prior to the work required in this specification.
- B. Furnish all necessary clothing and equipment required for the work and protection of personnel and property.
- C. Review inspection reports and/or drawings of the tank to be closed. Brief proper personnel on the location of sumps or other tank appurtenances considered hazardous to personnel.
- D. Prepare the tank and personnel for tank entry as required the Confined Space Entry Program.
- E. Lockout/Tagout all associated equipment feeding, drawing from or connected to the tank.
  - 1. For locations where the tank being closed is the only tank, leave lockout/tagout measures in place after the work is complete.
  - 2. For locations where there is more than one tank, ensure that the systems are placed back in service after the prescribed tank closure measures have been put in place.
- F. Drain down any piping associated with the tank as required. Coordinate any fuel system disruptions with the Owner prior to beginning the work.
- G. Confirm material ordered for tank outage is compliant and complete prior to work commencement.

### 3.02 INSTALLATION

- A. General
  - 1. Maintain a vapor-free condition throughout the course of the work inside the tank. The air movers if required shall be non-sparking, explosion-proof, electrically operated or air-driven exhaust type.
  - 2. Safeguard the tank from unauthorized entry during the entire course of the work, until all nozzles and manways have been closed.
- B. Tank Nozzles and Associated Piping
  - 1. Remove all shell nozzle valves. Blind flange any tank nozzle flanges and cap any threaded or coupling connections. Blind flanges shall have the prescribed gaskets and threaded connections shall have appropriate thread compound as specified in section 40 05 03.
    - a. For valves that are in working condition, clean valves with high pressure water and steam as required by UPRR project point of contact. Prepare for long term storage by lubricating per manufacturer's recommendations. Palletize and wrap valves and ship to the following address:  
  
MBA Engineering, Inc. Attn: VMI Process  
8651 Naples St NE, Suite 200  
Blaine, MN 55449
    - b. For valves that are not in working condition, dispose of in an approved bins/facility.
  - 2. Blind flange or cap associated piping.

- a. For locations where the tank being closed is the only tank, system decommissioning will take place and be under separate contract.
- b. For locations where there is more than one tank, pressure test blind flanges and caps after installation to ensure there are no leaks when the system is placed back in service.

#### C. Tank Venting

1. Inspect and ensure that all normal tank vents are free and clear of debris. Clean as required.
2. Any emergency tank venting devices or valves shall be left in place.

#### D. Electrical

1. Disconnect and terminate any electrical service if present to devices associated with the tank. DO NOT disconnect any cathodic protection system rectifiers.
2. Coordinate removal of MTS gauge, if present, with the Owner.
3. Grounding to remain in place if present.

#### E. Cathodic Protection Systems

1. Cathodic protection systems if present shall be left in place and remain energized. Rectifiers will continue to be monitored by the Owner.
2. If the rectifier is not functioning, notify the Owner immediately.

#### F. Tank Stabilization

1. Provide calculations by a registered professional engineer (within the jurisdiction of the tank) certifying that the tank anchorage, if present, will prevent overturning or other damage to the tank and foundation due to, but not limited to, wind loads, buoyancy loads if the containment becomes flooded, etc.
2. If the tank is not anchored, said engineer shall either provide calculations that show anchorage is not required, or a design to protect the tank from damage, which may include internal ballast, external anchorage, and any additional information mandated.
3. Contractor shall implement the required tank stabilization recommendations once they are approved by the Owner.

#### G. Labeling

1. Apply required labels per UPRR Aboveground Storage Tank Labeling standard.

### 3.03 RETURN TO SERVICE

#### A. Tank Inspection

Tank shall be inspected per API 653 and all recommended repairs made and testing done prior to tank being placed back in service.

#### B. Coatings

1. Verify coating thickness and integrity on the interior of the tank if present. Repair as required.
2. If no coating is present on the tank interior, coat per Section 09 97 50 – Fuel and Oil – Tank and Pipe Coatings.

C. Tank appurtenances

1. For nozzles 8-inches and smaller, install new ball valves, gaskets, bolts and nuts per Section 40 05 03 Piping Materials and Methods.
2. For nozzles 10-inches and larger, install new high performance butterfly valves, gaskets, bolts and nuts per Section 40 05 03 Piping Materials and Methods.
3. Reinstall MTS gauging if removed; no alternates without approval.
4. Inspect and ensure that all normal tank vents are free and clear of debris. Clean as required.
5. Inspect and ensure that all emergency venting devices are functional.
6. Reconnect any electrical appurtenances that were disconnected.
7. Test all tank level and gauging systems. Calibrate as required per manufacturer's recommendations.
8. Verify and test all overfill systems.

D. Piping

1. Remove all blind flanges and plugs and reconnect all piping that was disconnected from the tank.
2. New piping and associated materials shall conform to Section 40 05 03 Piping Materials and Methods.
3. Test all piping for leaks prior to placing tank back in service.
4. Report of tank status change will be reported to the UPRR project point of contact. UPRR project POC is responsible for notifying the environmental management group for SPCC plan updates reflecting change in tank status upon completion.

**END OF SECTION**

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## **SECTION 33 56 13 - ABOVEGROUND PETROLEUM STORAGE TANKS - FIELD ERECTED**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Design, fabrication and erection of API-650 field fabricated, welded steel aboveground fuel storage tanks and associated appurtenances. The tank shall be used to store {Storm Water} {No. 2 diesel fuel} with a specific gravity of {1.0 for water} {.84 to .88. for diesel}
  - a. The tank shall be {Tank Diameter In Feet} in diameter by {Tank Height In Feet} tall with a nominal capacity of {Number of Barrels} barrels or {Number of Gallons}.
  - b. The designed flow rate into and out of the tank is {Flow Rate # In GPM} gpm.
- B. Provide tank with cathodic protection. Design and install Cathodic protection system to conform to NACE Publication SP0169-2007 Current Edition - Standard Practice, Control of External Corrosion Underground and Submerged Metallic Piping Systems. Design and installation shall be by individuals certified by NACE.
- C. Provide tank grounding per UPRR Electrical Specification 26 05 26 - Grounding and Testing.
- D. Tank to be weakened roof to shell design.
- E. Wind, temperature, and seismic conditions shall be site specific. Fabricator to verify these conditions with the locales building codes authority.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. 09 97 50 – Tank and Pipe Coatings for Fuel and Oil Systems
- B. 40 05 53 – Mechanical Identification
- C. 40 46 50 – Cathodic Protection Impressed Current

#### **1.03 REFERENCED STANDARDS**

- A. American Petroleum Institute (API):
  1. 650, Welded Steel Tanks for Oil Storage
  2. 2000, Venting Atmospheric and Low-Pressure Storage Tanks.
- B. ASTM International (ASTM):
  1. A36, Standard Specification for Carbon Structural Steel.
- C. UPRR Standard Practice – Bulk Product Tank Roof Hand Rail Detail

#### 1.04 SUBMITTALS

- A. Submit under provisions of section 01 33 00.
- B. Shop drawings required by this Section include, but are not limited by, the following:
  - 1. Aboveground tanks including all accessories and appurtenances.
  - 2. Contractor to submit an internal laser strapping chart of the tank, stamped and dated by a registered Professional Engineer of the state where the tank is erected.
- C. Contractor shall perform radiographic weld and vacuum box testing and provide the test locations and the results of tests. Results will be either "Pass" or "Fail". If the results were "Fail" contractor shall document what corrective actions were taken, re-test results showing "Pass", and certification of weld(s) tested.
- D. All results of tests referenced in this Specification.
- E. Certificates:
  - 1. Welding Procedure Specifications (WPS)
  - 2. Welding Procedure Qualification Records (PQRs)
  - 3. Welder Performance Qualification Records (WPQ)
  - 4. Qualifications of Tank Erector
  - 5. Qualifications of API Std 653 Inspector
  - 6. Weld Inspector Certification
  - 7. NDE Personnel Certification
  - 8. Qualifications of Testing Agency
  - 9. Tank Calibration Experience

#### 1.05 QUALITY ASSURANCE

- A. The tank manufacturer and installer shall have a minimum of five (5) years experience in design and erection of API-650 storage tanks of similar size.

### PART 2 - PRODUCTS

#### 2.01 ABOVEGROUND TANKS

- A. The aboveground storage tank shall be designed, fabricated, and erected in accordance with the latest revision of API-650 – Welded Steel Tanks for Oil Storage
- B. Fixed cone style roof (1:10 pitch) with center and rafter support. Connection with the shell shall have top angle turnout. Lap roof 3/16 IN minimum.
- C. Fabrication of steel plates conforming to ASTM A36. Plate thickness shall be in accordance with API 650 with 1/16 IN additional thickness for corrosion allowance for the bottom plates, first shell course, and structural steel members.
- D. The tank shall be furnished with connections for the following accessories, size as required unless specified:
  - 1. Roof access manhole (36 IN).

2. Roof access inspection manhole (24 IN) placed 16 IN to 36 IN from outside face of tank.
3. Varec Model 6700 Storyboard Level Gauge, with Varec Model 226 – 24 IN manhole cover, and Varec Model 228 inspection hatch.
  - a. Contractor shall mount storyboard supports @ 4 FT-0 IN OC using locknuts.
4. Magnatrol High level and High-High level switches – Provide one (1) of each with the following:
  - a. Stainless steel construction and displacers.
  - b. 150# 4" flanged connection.
  - c. Double pole, double throw switches.
  - d. Magnatrol "Proof-er" test mechanism and chain.
5. MTS Level Gauge (4 IN flanged).
6. Pressure/Vacuum vent – sized according to API 650 design variables.
7. Drain line (3 IN) and water draw off (1 IN), valves to be lockable ball type valves.
8. Tank suction {6 IN, 8 IN, 10 IN, 12 IN verify with project manager} with 150 LB flanged nozzle)
9. Tank fill {6 IN, 8 IN, 10 IN, 12 IN verify with project manager} provided with 150 LB flanged interior 90 degree discharge nozzle.
10. Spare {6 IN, 8 IN, 10 IN, 12 IN verify with project manager} shell nozzle with blind flange.
11. Emergency vent – per API 650 design variables.
12. Shell manhole (Two (2) each. 36 IN – Hinged).
13. Floating suction.
- E. The tank shall be externally painted and fully internally coated as specified in Section 09 90 01 – Paint and Protective Coatings.
- F. Label the tank shell as indicated on the drawings.
- G. Fill and suction connections to the tank shall have dielectric isolation flanges.

## 2.02 TANK ACCESSORIES

- A. Floating suction – Provide a floating suction swing joint complete with supports, height limiting chain, turndown elbow, with anti-vortex baffle, and swing joint as detailed on the drawings. Floats shall be sized to ensure flotation of the complete swing line assembly for a specific gravity of {1.0 for water} {.84 to .88. for diesel}. Swing joint shall be Staytite or equal.
- B. Gauge and sampling hatch – Shall be 4 inch flanged with spark-proof cover. Varec Model 42 or equal.
- C. Pressure/Vacuum vent – Vent shall be in accordance with API 2000 and set to maintain a maximum of 1/2 OZ/SQ IN pressure and vacuum. Varec Model 2010B or equal.

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- D. Emergency vent – Provide an emergency vent in accordance with API 2000 set at one ounce per inch. Varec 221 or equal.
- E. High-level switch – Shall be Magnatrol “Proof-er” Series Place Magnatrol (narrow differential) Part Number Here displacement-type level switch, 120 vac, magnetic snap, DPDT (Double Pole, Double Throw) switch. Activation level shall be set as directed on the drawings or as directed by the Engineer.
- F. Level gauges:
  - 1. Electronic gauge – MTS Systems Corporation Level Plus M-Series Digital Level Gauge:
    - a. Stainless steel construction, Nitrophyl floats for product level.
    - b. Rigid gauge for probe lengths of 25 FT-0 IN or lower. Flexible gauge with bottom magnet for gauges longer than 25 FT-0 IN.
    - c. Single chamber enclosure, single 4-20mA continuous outputs.
    - d. Level monitor readout:
      - 1) Remote-mounted 6 digit with floating decimal, 1 IN high numerals, red LED digital display in feet with NEMA 3 enclosure.
      - 2) 110 Vac powered, two (2) 24 Vdc loop power supplies, two (2) programmable alarm relay/set points.
      - 3) Mount display where indicated on the drawings.
  - 2. Mechanical gauge – Varec 6700 or equal board gauge. Accuracy 1 IN, indication in feet and inches, aluminum board with vinyl face, complete with all mounting and anchoring hardware.
- G. Spiral Stair – Shall be in accordance with OSHA extending from grade level to the tank roof. Handrail and toe boards at the top of the tank shall extend the full perimeter of the tank.
  - 1. If stairs are to be welded into place, welds shall not be re-welded over previous placed tank welds.
- H. Grounding Lugs – Provide grounding lugs, four (4) per tank for exothermic type field connection of #2 bare copper tank grounding wire. Connect grounding wires to 3/4 IN x 10 FT-0 IN long ground rods and connect ground rods together with #2 bare copper wire. Coordinate with Division 26 - Electrical requirements.

## PART 3 - EXECUTION

### 3.01 TESTING OF WELDED JOINTS

- A. Testing of welded joints shall comply with all requirements of API-650 (notably Sections 5 and 6) as well as the following:
  - 1. Provide the testing services of an independent testing laboratory to perform all radiographic examination of welds. The testing laboratory shall submit test results directly to the Engineer with copies to the manufacturer. All defective welds shall be removed and re-welded at the Manufacturer's expense.



2. All tank bottom fillet welds shall be subjected to a soap test, from the inside, using a vacuum device prior to application of internal coating and hydrostatic testing.
3. The initial pass of the shell-to-bottom weld shall be tested using a “diesel” test.
  - a. The “diesel” test shall consist of spraying the weld with diesel fuel, and after (a prescribed time period) checking the reverse side to see if any diesel fuel is present.
- B. After all joint tests are completed and all appurtenances are installed, the interior of the tank shall be cleaned of all debris and inspected by the Railroad’s Representative prior to hydrostatic testing.

### 3.02 HYDROSTATIC TEST

- A. The Contractor shall provide all temporary equipment, accessories, hoses, and connections necessary for performing the test. The Railroad will provide a water hydrant that can be used for the test. The Contractor is responsible for removing water from the tank and piping and discharging it into the Railroad’s storm sewer connection. The Contractor shall also contact the local municipality to determine the acceptable flow rate.
- B. The Tank Manufacturer shall notify the Railroad’s Representative a minimum of seven (7) days prior to commencing the test. An estimate of the total filling time should also be given. The water test shall be completed prior to tank painting or connection to external piping.
- C. Tanks shall be filled to the top of the shell and then drained to a level of 6 IN below the top. Tanks shall be allowed to stand filled for a minimum period of 48 HRS.
- D. The Contractor shall monitor for leaks and record any settlement of the tank during the hydrostatic test. Settlement checks shall be made at the four (4) compass points of the tank. Submit test results to the Engineer.
- E. Record and verify level gauge, and high level settings when filling the tank for hydrostatic test.

**END OF SECTION**

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## SECTION 33 56 15 - ABOVEGROUND STORAGE TANKS - SHOP FABRICATED

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Section Includes:

1. Design, fabrication and erection of Aboveground UL tanks with tank volumes of 500 to 30,000 U.S. gallons and their associated appurtenances.
  2. Both single wall and double wall UL tanks.
- B. Wind, temperature, and seismic conditions shall be site specific. Fabricator to verify these conditions with the local building code authority.

#### 1.02 RELATED REQUIREMENTS (SECTIONS)

- A. Section 09 90 01 – Painting and Coating
- B. Section 09 97 50 – Tank and Pipe Coatings for Fuel and Oil Systems
- C. Section 33 05 26 – Mechanical Identification
- D. Section 40 46 50 – Cathodic Protection – Impressed Current
- E. Section 40 46 51 – Cathodic Protection - Galvanic

#### 1.03 REFERENCED STANDARDS

##### A. Underwriters Laboratories Inc. (UL):

1. 142, Steel Aboveground Tanks for Flammable and Combustible Liquids.
2. 2080, Standard for Fire Resistant Tanks for Flammable and Combustible Liquids
3. 2085, Standard for Protected Aboveground Tanks for Flammable and Combustible Liquids

##### B. ASTM International (ASTM):

1. A36M, Standard Specification for Carbon Structural Steel.

##### C. Occupational Safety and Health Administration (OSHA)

1. 1910.D. Walking and Working Surfaces

##### D. National Fire Protection Association (NFPA)

1. 30, Flammable and Combustible Liquids Code

#### 1.04 NOMINAL TANK DIMENSIONS

Tank Volume (in gallons)	Tank Diameter	Tank Height
500	4 FT-0 IN	5 FT-5 IN
1,000	5 FT-4 IN	6 FT-0 IN
1,400	5 FT-4 IN	8 FT-5 IN
2,000	5 FT-4 IN	12 FT-0 IN

3,000	5 FT-4 IN	18 FT-0 IN
5,000	8 FT-0 IN	13 FT-4 IN
6,000	8 FT-0 IN	16 FT-0 IN
8,000	10 FT-0 IN	14 FT-0 IN
10,000	10 FT-0 IN	17 FT-0 IN
12,000	10 FT-0 IN	20 FT-6 IN
15,000	10 FT-0 IN	25 FT-6 IN
16,000	10 FT-0 IN	27 FT-2 IN
20,000	10 FT-0 IN	34 FT-0 IN
25,000	10 FT-6 IN	38 FT-9 IN
30,000	10 FT-6 IN	46 FT-6 IN

#### 1.05 SUBMITTALS

- A. Submit under provisions of section 01 33 00.
- B. Shop drawings required by this section include, but are not limited by, the following:
  1. Aboveground tanks including all accessories and appurtenances.
- C. Qualifications of:
  1. Manufacturer
  2. Installer

#### 1.06 QUALITY ASSURANCE

- A. Tank manufacturer and installer shall have a minimum of 5 years experience in design and erection of UL 142 storage tanks of similar size.

### PART 2 - PRODUCTS

#### 2.01 ABOVEGROUND TANKS

- A. Aboveground storage tank shall be designed, fabricated, and erected in accordance with the latest revision of applicable UL standard for a Seismic Zone as indicated in local building codes.
- B. Fixed cone style roof (1:10 pitch) with center and rafter support. Connection with shell shall have top angle turnout. Lap roof 3/16 IN minimum.
- C. Fabrication of steel plates conforming to ASTM A36M. Plate thickness shall be in accordance with UL 142 with 1/16 IN additional thickness for corrosion allowance for the bottom plates, first shell course and structural steel members.
- D. The tank shall be furnished with connections for the following accessories, size as required unless specified:
  1. Roof Access Manhole (36 IN).
  2. Story Board Connection (1-1/2 IN, NPT threaded connection w/ 6 IN nipple).
  3. High Level Switch (4 IN, 150 LB flanged connection).

4. Level Gauges – Electronic (4 IN, 150 LB flanged connection).
  5. Pressure / Vacuum Vent.
  6. Water Draw-Off (decant) line (1 IN with valve, locked).
  7. Tank Suction ({2 IN, 4 IN, 6 IN, 8 IN verify with project manager}, 150 LB flanged connection).
  8. Tank Fill ({2 IN, 4 IN, 6 IN, 8 IN verify with project manager}, 150 LB flanged connection) – provided with interior 90 degree discharge nozzle.
  9. Two (2) Spare (4 IN 150 LB flanged connection) with blind flange.
  10. Emergency Vent.
  11. Shell Manhole (36 IN, hinged).
- E. Tank shall be externally painted and fully internally coated as specified in Section 09 97 50.
- F. Tank Labeling: Tanks should be labeled as shown on the drawings, stenciled in black and include the following information:
1. Union Pacific Shield – per Union Pacific Graphic Standards.
  2. Commodity Contained Within the Tank – i.e., Diesel Fuel, Storm Water, Used Oil, etc.
  3. Tank Capacity – in gallons – use comma for 1,000 separator.
  4. Nozzle indicators – Water Draw-Off, Suction, and Fill.
  5. Tank overfill protection level gauge mark
  6. NFPA (National Fire Protection Association) Diamond Codes, see NFPA 704 Placarding table at the end of this Section.
- G. All piping connections to tank that have cathodic protection shall have insulating flange kits at the first flange connection from the tank to the pipe.

## 2.02 DOUBLE WALLED TANKS

- A. Double walled tanks shall be constructed similarly to single walled tanks, and shall include all tank accessories as noted.
- B. All tank penetrations for double walled tanks shall be made at the top of tank, or where otherwise indicated by the design engineer.
- C. For double wall tanks, provide a monitoring tube the height of the tank and topped with 2 IN diameter threaded fitting for monitoring the interstitial space between the inner and outer walls.
  1. Interstitial monitoring tube shall be provided with a warning label identifying it as a monitoring tube only.
  2. Provide optic leak detection switch. See Part 2.03.I.1 for requirements.

## 2.03 TANK ACCESSORIES

- A. Pressure / Vacuum / Emergency Vent: Vent shall be in accordance with UL 142.

- B. High-level switch: Magnatrol “Proof-er” series displacement-type level switch, 120 VAC, non-mercury, double pull double throw (DPDT) switch. Activation level shall be set as directed on the drawings or by the Engineer.
- C. Level Gauges:
1. Electronic Level Gauge: MTS Level Plus M-Series
    - a. Model – Magnetostrictive Level Sensor.
    - b. Type – Digital Output Level Transmitter.
    - c. Input Power – 24 VDC.
    - d. Output – MTS DDA Protocol.
    - e. Housing Type – NEMA 4X, 316L stainless steel with NPT and internal terminal blocks.
    - f. Electronics Mounting – Integral Electronics.
    - g. Sensor Pipe – Flexible with bottom fixing magnet and stainless steel float.
    - h. Material of Construction – 316L stainless steel.
    - i. Process Connection Type – 150 LB Welded RF Flange.
    - j. Process Connection Size – 4 IN.
    - k. Thermometer – None.
    - l. Unit of Measure – U.S. Customary.
    - m. Length – To be determined by the Contractor.
    - n. Level Readout:
      - 1) Remote-mounted 6 digit with floating decimal, 1 IN tall numerals, red LED digital display in feet with NEMA 3 enclosure.
      - 2) 110 VAC powered, two (2) 24 VDC loop power supplies, two (2) programmable alarm relay/set points.
      - 3) Mount display readout where indicated on drawings.
  2. Mechanical Gauge: Varec 6700 Liquid Level Indicator – Mount supports @ 4 FT-0 IN OC using locknuts.
    - a. Indicator Board – 0.08 IN aluminum with vinyl facing – English measure.
    - b. Sheave Elbows – 316 stainless steel.
    - c. Indicator Target – 316 stainless steel HMWPE.
    - d. Float – 316 stainless steel.
    - e. Float Cable – 316 stainless steel.
    - f. Guide Cable – 316 stainless steel.
    - g. Top Anchors – 316 stainless steel.
    - h. Bottom Anchors – 316 stainless steel.
    - i. Cable Fastener – 316 stainless steel.

- j. Cable Crimp – Nickel plated copper.
- D. Fixed Tank Ladder: Shall be constructed and installed in accordance with OSHA and UL 142 guidelines, extending from grade level to tank roof. All fixed ladders installed or replaced (where the fall distance to the lower level exceeds 24 feet) must have a ladder safety system or personal fall protection system installed in addition to installed cage. Handrail and toe board at the top of the tank shall extend the full perimeter of the tank.
- E. Grounding Lugs: Provide grounding lugs, four per tank, for exothermic type field connection of #2 bare copper tank grounding wire. Connect grounding wires to four (4) 3/4 IN x 10 FT long ground rods and connect ground rods together with #2 bare copper wire. Coordinate with Division 26 requirements.
- F. Tank Pad: A 3/16 IN thick nitrile pad shall be placed under the tank, trimmed to fit after tank placement, and secured to the tank foundation using an approved adhesive.
- G. Anchor Bolts: Anchor bolt quantity shall be provided per UL 142 specifications, and secured as shown in the drawings.
- H. Heater (If indicated on drawings):
  - 1. Manufacturer: Chromalox – No substitutions.
  - 2. Drywell Type.
  - 3. Type J and K Thermocouples.
- I. For RIP Track IW Holding Tank provide:
  - 1. Tank Leak Switch: Provide an optic leak detection switch which shall be installed on the leak detection interstitial monitoring pipe. Leak switch shall be manufactured by Flowline Inc. model Switch-Tek LO10 or approved equal. Switch shall contain at least 1 SPST relay with selectable (NO/NC) contact. Switch shall be NEMA 4X rated. Cable length shall be 50 FT. Contractor shall field verify required cable length and shall coordinate with Owner if 25 FT cable is sufficient.
  - 2. Tank Leak Switch Remote Relay: Provide a remote relay controller to which the tank leak switch shall be wired. Relay shall be manufactured by Flowline Inc. model LC42 or approved equal. Relay shall accept leak switch LO10 input which shall be hardwired to the relay and it shall provide at least one (1) latched SPDT and one (1) SPDT relay outputs each rated for 250 VAC, 10A. Relay mode shall be field selectable between NO or NC. Relay supply voltage shall be 120 VAC, 50 - 60 Hz. Relay shall be mounted inside the tank alarm station. The NO contact of the relay shall be wired to the leak indication pilot light mounted on the front of the tank alarm station.

3. Tank Alarm Station: Provide NEMA 4X 316SS enclosure that shall be installed near the IW Holding Tank (TK-410). Install the remote relay for the tank leak switch inside the enclosure. Enclosure shall be provided with two (2) 30.5 MM pilot lights with amber colored lens. Pilot lights shall be heavy duty push-to-test (PTT) type Allen Bradley Bulletin 800H NEMA 4X rated, 120 VAC LED type or approved equal. Also provide one (1) process meter mounted on the front of the enclosure. Process meter shall be manufactured by Precision Digital model PD6000-6H2 and shall have a SunBright sublight readable display or approved equal. Process meter shall accept the tank level transmitter 4-20mA signal which shall be calibrated to display the tank level in feet. Provide a fiberglass sunshade on the tank alarm station. Sunshade shall be directly mounted on the station with a gap of 6 IN between the sunshade and the top of the station. Also provide a general purpose 4PDT relay manufactured by Allen Bradley model 700-HC14A1 mounted inside the enclosure. The tank level switch (Magnetrol) contact shall be wired to energize the relay and one NO contact of the relay shall be wired to energize the tank high level pilot light. The second NO contact shall be wired to the IW Pump Local Control Panel for high level control.

### PART 3 - EXECUTION

#### 3.01 TESTING OF WELDED JOINTS

- A. Testing of welded joints shall comply with all requirements of UL 142 (notably sections 5 and 6) as well as the following:
  1. The tank manufacturer shall provide the testing services of an independent testing laboratory to perform all radiographic examination of welds. Testing laboratory shall submit test results directly to the Railroad with copies to the Manufacturer. All defective welds shall be removed and re-welded at the Manufacturer's expense.
  2. All tank bottom fillet welds shall be subject to a soap film test, from the inside, using a vacuum device prior to application of internal coating and hydrostatic testing.
  3. The initial pass of the shell-to-bottom weld shall be tested using a "diesel" test.
- B. After all joint tests are completed and all appurtenances are installed, the interior of the tank shall be cleaned of all debris and inspected by a Railroad Representative prior to hydrostatic testing.

#### 3.02 STORMWATER STORAGE / PROCESSING TANKS

- A. All interior surfaces of UL 142 tanks to be used for the containment of stormwater and or "oily water" shall be subject to the following:
  1. All interior surfaces (including the bottom, top and full length sides) shall besandblasted to a Near-White Finish, as per SPCC-SP10, and Section 09 90 01.
  2. The tank shall then be coated with a 6 mil thick coating of zinc rich epoxy coating. The coating is to fully coat all inside surfaces and be applied in accordance with Section 09 90 01 requirements for interior tank coatings. The epoxy prime must fully cover the bottom, full length sides, and top interior surfaces of the tank.



3. Upon completion, the tank interior will be inspected by a Railroad Representative. Photos must also be submitted to the Engineer for approval prior to placing the tank into service.

**END OF SECTION**

Commodity Description / Sign Verbiage	NFPA 704 Placarding				
	Vendor (Safety Sign.com) Part #	Large NFPA 704 Diamond Outdoor Durable Vinyl (Adhesive Backed)	UP Stock Item #	Medium NFPA Diamond Outdoor Durable Vinyl (Adhesive Backed)	UP Stock Item #
WATER TREATMENT (RUST INHIBITOR) SODIUM BORATE NITRATE (UN3139) UP ITEM # 060-7274	HEALTH 1	HR24001 (1-0-0) - 24X24	315-1114	HR11011 (1-0-0) - 11X11	315-1122
LOCOMOTIVE TOILET FLUSH (PROPYLENE GLYCOL / SANI-TRETE) UP ITEM # 061-4483 / 4481	HEALTH 1, FLAMMABILITY 1	HR24003 (1-1-0) - 24X24	315-1116	HR11008 (1-1-0) - 11X11	315-1121
CLEANER, ALL GREEN KLEEN (GK LWC-SO1CB) UP ITEM # 061-4538	HEALTH 2	HR24002 (1-1-0) - 24X24	315-1115	HR11010 (2-0-0) - 11X11	315-1123
CONCENTRATED LOCOMOTIVE CLEANER UP ITEM # 061-4890	HEALTH 1	HR24001 (1-0-0) 24X24	315-1114	HR11011 (1-0-0) - 11X11	315-1122
CLEANER, GENERAL PUPOSE (SOAP) UP ITEM # 061-4895	HEALTH 1	HR24001 (1-0-0) 24X24	315-1114	HR11011 (1-0-0) - 11X11	315-1122
CLEANER, LOCOMOTIVE (SOAP) UP ITEM # 061-6160	HEALTH 1	HR24001 (1-0-0) 24X24	315-1114	HR11011 (1-0-0) - 11X11	315-1122
DIESEL FUEL ADDITIVE UP ITEM # 310-0051	HEALTH 1, FLAMMABILITY 2	HR24004 (1-2-0) - 24X24	315-1117	HR11007 (1-2-0) - 11X11	315-1120
LOCOMOTIVE AIR COMPRESSOR OIL (SAE 20) ISO VISCOSITY GRADE 68 UP ITEM # 310-0354	HEALTH 1, FLAMMABILITY 1	HR24003 (1-1-0) - 24X24	315-1116	HR11008 (1-1-0) - 11X11	315-1121
DIESEL ENGINE LUBRICATING OIL 710LS20W40 11 TBN BULK UP ITEM # 310-1515	HEALTH 1, FLAMMABILITY 2	HR24004 (1-2-0) - 24X24	315-1117	HR11007 (1-2-0) - 11X11	315-1120
DIESEL ENGINE LUBRICATING OIL 9 TBN SINGLE GRADE 40W UP ITEM # 310-1551	HEALTH 1, FLAMMABILITY 2	HR24004 (1-2-0) - 24X24	315-1117	HR11007 (1-2-0) - 11X11	315-1120
DIESEL ENGINE LOCOMOTIVE CRANKCASE LUBRICATING OIL (MULTI-GRADE 20W/40 11TBN) UP ITEM # 310-1560 / 1562	HEALTH 2, FLAMMABILITY 2	HR24005 (2-2-0) - 24X24	315-1118	HR11006 (2-2-0) - 11X11	315-1119
LOCOMOTIVE TRACTION MOTOR JOURNAL SUPPORT BEARING OIL (AAR-M-963) UP ITEM # 310-3756	FLAMMABILITY 1	HR24012 (0-1-0) - 24X24	315-1125	HR11009 (0-1-0) - 11X11	315-1124
LOCOMOTIVE TRACTION MOTOR JOURNAL SUPPORT BEARING OIL (AAR-M-963) UP# 310-3801	FLAMMABILITY 1	HR24012 (0-1-0) - 24X24	315-1125	HR11009 (0-1-0) - 11X11	315-1124
TRACTION MOTOR GEAR CASE OIL (M-SHC-634) UP ITEM 310-7486	FLAMMABILITY 1	HR24012 (0-1-0) - 24X24	315-1125	HR11009 (0-1-0) - 11X11	315-1124
DIESEL FUEL	HEALTH 2, FLAMMABILITY 2	HR24005 (2-2-0) - 24X24	315-1118	HR11006 (2-2-0) - 11X11	315-1119
WASTE WATER	HEALTH 1	HR24001 (1-0-0) - 24X24	315-1114	HR11011 (1-0-0) - 11X11	315-1122
WASTE WATER TREATMENT	HEALTH 1	HR24001 (1-0-0) - 24X24	315-1114	HR11011 (1-0-0) - 11X11	315-1122
USED OIL	HEALTH 2, FLAMMABILITY 2	HR24005 (2-2-0) - 24X24	315-1118	HR11006 (2-2-0) - 11X11	315-1119
INDUSTRIAL WATER	HEALTH 1	HR24001 (1-0-0) - 24X24	315-1114	HR11011 (1-0-0) - 11X11	315-1122
STORM WATER	HEALTH 1	HR24001 (1-0-0) - 24X24	315-1114	HR11011 (1-0-0) - 11X11	315-1122
KEROSENE	HEALTH 2, FLAMMABILITY 2	HR24005 (2-2-0) - 24X24	315-1118	HR11006 (2-2-0) - 11X11	315-1119
GASOLINE	HEALTH 1, FLAMMABILITY 3	HR24013 (1-3-0) - 24X24	315-1132	HR11012 (1-3-0) - 11X11	315-1133
POTABLE WATER	HEALTH 0, FLAMMABILITY 0, STABILITY 0	HR24014 (0-0-0) -24X24	315-1135	HR11013 (0-0-0) - 11X11	315-1134
NON POTABLE WATER	HEALTH 1	HR24001 (1-0-0) - 24X24	315-1114	HR11011 (1-0-0) - 11X11	315-1122

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## **SECTION 33 71 14 - OVERHEAD ELECTRIC SERVICE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

**A. Section Includes:**

1. Overhead electric service.
- B. Overhead distribution systems shall be built to 15 kV requirements unless stated otherwise.
- C. Contractor shall furnish all materials for the work herein specified, and for delivery, storage, uncrating, installation, and final acceptance except where otherwise noted on the drawings or specifications.
- D. Distribution class surge arrestors are required on the overhead distribution system.
- E. Pole details shall be as indicated on UPRR Electrical Construction Manual.

#### **1.02 REFERENCED STANDARDS**

- A. American National Standards Institute (ANSI).
- B. American Wood Protection Association (AWPA).
- C. Edison Electric Institute (EEI).

#### **1.03 SUBMITTALS**

**A. Shop Drawings:**

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Product technical data.
  - a. Provide submittal data for all products specified in this Specification Section.
  - b. See Specification Section 26 05 00 for additional requirements.

### **PART 2 - PRODUCTS**

#### **2.01 POLES, CROSSARMS, AND OTHER WOOD MEMBERS**

- A. Poles shall be ASA Class 2 or 3, as indicated on the plans, douglas fir or southern yellow pine, roofed only, not gained, or drilled. Do not substitute Western Red Cedar. Set the poles at depths as indicated on ST-D3 standard "Minimum Dimensions and Setting Depths for Poles". All poles shall be treated with Copper Naphthanate, or Pentachlorophenol, per standards of the American Wood Preservers Association, and EEI Specifications.
- B. Poles supporting primary lines crossing tracks shall be 55 FT long unless otherwise indicated.

- C. All crossarms shall be 3-1/2 IN x 4-1/4 IN x 8 FT-0 IN long standard EEI distribution type, pre-drilled for steel pins and double arming bolts per standard EEI dimensions. Crossarms shall be pressure treated with Copper Naphthanate, or Pentachlorophenol, per standards of the AWP and EEI Specifications.
- D. All other wood members shall be as specified on the plans and shall be pressure treated with Copper Naphthanate, or Pentachlorophenol, per standards of the AWP and EEI Specifications unless otherwise noted.

## 2.02 HARDWARE AND GUYS

- A. All hardware installed shall be hot-dipped galvanized steel. Hardware shall include bolts, washers, nuts, and all other members required to complete the specified work.
- B. Guy wire shall be 3/8 IN diameter steel, high strength, galvanized. Guy assemblies shall be as detailed on the drawings. The down guy angle shall not be greater than 60 or less than 25 degrees from the horizontal unless detailed otherwise.
- C. Guy anchors shall be of the type required for the installation.
- D. Existing poles on which contractor works shall have steps removed below 8 FT above grade.

## 2.03 INSULATORS

- A. Suspension insulators shall be of standard ANSI classification for strength and voltage as specified on the drawings.
- B. All pin type insulators shall be as specified on the drawings and shall be suitable for use with standard 1 IN lead threaded steel support pins. Pin type insulators shall be of standard ANSI classification for voltage as specified on the plans. Ties shall be made per standard REA recommendations. Preformed tie wraps are preferred.

## 2.04 TERMINATION KITS

- A. Termination kits shall be 3M, 15kV, QT-III, 7640 series. Select proper size termination kit for the application. Cable shall be protected by non-metallic, U-shaped, cable guards.

## 2.05 POLE BANDING

- A. All new poles and existing poles which have work as part of this contract shall have a self-adhering, plastic, reflective, safety yellow band at least 2 IN wide completely around pole diameter. The band shall be mounted 3 to 4 FT from grade. The band shall be securely affixed with #6 aluminum nails or non-rusting screws for a permanent installation. Bands shall be installed between any risers or equipment and the pole. Bands shall not be installed around risers or other equipment.

## 2.06 POLE NUMBERING

- A. All new poles and existing poles which are reused as part of this project shall be numbered according to the design drawing(s). Numbers shall be metal, at least 3 IN in height, and shall be securely affixed to poles with nails. All poles designated as Primary will have the numbers attached horizontally to the pole; all Secondary poles will have the numbers attached vertically to the pole.

- B. If there is no pole numbering scheme on the design drawing(s), or the existing numbers conflict with the design drawing(s), a numbering plan (created according to the UPRR Pole Numbering Procedure) shall be submitted to the UPRR Omaha Electrical Design Project Engineer for approval prior to numbering poles.

## 2.07 AERIAL CABLE MARKERS

- A. Union Pacific Railroad requires all new and replacement aerial power cables that cross track(s) be marked to enhance the visibility of the cables.
- B. Markers shall be molded acrylic plastic or molded ABS plastic. Markers shall be Danger Orange in color with the coloring agent incorporated into the molded material. Where recommended by the manufacturer, other colors may be submitted for approval. Provide provisions for attaching to the cables. Where applicable, provide corona effect protection.
- C. Markers shall be installed on the lowest hanging conductor.
- D. Markers for cables over 50 FT above top of rails shall be 36 IN in diameter. Markers for cables below 50 FT but above 29.5 FT above top of rails shall be 20 IN in diameter. Markers for cables below 29.5 FT shall be 12 IN in diameter.

## PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

### END OF SECTION

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## **SECTION 33 71 19 - PRECAST CONCRETE MANHOLES FOR BUILDINGS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Precast electrical manholes and pullboxes.

##### **B. Scope of Work:**

1. Manhole and pullbox locations are shown in approximate locations unless dimensions are indicated. Route and locate as required to complete duct bank system.

##### **C. This section does not apply to the construction of mainline and/or yard track projects.**

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Section 01 33 00 - Submittals and Substitutions.**

##### **B. Section 01 77 10 - Project Closeout and Cleaning.**

##### **C. Section 31 23 10 - Excavation and Fill.**

#### **1.03 REFERENCED STANDARDS**

##### **A. ASTM International (ASTM):**

1. A48, Gray Iron Castings.
2. C857, Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
3. C858, Underground Precast Concrete Utility Structures.
4. C891, Installation of Underground Precast Utility Structures.
5. C1037, Inspection of Underground Precast Utility Structures.

##### **B. Code of Federal Regulations Occupational Safety and Health Administration Title 29 - Labor, Subpart D, Walking - Working Surfaces**

##### **C. American Association of State Highway and Transportation Officials (AASHTO) Roadside Design Guide, 4<sup>th</sup> Edition.**

#### **1.04 SUBMITTALS**

##### **A. See Section 01 33 00 for requirements.**

##### **B. Shop Drawings: Indicate dimensions, reinforcement, size and locations of openings, and accessory locations for precast manholes. Also indicate design load capacities and shipping weight of individual pieces.**

##### **C. Manufacturer's Installation Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.**

##### **D. Closeout Submittals:**

UP General Specifications

PRECAST CONCRETE MANHOLES FOR BUILDINGS

Issued: 03-26-2019

33 71 19-1

1. Section 01 77 10 - Project Closeout and Cleaning.
2. Project Record Documents: Record locations and sizes of manholes and pullboxes.

#### 1.05 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 5 years documented experience.

#### 1.06 COORDINATION

- A. Coordinate the work with existing underground utilities, sitework, and structures.

### PART 2 - PRODUCTS

#### 2.01 PRECAST CONCRETE MANHOLES

- A. Product Description: Precast manhole designed in accordance with ASTM C858 comprising modular, interlocking sections, complete with accessories. Use concrete with a minimum 28-day compressive strength of 5,000 LBS/SQ IN minimum for manhole sections.
- B. Manufacturer is responsible for providing lifting devices for manhole sections under the provisions of ASTM C857. The Manufacturer shall furnish information for proper lifting hardware and handling procedures.
  1. Loading: ASTM C857, Class A-16; include impact factor, and AASHTO HS20.
  2. Shape and size: As indicated by design drawings.
  3. Frames and Covers: ASTM A48; Class 30B gray cast iron, 36 IN size, machine finished with flat bearing surfaces. Provide marked covers indicating type of utility enclosed (e.g. HIGH VOLTAGE, SIGNAL, ELECTRIC, etc). Also provide "UPRR" on label. Permanently secure frame in top section of manhole structure.
  4. Duct Entry Provisions: Window areas shall be provided only as shown on design drawings other openings shall be core drilled in place. See design drawings for manhole window details.
- C. Manufacturer is to locate pulling eyes, rack inserts, embedded strut, ladders and other inserts as detailed on drawings. Inserts will not be aluminum.
  1. Cable Pulling Irons: Use galvanized rod and hardware.
  2. Cable Rack Inserts: Minimum load rating of 2,000 LBS.
  3. Cable Tray/Support Rack Concrete Inserts: 1-5/8 IN x 1-5/8 IN Hot-dip galvanized steel strut channel with tieback anchors. Cut channels to length as required.
  4. Cable Tray Support Racks: 1-5/8 IN x 1-5/8 IN Hot-dip galvanized steel strut channel, with fittings to match as recommended by manufacturer.
  5. Cable Supports: Cable tray in accordance with Section 26 05 36, Engineer approved fiberglass grating or Engineer approved equal. Fiberglass grating shall be manufactured without grit for a smooth surface for cables.

6. Source Quality Control: Inspect manholes in accordance with ASTM C1037.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Section 01 31 10- Project Coordination and Scheduling: Coordination and Critical Path Progress Schedule
- B. Verify locations of manholes prior to excavating for installation.

#### **3.02 EXISTING WORK**

- A. Insure access to existing duct bank and other installations which remain active and require access. Modify installation, or provide access panel, as appropriate.

#### **3.03 INSTALLATION**

- A. Excavate for manhole installation under the provisions of Section 31 23 10.
- B. Install and seal precast sections in accordance with ASTM C891.
- C. Install manholes plumb.
- D. Use precast neck and shaft sections to bring manhole cover to finished elevation.
- E. Clean and line entire inside of manhole, including the inside portion of frame and cover, with pvc, "Sauereisen No. 210" or approved equal.
- F. Manufacturer shall apply waterproofing compound on all exterior surfaces of manholes.
- G. Backfill manhole excavation under the provisions of Section 31 23 10 and the drawings.

**END OF SECTION**

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## **SECTION 34 11 10 - RAILROAD TRACK CONSTRUCTION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Unloading, stockpiling, transporting and inventory of material, distributing and placing of ties, tie plates, all other track material (OTM), fittings and fastenings. Track Construction shall also include the laying, bolting, gauging and spiking of rail and all thermal corrections, welding and adjustments of rail, the installing of bumping posts, derails, frogs, switches, guardrails, switch stands, road crossings, the placing of ballast, lining, surfacing and finishing of tracks, on previously prepared sub-grade or sub-ballast.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- ##### **A. Documents affecting work of this section include, but are not limited to, the General Requirements, Section 00 07 00 –General Conditions, and any Special Conditions required for this work.**

#### **1.03 REFERENCED STANDARDS**

- ##### **A. Current versions of the following rules, standards, specifications, and references shall apply to all track work:**
1. Union Pacific Railroad Safety Rules.
  2. Union Pacific Railroad Maintenance of Way Rules.
  3. Union Pacific Railroad Engineering Standards.
  4. Union Pacific Railroad Chief Engineer's Bulletins.
  5. Union Pacific Railroad Engineering Track Maintenance Field Manual.
  6. Union Pacific Railroad Track Welding Rules and Prodedures
  7. American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering.
  8. Track Safety Standards of the Federal Railroad Administration.

#### **1.04 QUALITY ASSURANCE**

- ##### **A. Construction Supervision - The track construction shall be progressed with skilled supervision and labor and the Contractor shall assemble the track material in such a manner as may be required by the Engineer. Any supervisor or laborer not satisfactory to the Company shall be removed from the project on request of the Engineer.**
- ##### **B. Inspection Of Subgrade - Shall be made just prior to track laying. Track construction shall not commence until the subgrade and subballast has been approved by the Engineer.**

- C. Damage And Restoration - The Contractor shall perform hauling, loading and unloading operations as well as track construction in such a manner as to cause no damage to the roadbed, ditches, shoulders, slopes, drainage pipes, risers, drop inlets, roads and any other facilities. Any damage to the foregoing shall be repaired or replaced, where necessary, in a manner satisfactory to the Engineer and at the expense of the Contractor. In making repairs and replacements, equivalent materials shall be used and the method of placement shall be as directed by the Engineer.

## PART 2 - PRODUCTS

### 2.01 TRACK MATERIAL

#### A. Summary:

1. Track material for the project, if provided by the Railroad, will be delivered to the closest available siding or nearest available location at no cost to the Contractor. All material furnished by the Railroad, including that which will be installed by the Railroad, shall be unloaded by the Contractor and carefully handled to avoid damage when unloading, hauling, stockpiling, and installing. The Contractor shall also be responsible for unloading rail from the rail train. All track material shall be provided loose and transported in railroad cars or other means of transportation. The Contractor shall supply a waterproof container or trailer for storage of weld kits, supplies, and any other material that requires protection from the weather. Storage and security of all track material shall be at the expense of the Contractor and will be incidental to the appropriate pay item.
  2. When handling track material, the Contractor must abide by Union Pacific Railroad Engineering Track Maintenance Field Manual and Maintenance of Way Rules.
- B. CWR, continuous welded strings of rail, and stick rail shall be handled in accordance with Engineering Track Maintenance Field Manual, using special equipment provided for that purpose. With the exception of bonded joint plugs, rail less than 15 FT shall not be installed in the track without the engineer's approval. Bonded joint plugs shall be paid for as part of track construction and welds shall be paid for per each successfully installed weld. The temporary joint bars and bolts will be the responsibility of the contractor and incidental to the track construction.
- C. Ballast, if provided by the Railroad, will be delivered to the job site in ballast cars, unless otherwise stated. The contractor shall unload and place or stockpile the ballast; clean, close and lock the doors and release the cars to the engineer within 2 working days after delivery to the job site. The Contractor shall be required to stockpile the ballast if it cannot be dumped directly on the track. Ballast shall be uniformly distributed and the track raised, lined, surfaced and tamped, with the finished surface of the ballast dressed in accordance with the Engineering Track Maintenance Field Manual, standard drawings and plan drawings.

- D. All material delivered will be counted and recorded as it is unloaded by the Contractor and quantities checked against the waybill. Any discrepancies are to be reported immediately to the Engineer. If the quantities check, the Contractor or his Superintendent will sign for the material, and the Contractor is then responsible for the material. A copy of the inventory sheets showing the car number, date received, material inventoried from the car or truck, and storage location, if stored, shall be furnished the Engineer. Any shortage or overage of materials shall be immediately reported to the Engineer. At the end of the project, the contractor shall load all excess material in rail cars and/or stockpile at a designated location as directed by the Engineer.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. All horizontal and vertical field track survey layout required, for both Contractor and Railroad work, shall be provided by the Contractor in accordance with Section 01 71 23 and included in the unit track price. The Company will furnish horizontal and vertical control points and track layout plans or coordinate files. The final track surface, cross level and line shall not deviate from the plans more than limits defined in the Engineering Track Maintenance Field Manual for the specified class of track.
- B. All track construction will conform to the Engineering Track Maintenance Field Manual with the following modifications:
1. New treated ties shall not be adzed without authority from the Engineer. If adzing is authorized, an approved preservative shall be applied to the adzed surface.
  2. Insulated joints shall be installed as indicated on the plans. If not indicated on the plans, insulated joints may be required at locations as directed by the Engineer.
  3. Tie plugs, where required, shall fill holes from which spikes are drawn. The plugs shall conform to the current AREMA Specifications for tie plugs. All spike holes must be filled with standard wooden tie plugs or another suitable plugging material as approved by the Chief Engineer, before re-spiking.
  4. Rail anchors shall be installed after the ballast operation and the track is raised, lined and destressed. Anchors shall be installed on the same side(s) of the tie on both rails. Anchors must not be applied to one rail only, but must be applied to both rails in a uniform pattern.
  5. When using sledge to remove rail anchors, the foot must be placed on top of the rail anchor in such a manner to prevent the anchor from flying and causing injuries. Spike mauls must not be used in lieu of sledges for applying and removing rail anchors.
  6. Track panels may be utilized in track construction when approved by the Engineer. Care shall be taken in unloading or moving the panel sections so as not to skew or bend the section.
  7. Rails shall not be moved into position with a hammer, maul, or similar tool, but shall be moved with rail tongs, rail forks, or lining bars.

8. Laying of continuous welded rail in track using a track-laying machine is acceptable.
9. Where track panels have been utilized in track construction and are to be relayed with CWR, the provisions governing CWR and thermal correction shall apply. All spikes removed shall have the holes plugged with approved tie plugs. Anchors shall be applied per these specifications. All jointed rail and OTM shall be loaded in rail cars or stock piled as directed by the Engineer.
10. When rail is released from track, it shall be promptly classified by the Engineer in accordance with Chief Engineer's instructions.
11. Welding shall be performed under the direct supervision of an experienced and certified welding foreman or supervisor. All welds given fault indication by ultrasonic inspection, magnetic particle inspection, or visible inspection, shall be replaced at no expense to the Company, including the addition of the rail plug and additional welds as required. All initial testing shall be performed as directed by the Engineer. If a defective weld is found, it shall be cut out and replaced with a section of rail not less than 15 FT long. The Contractor shall inform the Engineer of the location of completed welds in order for the Engineer to arrange testing, if required. A record shall be kept by the Contractor for each completed weld. All welds shall be marked on the rail per requirements of Form 7913.
  - a. The Contractor shall perform the following incidental work to complete rail welds:
    - 1) Re-space cross ties as necessary to prevent a weld from sitting on a tie.
    - 2) Tamp and dress the track as necessary to provide firm support at the weld.
    - 3) Plug ties and re-spike as necessary.
    - 4) Reapply and adjust anchors as necessary to conform to the anchor pattern.
    - 5) Clean up all waste from the welding process and dispose of superfluous materials.
    - 6) The cost incurred by the Contractor for this work shall be included in the bid price of the weld.
  - b. Ultrasonic Testing of Rail Welds:
    - 1) All thermite and electric flash-butt rail welds installed as part of the project shall be hand tested ultrasonically for defects or inclusions before track is placed into service. Prior to ultrasonic inspection, each weld will be ground to a finish that eliminates grooves, heavy facets, or debris that could interfere with hand test operation. All test surfaces will be free of debris, scale, grease and heavy rust, which may inhibit inspection.



- 2) The operator in charge of the testing crew shall have a minimum of American Society of Nondestructive Testing (ASNT) Level II training and experience. Documentation of each qualified operator's certification and a proposed written procedure for testing will be provided to Railroad for approval. The written procedure shall be prepared and the approved testing program shall be administered by a certified ASNT Level III or comparable individual. The written procedure shall describe the program for the control and administration of the testing personnel training, examination and certification. Qualifications shall be specific to the equipment and method used. The Railroad reserves the right to disqualify an operator from testing on Railroad property because of previous experience with operator's performance or operator's ability without further explanation. Any exceptions to these rail testing qualifications shall be pre-approved in writing by the Railroad.
- 3) Functionality of the UT hand testing instrumentation shall be checked, and the equipment shall be calibrated and normalized by use of a calibration standard at the beginning and end of the daily testing operation, after inactivity or delay if practical, and any time when a malfunction is suspected. If any malfunction is discovered, all material shall be reexamined to the previous valid calibration and normalization.
- 4) Each weld will be hand tested with each of the following transducer angles: 70 degree, 37.5 or 45 degree, and 0 degree.
  - a) The 70 degree (+/-) sound envelope hand test transducer, full railhead coverage (gage, center and field) shall be capable of detecting transverse flaws, with calibration and detection minimums of a 1/32 inch flat bottom hole.
  - b) The 37.5 (+/-) degree or 45 (+/-) degree transducer will inspect fillet, web and base of rail with calibration and detection minimums of a 1/32 IN flat bottom hole.
  - c) The 0 degree transducer will inspect the head, web and base. Detection capabilities for web, head web flaw minimums 1/32 IN. In addition to detection of transverse or horizontal flaws from top of rail, the 0 degree transducer will be employed to inspect the head from side of the rail, at 90 degrees to vertical, for vertical split head separations. 0 degree detection minimums shall be 1/32 IN flat bottom hole.
- 5) All testing shall be performed by personnel qualified and certified in accord with the approved written procedure. The testing operator will locate and mark defects found according to Railroad specifications and accuracy requirements. Each defective weld shall be marked with a highly visible marking on both sides of the rail web and base. The Railroad also reserves the right to independently re-test suspect welds at the Contractor's expense.
- 6) Welds with single 1/16 IN or greater reflective surface shall be rejected. Welds with three or more 1/32 IN reflective surfaces within range of transducer scan shall be rejected also. Defective welds will be reported and subsequently repaired at Railroad's direction.

- 7) The Railroad will be provided all test records following the UT inspection. The Contractor shall certify all test records and maintain a copy of all test records for a minimum of four years following the test.
12. At the end of the project, the Contractor shall perform VERSE testing after destressing rail to ensure the rail was installed at specified neutral temperature. The Contractor shall support the VERSE tester with labor and equipment to remove and replace rail clips required to perform each test. The Contractor shall be responsible for replacing any damaged or lost clips and inserts. Locations for the VERSE tests will be chosen by the Engineer. Anticipate testing to occur every 500 to 1000 FT on both rails of main and siding tracks. Testing on yard and other subsidiary tracks is not required. The Engineer shall be present for each test unless waived by the Engineer. The approved VERSE tester is:

Keith Lane  
Pandrol - Vortok US  
3013 Notting Hill Court, SW  
Conyers, Georgia 30094  
Phone: (770)-262-4956  
E-mail: keith@vortok.com

The Railroad may elect to perform VERSE testing. In this case no service item for VERSE testing will be present on the Proposal and Bid Form, but the Contractor shall support the VERSE tester with labor and equipment to remove and replace rail clips required to perform each test.

### 3.02 TURNOUTS

#### A. Turnouts:

1. Shall be constructed in strict conformity with the Engineering Track Standard plans. The switch stands shall be fastened securely to headblocks and shall be square with the track. The targets shall be lined parallel with the rails of the major track when the switch is lined for the major track. All switch ties shall be fully tie plated. All frogs, with the exception of self-guarded frogs, shall be protected by guardrails installed in accordance with the standard plans before any train is allowed to pass over them. Turnouts shall also include switchman walkways.

#### B. Panel Turnouts:

1. Shall be constructed in strict conformity with the standard plans and these specifications. Care shall be taken in unloading or moving the panel sections so as not to skew or bend the sections or cause damage to the prepared subgrade. The Contractor shall adjust anchors, ties, spikes, switch plates, braces, etc., as necessary to conform to the standard plan.

### 3.03 DERAILS & BUMPERS

- A. Where required, derails and bumpers shall be installed in conformity with standard plans and/or instructions, and shall be inspected and approved by the Engineer before final acceptance and operation over the track.

- B. It is the Contractor's responsibility to install temporary derails as necessary to protect the main track or any track in that may be in operation.

### 3.04 BALLASTING AND SURFACING

#### A. SURFACING

1. The track shall be laid and connected before ballast is spread and track raised. Immediately prior to unloading ballast for the final raise of not more than four (4) inches, the track shall be lined as close as practical to the stakes and all ties straightened and re-spaced as necessary. Ballast shall then be spread evenly and leveled to the required section, taking care to assure that subgrade material is not intermixed with the ballast. Ballast shall be spread and the track raised in a series of lifts to the approved elevation.
  2. No single lift shall be higher than 4 IN. In raising track, the operation shall be so regulated as to avoid the bending of angle bars or straining of joints. Care shall be taken to avoid sharp breaks or bends in the rail when the track is raised. Both rails shall be raised simultaneously and to proper cross-level. Ballast shall be tamped with an approved tamping machine (Jackson 6700 or equivalent) and/or tamping tools in good condition with less than 20 percent surface area missing. The number of insertions by the tamper on each lift should be monitored to ensure adequate and even ballast compaction, yet prevention of center bound track must also be considered.
  3. The Contractor shall coordinate work to avoid unnecessary stockpiling of ballast material. In the event that the material is required to be stockpiled, the Contractor shall take care not to mix in fines and other foreign material. The Engineer may reject stockpiled material or require the Contractor to perform additional testing on field samples if the material does not appear to meet the UPRR standard gradation or other physical properties for ballast.
- B. If track is raised above the designed and staked grade, the cost to lower the track shall be borne by the Contractor.
  - C. Turnouts shall be tamped using a switch/production tamper designed to tamp turnouts. Tamping may also be done, in areas where a production tamper cannot be utilized, with tamping bars, "jitter bugs" or by machines approved by the Engineer in a manner that will produce uniform compaction. Locations in turnouts, which can not be mechanically tamped (example, heel blocks or frogs), shall be thoroughly hand tamped under the rail seat areas. Switchman walkways shall be constructed as required using walkway or Class 2 ballast.
  - D. Tamping must not disturb subgrade and subballast. Dressing of the ballast by placing earth higher than the toe of ballast, thus preventing proper drainage, will not be permitted.

- E. Thorough tamping under the rail seat is required, and joint ties shall be tamped especially firm. Tamping will not be permitted at the middle of a tie where ballast is to be left to settle on its own accord. Both ends of a tie, inside and outside of the rail, shall be tamped simultaneously. All ties that are pulled loose or skewed in the track raising operation shall be placed in their proper position and properly tie-plated, plugged and fully spiked before tamping, insuring all rail seat areas are clean and free of dirt and ballast. Any anchors, bolts, braces or switch material which has been damaged, loosened or does not comply with these specifications shall be adjusted accordingly. The track shall be true to line, grade and cross level as designed and staked.
- F. During each track raise, the track is to be tamped in such a manner that it will be uniform. During the raising and tamping operations, approved track level boards or other approved measuring devices shall be constantly used to ensure the correct surface and cross level in the track after tamping work is completed. After ballasting is completed and the track is in correct gauge, surfaced and lined according to the stakes, the ballast shall be neatly trimmed or regulated to the section shown on the drawings, and any surplus material shall be spread evenly along the slopes of the ballast section.
- G. Unless specified otherwise, construct yard tracks with 8 IN ballast under the ties, and main tracks and siding tracks with 12 IN of ballast under the ties. Some areas may vary slightly. In all cases it is necessary that the top of rail elevations be followed as indicated.

## PART 4 - PAYMENT AND MEASUREMENT

### 4.01 MEASUREMENT

- A. Track construction shall be measured by the track foot as measured in feet along the centerline of track, excluding turnouts and switch point derails. The unit price for track construction shall include surfacing and lining as required to achieve proposed top of rail elevation. For the purpose of determining the proportionate value of completed track each month, the following criterion shall be used:

- |  |      |
|--|------|
| 1. All track material unloaded   | 10%  |
| 2. All ties placed, OTM distributed and ready for rail placement                     | 30%  |
| 3. Track structure completely built and ready for ballast placement                  | 60%  |
| 4. Ballast unloaded and first raise is complete                                      | 80%  |
| 5. Track structure completed<br>(as per these specifications and contract documents) | 100% |
| 6. Testing support will be incidental to track construction.                         |      |

- B. Turnouts:

- 1. Shall be measured per each completed. A turnout is considered both the straight side and diverging side. Turnout lengths will be based on the following chart:

<u>TURNOUT SIZE</u>	<u>WOOD LENGTH</u>	<u>CONCRETE LENGTH</u>
No.9	107	107

No.11	125	125
No.15	180	169
No.20	249	235
No.24	281	267

C. Switchman Walkways:

1. Shall be included in the unit price of the turnout and/or track, unless otherwise specified.

D. Prefabricated Road Crossings:

1. Shall be measured in track feet along the centerline of track.

E. Relay Track:

1. Shall include surface and line track and relay jointed rail with CWR and shall be measured by the track foot as measured in feet along the center line of track. This shall include bringing the track to surface, line and grade, dumping ballast as needed, adjusting tie spacing, relaying the jointed rail with CWR and all other items to bring the track to completion per these specifications. It shall also include the stockpiling or loading of rail and OTM as directed by the Engineer.

F. Thermite Welds:

1. Welds in track and turnouts shall be measured per each weld successfully completed. The number of welds required for each turnout are provided on the following chart:

<u>TURNOUT SIZE</u>	<u>Number of Welds</u>
No.9	18
No.11	18
No.15	18
No.20	22
No.24	26

G. Insulated Joints:

1. Shall be measured per each joint installed. Insulated joints shall be installed per the manufacturer's recommendations. Insulated joints installed at existing joint locations shall be incidental to track or turnout construction. Insulated joints installed at other locations requiring rail cuts and drilling shall be paid for at the contract unit price. "I" bonds or prefabricated insulated joints, which are welded into the track, shall be paid for under the track construction and thermite welds sections.

H. Ultrasonic Testing of Rail Welds:

1. Ultrasonic Testing of rail welds shall be incidental to track or turnout construction.

I. VERSE tests:

1. VERSE test shall be measured per each passing test completed by the approved tester. A single test for payment shall comprise of two tests, a test on each rail at a single location. Labor and equipment necessary to support the VERSE tester, i.e. clip removal and replacement, shall be incidental to track construction.

J. Other Items:

1. Shall be measured at the contract unit of measure shown on the Proposal and Bid Form for that item.

4.02 PAYMENT:

- A. Payment shall be made at the contract unit price per unit acceptably completed. This price shall be full compensation for all labor, equipment, tools, and incidentals necessary to unload, handle, stockpile, transport, prepare and install materials as per Contract and these specifications.
- B. Contractor's support of the VERSE tester with labor and equipment to remove and replace rail clips to perform each test shall be incidental to track construction.
- C. If any of the VERSE or ultrasonic tests fail, the Contractor shall be responsible for any remediation necessary to pass the subsequent test.

**END OF SECTION**

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## SECTION 34 11 27 - SUBBALLAST

### PART 1 - GENERAL

#### 1.01 SUMMARY

##### A. Section Includes:

1. Foundation course for asphalt surface course or railroad ballast shall be composed of crushed stone from an approved source and shall be constructed as herein specified in one or more courses in conformity with the typical sections shown on plans and to the lines provided by the Engineer.

#### 1.02 RELATED REQUIREMENTS (SECTIONS)

##### A. 01 43 26 Laboratory and Field Testing Services

#### 1.03 DEFINITIONS AND TERMS:

- A. Compaction - The process of mechanically stabilizing a material by increasing its density within a range of acceptable moisture contents. "Degree of Compaction" is expressed as a percent of maximum density obtained by the test procedure described in ASTM D1557, Test Method for Determining Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 FT-LBF/FT<sup>3</sup> (2,700 Kn-m/m<sup>3</sup>)).
- B. Density in place – Field testing to determine the density and degree of compaction of fill in place shall be determined in accordance with ASTM D2922, Density of Soils and Soil-Aggregate in Place by Nuclear Methods; or other methods approved by the Engineer and/or Soils Engineer.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

##### A. Requirements:

1. Materials shall be 100 percent crushed stone produced from oversize quarried aggregate, sized by crushing and produced from a naturally occurring single source. Aggregate shall have:
  - a. no more than 10% freeze-thaw loss when tested in accordance with ASTM C88, Standard Test Method for Soundness of Aggregate by Use of Sodium Sulfate (under 5 cycles of freeze-thaw with sodium sulfate solution)
  - b. no more than 50% loss when tested in accordance with ASTM C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
  - c. A higher or lower percentage of wear may be specified by the Engineer, depending on the material available.

##### B. Gradations:

1. It is the intent of this specification, that unless otherwise indicated on the plans, the subballast shall consist of gradations as set forth in the following table:

SIEVE SIZE	2"	1"	3/8"	No. 10	N0. 40	No. 200
% passing (opt.)	100	95	67	38	21	3
% passing (perm.)	100	90-100	50-84	26-50	12-30	0-5

2. The No. 200 sieve shall be reported in accordance with the most recent version of AASHTO T 11.

## 2.02 DESIGN REQUIREMENTS

- A. Subballast will be used as indicated by the following charts or as directed by the Engineer:

1. 6 IN of subballast shall be required when sub-grade material sizes are smaller than listed above, but not finer than the gradations listed below:

PERCENT PASSING	SIEVE SIZE	GRAIN SIZE
By Weight	N0. Mesh per in.	In mm.
19	200	.08
74	100	.16
92	60	.26
100	40	.42

2. 12 IN of subballast shall be required when sub-grade materials have gradation smaller than listed above.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Preparation of Subgrade:

1. The road bed shall be shaped in conformity with the typical sections shown on plans and to the line and grades provided by the Engineer. All unstable or otherwise objectionable material shall be removed from the subgrade and replaced with approved material. All holes, ruts and depressions shall be filled with approved material and if required, the subgrade shall be properly wetted with water and reshaped and rolled to the extent directed in order to place the subgrade in an acceptable condition to receive the subballast material. Sufficient subgrade shall be prepared in advance to insure satisfactory progression of the work.

### 3.02 CONSTRUCTION

- A. If the required compacted depth of the subballast exceeds 6 IN, the subballast shall be constructed in two or more layers of approximate equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 IN and shall be compacted to a minimum of 95 percent modified Proctor density (ASTM D1557).

- B. If the material is laid and compacted in more than one layer, the Contractor shall plan and coordinate this work in such a manner that the previously placed and compacted layers be allowed ample time for curing and development of sufficient stability before vehicles hauling materials for the succeeding layers, or other heavy equipment are permitted on the subballast. Prior to placing the succeeding layers of material, the top of the under layer shall be sufficiently moist to insure a strong bond between the layers. The edges and/or edge slopes of the subballast shall be bladed or otherwise dressed to conform to the lines and dimensions shown on the plans and present straight, neat, and workmanlike lines and/or slopes as free of loose material as practicable.
- C. The Contractor shall coordinate work to avoid unnecessary stockpiling of subballast material. In the event that the material is required to be stockpiled, the Contractor shall take care not to mix in fines and other foreign material. The Engineer may reject stockpiled material or require the Contractor to perform additional testing on field samples if the material does not appear to meet specifications for gradation or other physical properties in Part 2 of this Section.

### 3.03 MOISTURE AND DENSITY CONTROL

- A. Unless otherwise shown on the Drawings, or designated by the Engineer, subballast shall be constructed with moisture and density control. Unless otherwise directed by the Engineer, the moisture content of the subballast at the time of compaction shall be near the optimum moisture content as determined by ASTM D1557 content to facilitate compaction of cohesionless material.
- B. The application of water to subballast shall be done with sprinkling equipment consisting of tank trucks, pressure distributors, or other equipment designed to apply water uniformly and in controlled quantities and at variable widths. Mobile sprinkling equipment shall have adequate tractive power and shall be equipped with controls operated from the driver's seat to control the rate of water flow. The Contractor shall be required to furnish sufficient water equipment to ensure proper and uniform moisture content required for the material.

### 3.04 FIELD QUALITY CONTROL

- A. Frequency of moisture and density tests (ASTM D2922) shall be 1 test per 1000 SY on each lift but no greater than 500' spacing on each lift for narrow grading operations.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 MEASUREMENT

- A. Placement of subballast shall be measured in cubic yards within the neat lines of the typical sections, line, grades and slopes established.

### 4.02 PAYMENT

- A. Subballast shall be paid for at the contract unit price as placed according to the specifications including furnishing, unloading, hauling, compacting, dressing, testing and incidental work or equipment required.

**END OF SECTION**

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## **SECTION 34 76 10 - LOCOMOTIVE TRACTION MOTOR DROP TABLE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. The requirements for purchase of one (1) new 50 ton capacity traction motor drop table for placement into a new Union Pacific Railroad Locomotive Repair Facility.

#### **1.02 SAFETY REQUIREMENTS**

- A. The equipment and all its related components must meet all applicable requirements for Federal, State, County and OSHA safety codes and regulations in effect at the date of purchase. In the case of discrepancies between the requirements of this specification and applicable safety codes and regulations, the most stringent code, regulation, or standard shall govern. Operator safety must be the utmost consideration in the design and construction of this machine.

#### **1.03 NOISE ABATEMENT REQUIREMENTS**

- A. This equipment must comply with OSHA Occupational Noise Exposure Standard 29 CFR, Part 1910.95 (b.1) table G-16 at the operator's location as indicated in 29 CFR, Part 1910.95 (a) for duty cycle or machine speed. Any failure of this equipment to meet noise exposure standards must be stipulated on your quotations. The reason noise exposures cannot be met must be outlined along with alternatives and costs to meet these requirements.

#### **1.04 WARRANTY REQUIREMENTS**

- A. The manufacturer shall warrant the materials and workmanship applied to the equipment and all components for a period of not less than one (1) year from the date of first operation at the receiving location. **REPLACEMENT AND INSTALLATION OF DEFECTIVE PARTS, COMPONENTS, OR WORKMANSHIP WILL BE AT NO COST OF THE UNION PACIFIC RAILROAD DURING THE WARRANTY PERIOD INCLUDING ANY ASSOCIATED TRANSPORTATION COSTS FOR EITHER THE EQUIPMENT ITSELF OR ANY OF ITS PARTS.** Warranty is to include both parts and labor for the covered period. The manufacturer will be expected to rectify major warranty concern by making site visit. Minor warranty problems will be corrected by Union Pacific with the guidance and assistance of the manufacturer. The manufacturer will pay for all parts deemed to be defective and reimburse Union Pacific for labor a rate of \$50.00 per hour. The manufacturer may also assign a local, reputable contractor to perform the warranty work on the machine in lieu of Union Pacific. The placement of a contract representative to perform warranty work as well as other maintenance is preferred.
- B. The quotation must include all warranty information and specify any variances from our indicated warranty policy. Bidders must indicate the nearest source of parts and service to the specified delivery point of the drop table in the space provided below:

UP General Specifications

LOCOMOTIVE TRACTION MOTOR DROP TABLE

Issued: 03-26-2019

34 76 10-1

Dealer Name: \_\_\_\_\_

Dealer Address: \_\_\_\_\_

Dealer City and State: \_\_\_\_\_

Dealer Phone Number (including Area Code): \_\_\_\_\_

#### 1.05 VARIANCES

- A. Any and all variances from these specifications must be listed and outlined, including the reason the specification cannot be met, cost changes and alternatives.

#### 1.06 EXCLUSIONS

- A. The equipment shall not be excluded from consideration on the basis of minor variations from specifications, provided that all essential requirements are met relative to safety, operation, materials, and performance.

#### 1.07 DELIVERABLES

- A. The successful bidder shall furnish Union Pacific Railroad with the following upon receipt of purchase order:
  - 1. Three (3) each copies of drawings that thoroughly depict all foundation, electrical and other installation requirements for the drop table.
  - 2. Three (3) each copies of schedule of delivery of drop table to Union Pacific's facility.
  - 3. Three (3) each copies of general arrangement and construction drawings for approval by authorized representative of Union Pacific prior to commencement of construction.
- B. The successful bidder shall furnish the Union Pacific Railroad with the following upon delivery of the equipment:
  - 1. Three (3) each copies of operator's manuals.
  - 2. Three (3) each copies of maintenance and parts manuals.
  - 3. Three (3) each copies of electrical, mechanical, and hydraulic schematic drawings.
  - 4. Three (3) each copies of recommended spare parts lists.

#### 1.08 SHOP TESTING

- A. Prior to shipment, the machine is to be fully erected, and tested at the successful bidder's plant. The drop table must meet the requirements described in this specification. Successful completion of the test will constitute the necessary authority to ship the machine as authorized by a representative of Union Pacific. Any failure to meet our specification criteria must be corrected at no additional costs to Union Pacific. Changes must be made to meet this specification will be the responsibility of the successful bidder. Changes requested by Union Pacific above and beyond the scope of these specifications will be the responsibility of Union Pacific. All changes made to the specifications for this table must be agreed upon by a representative of Union Pacific and placed in writing.



#### 1.09 VENDOR INFORMATION

- A. Please indicate in the space provided below the person that should be contacted to answer any questions or receive further information regarding the quotation.

Name: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

City, State: \_\_\_\_\_

Phone Number (including Area Code): \_\_\_\_

#### 1.10 SCOPE OF WORK

- A. The successful bidder will be responsible for designing and construction of the drop table in accordance with these specifications. The table will be installed at a new Locomotive Repair Facility. It will be used to remove and replace locomotive traction motors assemblies on shop track(s). A separate traction motor release area will be provided. Locomotive traffic will not traverse over the release area. The table will be expected to efficiently accomplish all functions of traction motor replacement across both tracks and the motor release area. The manufacturer must supply all necessary components and equipment to effectively achieve a “turn-key” operation of the table.
- B. Foundations, pit rails, anchor bolts, grouting, curb angles, and pit lighting will be provided by Union Pacific.
- C. The tables will be operating at an indoor environment with temperatures typically ranging from 45 to 110 DegF. The pit environment of the table is dirty, oily and greasy. Water may enter the pit from high rain levels, or washing of locomotives. All components, including controllers, electrical equipment and hydraulic systems, if used, will be expected to operate effectively within this climate. All components must be sealed and protected against damage from water, oil, diesel fuel and soap.
- D. Safety of operation will be the utmost consideration for the drop table system and will supersede all other design considerations. Open pits must be kept at a minimum. Operator protection must be provided for any open pit.
- E. Vendors must submit complete and descriptive product literature with their quotations. This literature must accurately describe actual machine weight, make, model, capacities and other information to verify compliance with bid specifications. Vendors must also submit a requested payment schedule.

#### 1.11 ON-SITE INSPECTION

- A. Since the equipment will be installed within a new building, an on-site inspection will not be necessary. Drawings of the new building with drop table locations and details will be provided to the successful bidder.

#### 1.12 MAINTENANCE CONTRACT

- A. Bidders must submit a proposal to provide a maintenance contract for the drop table. The contract must include both preventative and reactive maintenance. The proposal should include a schedule, work description, and related cost for preventative maintenance and servicing, and a cost to work on unscheduled machine break-downs. Prices should be broken down into preventative and reactive categories. The name of the dealer or servicing shop that will be established to perform the work must be indicated. The dealer should be located within 60 miles radius of the city of installation. The reactive maintenance contract will not commence until the specified machine warranty period has terminated. This proposal must be listed as a separate, optional consideration.

1. Servicing Dealer Information:

Dealer Name: \_\_\_\_\_

Address: \_\_\_\_\_

City, State: \_\_\_\_\_

Phone Number (including Area Code): \_\_\_\_

#### 1.13 “AC” TRACTION MOTOR CONSIDERATIONS

- A. Union Pacific Railroad has acquired a number of new locomotives that are equipped with “AC” as opposed to “DC” traction motors. Additionally, newer UPRR locomotives are equipped for simplistic replacement of AC traction motors. It must also take the new style radial truck into consideration.
- B. Bidders should contact employees working at North Platte, Nebraska in respect to the replacement of AC motors. Several AC motors and radial trucks have been replaced at this location. Any concerns that arise involving AC motor replacement or radial trucks that directly involve the drop table and its operation must be addressed prior to construction of the table.
- C. The pits and tables on both the working tracks must be designed in a manner to allow drop table operators sufficient room to access and remove the traction motor connection rod on the new style traction motors. The connection rod is mounted on the rear of the motor assembly.

#### 1.14 SPECIFICATIONS

A. General:

1. Minimum rated capacity of drop table to be 50 tons.
2. Table may be of either screw, ball screw, or hydraulic construction.
  - a. Screw and ball screws must be completely enclosed to prevent damage from contaminates.
  - b. Screw and ball screws must have a locking mechanism to support columns in the event of ball screw failure.
  - c. Controls must have been incorporated to stop the table and set the locking mechanism in the event any of the ball screws lose their synchronization.

- d. Screw and ball screw drive must complete with all necessary drives, motors, and controls.
  - e. Hydraulic tables must be equipped with the same fail safe locking.
  - f. Hydraulic table must be equipped with all necessary pump, motors, fittings, piping, filtration system, and hydraulic fluid tank.
3. Hoisting and traverse must have two (2) speeds:
- a. Low speed at top and bottom portions of hoisting travel is to be approximately 2 FT per minute.
  - b. All other portion of hoisting travel is to be not less than 6 FT per minute.
  - c. Low table traverse speed for positioning at the release tracks and shop tracks must be 5 FT per minute.
  - d. All other portions of table traverse speed must be not less than 30 FT per minute.
  - e. Table must be equipped with a protective mechanism to prevent damage in the event of over-travel in either the hoisting up or down stroke or the table traverse movements.
  - f. The drop table must be capable of completely automatic operation from a point 36 IN below the service track level. Controls to manually override the automatic operation must be included.
  - g. The drives for mechanical table should be variable speed.
4. Vendor is to furnish drop table complete with all necessary motors, drives, controls, piping, wiring, work tables, traction motor support systems, hydraulics and other equipment as necessary to provide a turn-key operation.
5. Machine must be equipped with automatically actuated continuous lubrication. Systems on all components requiring periodic lubrication.
6. Machine must include one (1) traction motor work table.
- a. The table must have capacity of less than 50 tons.
  - b. The table must be equipped with:
    - 1) All support and locking mechanisms. Locking mechanism may be mechanically or hydraulically actuated.
    - 2) A complete 2-speed hydraulic tilting system capable of raising and lowering the rear of the traction motor for removal and replacement.
    - 3) All necessary interfaces and connections with the traction motor transport system.
    - 4) All working surfaces of the worktable must be equipped with anti-skid steel plates.
7. All machine components must be cleaned, primer coated, and painted in accordance with current OSHA colors for shop machinery.
8. Upon completion of installation at NAME OF YARD HERE, the manufacturer must demonstrate successful operation of the drop table.

B. Electrical:

1. The primary voltage of this machine is to be 440 Volt, Triple Phase.
2. All control voltages are to be no greater than 110 Volt, Single Phase.
3. In pit electrical components to be NEMA 4. Motor to be TEFC.
4. All electrical control panels and cabinets are to be located above the drop table pit.
5. An operator control panel must be included.
  - a. Panel must include all necessary switches or buttons to achieve all aspects of automatic or manual table operation.
  - b. An emergency stop function must be included.
  - c. Lights or indicators must be included to indicate table operational status.
6. All electrical equipment must comply with all existing state, county, and city wiring codes in effect at the time of construction.
7. All necessary take-up reels to provide power to the table must be included. Reels must be spring type automatic extend and retract.
8. The table and all its operational functions are to be Programmable Logic Controlled (PLC).
  - a. The controller and all related components for machine operation must be included.
  - b. The controller must be equipped with a phone modem for on-line troubleshooting and re-programming support.
  - c. The controller must be programmed to prevent operation of the drop table if any unsafe operation of the drop table if any unsafe mechanical conditions exist.
  - d. All programming for complete machine operation must be installed.
  - e. PLC must be capable of simplistic re-programming in case of memory failure.
9. All electrical enclosures must be waterproof rated.
10. All electrical components necessary for turn-key operation must be included.

C. Release Track Bascule Top:

1. A bascule style top must be provided for the release track.
2. Release track bascule top bascule top must be capable of supporting the cross-over load of a forklift carrying a traction motor set. It will not be required to support the load of a locomotive.
3. Top may be mechanically or hydraulically raised and lowered.
4. All walking surfaces on table top must be constructed of a non-slip steel plate.
5. All components of the top must be included as required for installation upon receipt.

6. Guard rail must be provided for operator protection when the release track top is in the open position.
  7. Top must automatically open during the traction motor hoisting operation.
- D. Drop Table Installation and Start-Up Supervision:
1. Vendor must provide a quote for installation supervision only.
  2. Quote should list all costs of labor, transportation, lodging and other expenses.
  3. Installation and start-up supervision must be listed as a separate, optional item.
- E. Traction Motor Shimming Operations:
1. Provisions must be made for the shimming of traction motor spring packs.
  2. The shimming operation may be performed by the drop table or separate equipment.
  3. The shimming equipment should be hydraulically powered.
  4. The minimum capacity of the shimming table should be 50 tons.
  5. All operator controls for the shimming operations must be included.
  6. If separate shimming equipment is used, detailed foundation and installation instructions must be included.

#### 1.15 TRAINING REQUIREMENTS

- A. Successful bidder must provide on-site training on Union Pacific employees for safe operation of this table. Training must include but not limited to all aspects of machine motion and control; alignment with service and release tracks; table involvement with actual removal and replacement of motors, and emergency situations. Safety will be the utmost concern in all aspects of operator training. Upon completion of training, all operators must demonstrate their ability to safely and competently control all aspects of the operation of this equipment.
- B. Training must also be provided for maintenance personnel. Training in this area must include, but not limited to:
1. All operational aspects of the table.
  2. Adjustments and lubrication.
  3. Preventative maintenance scheduling and procedures.
  4. General repairs to the equipment.
- C. Safety will be the utmost concern in all aspects of maintenance training. Upon completion of training, all maintenance personnel must demonstrate a general knowledge of the operation of the machine, and competence in its proper care and maintenance.

#### 1.16 DELIVERY POINT

Name: \_\_\_\_\_

Title: \_\_\_\_\_

Address: \_\_\_\_\_

UP General Specifications

LOCOMOTIVE TRACTION MOTOR DROP TABLE

Issued: 03-26-2019

34 76 10-7

City: \_\_\_\_\_

State: \_\_\_\_\_

Zip Code: \_\_\_\_\_

Phone Number (including Area Code): \_\_\_\_ \_\_\_\_\_

#### 1.17 PROJECT CONTACTS

A. The Project Drawings shall include a table that specifies Project Contacts as follows:

1. A contact in Omaha at the Union Pacific Headquarters for questions regarding technical aspects of the quotation
2. A contact for the Local Manager of Locomotive Maintenance at the installation location, for questions regarding on-site application of the drop table
3. A contact in UPRR Supply in Omaha at the Union Pacific Headquarters, for questions regarding submissions of quotation or pricing
4. A contact for Manager of Mechanical Systems Design in Omaha at the Union Pacific Headquarters, for questions regarding application with the new locomotive facility

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**

## **SECTION 40 05 03 - PIPING MATERIALS AND METHODS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

**A. Section Includes:**

1. Piping system materials, installation and testing.
- B. All work covered by this Specification shall be in strict compliance with any and all applicable codes, regulations and ordinances. The Contractor shall obtain and pay all fees, required for permits and inspection that may be required locally.

#### **1.02 REFERENCED STANDARDS**

**A. American Petroleum Institute (API):**

1. 5L, Specification for Line Piping.

**B. American National Standards Institute (ANSI):**

1. B1.20.1, Pipe Threads, General Purpose (Inch).
2. B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
3. B16.9, Factory-Made Wrought Steel Buttwelding Fittings.
4. B16.11, Forged Fittings, Socket-Welding and Threaded.
5. B16.20, Metallic Gaskets for Pipe Flanges – Ring-Joint, Spiral Wound and Jacketed.
6. B16.25, Buttwelding Ends.

**C. American Society of Mechanical Engineers (ASME):**

1. Boiler and Pressure Vessel Code – Section I and IX.
2. B31.3, Process Piping.

**D. ASTM International (ASTM):**

1. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
2. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
3. A105, Standard Specification for Carbon Steel Forgings, for Piping Applications.
4. A181, Standard Specification for Carbon Steel Forgings, for General Purpose Piping.
5. A193, Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications.
6. A194, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.
7. A234, Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

8. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
  9. A563, Standard Specification for Carbons and Alloy Steel Nuts.
  10. A888, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
  11. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
  12. C1277, Standard Specification for Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings.
  13. D1784, Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
  14. D1785, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe. Schedules 40, 80 and 120.
  15. D2241, Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).
  16. D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
  17. D2466, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
  18. D2467, Standard Specification for Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80.
  19. D2657, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
  20. D2665, Standard Specification for Polyvinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings.
  21. D2672, Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement.
  22. D3034, Standard Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.
  23. D3261, Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.
  24. F1417, Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
- E. American Water Works Association (AWWA):
1. C900, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. Through 12 in., for Water Transmission and Distribution.
  2. C905, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 in. Through 36 in., for Water Transmission and Distribution.
- F. American Welding Society (AWS):
1. AWS D1.1, Structural Welding Code.



G. Cast Iron Soil Pipe Institute (CISPI):

1. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.
2. 310, Specification for Couplings for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.

H. National Fire Protection Association (NFPA).

1.03 RELATED REQUIREMENTS (SECTIONS)

- A. Section 01 33 00 – Submittal Procedures
- B. Section 09 90 01 – Painting and Coatings
- C. Section 09 97 50 – Tank and Piping Coatings for Fuel and Oil Systems
- D. Section 33 05 26 – Mechanical Identification
- E. Section 40 46 50 – Cathodic Protection, Impressed Current
- F. Section 40 46 50 – Cathodic Protection, Galvanic

1.04 SUBMITTALS

- A. Submit as specified in Division 01 specification.
- B. Shop drawings required by this Section include, but are not limited by, the following:
  1. Piping and accessories.
  2. Pipe testing procedures and results.
  3. Welder qualifications.
  4. Welding test results.
- C. As-built drawings that include an accurate record of the exact location and elevation of aboveground and belowground piping installed.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Cathodic Protection:
  1. Install cathodic protection to below grade, single and double wall steel piping per drawings or as otherwise indicated.
- B. Painting and Coatings:
  1. Steel pipe:
    - a. Above grade (exposed):
      - 1) All piping shall be painted per Section 09 90 01 or 09 97 50, as applicable.

- 2) In Secondary Containment systems all carrier pipe within containment pipe shall be epoxy coated. All joints of the carrier pipe shall be tested per these specifications before the epoxy coating is applied.
- b. Below grade:
  - 1) All piping (carrier and containment pipe) shall be epoxy coated. All joints of the carrier pipe shall be tested per these specifications before the epoxy coating is applied.
- C. Pipe Marking:
  - 1. Label above grade piping as per Section 33 05 26.
- D. Pipe Identification:
  - 1. Label above grade piping, valves, equipment, and other accessories per Section 33 05 26.
- E. Tracing:
  - 1. Tracer wire is to be taped to any below grade piping with marker tape above the pipe per drawings or as otherwise stated.

## 2.02 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  - 1. Dielectric-Flange Insulating Kits:
    - a. Calpico, Inc.
    - b. Central Plastics Co.
    - c. PSI, Inc.
  - 2. Mechanical Sleeve Seals
    - a. Advance Products & Systems

## 2.03 STEEL PIPING

- A. General:
  - 1. Pipe shall be ASTM A53 Grade A or B or APL 5L Grade B, seamless or electric resistance welded. All pipe two and one half inches (2-1/2") or larger shall be Schedule 40 or Standard Thickness whichever is less, butt welded, unless otherwise indicated on the Drawings. Piping two inches (2") or smaller shall be Schedule 80, socket welded, unless otherwise required at process and instrument connections.
  - 2. Fittings for Welded Pipe:
    - a. Pipe 2 1/2 IN or larger:
      - 1) Fittings shall be butt welding type carbon steel, ASTM A234 Grade B, ANSI B16.9. Wall thickness shall match pipe.
    - b. Pipe 2 IN or smaller:

- 1) 3000 LB forged steel conforming to ANSI B16.11. Threads shall be full, clean, sharp and true. Screwed pipe joint compound shall be resistant to the effects of diesel fuel.
  - 2) For petroleum and industrial wastewater, fuel/oil /sludge service, fittings two inches (2") or smaller shall be socket welded, class 3000, conforming to ASTM A105 and ASME B16.11. Threaded connections are only acceptable as required at process and instrument connections.
  - c. Elbows shall be long radius unless otherwise indicated.
  - d. Tee connections 2 IN or larger shall be butt welded. Fabricated tees may be used in lieu of butt welding provided they are accomplished using weldolets or elbolets.
3. Flanges:
- a. Standard weld neck type flanges shall be ASTM A181 forged steel and conform to ANSI B16.5. Rating shall be 150 LB forged steel, except where 300 LB flanges are required to match the equipment to which the piping is jointed.
  - b. Flange facings shall be standard 1/16 IN raised face, unless otherwise required to match equipment flanges.
  - c. Gaskets shall be full faced type for flat faced flanges, and ring type for raised face flanges conforming to ANSI B16.5 "Group I Gaskets".
    - 1) Gaskets utilized outside tank containment areas shall be 1/16 IN thick compressed asbestos-free with Nitrile binder resistant to the effects of diesel fuel. Spiral wound metallic gaskets as outlined below are also acceptable outside tank containment areas.
    - 2) Inside tank containment areas, gaskets shall be fire resistant Flexitallic CGI Style – 304 Stainless steel spiral wound metal with Flexicarb filler material for Class II liquid which is compliant with UPRR diesel specifications. Installation shall be in accordance with the manufacturers recommendations.
    - 3) In all applications utilize proper torque requirements per ASME B16.5.
    - 4) NFPA 30 conditions must be met for all applications.
  - d. Flange bolts shall be alloy steel, Teflon coated, conforming to ASTM A193 Grade B7.
  - e. Flange nuts shall be heavy hexagon carbon steel conforming to ASTM A194 Grade 2H.

#### B. Double Wall

1. Pipe shall be ASTM A53 Grade A or B or APL 5L Grade B, seamless or electric resistance welded. All carrier pipes shall be Schedule 40 or Standard Thickness whichever is less, unless otherwise indicated on the Drawings. Containment pipe shall be Schedule 20 or standard thickness, whichever is less, unless otherwise indicated on the drawings.

2. Piping shall consist of a steel carrier pipe inside of a steel containment pipe that shall be fully testable to ensure its integrity.
3. Carrier pipe shall be supported at intervals within the containment piping based on the structural requirements for the diameter of piping utilized. Pipe supports shall be fixed and any fluid buildup shall be allowed to drain to the nearest leak detection port.
4. Containment piping shall be sized to contain the carrier piping with sufficient clearance for field assembly and thermal expansion or contraction.
5. Where insulated piping is required, insulation shall be factory injected polyurethane foam to completely fill the annular space between the steel carrier pipe and the steel containment pipe. Provide with leak detection or heat trace channel to allow for leak detection or installation of heat tracing.

#### 2.04 BURIED COMPRESSED AIR PIPE

- A. Piping shall be Asahi/American Air-Pro(R) compressed air pipe.
- B. All pipe transitions shall be done a minimum of 1 FT-0 IN below grade.
- C. Transitions fittings as approved by the pipe manufacturer shall be used when connecting underground pipe to aboveground steel pipe.
- D. Piping 1-1/2 IN and smaller will be socket fused together. Piping 2 IN and greater to be butt fused.
- E. Piping to be welded per manufacturers' recommendation including protecting pipe welding during cold temperatures.

#### 2.05 HIGH DENSITY POLYETHYLENE (HDPE) PIPE

- A. Piping shall be single wall, SDR-11 thickness, PE3408 black pipe compatible with diesel fuel and water for gravity drain applications.
- B. Fittings shall be factory fabricated SDR-11 minimum thickness with plain ends for butt fusion per ASTM D3261 unless otherwise specified or indicated.
- C. For connections to materials or pipe other than HDPE (steel, PVC, basin liners, etc.), provide fittings and adapters as recommended by the pipe manufacturer. Submit connection details for review.
- D. Piping 1-1/2 IN and smaller will be socket welded. Piping 2 IN and greater to be butt welded.
- E. Provide piping in maximum lengths provided by manufacturer to minimize field joints.

#### 2.06 CAST IRON PIPE

- A. Piping and fittings shall be service weight and conform to the requirements of ASTM A74 or ASTM A888.
- B. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions and local code requirements. Hubless couplings shall be composed of a stainless steel shield, clamp assembly, and a neoprene sealing sleeve conforming to ASTM C1277.

- C. Joints for hub and spigot pipe shall be installed per the manufacturer's installation instructions and shall utilize neoprene compression gaskets conforming to the requirements of ASTM C564.
- D. Under no circumstances will cast iron piping or fittings be used in petroleum services, to include industrial wastewater collection.

## 2.07 DUCTILE IRON PIPE

- A. Ductile Iron Pipe: AWWA C151 with push on type joints. Cement mortar line in accordance with AWWA C104.
  - 1. Fittings: Ductile iron mechanical joint per AWWA C110. Cement mortar line in accordance with AWWA C104.
  - 2. Joints: AWWA C111 Viton push-on-gaskets.
  - 3. Polyethylene encasement: ASTM A674 or AWWA C105 polyethylene film 0.008 IN (0.20 mm) minimum thickness, tube or sheet.

## 2.08 PVC PIPE

- A. Refer to Section 40 05 32 for details.

## 2.09 DIELECTRIC-FLANGE INSULATION KITS

- A. Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gaskets, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

## 2.10 TRACER WIRE

- A. Wire Material: 10 AWG, Copper Clad Steel (CCS).
- B. Jacket Material: High Density Polyethylene (HDPE) or High Molecular Weight Polyethylene (HMWPE) designed for direct burial.
- C. Terminations shall be suitable for direct burial and wet location electrical connections.
  - 1. Connector Manufacturers:
    - a. Copperhead SnakeBite.
    - b. 3M DBR.
    - c. Or Approved Equal.

## 2.11 FLEXIBLE CONNECTORS

- A. General:
  - 1. Fabricated from materials suitable for system fluid and that will provide flexible pipe connections. End connections shall have a minimum working pressure of 150 psig and will be as follows:
    - a. 2 IN NPS (DN50) and Smaller – Threaded.
    - b. 2-1/2 IN NPS (DN65) and Larger – Flanged.

B. Stainless Steel Hose Flexible Connectors:

1. Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.

C. Rubber, Flexible Connectors:

1. CR or EPDM elastomer rubber construction, with multiples plies of NP fabric, molded and cured in hydraulic presses. Include 125 psig minimum working-pressure rating at 220 DegF. Units may be straight or elbow type, unless otherwise indicated.

2.12 MECHANICAL SLEEVE SEALS

A. Sleeves:

1. The following materials are for wall, floor, slab and roof penetrations:
  - a. Steel Sheet Metal – 0.0239 IN (0.6-mm) minimum thickness, galvanized, round tube closed with welded longitudinal joint.
  - b. Steel Pipe – ASTM A53, Type E, Grade A, Schedule 40, galvanized, plain ends.

2.13 PROCESS PIPING SYSTEMS

A. Industrial Waste Piping (Gravity), Buried:

1. Ductile Iron Pipe: AWWA C151 with push on type joints. Cement mortar line in accordance with AWWA C104.
  - a. Fittings: Ductile iron mechanical joint per AWWA C110. Cement mortar line in accordance with AWWA C104.
  - b. Joints: AWWA C111 Viton push-on-gaskets
  - c. Polyethylene encasement: ASTM A674 or AWWA C105 polyethylene film 0.008 IN (0.20 mm) minimum thickness, tube or sheet.

B. Industrial Waste Piping (Force Main):

1. Above grade:
  - a. Steel, ASTM A53 Grade B, Schedule 40.
  - b. Fittings: Malleable iron meeting ASTM A197 and ANSI B16.3, Class 150.
  - c. Joints: Threaded or flanged, joint compound resistant to piped fluid.
2. Below grade:
  - a. PE4710 HDPE, ASTM D2513.
  - b. Fittings: Socket fusion or butt fusion fittings complying with ASTM D2683 and ASTM D3261.
  - c. Joints: Fusion joint system.

C. Water Piping, Buried Within 5 FT of Building:

1. Copper Tubing: ASTM B88, Type K, annealed.

- a. Fittings: ASME B16.18 cast bronze, ASME B16.22 wrought copper and bronze, or ASME B16.24 150 psi flanged.
- b. Joints: No joints allowed below concrete slab.
- c. Include suitable homogeneous backfill material (e.g. washed sand, limestone sand or small limestone chips, small smooth river stone, or washed pea gravel) a minimum of 4 IN above and below pipe.

D. Water Piping, Above Grade:

- 1. Copper Tubing: ASTM B88, Type L, hard drawn.
  - a. Fittings: ASME B16.18 cast bronze, ASME B16.22 wrought copper and bronze, or ASME B16.24 150 psi flanged.
  - b. Joints: ASTM B32, solder, alloy Sn95, Sn94, E, HA, or HB or AWS A5.8, BCuP silver braze.
  - c. Unions: 150 psi copper, solder type socket ends.

E. Compressed Air:

- 1. Above grade:
  - a. Steel, ASTM A53 Grade B or API-5L Grade, schedule 40, seamless or ERW. Condensate lines shall be type M copper.
  - b. Fittings:
    - 1) Pipe 2 IN or larger: Butt welding type carbon steel, ASTM A234 Grade B, ANSI B16.9. Wall thickness shall match pipe.
    - 2) Pipe 1-1/2 IN and smaller: Threaded pipe fittings shall be 3000 LB, forged steel conforming to ANSI B16.11.
    - 3) Piping is not to present a tripping hazard, a maintenance obstacle, or violate NEC required clearances.
  - c. Pipe dope to be used on all threaded connections, no Teflon tape shall be used.
- 2. Below grade:
  - a. Piping shall be Asahi/American Air-Pro compressed air pipe, no substitutions.
    - 1) All pipe transitions shall be done a minimum of 1 FT below grade.
    - 2) Transitions fittings as approved by the pipe manufacturer shall be used when connecting underground pipe to aboveground steel pipe.
    - 3) Piping 1-1/2 IN and smaller will be socket fused together. Piping 2 IN and greater to be butt fused.
    - 4) Piping to be welded per manufacturers' recommendation including protecting pipe welding during cold temperatures.

F. Oxygen and Acetylene Gas Piping, Above Grade:

1. Steel Pipe up to and including 1-1/2 IN: ASTM A53, Schedule 40 black, Type E Grade B, or Type S Grade B. Meeting requirements of ASME B31.3 and NFPA 51.
  - a. Fittings: ASME B16.11, 2000 psi forged steel, welded or threaded type; Class 300 black malleable iron, threaded, ASME B16.3.
  - b. Joints: NFPA 51, threaded or welded to ANSI B31.2, ANSI B31.8.
    - 1) Tapered threaded connections in oxygen pipe shall be tinned or made up with polytetrafluoroethylene (such as Teflon) tape or other thread sealants suitable for oxygen service. Sealants shall be applied to the externally threaded portion only.
  - c. Oxygen pipe sealant shall be OXY-TITE, Loctite (Thread Sealant for Oxygen Systems) or equal.
  - d. Couplings: ASME B16.11, forged steel, 3000 psi, threaded or welded; Class 300 black malleable iron, threaded, ASME B16.3
  - e. Unions: Forged steel, 3000 psi SWP, threaded, bronze to steel seat; Class 300 black malleable iron. Use dielectric insulating unions to electrically isolate underground piping from aboveground piping.
  - f. Provide grounding at suitable intervals to protect against the effects of lightning and static electricity. The electrical resistance to earth of the installed aboveground piping system should not exceed 10 Ohms for lightning protection.
  - g. Provide isolating pads at all pipe supports.
  - h. Hose and hose connections: Shall comply with CGA E-1, Standard for Rubber Welding Hose and Hose Connections for Gas, Welding, Cutting, and Allied Processes.
2. See Section 22 05 28 for manifold requirements.

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. The Contractor shall keep an accurate record of the exact location and elevation of all underground and aboveground piping installed and shall, upon completion of the piping systems, furnish these records to the Railroad as required by the condition of the Contract.
- B. Clean interior of all pipe, fittings, and joints prior to installation. Installed piping shall be temporarily plugged at the end of each day's work or other interruption to progress. Plugging shall be installed in a manner satisfactory to the Engineer and shall be adequate to prevent entry of water, animals, and debris into the pipe and equipment.
- C. Install piping in accordance with the manufacturer's recommendations where applicable.



### 3.02 INSTALLATION

#### A. Steel Pipe:

##### 1. General:

- a. Install each piping run with a minimum of joints and couplings, but with adequate and accessible unions for disassembly and maintenance or replacement of valves and equipment. Provide all bolts, studs, nuts, and gaskets for makeup of all connections of piping and equipment or fittings.
- b. Reduce pipe sizes where indicated by use of reducing fittings.
- c. Align pipe accurately at connections within 1/16 IN misalignment tolerance.
- d. Provide all necessary supports, brackets, or foundations required to properly install piping and equipment.
- e. Provide high point vents and low point drains as required to effectively vent and drain the entire piping system or where indicated on the drawings. Vent valves shall be a lockable ball type and the open end shall be sealed with a threaded plug or blind flange as appropriate.
- f. Piping shall be painted and labeled as indicated on the drawings and as specified sections 09 90 01, 09 97 50, and 33 05 26..

##### 2. Welding:

- a. Welding shall be accomplished by the shielded metallic arc process and shall be in strict accordance with ASME B31.3 welding rods, whose physical characteristics are not less than the parent metal.
- b. The Contractor shall use welders qualified per ASME B31.3 and AWS standards and shall be capable of supervising all welding and installation.
- c. Welders assigned to the work shall be duly qualified in accordance with ASME Section IX Boiler and Pressure Vessel Code for Welder's Qualification Test, Welding Procedures, and Quality Requirements, and Procedures and Tests for Qualifying Welders; and AWS B2.1 6G E6010 open root and E7018 fill and cap pipe welding certification. Contractor will provide copies of welder certification demonstrating certification renewal within six (6) months of project start date at project commencement to the designated project manager. Contractor is responsible for ensuring that welder's certifications are maintained for the duration of the project.
- d. All welding shall be conducted in a "Gas-Free" condition. All welding of pipes that may have previously contained fuel shall be sufficiently purged fuel and vapors to provide for a safe welding environment. It is the responsibility of the Contractor to maintain safe conditions.

##### 3. Welding Methods:

- a. No welding shall be done if the metal temperature is below zero degrees Fahrenheit or if the surfaces are wet. All surfaces shall be prepared and with the temperature range prescribed by the AWS standard.
- b. All joints shall conform to the latest published standard of the AWS, IAW, and ANSI codes.

- c. In the installation of socket weld fitting and valves, a 1/16 IN clearance shall be left between the end of the pipe and the shoulder in the socket.
- d. Align pipe joints with pipe clamps prior to welding. Clamps or other alignment devices shall not reduce the pipe diameter. Tack welds in the grooves may be used if fixtures cannot be used but shall be kept to a minimum.
- e. Clean each joint before welding into the system to remove all grease, rust, paint, burrs and loose debris.
- f. The number of passes for welding joints and the methods of welding shall be in accordance with AWS D1.1.
- g. Complete fusion shall be obtained and care shall be taken that full penetration is obtained through thickness of metal without stalactite or dripping.
- h. All slag and flux shall be removed by wire brushing before each succeeding pass is made.
- i. The completed weld shall be free from all defects including undercutting, porosity, and cracking.
- j. Welds shall present a smooth, regular workmanship appearance.
- k. No weld metal shall project within the piping at completion of the welding.

4. Inspection:

- a. All piping welded joints shall be subject to inspection and, if requested by the Engineer, testing. All costs of labor and material required for testing shall be the responsibility of the contractors.

- 1) Petroleum tanks and pipelines welding inspection requirements to be done in accordance with ASME B.31.3 process piping.

Welding Work Inspection			
	Above Ground	Below Ground	Tanks
	20%	100%	100%
Small job exemption: No weld inspection required for non-tank, above ground pipe welding less than 8' in height where less than 5 welds are made.			

- b. Welding defects considered cause for rejection shall be defined as follows:
  - 1) Undercutting.
  - 2) Cracks.
  - 3) Lack of fusion.
  - 4) Weld reinforcement in excess of 1/8 IN.
  - 5) Gas pockets (slag inclusions over 1/8 IN in longest dimension).
  - 6) Surface porosity (more than six (6) gas pockets per square inch of etched surface).

- c. If more than 20 percent of the welds tested are found defective, a second group of welds shall be tested. If more than 20 percent of the second group are found defective, all welds in the system shall be removed, without further testing and shall be re-welded without any additional cost to the Railroad.
- d. Defective welds shall be repaired in accordance with ASME B31.3 at the Contractors' expense.

B. HDPE Pipe:

1. Heat Fusion Procedures:

- a. All joining of HDPE pipe and fittings shall follow the general guidelines given in ASTM D2657 and specific guidelines as recommended by the manufacturer.
- b. Personnel trained in heat fusion joining using tools approved by the pipe manufacturer shall do procedures necessary for correct assembly of pipe and fittings.
- c. Pipe ends and fittings shall be cut square, cleaned, beveled and prepared for heat fusion as recommended by the manufacturer.
- d. When piping installation will occur in cold weather, below 55 DegF, trial melt patterns shall be made on extra pieces of pipe to establish proper melt times.

2. Gravity pipe testing:

- a. Perform air tests per ASTM F1417 and submit proposed testing procedure for approval prior to conducting tests.

C. Tracer Wire:

- 1. Attach to pipe at a maximum of 10 FT intervals with tape or tie-wraps.
- 2. Continuous pass from each valve box and above grade at each structure.
- 3. Coil enough wire at each valve box to extend wire a foot above the ground surface.
- 4. If split bolts are used for splicing, wrap with electrical tape.
- 5. If wire nuts are used for splicing, knot wire at each splice point leaving 6 IN of wire for splicing.
- 6. Use continuous strand of wire between valve box where possible.
  - a. Continuous length shall be no shorter than 100 FT.
- 7. Tracer Wire Testing:
  - a. Contractor to perform conductivity test and spot locate testing.

### 3.03 TESTING

#### A. General:

1. All tests shall be made in the presence of the Engineer or railroad representative. Any preliminary tests that the Contractor may make without such tests being observed by the Engineer will not be accepted unless prior approval is obtained. The Contractor shall notify the Engineer at least 48 HRS before any work is to be inspected or tested.
2. If inspection or test shows defects, the piping system(s) shall be repaired and/or replaced and the inspection repeated, until such piping is acceptable to the Engineer. Any repair or replacement necessary due to faulty materials furnished by the Railroad will be considered additional work.
3. Short sections of line may be isolated for testing. If shorter sections are tested, test plugs or bulkheads required at the ends of the test section shall be furnished and installed by the Contractor, together with all anchors, braces, and other devices required to withstand the hydrostatic pressure without imposing any thrust on the pipeline. The Contractor shall be solely responsible for any damage that may result from the failure of test plugs or supports. If sections of the system are tested and not accepted they shall be promptly corrected and re-tested.
4. All piping systems shall be tested in accordance with this Specification in addition to any tests required by Local and State codes or building authorities. Obtain and pay for all necessary approvals, acceptances, and permits.
5. All apparent leaks discovered within one year from the date of acceptance of the Work by the Railroad shall be located and repaired by the Contractor, regardless of the total line leakage rate.
6. All necessary testing equipment and materials including tools, appliances, and devices shall be furnished and all tests shall be made by and at the expense of the Contractor.

#### B. Pressure Piping Hydrostatic Test:

1. Piping shall be slowly filled with water and all air expelled. Care shall be taken that all air valves on high point vents are installed and open in the section being filled, and that the rate of filling does not exceed the venting capacity of the air vents.
2. The pressure shall be gradually increased until a gauge pressure of one-half (1/2) the test pressure is attained, at which time a preliminary check of the pipe shall be made. This preliminary test pressure shall be maintained for a minimum of ten (10) minute, or for as long as necessary for the Engineer to complete the inspection of the line under test. The pressure shall then be gradually increased until the test pressure is reached. Hydrostatic test pressure shall be one and one half (1.5) times the designed operating pressure, but in no case less than 100 psig. Do not exceed the pipe manufacturers recommended test duration.
3. Subject the piping to pressurization cycles by venting pressure at the high points and then increasing pressure again to the maximum test pressure. Hold test pressure again for a ten (10) minute period at the test pressure. Maintain the final pressure cycle for 2 HRS and check for leaks.

4. If defects are noted, repairs shall be made and the test cycle repeated until all parts of the line withstand the test pressure.
5. After the hydrostatic pressure test has been completed, the lines shall be subjected to a hydrostatic leak test. The pressure range of the leak test will be 50 to 100 percent of maximum test pressure, and will be determined by the Contractor. A successful test will be the pressure maintained within a maximum variation of 5 percent during the entire leak test, over a cycle of 2 HRS minimum, or for such additional time necessary for the Engineer to complete inspection of line under test. Test duration shall not start until a constant pressure has been established. The line leakage shall be measured by means of a water meter installed on the supply line of the pressure pump.
6. After the successful completion of the pressure tests the line tested shall be pigged three (3) times to completely purge all water.

C. Pressure Piping Pneumatic / Soap Test:

1. Piping shall be slowly pressurized with clean, dry air until a gauge pressure of one-half (1/2) the test pressure is attained, at which time a preliminary check shall be made. Maintained preliminary test pressure for a minimum of ten (10) minutes and for such additional period necessary for the Engineer to complete the inspection of the line under test. Thereafter, gradually increase pressure until the test pressure is reached. Pneumatic test pressure shall be one and one half times (1 1/2x) times the designed operating pressure, but in no case less than 5 psig or more than 50 psig. Do not exceed the pipe manufacturer's recommended test duration.
2. Maintain the final pressure for 1 HR minimum and check for leaks using a soap solution.
3. If defects are noted, repairs shall be made and the test repeated until all parts of the line withstand the test pressure.
4. Containment Piping:
  - a. Provide boots and end seals with pressure connections as required to pressure test containment piping. Loosen boots or end seals upon successful completion of pressure testing in order to allow carrier piping leaks to be visually detected.
  - b. Pressure test at 5 psig for a minimum period of twenty (20) minutes, and as long as required to visually test each joint with a soap solution.

D. Gravity Drainage and Venting Systems:

1. Test by filling with water to the level of the highest vent stack or 10 FT-0 IN above highest grade, whichever is higher. Openings shall be plugged as necessary. To be considered free of leaks, the system shall hold the water for thirty (30) minutes without any drop in the water level.

E. Double Wall Containment:

1. Testing:
  - a. An air pressure leak test shall be performed on the containment pipe.

- b. All welds on the containment piping are to be leak tested with dye penetrant and by soapy water during the pressure testing requirement listed in this specification. The joints that pass are to be cleaned and either epoxy coated and wrapped in bituminous tape.
  - c. A hydrostatic test of the carrier pipe shall be performed as outlined in the Uniform Plumbing Code, Section 318 as directed by the Local Administrative Authority having jurisdiction.
  - d. Leak detection shall be provided to monitor the integrity of the carrier piping according to details listed on the drawings.
  - e. For system drainage applications, a hydrostatic test of one and one half times (1-1/2x) the working pressure is required for the carrier pipe.
2. Welding Inspection:
- a. All welded joints on carrier pipe to be contained are to be 100 percent X-ray tested prior to painting and installation in of the containment piping.
  - b. Any carrier pipe 8 FT above the ground shall be 100 percent X-ray tested. All X-ray testing is to be done in accordance with ASTM E915.
  - c. All X-ray testing required must be documented and the inspection records turned over to the Engineer prior to the installation of the secondary containment piping.
  - d. All X-ray testing is subsidiary to these work items and no additional payment will be made by the Railroad for this requirement beyond the original bid amount.
  - e. All X-ray testing must pass the ASTM E915 requirement prior to incorporating the work on the project.
  - f. All welds on the containment piping are to be leak tested with dye penetrant and by soapy water during the pressure testing requirement listed in this specification. The joints that pass are to be cleaned and either epoxy coated and wrapped in bituminous tape.
  - g. Both the secondary containment and carrier pipe are to be fully (100 percent) epoxy coated. any joints may be field coated after welding and wrapped pin bituminous tape.

**END OF SECTION**

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## **SECTION 40 05 07 - HANGERS AND SUPPORT**

### **1.01 SUMMARY**

#### **A. Section Includes:**

1. Hangers and supports for mechanical system piping and equipment.
- B. Pipe hanger and support locations indicated on drawings are shown for information only and not to describe the exact location(s) of required supports. The Contractor shall ensure that all piping is properly supported along its entire routing.

### **1.02 REFERENCED STANDARDS**

#### **A. Manufacturers Standardization Society (MSS):**

1. SP-58, Pipe Hangers and Supports – Materials, Design and Manufacture.
2. SP-69, Pipe Hangers and Supports – Selection and Application.

#### **B. National Fire Protection Association (NFPA):**

1. 13, Installation of Sprinkler Systems.
2. 70, National Electric Code (NEC).

#### **C. Underwriters Laboratories (UL).**

### **1.03 SUBMITTALS**

#### **A. Submit as specified in Section 01 33 00 – Submittals and Substitutions**

- B. Product Data – Submit manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing manufacturer's figure number, size, location, and features for each required pipe hanger and support.
- C. Coordinate submittals with piping submittals to show support locations and type on all spool drawings for pipe systems.

### **1.04 QUALITY ASSURANCE**

- A. Fire protection piping hangers and supports shall comply with NFPA 13, UL and FM.
- B. Prepare hanger and support design drawings and calculations for seismic restraint of piping and equipment if required by local jurisdiction.

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS OF HANGERS AND SUPPORTS**

- A. Available Manufacturers – Subject to compliance with requirements, manufacturer's offering hangers and supports which may be incorporated in the work include, but are not limited to, the following:
  1. B-Line Systems Inc.
  2. Carpenter and Paterson Inc.

3. Elcen Metal Products Co.
4. Fee and Mason Mfg. Co.
5. ITT Grinnell Corp.
6. Pipe Shields Inc.

## 2.02 HORIZONTAL – PIPING HANGERS AND SUPPORTS

- A. Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with MSS SP-58, selected by the Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information.

## 2.03 HANGER-ROD ATTACHMENTS

- A. Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with MSS SP-58, selected by the Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturers published product information.

## 2.04 STRUCTURAL ATTACHMENTS

- A. Except as otherwise indicated, provide factory-fabricated building attachments complying with MSS SP-58, selected by the Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information.

## 2.05 SADDLES AND SHIELDS

- A. Except as otherwise indicated, provide saddles and shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shield for exact fit to mate with pipe insulation.

## 2.06 MISCELLANEOUS MATERIALS

- A. Metal Framing – Provide products complying with NEMA STD ML 1.
- B. Steel Plates, Shapes and Bars – Provide products complying with ASTM A36.
- C. Heavy-Duty Steel Trapezes – Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.

# PART 3 - EXECUTION

## 3.01 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69.
- B. Arrange for grouping of parallel runs of horizontal piping supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69.

- C. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

### 3.02 ADJUSTING AND CLEANING

- A. Hanger Adjustments – Adjust hangers so as to distribute loads equally on attachments and to achieve indicated slope of pipe.

**END OF SECTION**

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## **SECTION 40 05 32 - POLYVINYL CHLORIDE (PVC) PRESSURE PIPE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. 4 - 27 IN buried polyvinylchloride (PVC) pressure pipe. PVC pressure pipe shall be furnished complete with all fittings, jointing materials, anchors, blocking, encasement, and other necessary appurtenances. Pressure and leakage tests and cleaning are covered in other sections. Pipe trenching, bedding, and backfill are covered in Section 31 00 00 - Earthwork.

#### **1.02 REFERENCED STANDARDS**

- A. Except as modified or supplemented herein, all PVC pressure pipe shall conform to the applicable requirements of ANSI/AWWA C900 and C905.
- B. The supplementary information required in the governing standards is as follows:

Affidavit of Compliance	Required
Plant Inspection	Not Required
Special Markings	Not Required
Special Preparation for Shipment	Not Required
Certification	Required

#### **1.03 SUBMITTALS**

- A. Drawings and data shall be submitted in accordance with the submittals section. Drawings and data shall include, but shall not be limited to, the following:
  1. Gasket Material.
  2. Pipe Length.
  3. Affidavit of Compliance (ANSI/AWWA C900, Sec. 1.4).
  4. Affidavit of Compliance (ANSI/AWWA C905, Sec. 1.4).
  5. Certification (ANSI/AWWA C900, Sec. 2.1.4).
  6. Certification (ANSI/AWWA C905, Sec. 2.2.2).

#### **1.04 STORAGE AND HANDLING**

- A. Pipe, fittings, and accessories shall be handled in accordance with Chapter 6 of AWWA Manual M23, to ensure installation in sound, undamaged condition. Pipe shall not be stored uncovered in direct sunlight.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

#### A. Pipe:

1. ANSI/AWWA C900 or C905; cast iron pipe OD, DR = 18.

#### B. Fittings:

1. Cast iron ANSI/AWWA C110/A21.10, 250 psi pressure rating, except shorter laying lengths will be acceptable.

#### C. Joints:

1. PVC to PVC – ANSI/AWWA C900 or C905, stab type, with elastomeric synthetic rubber gaskets. Gaskets of natural rubber will not be acceptable.
2. PVC to Cast Iron – ANSI/AWWA C111/A21.11, except gaskets shall be synthetic rubber. Natural rubber will not be acceptable.

#### D. Tapping Saddles:

1. Ductile iron, with galvanized steel straps and synthetic rubber sealing gasket, 250 psi. pressure rating.

#### E. Tapping Sleeves:

1. Ductile iron, 250 psi pressure rating.

#### F. Polyethylene Encasement:

1. Tube or sheet, ANSI/AWWA C105/A21.5.

#### G. Joint Tape:

1. Self-sticking, PVC or polyethylene, 10 mils thick; Chase “Chasekote 750”, Kendall “Polyken 900” or 3M “Scotchrap 50”.

#### H. Conductive Tracer:

1. Detection Tape, 3 IN wide; aluminum foil core, 0.5 mils thick, encased in a protective inert plastic jacket.
2. 5000 psi min. tensile strength; 2.5 LBS per in per 1000 FT min. mass.
3. Color coded in accordance with APWA Uniform Color Code.
4. Allen Systems “Detectatape”, Lineguard “Type III” or Reef Industries “Terra Tape D”.
5. Manufacturing quality control shall be maintained by frequent, regularly scheduled sampling and testing. Testing shall comply with the governing standards.

### 2.02 SHOP COATING AND LINING

- A. The exterior surfaces of cast iron fittings shall be coated with a bituminous coating. The interior surfaces of cast iron fittings shall be lined with cement mortar.

## PART 3 - EXECUTION

### 3.01 NOTICE:

- A. Before beginning any work under these specifications, Contractor shall, without fail, telephone the Union Pacific Railroad at 1 800 336 9193 (a 24 hour number) to determine if fiber optic cable is buried anywhere on the Railroad's premises to be used by the Contractor. If fiber optic cables are buried on the premises, the Contractor shall telephone the telecommunications company(ies) involved, arrange for the cable locator, make arrangements for relocation or other protection of the fiber optic cable, and shall not commence any work on the premises until all such protection or relocation has been accomplished. If the Contractor contacts the Railroad and telecommunications company(ies) as required, the Contractor will not be responsible for the cost to locate, relocate, or protect the fiber optic cable.

### 3.02 INSPECTION

- A. Pipe and fittings shall be carefully examined for cracks and other defects immediately before installation; spigot ends and bells shall be examined with particular care. All defective pipe and fittings shall be removed from the site of the work.

### 3.03 LAYING PIPE

- A. Pipe shall be protected from lateral displacement by pipe embedment material installed as specified in the earthwork section. Pipe shall not be laid in water or under unsuitable weather or trench conditions.
- B. During cold weather, particular care shall be taken in handling and laying pipe to prevent impact damage.
- C. Pipe shall be laid with bell ends facing the direction of laying, except when reverse laying is specifically permitted by the Engineer.
- D. Foreign matter shall be prevented from entering the pipe during installation.
- E. Whenever pipe laying is stopped, the open end of the line shall be sealed with a watertight plug. All water shall be removed from the trench prior to removing the plug.
- F. Pipe shall be kept shaded and as cool as possible during installation and shall be covered with backfill immediately after installation.
- G. Conductive tracer shall be buried above PVC pipe, not more than 18 IN below the ground surface.

### 3.04 CLEANING

- A. The interior of all pipe and fittings shall be thoroughly cleaned before installation and shall be kept clean until the work has been accepted.

### 3.05 ALIGNMENT

- A. Piping shall be laid to the lines and grades indicated on the drawings. Pipelines or runs intended to be straight shall be laid straight. Deflections from a straight line or grade shall not exceed the maximum deflections specified by the manufacturer. Unless otherwise specified or indicated on the drawings, and subject to acceptance by the Owner, either shorter pipe sections or fittings shall be installed as required to maintain the indicated alignment or grade.

### 3.06 JOINTING

- A. Slab-Type Joints – Jointing shall conform to the instructions and recommendations of the pipe manufacturer. All surfaces for gasketed joints shall be lubricated immediately before the joint is completed. Gaskets and lubricants shall be supplied by the pipe manufacturer, shall be suitable for use in potable water, shall be compatible with the pipe materials, shall be stored in closed containers, and shall be kept clean. Each spigot shall be suitably beveled to facilitate assembly.
- B. Mechanical Joints – Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled. Overtightening of bolts to compensate for poor installation practice will not be permitted.

### 3.07 POLYETHYLENE ENCASEMENT

- A. All cast iron fittings, tapping saddles, tapping sleeves, valves, or other cast iron accessories shall be provided with polyethylene tube or sheet protection, installed in accordance with ANSI/AWWA C105/A21.5, Method A or C.

### 3.08 CONNECTIONS WITH EXISTING PIPING

- A. Connections between new work and existing piping shall be made using fittings suitable for the conditions encountered. Each connection with an existing pipe shall be made at a time and under conditions which will least interfere with service to customers, and as authorized by the Owner. Facilities shall be provided for proper de-watering and for disposal of water removed from the de-watered lines and excavations without damage to adjacent property.
- B. The following paragraph applies only to connections with lines carrying potable water:
- C. Special care shall be taken to prevent contamination of potable water lines when de-watering, cutting into, and making connections with existing pipe. No trench water, mud, or other contaminating substances shall be permitted to enter the lines. The interior of all pipe, fittings, and valves installed in such connections shall be thoroughly cleaned and then swabbed with, or dipped in, a 200 mg/L chlorine solution.

### 3.09 SERVICE CONNECTIONS

- A. Tapping saddles or tapping sleeves shall be used for all service connections 2 IN and smaller. Direct tapping of PVC pipe will not be permitted. Fittings shall be used for service connections larger than 2 IN.



### 3.10 CONCRETE ENCASEMENT

- A. Concrete encasement shall be installed as directed by the Engineer. Concrete and reinforcing steel shall be as specified in the cast in place concrete section. All pipe to be encased shall be suitably supported and blocked in proper position and shall be anchored against flotation.

### 3.11 REACTION ANCHORAGE AND BLOCKING

- A. All bell and spigot or all bell tees, Y branches, bends deflecting 11-1/4 degrees or more, valves, and plugs which are installed in piping subjected to internal hydrostatic heads in excess of 30 FT shall be provided with suitable reaction blocking or other acceptable means of preventing movement of the pipe caused by internal pressure.
- B. Concrete blocking shall extend from the fitting to solid, undisturbed earth and shall be installed so that all joints are accessible for repair. The dimensions of concrete reaction blocking shall be as indicated on the drawings or as directed by the Engineer. If the absence of suitable solid vertical excavation face is due to improper trench excavation, the Contractor shall furnish and install acceptable metal harness anchorages using ductile iron pipe of the appropriate class at no additional cost to the Railroad.
- C. Reaction blocking, anchorages, or other supports for fittings installed in fills or other unstable ground shall be provided as directed by the Engineer.

### 3.12 HYDROSTATIC TESTS

- A. After installation, PVC piping shall be hydrostatically tested for defective workmanship and materials as specified in the pipeline pressure and leakage testing section.

### 3.13 LEAKAGE

- A. All PVC piping shall be watertight and free from leaks. Each leak which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of the Contractor.

### 3.14 CLEANING AND DISINFECTION

- A. After installation, all PVC piping shall be cleaned as specified in the cleaning and disinfection section. PVC piping for potable water supply shall be disinfected as specified in the cleaning and disinfection section.

## **END OF SECTION**

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## **SECTION 40 05 39 - REINFORCED CONCRETE PIPE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Fabrication and installation of concrete:
  - a. Round, elliptical, arch pipes.
  - b. Manhole riser.
  - c. Flared end pipes.
  - d. Each of which will be referred to as "pipe culverts". Pipe culverts may be for culverts, siphons, drains, and conduits as shown on the plans or directed by the Engineer in accordance with these Specifications, C.E. Drawings 680000, and in all accordance with Chapter 8 Part 10 of the current American Railway Engineering and Maintenance of Way Association (AREMA) Specifications for Culverts.

### **PART 2 - PRODUCTS**

#### **2.01 PIPE CULVERT MATERIAL**

- A. Pipe culvert material must meet the standards set forth in Chapter 8, part 10 of the current AREA Specifications. RCP pipe culvert materials shall be furnished in lengths not less than 4 FT. Material is to be new material.
- B. All pipe material shall be designed for Cooper E80 loading and no pipe lighter than Class IV will be permitted. The minimum factor of safety against formation of a 0.01 IN crack shall be 1.0. In lieu of design analysis, the Contractor may furnish Class V pipe for installations with 14 FT maximum cover.

### **PART 3 - EXECUTION**

#### **3.01 HANDLING OF PIPE CULVERT MATERIAL**

- A. The Contractor shall handle pipe culverts, and the pipe culvert material, carefully in order to prevent damage including, but not limited to, injury to bituminous and other pipe culvert coatings. The pipe culverts shall never be dragged over the ground but shall be handled with skids, rolling slings, or crane. The Contractor shall promptly repair, to the satisfaction of the Engineer, any damage to the pipe culverts or culvert material which the Contractor causes. In the event that such damage to culverts or pipe culvert material cannot be repaired to the satisfaction of the Engineer, replacement of pipe culvert and/or pipe culvert material must be provided by the Contractor at his expense.

### 3.02 EXCAVATION AND LOCATION

- A. Pipe culverts shall be placed at the location, elevation and alignment shown on the Drawings.
- B. The Contractor shall perform pipe culvert excavation. Prior to pipe culvert excavation, embankment must be constructed to a height no less than 2 FT above the top of the proposed pipe culvert when it is in place. Pipe culvert excavations shall be wide enough to permit thorough compaction of the backfill under and around the pipe culvert, as required by Sub-Section 3.07, and the base width of the pipe culvert excavation shall not exceed the external width of the pipe culvert plus:
  - 1. 12 IN on each side for pipes less than 48 IN DIA.
  - 2. 18 IN on each side for pipes 54 - 84 IN DIA.
  - 3. 24 IN on each side for pipes 84 IN DIA or larger.
- C. Protection of Foundations and Bedding:
  - 1. Unless soft soil conditions are encountered in which case Sub-Section 3.03.B. shall govern, pipe culvert excavations shall be deep enough to permit compliance with the foundation and bedding requirements for pipe culverts. Care shall be taken to insure drainage is diverted away from the pipe bed during preparation. Any damage or deterioration of pipe bedding prior to installation shall be repaired by the Contractor at no expense to the Railroad.
- D. Trenching: The Contractor shall comply with all current applicable Federal, State and local rules and regulations governing the safety of men and materials during pipe culvert excavation, installation, and backfilling operations. The Contractor shall comply with all requirements of the Occupational Safety and Health Administration relating to excavations, trenching and shoring as set forth in Title 29, Part 1926, Subpart Sections 1926.650 through 1926.653, Code of Federal Regulations, and any subsequent revisions.

### 3.03 FOUNDATION, BEDDING AND COMPACTION

- A. Pipe culverts shall be placed at the flowline grade and elevation established by the Engineer on a uniform bed of stable earth or granular material such as sand, gravel and such bedding shall be compacted to not less than 100 percent of maximum density as determined by ASTM D1557, with moisture content adjusted as necessary. The compacted bed shall contain the camber required by the Engineer or as covered by these Specifications, Sub-Section 3.04. The compacted bed shall be shaped to fit the bottom of the pipe and shall conform to Class A, B or C bedding (see Table 10.33.4 bedding factors) AREMA chapter 8-10. Where sand-gravel material is used for bedding, the ends of the pipe culvert excavation shall be sealed to prevent leaking and infiltration of water along the pipe culvert. Such sealing can often be accomplished by blanketing the ends of the pipe culvert embankment with well tamped clay. In all cases, the ends of pipe culverts shall be protected by riprap as outlined in Sub-Section 3.05 and C.E. Drawing 680000.

B. Soft Soil Conditions:

1. Where the flowline grade crosses soft areas of soil which will not provide a suitable uniform foundation for the pipe culvert bed, the Contractor shall excavate 18 IN below the flowline grade for a width equal to twice the outside width of the pipe culvert. Prior to backfilling, the Engineer shall inspect the excavation and the Contractor shall also perform any additional excavation below 18 IN of the flowline grade which may be required by the Engineer; provided, however, that the expense of such additional excavation beneath 18 IN of the flowline grade shall be considered extra work. Upon completion of all the excavation, the Contractor will backfill such excavation with sand-gravel material formed as required in Sub-Section 3.06.B.

C. Rock:

1. When the flowline grade passes over rock, the Contractor shall excavate such rock to a depth which is at least 6 IN below the flowline grade. The pipe culvert will not rest on rock at any point. The Contractor will backfill excavations in rock with sand-gravel material which shall be compacted and formed as required by Sub-Section 3.07.

3.04 CAMBER

- A. Camber shall be placed in all culverts where it is anticipated that the culvert will settle as the result of high embankment construction or compressible foundation soils below the culvert bedding. Unless otherwise specified by the Engineer, all culverts shall be cambered in accordance with the following:
1. In no case shall the culvert be cambered so high in the center that water will be pocketed at the inlet end of the pipe.
  2. Culverts resting on rock foundation need not be cambered. In accordance with Sub-Section 3.03.C.
  3. Embankments up to 8 FT high (measured base of rail to flowline) require 1-1/2 IN camber.
  4. Embankments 8 FT to 12 FT high require a 2-1/2 IN camber.
  5. Embankments 12 FT to 24 FT high require a 4 IN camber.
  6. Embankments 24 FT to 36 FT high require a 6 IN camber.
- B. The above camber standards, based on the height of embankments, may be adjusted in the field where, at the discretion of the Engineer, a greater or lesser amount of camber should be built into pipe to adjust for soil conditions encountered at the site. For fills higher than 36 FT, the Chief Engineer - Design will provide the camber requirements.

3.05 RIPRAP PROTECTION

- A. Both the inlet and outlet ends of all culverts shall be protected by riprap, packaged riprap, concrete headwalls, or as shown on the Drawings. Riprap shall be installed per detail on C.E. Drawing 680000 or as shown on the Drawings.

### 3.06 INSTALLATION

#### A. Joining Pipe:

1. Pipe may be bell and spigot or tongue and groove unless otherwise specified. When bell pipe is used, a shallow excavation shall be made underneath the bell of sufficient depth so the bell does not rest on the bedding material. Ends of reinforced concrete pipe shall be of such design that when properly laid, they shall have a smooth and uniform interior surface. In areas where the pipe will tend to separate, suitable ties shall be installed.
2. Joints shall be made with mortar, grout, rubber gaskets, plastic mastic compounds, or by a combination of these types. Any joint system must be approved by the Engineer prior to installation.
3. Curved pipes shall have one or both ends beveled to provide a smooth curve. In no case shall any pipe end be beveled greater than 7-1/2 degrees for a change in grade or more than two degrees for a horizontal change. If the resulting gap is less than 1 IN, the resulting space is to be filled with mortar concrete. For gaps of 1 IN or greater, a reinforced concrete collar shall be poured around the joint as directed by the Engineer.

#### B. Laying Culvert Pipe:

1. Each pipe culvert shall be laid true to the following grade. The minimum gradient for any pipe culvert shall be 0.5 percent unless indicated otherwise on the Plans, or as directed by the Engineer. If two or more pipe culverts are to be laid parallel to each other, such parallel pipe culverts shall be spaced to permit thorough compaction of the backfill as required by Sub-Section 3.07. Parallel culverts shall be separated by a distance of at least one-half of the nominal diameter of the pipe culverts or one-third (1/3) of the span width of pipe arch culverts, but not less than 12 IN nor more than 48 IN.
2. Pipe laying shall begin at the downstream end of the culvert. The bell or groove end of the pipe shall be placed facing upstream. No culvert shall be placed in service until a suitable outlet is provided.
3. Elliptical and elliptically reinforced pipe shall be placed with the vertical axis within 5 degrees of a vertical plane through the longitudinal axis of the culvert.

#### C. Special Installation Conditions:

##### 1. Jacking Pipe:

- a. Shall be accomplished by the AREMA Specifications, Chapter 8 Part 10. The Contractor shall prepare and submit plans showing the construction details to the Engineer for approval before installing pipe.

##### 2. Constructing Culverts in Tunnels:

- a. When necessary to place pipe by tunneling, (AREMA) Specification Chapter 8, Part 10.4.3.6 and the Plans and Specifications for the completed structure shall be prepared by the Engineer. The Contractor shall set forth construction procedures and other necessary details and submit for review by the Engineer before starting the installation.

### 3.07 BACKFILLING AND COMPACTION

- A. Backfill materials shall be placed simultaneously on both sides of the pipe culvert in uniform layers not exceeding 6 IN in thickness. For multiple pipes, the backfill shall be placed simultaneously in uniform layers between and outside of the pipes. Each successive layer shall be compacted to not less than 100 percent of maximum density as determined by ASTM D1557, with moisture content adjusted, if necessary, and 6 IN layers shall be properly compacted before the next layer is placed.
- B. Backfilling shall be started and completed as quickly as possible after the pipe culvert has been assembled and placed on its bed.
- C. Special care must be taken to obtain adequate compaction under the pipe culvert haunches; however, care must be exercised to avoid lifting of the pipe culvert as the result of tamping to compact material under the haunches.
- D. Where compaction may be difficult to obtain due to space constraints or other factors, the Contractor may, with the approval of the Engineer, utilize Controlled Low-Strength Concrete Fill Material (CLSM), commonly called flowable fill, as backfill material to a point one foot above the top of the culvert. Unless specified or shown elsewhere in the plans the CLSM shall meet the requirements for flowable fill of the respective Department of Transportation.

### 3.08 PIPE PROTECTION

- A. Materials used to complete the embankment over the pipe culvert should be essentially the same as the materials used for the pipe culvert backfill and should be placed and compacted in the same manner as pipe culvert backfill materials are placed. Such material must be used to complete the embankment at least to a height over the top of the pipe culvert equal to the nominal diameter of the pipe culvert, or if the height of the completed embankment over the top of the pipe culvert is less than the nominal diameter of the pipe culvert, then such material must be used to complete the embankment. The pipe culvert must be protected from damage during the entire construction period, especially if heavy compaction and/or construction equipment is used. Heavy equipment shall not be operated over the pipe culvert until it has been covered with compacted backfill material to a depth of at least 24 IN.

### 3.09 REMOVAL OF EXISTING HEADWALLS OR CULVERTS IN PREPARATION FOR EXTENSION OF EXISTING PIPE CULVERTS

- A. The Contractor shall remove existing headwalls and/or culverts in whole or in part as shown on the Drawings and shall perform all work called for, as shown on the drawings, and in the Specifications and which may be necessary to adapt existing pipe culverts for extension or reconstruction, including required excavation and backfilling. Except as otherwise provided for in the Specifications, the Contractor will determine the method of extending existing pipe culvert structures by consulting with the Engineer.

## PART 4 - MEASUREMENT AND PAYMENT

### 4.01 GENERAL

- A. The number of linear feet of pipe culvert installed will be determined by measuring the installed pipe culvert along its longitudinal axis and shall be paid for on the contract unit price per linear foot of pipe installed per the Specifications.
- B. The Cost of Riprap required per the Engineering Standard Drawings is to be included in the price per linear foot of pipe.
- C. Included in the L.F. cost is the 18 IN of bedding, and the removal and disposal of the excavated unsuitable soil.
- D. Below 18 IN, the bedding and removal and disposal of unsuitable soils will be paid for on the Cubic Yard, "C. Y.". basis.
- E. No additional payment will be made for the use of CLSM, or flowable fill, as backfill around culverts, but shall be considered subsidiary to the cost of the culvert pipe.

### END OF SECTION



## **SECTION 40 05 51 - VALVES AND ACCESSORIES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Valves and valve accessories used for water, chemicals, petroleum and other fluids used by the railroad.
2. Hose and fittings for hose reels.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 00 – Submittal Procedures
- B. Section 33 05 26 – Mechanical Identification
- C. Section 40 05 57 – Fuel System Motor Operated Valves

#### **1.03 REFERENCED STANDARDS**

##### **A. American Petroleum Institute (API):**

1. 594, Check Valves: Wafer, Wafer-Lug and Double Flange Type.
2. 600, Steel Gate Valves – Flanged and Buttwelding Ends.
3. 607, Fire Tests for Soft-Seated Quarter-Turn Valves.

##### **B. American National Standards Institute (ANSI).**

##### **C. ASTM International (ASTM):**

1. A216, Standard Specification for Steel Casings, Carbon, Suitable for Fusion Welding for High-Temperature Service.

##### **D. American Water Works Association (AWWA).**

##### **E. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS).**

#### **1.04 SUBMITTALS**

- A. Submit as specified in Section 01 33 00 - Submittals and Substitutions.
- B. Shop drawings required by this Section include, but are not limited by, the following:
  1. Manufacturer's product data for all components, drawings, operation and maintenance manuals and testing results if required.
  2. Piping diagrams for new or modified control valves.

### **PART 2 - PRODUCTS**

#### **2.01 OWNER SUPPLIED EQUIPMENT**

- A. None, or as indicated on drawings.

## 2.02 BALL VALVES

- A. Materials shall be of carbon steel body with 316 stainless steel ball and stem with Viton seals and or seats.
- B. Petroleum and industrial wastewater oil/sludge service.
  - 1. Valves 2-1/2 IN or larger – Two piece, full port, split body construction with ANSI 150 LB raised face flanged connections. Manufacturer shall be WKM Dynaseal or equal.
  - 2. Valves 1 to 2 inch – three-piece, standard port, bolted connections, with ANSI 150 LB raised faced, flanged connections.
  - 3. Valves 3/4 IN or smaller – Three-piece, standard port, bolted connection with threaded end connections. Manufacturer shall be Neles-Jamesbury or equal.
- C. Valves 2 IN and smaller for air and water service shall be of bronze or brass construction with two-piece body, bronze or brass ball, Viton seals and seats, removable operating lever and threaded end connections. Valves shall be rated not less than 500 psi non-shock cold WOG and shall be driptight in both directions. Apollo 70-100 series or equal.
  - 1. For compressed air:
    - a. Standard Ball Valves; Apollo 70-100 series or equal.
    - b. Block / Bleed Ball Valves; Apollo 7K-106-01.
- D. Valves 3 IN and larger for air service shall be of carbon steel construction with two-piece body, stainless steel ball, Viton seals and seats, removable operating lever and flanged end connections. Valves shall be rated not less than 285 psi non-shock cold WOG and shall be driptight in both directions.
  - 1. Valve box valves all sizes: Provide ductile iron construction with two-piece body, stainless steel ball, Viton seals and seats, removable operating lever and grooved end connections. Coupling gaskets shall be Nitrile with Gruvlok Xtreme lubricant or equal.
- E. Where noted, valves shall have a quick-closing, spring return handle.

## 2.03 BUTTERFLY VALVES

- A. Shall be ANSI 150 LB raised face single flanged lug style, carbon steel body, 316 stainless steel disc and shaft, TFE/316SS seat, high performance with a 275 psig working pressure.
- B. The disc shall have a double-offset design and be capable of bi-directional flow with the same flow characteristics.
- C. Valves for petroleum service located within tank dikes shall be certified “fire safe” per API 607.
- D. Valves 6 IN and smaller shall have a spring-loaded, squeeze trigger handle with locking device. Valve sizes 8 IN and larger shall have a weatherproof gear operator.
- E. Where noted or indicated on drawings, provide with valve actuator as specified herein. Valve and actuator shall be pre-assembled, tested and adjusted at the factory.

## 2.04 CHECK VALVES

### A. Fusible-link safety check valves:

1. Carbon steel body with stainless steel trim, quick closing swing check, 212 DegF fusible link.
2. Flange connections shall be ANSI 150 LB raised face.
3. Manufactured by Greenwood or equal.

### B. Petroleum and industrial wastewater fuel/oil/sludge service:

1. Valves shall be carbon steel and have flanged end connections unless otherwise noted and conform to ASME B16.34, Class 150. Provide stainless steel stem and trim for each valve. Valves shall have a weatherproof housing. Seats, body seals, and stem seals shall be Viton.
2. Swing type check valve – Shall be the full-opening, tilting disc, non-slam, swing type. Discs and seating rings shall be renewable without removing from the line. The disc shall be guided and controlled to contact the entire seating surface.
3. Wafer type check valve - Wafer type check valves may be provided in lieu of swing check valves in piping sizes larger than 4 inches. Valve shall be the dual-plate, double flanged, wafer type that conforms to API Std 594. Valve disc shall be constructed of ASTM A351/A351M, Grade CF8M stainless steel. Valve spring, hinge pin, stop pin, and radial-thrust bearing materials shall be constructed of Type 316 stainless steel. Manufactured by Marlin (Duo-Chek II) or equal.

### C. Check valves 3 IN and larger:

1. Carbon steel body with stainless steel pins and springs, Viton elastomers.
2. Valve shall be dual-plate, wafer style design to fit between raised face flanges suitable for 275 psig working pressure (API-594).
3. Manufactured by Marlin (Duo-Chek II) or equal.

### D. Check valves 2 IN and smaller: Forged steel, class 800, lift check with Viton elastomers. Socket welded or threaded.

### E. Check valves 2 IN and smaller shall be MSS SP-80, Class 125 brass or bronze construction with threaded or soldered end connections, Teflon packing and malleable iron handwheel. Class 150 valves meeting the above requirements shall be provided where system pressure requires.

### F. Check valves 2 IN and smaller for compressed air service shall be MSS SP-80, Class 125 brass construction with threaded end connections, Teflon packing. Class 150 valves meeting the above requirements shall be provided where system pressure requires. Kinston Model 205 or equal.

## 2.05 GLOBE VALVES

### A. 2 IN and smaller valves for air service shall be Class 150 valves of bronze construction with bronze seat, Viton disc, union bonnet, rising stem, Viton impregnated packing, and threaded ends.

## 2.06 PLUG VALVES (DB&B)

- A. Valve body shall be steel with drain plug and drain valve suitable for double block and bleed service. Plug seals shall be Viton. End connections shall be 150 LB Class flanged.
- B. Handwheel operator for valves 8 IN and smaller. Gear operator for valves 10 IN and larger.
- C. Valves shall be General Twin Seal or Orbit TruSeal.
- D. For Compressed Air Service:
  - 1. Valves 2 IN and smaller for air service shall be bronze construction with two-piece body, chrome plated ball, Viton seals and sets, and threaded end connections. Valves shall be rated not less than 500 psi non-shock cold WOG and shall be drip tight in both connections. Apollo 78-620.

## 2.07 OVERFILL PREVENTION VALVES

- A. Shall be utilized for aboveground diesel fuel storage tank applications with pressurized delivery systems to provide positive shutoff of product delivery with no line shock.
- B. Overfill prevention valves valve shall be hydraulically operated and shall be provided with a testable tank exterior or interior mounted float. Activation point of the float for opening and closing the high liquid level shut-off valve shall be as shown on the drawings. Upon a rise in fluid level to the float activation point, the float control system shall cause the main valve to close tightly. The main valve shall remain closed until a drop in tank fluid level occurs. Upon a drop in fluid level beneath the float activation point, the float control shall cause the main valve to open completely.
- C. Valve shall include the following features:
  - 1. Check valve feature.
  - 2. Ability to manually test the valve and the exterior/interior mounted float's automatic opening and closing of the valve.
  - 3. The valve shall be equipped with a minimum differential pressure pilot to maintain a differential pressure across the valve. Pressure shall be adjustable with a range of 5 to 25 psi.
- D. Valve shall meet all requirements for control valves as outlined in Subsection 2.08 below..

## 2.08 CONTROL VALVES

- A. Control valves shall be single-seated globe type, diaphragm actuated, hydraulically operated valves. In the event of diaphragm failure, valve shall fail closed against flow, unless otherwise indicated. The main valve shall be drip-tight when closed. Each valve shall have an external indicator to show the position of the valve disc at all times. Control valves shall be shipped from the factory as a complete assembly with all pilot controls and pilot auxiliary piping properly installed on the main valve. Materials for control valves, and items to be mounted on the valves shall be as follows:

1. Bodies, bonnets and covers shall be constructed of cast steel conforming to ASTM A216, Grade WCB or Ductile iron conforming to ASTM A536, and shall have flanged inlet and outlet connections. Valve shall have a screwed bottom drain plug.
2. Valve seat shall be stainless steel. Valve disc shall be Viton. Valve stem shall be stainless steel. All other materials shall be compatible with the fluid specified.
3. Pilot control system and auxiliary piping shall be stainless steel, seamless, fully annealed tubing conforming to ASTM A269, Grade TP316. Wall thickness for 1/2-inch tubing to 0.049-inch. Threaded connections shall be used in pilot system piping and shall be o-ring type with FKM o-rings. Tubing connections shall not be welded.
4. Solenoids for operation of pilot valves shall operate on 120 volts, 60 cycle, single phase, alternating current. A manual type operator or needle valve to bypass the solenoid valve shall be provided for emergency manual operation.
5. Pilot valves shall have the field adjusted start up setting engraved on a plastic tag, white with black lettering.

#### 2.09 SOLENOID VALVES

- A. Solenoid valves for air line control shall be ASCO Red Hat or equal, 2-way normally closed, 120VAC solenoid in NEMA 4 enclosure, 0 - 150 LB psig minimum pressure range. Valve size shall match pipe diameter.

#### 2.10 PNEUMATIC VALVE ACTUATORS

- A. Actuators shall be spring-return type pneumatic actuators that fail close upon loss of air pressure or electrical signal.
- B. Accessories include a 120V/60Hz single phase NEMA 4 (3-way) solenoid with two single-pole double-throw (SPDT) adjustable open/close limit switches and high visibility valve position indicator.
- C. Actuator output torque shall be sufficient to fully seat and open the valve with 80 psig air pressure.

#### 2.11 PRESSURE RELIEF VALVES

- A. For Petroleum and industrial wastewater service:
  1. Valves shall have integral flanged end connections and conform to ASME B16.34, Class 150 except as modified herein. Provide stainless steel stem and trim for each valve. Valves shall have a weatherproof housing. Seats, body seals, and stem seals shall be Viton.
  2. Valve shall be the fully enclosed, spring loaded, angle pattern, ball seated type with lift lever. Valve shall have corrosion-resistant valve seats. Valve stem shall be fully guided between the fully opened and fully closed positions. Valve shall be factory set to open at the indicated pressure (plus or minus ten percent deviation). Valve set point shall be field adjustable within a minimum range of plus or minus 20 percent of the indicated set point. Valves shall be installed vertically oriented unless otherwise allowed by the manufacturer.

3. For thermal relief applications where inventory control is not involved, a flange insert spring check valve may be used. Provide carbon steel insert check valve, class 600 for use in schedule 80 piping, with 10 psig cracking pressure, Check-All F6 or approved equal.

#### 2.12 HOSE END ACCESSORIES

- A. Lube oil: The hose assembly shall have a 1" MPT swivel connection on both ends fitting with male pipe threads and a OPW 210 drip proof nozzle and spout or equal.
- B. Compressor oil: The service end of the hose shall have a fitting with male pipe threads. The nominal pipe size of the service end hose fitting shall be the same size as the inside diameter of the hose.
- C. Compressed air: The service end of the hose shall have a 1/2 IN quick disconnect fitting for air-operated tools.
- D. Radiator water: Provide a non-dripping (when fully closed) ball valve at the end of the pendant length of hose. The ball valves shall be "Clincher Type 2000" manufactured by Jamesbury Corporation or equal. Valves shall have brass bodies with stainless steel trim and TFE seats. Downstream of valve provide an additional foot of hose cut at one end and threaded to valve at the other.

### PART 3 - EXECUTION

#### 3.01 GENERAL

- A. Install where indicated on the drawings and in accordance with Manufacturer's recommendations.
- B. Inspect valves and equipment for cleanliness, corrosion, and operability prior to installation.
- C. Actuate valves through an open-close cycle and examine for proper movement and seating.

#### 3.02 VALVE AND EQUIPMENT INSTALLATION

- A. Arrange all valves during installation such that operating handles and controls are accessible and have sufficient clearance for proper operation.
- B. Provide spool pieces or spacers in the piping as necessary to ensure valve parts, operators, and butterfly discs have sufficient operating clearances.
- C. Ensure valve actuators are properly wired and adjusted to proper torque and limit settings.

#### 3.03 TUBING INSTALLATION

- A. Route, assemble and tighten tube and fittings as recommended by the manufacturer to interconnect the instrumentation and equipment provided.

#### 3.04 VALVES

- A. Unless shown otherwise on Drawings and drawing schedules, provide valves as follows:

SERVICE	LOCATION	MANUFACTURER MODEL#	SIZE	END CONNECTION	TYPE
Compressed Air (CA)	Hump Air System	Nibco F-515-CS-F-66-FS	3 IN and Larger	150 LB ANSI Flange	Ball valve, carbon steel construction with two-piece body, stainless steel ball, Viton seals and seats, removable operating lever.
	Hump Air System	Apollo 70-100 series	2 IN and smaller	Threaded	Ball valve, bronze or brass construction with two-piece body, bronze or brass ball, Viton seals and seats, removable operating lever.
	Hump Air Valve Boxes	Gruvlok Series 7500	All sizes	Grooved	Ball valve, ductile iron construction with two-piece body, stainless steel ball, Viton seals and seats, removable operating lever. Coupling gaskets shall be Nitrile with Gruvlok Xtreme lubricant or equal
	Yard Air & RIP Container	Apollo	2 IN and smaller	Threaded	Ball valve, ANSI Class 600 with lever handle, carbon steel body, Teflon seats, stainless steel trim and NPS ends. See Section 22 15 10.
	Yard Air System	American Valve Model 4000	2 IN and 3 IN	150 LB ANSI Flange	Curb Valve; 125# full port ball valve with 2 IN SQ key stem. See Detail 9/U502.
	Yard Air System	Apollo 70-100 series	2 IN and smaller	Threaded	Ball valve, bronze or brass construction with two-piece body, bronze or brass ball, Viton seals and seats, removable operating lever.
	Yard Air System	Apollo 7K-106-01	2 IN and smaller	Threaded	Block / Bleed Ball Valves, bronze or brass construction with two-piece body, bronze or brass ball, Viton seals and seats, removable operating lever .
	Yard Air System	Apollo 78-620	2 IN and smaller	Threaded	Plug valve, bronze construction with two-piece body, chrome plated ball, Viton seals and sets.
	Yard Air System	Kinston Model 205	2 IN and smaller	Threaded	Check valve, MSS SP-80, Class 125 brass construction with threaded end connections, Teflon packing. Class 150 valves
Industrial Waste Force (IWF)	RIP Canopy	Apollo 70-100 series	2 IN and smaller		Ball valve, bronze or brass construction with two-piece body, bronze or brass ball, Viton seals and seats, removable operating lever
	RIP Canopy	Nibco 413B	2 IN and smaller	Threaded	Check valve, MSS SP-80, Class 125 brass or bronze construction with threaded or soldered end connections, Teflon packing, horizontal swing, renewable disc.
Oxygen (OX)	RIP Canopy	Rexarc 1-02-1238	1 1/2 IN and smaller	Threaded	Ball valve, 300 psi WOG, forged brass uni-body, Teflon seat, reinforced stem packing, ball thrust washer, stainless steel ball, lever handle. Rated for oxygen service
	RIP Canopy	Rexarc 2-01	1 1/2 IN and smaller	Threaded	Check valve, brass body, stainless steel operating spring and valve disc, Buna-N seat, UL listed, meet or exceed requirements of CGA.
Acetylene (ACT)	RIP Canopy	Rexarc 1-02-1238	1 1/2 IN and smaller	Threaded	Ball valve, 300 psi WOG, forged brass uni-body, Teflon seat, reinforced stem packing, ball thrust washer, stainless steel ball, lever handle.
	RIP Canopy	Rexarc 2-01	1 1/2 IN and smaller	Threaded	Check valve, brass body, stainless steel operating spring and valve disc, Buna-N seat, UL listed, meet or exceed requirements of CGA.
Domestic Cold Water (DCW)	RIP Canopy	Apollo 70-100 series	2 IN and smaller	Threaded	Ball valve, bronze or brass construction with two-piece body, bronze or brass ball, Viton seals and seats, removable operating lever

## END OF SECTION

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## **SECTION 40 05 57 - FUEL SYSTEM MOTOR OPERATED VALVES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. This section of the specification includes general valves for use in isolating various segments of the diesel fuel system. This section also includes motor operators. General values specified in this section include the following:
  - a. Ball Valves, 2 1/2" - 8"
  - b. Butterfly Valves, 10" and Over
  - c. Motor Operators

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 00 – Submittal Procedures
- B. Section 33 05 26 – Mechanical Identification

#### **1.03 REFERENCED STANDARDS**

- A. American Petroleum Institute (API)
  1. 6D – Specification for Pipeline Valves
  2. 6FA – Specification for Fire Test for Valves
  3. 607 – Fire Test for Soft-Seated Quarter-Turn Valves
  4. 609 – Butterfly Valves: Double Flanged, Lug and Wafer-Type
- B. American Society of Mechanical Engineers
  1. 16.34 – Valves – Flanged, Threaded, and Welding End.
- C. Underwriters Laboratory (UL)
- D. Oil Companies Materials Association (OCMA)
- E. American Society of Mechanical Engineers (ASME)
- F. Factory Mutual (FM)

#### **1.04 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Submittals shall include, but not be limited to:
  1. All valves and accessories, indicating the make, model, type, material, size, and pressure rating.
  2. Actuators

## 1.05 QUALITY ASSURANCE

- A. The valve and motor operator manufacturers shall have products in satisfactory use in similar applications for a minimum of five years.
- B. Valves and motor operators shall be of the same Manufacturer throughout. Manufacturer's name and pressure rating shall be located on a permanent nameplate on outside of valve.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

#### A. BALL VALVES (2-1/2-inch to 8"):

- 1. The valve shall be Flow-Tek Model F15 or approved equal. The valve shall be of two-piece full port ball valve. The valve shall be capable of not less than 275 psi, and shall have a working temperature range of at least -20°F to 300°F.
- 2. Valves shall consist of carbon steel, two part assembly with replaceable body seal of SS316/Graphite. The ball and stem shall be 316 Stainless Steel. The replaceable ball seat shall be 15% RPTFE and stem packing shall be constructed of Graphite.
- 3. Valves shall have a "fire safe" rating per API 607.
- 4. Valves shall have a lever type handle with vinyl grip and a 90-degree stop on the extended stem. Handle shall be carbon steel suitable for padlocking in both the open or closed position.
- 5. All valves shall have ANSI 150# raised face flanged connections.
- 6. Reference Specification
  - a. Valve Size: 2 1/2" to 8"
  - b. Type: Ball Valve, Two Piece, Flanged, Full Port
  - c. Pressure class: ANSI Class 150 with rated working pressure of the valve to be not less than 275PSI
  - d. End Connections: ANSI class 150 raised face
  - e. Body Material: ASTM A216 WCB Carbon Steel
  - f. End Cap: ASTM A351 CF8M Stainless Steel
  - g. Ball Material: ASTM A351 CF8M Stainless Steel
  - h. Stem Material: ASTM 479 Type 316 Stainless Steel
  - i. Ball Seat: TFM 1600 (RPTFE)
  - j. Body Seal: Spiral Wound, 316/Graphite
  - k. Stem Packing: RPTFE/Graphite
  - l. Fire Safe: Valves shall have a "Fire Safe" rating per API 607

#### B. QUARTER TURN BUTTERFLY VALVES (10" and Over)

1. Butterfly valves shall be used for bi-direction bubble-tight shut-off of flow within the system. Valves shall be mounted between ANSI Class 150 flanges with rated working pressure of the valve to be not less than 275 psi.
2. The valves shall have a carbon steel ASTM, A216 full lug body, drilled and tapped lugs, 316 ASTM stainless steel disc, stainless steel stem, and 316 stainless steel seat with TFE insert material. Valves shall have a “fire safe” rating per OCMA and/or API 607.
3. Valves shall be WKM “Dynacentric”, Posi-Seal “Phoenix III”, FlowSeal “Fire-Flow”, or approved equal.
4. Reference Specification:
  - a. Valve Size: 10” and larger
  - b. Type: Butterfly, High Performance
  - c. Pressure class: ANSI class 150 with rated working pressure of the valve to be not less than 275PSI
  - d. End Connections: Lug
  - e. Body Material: ASTM A216 WCB Carbon Steel
  - f. Disc Material: ASTM A351 CF8M Stainless Steel
  - g. Stem Material: 17-4PH Stainless Steel
  - h. Seat Material: 316L Stainless Steel
  - i. Seal Ring: Stainless Steel & Graphite
  - j. Leakage: Zero leakage per API 598 in the direction specified
  - k. Fire Safe: per OCMA and/or API 607

#### C. ELECTRIC VALVE ACUATORS FOR quarter-turn valves

1. General: Actuators, their controls and accessories shall be the responsibility of the valve/actuator supplier for sizing, assembly, certification, field-testing and any adjustments necessary to operate the valve as specified. The electric valve actuators shall include as an integral unit, but not be limited to, the electric motor, actuator unit gearing, reversing starter, limit switch gearing, position limit switches, torque switches, drive bushing or stem nut, declutch lever, control power transformer, local controls, communication card, wiring terminals for power, remote control and indication connections, and hand-wheel. The electrically actuated valves are used as isolation valves and shall be set to close completely in a maximum of 45 seconds and designed to fail in position.
2. Design basis is for Rotork IQ series motor actuators, no substitutions.
3. The actuators shall be suitable for use on a nominal volt, phase and Hz power supply as specified in the engineering design documents.

4. Actuator Sizing: The actuator shall be sized to guarantee valve closure at the specified differential pressure and temperature. The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal. For linear operating valves, the operating speed shall be such as to give valve closing and opening at approximately 10-12 inches per minute unless otherwise stated in the data sheet. For 90° valve types the operating time will be specified.
5. Enclosure
  - a. The valve actuator motor and all electrical enclosures shall be rated NEMA 4X and shall be suitable for operation in a Class I Division 1 Groups C and D outdoor location.
  - b. The valve actuator shall be suitable for mounting in the vertical or horizontal positions as required.
  - c. Actuators shall be suitable for indoor and outdoor use. The actuator shall be capable of functioning in an ambient temperature ranging from -33°C (22°F) to 70°C (140°F), up to 100% relative humidity. Actuators for hazardous area applications shall meet the area classification, gas group and surface temperature requirements specified in engineering design documents.
6. Motor
  - a. The electric motor shall be specifically designed for valve actuator service and shall be of high starting torque, totally enclosed, non-ventilated construction.
  - b. Motor insulation shall be a minimum NEMA Class F, with a maximum continuous temperature rating of 155 degrees C (rise plus ambient) for the duty cycle specified.
  - c. The motor shall be of sufficient size to open or close the valve at the maximum stated torque. The motor shall be capable of complete operation at plus or minus 10 percent of specified voltage. The motor duty rating shall be sufficient for one complete cycle (open-close-open, or close-open-close) without exceeding its temperature rating or rated to allow 15 minute operation at 33 percent of maximum rated torque without exceeding its temperature rating. Motor bearings shall be of the antifriction type and permanently lubricated.
  - d. The motor shall be an independent removable subassembly to allow for motor or gear or ratio changes dictated by system operation requirements.
    - 1) The motor shall be equipped with internal thermal sensors embedded in the windings to protect against motor overload. Maximum temperature rating of motor shall be T3B-329° F as defined by NFPA 70. Thermostats shall automatically set.
  - e. A motor winding heater shall be provided in the motor. Space heaters shall be powered via the motor input power supply.
7. Integral Starter and Transformer:

- a. The reversing contactor starter, control transformer and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation buildup.
  - b. The starter shall be suitable for 60 starts per hour and shall comprise mechanically and electrically interlocked reversing contactors of rating appropriate to motor size.
  - c. Control power to be specified by the engineer. Control power to be a nominal voltage, phase and Hz.
    - 1) Supply for local controls and indication, and where required, for remote control.
  - d. Easily replaceable cartridge-type fuses shall protect the primary and secondary windings.
8. Power Gearing:
- a. The actuator shall be a single or multiple reduction unit with power gearing consisting of spur, helical or bevel gears and/or worm gearing. The spur, helical, or bevel gearing and worm shall be of hardened alloy steel, and the worm gear shall be alloy bronze. All gearing shall be accurately cut. Nonmetallic aluminum or cast gearing shall not be allowed.
  - b. All gears and shafting shall be supported on anti-friction bearings. Where thrust is a consideration, tapered roller bearings (to accept thrust) shall be provided.
9. Lubrication:
- a. All rotating power train components shall be immersed in grease or oil with provisions for inspection and re-lubrication without disassembly.
  - b. Seals shall be provided at all exit points of the gear case to prevent leakage of lubricant. Critical areas subject to high wear shall be double sealed.
  - c. Lubricants shall be suitable for ambient conditions of minus 20 degrees F to 150 degrees F.
10. Lost-Motion Device:
- a. The actuator shall have a built-in device (independent of gear backlash), incorporated in the power train, to permit load impact under dynamic efficiency conditions, with a hammer blow effect, to allow the motor to reach full speed before engaging the valve load.
11. Manual Operation:
- a. Integral to the actuator shall be local controls comprising push-button switches for Open, Close and Stop, and a Local/Remote selector switch pad-lockable in any one of the following three positions: Local control only, Off (no electrical operation), Remote control plus local stop only.

- b. A metallic hand-wheel shall be provided for manual operation. An arrow and the word "open" to indicate open rotation direction shall be provided. The hand-wheel shall operate in the clockwise direction to close. The hand-wheel shall not rotate during motor operation and operation by hand-wheel shall not rotate during motor operation and operation by hand-wheel shall not cause the motor to rotate.
- c. A fused motor shall not prevent manual operation.
- d. When in the manual operating mode, the actuator will remain in this mode until the motor is energized, at which time the actuator will automatically return to electric operation. Use of the hand-wheel shall not negate the hammer blow feature.
- e. The hand-wheel shall require an effort of no more than 80 pounds on the rim for seating or unseating load, or 60 pounds for running load.
- f. Movement from motor operation to hand-wheel operation shall be accomplished by a positive declutch lever which mechanically disengages the motor and related gearing. Declutch lever shall be pad-lockable in either the manual (hand-wheel) or motor mode.
- g. It shall be impossible for simultaneous manual and motor operation to occur. Friction type declutch mechanism is not acceptable.

#### 12. Stem Nut:

- a. The valve actuator shall have a removable stem nut (or drive bushing) of high tensile bronze or other material compatible with the valve stem material.

#### 13. Position Limit Switches:

- a. Position limit switches and the associated gearing shall be an integral part of the valve actuator. Limit switch gearing shall be functional at all times, whether the unit is operated electrically or manually.
- b. Gearing shall be made of bronze or stainless steel, grease lubricated and totally enclosed to prevent dirt and foreign matter from entering the gear train.
- c. Switches shall be field adjustable, allowing for trip points from fully open to fully closed positions or any intermediate point of valve travel. They shall not be subject to breakage or slippage due to over-travel.
- d. Limit switch contacts shall be heavy-duty, silver or silver plated
- e. Provide a minimum (4) programmable contacts. Contacts shall be convertible from N/O to N/C or reverse. Use of cams or setscrews in securing switches or the drive system is unacceptable.
- f. Switch design shall permit visual verification of switch position without disassembly.

#### 14. Microprocessor Control Unit

- a. Each valve actuator shall be provided with an electronic microprocessor based control unit (field unit) as an integral part of the valve actuator enclosure.

- b. The field unit shall also allow for 120 VAC input/output (I/O) control. Field unit shall accept dry contact closures from remote devices as inputs and shall open/close integral dry contacts for interface with (1) remote hardwire programmable logic controller (PLC) located in the Fuel System Control Panel and (2) dry contact inputs from tank High High Level Switches signaling emergency closing of valve on fuel storage tanks inlets.

15. Torque Switch:

- a. Each valve actuator shall be equipped with a switch that will interrupt the control circuit in both the opening and closing directions when valve torque overload occurs or when valves require torque seating in the closed or open position.
- b. Contacts shall be silver or silver plated having a minimum rating of 5 amperes (break) inductive at 120 volts ac.
- c. The torque switch shall be independently adjustable for both open and close directions of travel, with a positive means to limit the adjustability so as not to exceed the actuator output torque capability.
- d. Switch design shall permit visible verification of switch position without disassembly.

16. Control Compartment Heating:

- a. The control compartment shall be provided with a space heater suitable for operation from the motor power supply power.

17. Start-Up Kit:

- a. Each actuator shall be supplied with a start-up kit comprising installation instruction, electrical wiring diagram and sufficient spare cover screws and seals to make good any site losses during the commissioning period.

18. A non-intrusive hand-held programmer must be provided and left with Owner at completion of project. Hand-held programmer shall be micro-processor based and shall be capable of two-way communication for uploading and downloading all actuator variables and performing detailed diagnostics.

19. Actuator Operating Conditions

- a. Actuators shall be capable of operating with a 275-psi upstream to downstream line pressure differential, with corresponding 275 psig upstream and 0 psig downstream pressures, while complying with hand-wheel requirements specified in paragraph I.

20. Performance Test Certificate:

- a. Each actuator must be performance tested and individual test certificates shall be supplied free of charge. The test equipment should simulate a typical valve load and the following parameters should be recorded.
  - 1) No load current
  - 2) Current at max torque setting
  - 3) Stall current

- 4) Torque at max torque setting
  - 5) Stall torque
  - 6) Test voltage and frequency
  - 7) Flash test voltage
  - 8) Actuator output speed
- b. In addition, the test certificates should record details of specification such as gear ratios for both manual and automatic drive, closing direction, wiring diagram code number and, when applicable, remote position transmitter resistance and interposing relay voltage.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Valves shall be installed in accordance with manufacturer's recommendations and as indicated on the plans.
- B. Each valve shall be installed in an easily accessible location such that valve operator shall not have to interfere with adjacent equipment for operation and maintenance. Provide spool piping, whether indicated on the drawings or not, if required for proper movement of valve operator and disc.
- C. Replace all valves that prove defective during system testing.
- D. Install all butterfly valves with valve shaft in the horizontal position.
- E. Manufacturer's Service Engineer
  1. Furnish the services of an experienced motor operator service engineer for a minimum of two days on the jobsite to verify proper installation and assist in start-up, check-out and calibration. Allow for two separate trips to the jobsite if required by the construction schedule. Service engineer shall be fully qualified to troubleshoot and correct both mechanical and electrical issues with motor operated valves. If required to meet this criteria, provide two service engineers on the jobsite to commission system. Electrical issues shall include power, control via hardwire controls, electrical programming of actuator, communications card in MOVs, communication to Pakscan P3 controller and to troubleshoot P3 controller issues.

### **END OF SECTION**



## **SECTION 40 42 00 - MECHANICAL INSULATION**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Furnishing and installing of insulation, jackets, and accessories for mechanical piping, ductwork, tanks and equipment. Building insulation materials are specified in other sections.
- B. Materials furnished and installed under this section shall be in full conformity with the drawings, specifications, engineering data, instructions, and recommendations furnished by the insulation manufacturer unless exceptions are approved by the Owner.

#### **1.02 REFERENCED STANDARDS**

##### **A. ASTM International (ASTM):**

1. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
2. C533, Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
3. C534, Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
4. C574, Standard Specification for Mineral Fiber Pipe Insulation.
5. C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
6. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

#### **1.03 SUBMITTALS**

- A. Submit as specified in Section 01 33 00.
- B. Product Data – Submit manufacturer's technical product data and insulation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

#### **1.04 QUALITY ASSURANCE**

- A. Flame / Smoke Ratings – Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics, and adhesives) with flame-spread index of 25, or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, provide products of one of the following:
1. Armstrong.
  2. CertainTeed Corp.
  3. Knaff Fiberglass.
  4. Manville Products Corp.
  5. Owens-Corning Fiberglass Corp.
  6. Pittsburgh Corning Corp.

### 2.02 PIPING INSULATION

- A. Type PMF1 pipe insulation shall be a mineral fiber pipe insulation. The insulation shall be a one-piece molded glass fiber pipe insulation with all-purpose jacket. The all-purpose jacket shall be a factory applied fiberglass reinforced vapor barrier type with white kraft bonded aluminum foil and self-sealing adhesive lap. The insulation shall be suitable for a temperature range of -20 to 450 DegF and shall have a maximum thermal conductivity (k) of 0.24, at 75 DegF. The insulation shall conform to ASTM C547. Manufacturer shall be Fibrex "Epitherm 1200" or equal.
- B. Type PMF2 pipe insulation shall be a high temperature mineral fiber pipe insulation. The insulation shall be sectional or segmented mineral fiber forms with thermosetting binder suitable for a maximum temperature of 1200 DegF, and shall be provided in multiple layers. Fittings and valves shall be insulated with factory made molded fiber fittings or built up sections of pipe covering. The insulation shall conform to ASTM C547. Manufacturer shall be Fibrex "Epitherm 1200" or equal.
- C. Type PFC1 pipe insulation shall be a one-piece, molded elastomeric or polyolefin foam insulation. The insulation shall be suitable for a temperature range of -40 to 210 DegF, and shall have a maximum thermal conductivity (k) of 0.28 at 75 DegF. The insulation shall be suitable for exposure to weather and direct sunlight or where not indicated to be jacketed, shall be suitable for exposure to weather and direct sunlight or where not indicated or be jacketed, shall be given two coats of ultraviolet resistant finish as recommended by the manufacturer. The insulation shall conform to ASTM C534. Manufacturer shall be Armstrong "Armaflex", Rubatex "R-180-FS", IMCOA "Imcolock / Imcoshield", or equal.

### 2.03 DUCTWORK INSULATION

- A. Flexible Fiberglass Ductwork Insulation: ASTM C533, Type 1, Class B-4.
- B. Rigid Fiberglass Ductwork Insulation: ASTM C612, Class 1.

### 2.04 TANK AND EQUIPMENT INSULATION

- A. Tank and equipment insulation shall be closed cell, flexible foamed plastic in sheet form. Insulation shall have a K factor of 0.28, maximum, at 75 DegF mean temperature and shall have a built-in vapor barrier.

## 2.05 ALUMINUM INSULATION JACKETS

- A. Insulation jackets shall be furnished and installed piping systems as indicated herein and on the drawings.
- B. Fittings in insulated piping systems and piping or equipment where indicated shall be provided with an aluminum jacket. Piping systems where indicated to have aluminum jackets shall be insulated with the same aluminum jacketing material.
- C. The aluminum jacket shall comply with ASTM B209 Alclad 3004 requirements. Jacketing shall be a nominal minimum thickness of 0.020 IN with an embossed finish. A factory asphalt and kraft paper vapor barrier or polyethylene film and kraft paper vapor barrier shall be applied to the full width of the jacket.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. The Contractor shall install all insulation materials as required and as specified herein for the piping systems, ductwork, tanks and equipment which is not factory insulated.
- B. Insulation materials shall be installed in accordance with the manufacturer's written instructions and recommendations. Surfaces to be insulated shall be cleaned and dried.
- C. Insulation shall be kept clean and dry and shall not be removed from the factory container until it is installed. Packages or factory containers shall bear the manufacturer's stamp or label indicating the name of the manufacturer and the description of materials.
- D. Seams in exposed insulation and jackets shall be located in the least visible location.

### 3.02 PIPING INSULATION

- A. General:
  - 1. Apply insulation to clean, dry piping with joints tightly butted.
  - 2. Adhere "factory applied vapor barrier jacket lap" smoothly and securely at longitudinal laps with a white vapor barrier adhesive.
  - 3. Adhere 3 IN wide self-sealing butt joints strips over end joints.
  - 4. Fittings:
    - a. Insulate fittings with same type and thickness of insulation as pipe, with ends of insulation tucked snugly into throat of fitting and edges adjacent to pipe insulation tufted and tucked in.
    - b. Cover insulation with one piece PVC fitting cover secured by taping ends to adjacent pipe covering.
    - c. Contractor Option – built-up to equivalent thickness with insulating cement. Finish jacket to adjacent piping. Jacket to extend 2 IN into adjacent insulation.

5. Valves – Insulate and finish by one (1) of the following:
  - a. With hydraulic setting insulating cement, or equal, to a thickness equal to adjoining pipe insulation.
  - b. With segments of molded insulation securely wired in place.
  - c. With prefabricated covers made from molded pipe insulation finished with vapor barrier adhesive.
  - d. One-piece PVC insulated cover with cover secured by taping the ends to adjacent pipe covering.

B. Type PMF1 Insulation:

1. Insulation shall be installed to cover piping, fittings and appurtenances. Insulation shall be full length of the factory unit using a single cut piece to complete the run. Abutting cut pieces or scraps shall not be used. The insulation end joints and longitudinal seams shall be tightly butted. Insulation for fittings shall be of the same thickness and conductivity as the adjoining pipe insulation.
2. Insulated pipe conveying fluids below ambient temperatures shall be insulated with a continuous vapor barrier. The insulation shall be continuous through hangers and penetrations, except at firewall penetrations, and sealed off with vapor barrier coating. The vapor barrier coating shall be at intervals not exceeding 15 FT-0 IN for straight runs and not more than 6 IN from fittings. Fibrous insulation laps and butt strips shall be secured with adhesive and stapled if not factory self-sealing. Staples and seams shall be coated with vapor barrier coating.
3. On piping 2 IN or larger where insulation is continuous through the hanger, an insert shall be installed between the support shield and piping. The insert shall be the same thickness and contour as the adjoining insulation and installed to maintain a continuous vapor barrier through the support. Insert material shall be constructed of wood or heavy density insulating material suitable for the system operating temperature range.

C. Type PMF2 Insulation:

1. The insulation shall be installed in layers as required to obtain the specified minimum thickness. Joints between insulation sections and sections or segments shall be staggered between insulation layers.
2. The insulation shall be applied with tight seams and joints using stainless steel wire loops on 6 IN centers. The wire shall be embedded into the outer layer of the insulation and all cracks, voids, and depressions shall be filled with insulating cement suitable for the piping temperature. The surfaces to receive outer coverings shall be smooth and uniform. Flanges and exhaust piping shall not be insulated.

### 3.03 DUCTWORK SYSTEMS INSULATION

- A. Insulate ductwork in accordance with the manufacturer's recommendations and as shown on the drawings.

### END OF SECTION

## **SECTION 40 46 20 - HYDRO-POX CORROSION CONTROL LINING SYSTEM**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This application data-sheet covers surface preparation, application, inspection and testing of the HYDRO-POX 212 GL protective lining system.
- B. HYDRO-POX lining systems with documented resistance to microbial influenced corrosion, hydrogen sulfide gases, and other chemicals will fill, coat, seal, and protect the interior concrete surfaces of manholes, wet wells, clarifiers, digesters, sedimentation basins, sludge thickeners, chlorine contact basins, and all related collection and treatment system substrates. When applied in accordance with this application data-sheet.

#### **1.02 CONTRACTORS**

- A. The ultimate performance of HYDRO-POX depends on application by Licensed Professional Applicators, which shall be manufacture approved on a non-exclusive basis.

#### **1.03 QUALITY ASSURANCE**

- A. The Contractor shall quality assure all work prior to owner furnished inspection.

#### **1.04 INSPECTION**

- A. The entire procedure of inspection; surface preparation and application should be inspected. Such inspection shall not relieve the contractor from its responsibility to furnish materials and perform work in accordance with these procedures.
- B. When the owner furnishes an inspector, all coating work shall be done in the presence of the inspector. Any coating work done in the absence of the inspector is subject to rejection unless specifically allowed by the inspector.

### **PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)**

### **PART 3 - EXECUTION**

#### **3.01 SURFACE PREPARATION**

- A. All surfaces to be coated with HYDRO-POX 212 GL must be clean, sound, dry and have an “open” capillary system to ensure penetration and mechanical bond (adhesion). Remove all dirt, dust, cement laitence, efflorescence, form release agents, curing compounds, grease, oils, growths, etc. Surface preparation is best accomplished by mechanical means, such as abrasive air blasting or high pressure water blasting above 5000 psi to achieve an anchor pattern similar to coarse sandpaper. For concrete reference applicable standards, ASTM D4259 or NACE RPO892-92.

- B. Any ferrous metal surface contained within the structure to be lined shall be cleaned according to SSPC SP-10, or NACE #2 and coated prior to flash rusting.

### 3.02 APPLICATION

- A. All prepared concrete surfaces shall be fully saturated with HYDRO-POX 251 penetrating primer. (See HYDRO-POX 251 Data-sheet.)
- B. For optimum application properties pre-condition material to 70 - 80 DegF prior to mixing and application. Mix the entire contents of A + B with a power mixer, scraping the sides until a smooth homogenous consistency is obtained. Jiffy mixers have been proven to be very effective. Material is supplied as a unit. Do not apply material below 40 DegF.
- C. The lining system shall be applied over a freshly primed in a single-coat multiple-pass application to achieve an 80 - 150 mil thickness. Successive coats must be applied within the re-coat time period for proper bonding (See HYDRO-POX 212 GL data-sheet). For successive coats applied after the re-coat interval has been exceeded, a sweep blast will be necessary to remove any gloss to achieve a 2 - 4 mil anchor pattern to achieve proper bonding.
- D. Eliminate pin-holing, and shadowing, of the applied HYDRO-POX 212 GL system by fully saturating the surface with HYDRO-POX 251, and applying HYDRO-POX 212 GL in a decreasing temperature or shaded surface condition. Always use a multiple pass method when applying.
- E. Complete cure of the HYDRO-POX system will take 3 days. Down time is avoided by allowing a structure to be returned to service after a thin film set. For immersion, a minimum 24 HR cure is required.

### END OF SECTION

## **SECTION 40 46 50 - CATHODIC PROTECTION - IMPRESSED CURRENT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. A complete Cathodic Protection system shall be installed as indicated on the Drawings, including all necessary materials and labor for testing.
2. The Cathodic Protection system shall be installed in accordance with the provisions of the specifications, applicable plans, codes and standards, and is subject to other terms and conditions of the project.

##### **B. Design Criteria:**

1. The cathodic protection system shall be designed in accordance with the minimum standards established for the structure(s) by the National Association of Corrosion Engineers.
  - a. Theoretical Design Life: 30 years (minimum).
  - b. Criteria for Protection: The NACE -850 mV 'Instant Off' criterion shall be used as the primary criterion or as an approved equal 100 mV depolarization criterion to a Cu/CuSO<sub>4</sub> reference electrode for the tank bottom cathodic system. It is noted that the -850 mV 'Instant Off' criterion may require additional cathodic current that may have a tendency to dry the sand surrounding the anode and also create depolarizing gasses

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Section 01 33 00 – Submittals**

##### **B. Section 26 05 00 – Electrical Basic Requirements**

#### **1.03 REFERENCED STANDARDS**

##### **A. National Association of Corrosion Engineers (NACE):**

1. RP0193 "External Cathodic Protection of ON-Grade Carbon Steel Storage Tank Bottoms" (latest edition)

##### **B. Underwriter' Laboratories, Inc. (UL) Publications:**

1. Standards for Safety

##### **C. National Fire Protection Association (NFPA):**

1. No. 70: National Electrical Code (NEC)

##### **D. Institute of Electrical and Electronic Engineers (IEEE):**

1. Standards and Specifications

##### **E. American Society for Testing and Materials (ASTM):**

1. Testing Methods and Materials

#### 1.04 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Manufacturer's Product Data: Submit material specifications and installation data for products specified under Part 2 - Products, to include:
  - 1. Rectifier
  - 2. Remote monitoring
  - 3. Reference Electrode
  - 4. Junction Box
  - 5. MMO Wire Anode
  - 6. Conductors/Cable
  - 7. Copper Crimps
  - 8. Exothermic Weld
- C. Shop Drawings: Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract documents.
- D. Record Drawings:
  - 1. Provide a complete set of system manufacturer's product data and shop drawings indicating all post bid revisions and field changes.

#### 1.05 QUALITY ASSURANCE

- A. Coordinate the system installation with the contract documents and other contractors. Adjust installation to eliminate conflicts and provide the fastest overall installation schedule.
- B. All materials shall be new.
- C. Where equipment, materials or systems are specified by designation of manufacturer, such designation is intended to convey the minimum requirements for construction, electrical characteristics and ratings, and operating function. Equipment having electrical characteristics and ratings, construction features and operating functions not less than those specified shall be acceptable upon approval of the Engineer.
- D. Design Responsibility:
  - 1. Contractor shall include in his Bid to provide services of a Corrosion Engineer who is a NACE-certified Corrosion Specialist or Cathodic Protection Specialist. Qualifications of the Corrosion Engineer shall be provided.
  - 2. The Contract Documents establish the design intent of the cathodic protection system and include schedules, notes, and typical details to show the major system components and suggested methods of installation.
  - 3. The installed cathodic protection system shall meet the minimum requirements indicated, include components not indicated but necessary for proper function and performance, and shall be a complete and operational system.



4. Cathodic protection Suppliers shall be firms regularly engaged in the fabrication of the materials required by this Specification whose products have been in satisfactory use in similar service for not less than 5 years. The products of any reputable Supplier regularly engaged in the commercial production of cathodic protection materials required by this Specification will not be excluded on the basis of minor differences, provided all essential requirements of the specification relative to materials, capacity, and performance are met.

E. DRAWINGS:

1. The drawings indicate the arrangement of cathodic protection equipment. Coordinate the installation of the cathodic protection equipment other disciplines.
2. Do not scale drawings. Obtain dimensions for layout of equipment from Civil, Mechanical or Architectural plans unless indicated on Electrical plans.
3. Bring all discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions to the immediate attention of the Engineer.

F. DEVIATIONS:

1. The Contractor shall provide written notice of any deviations from the requirements of the contract or construction documents that are proposed. The Contractor remains liable for any deviations unless reviewed and written acknowledgment is received from the Engineer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Inspect material upon arrival at Project and verify conformance to Contract Documents. Prevent unloading of unsatisfactory material.
- B. Provide trailers or shed for storage of materials, equipment, tools, etc., requiring such a facility. Contractor shall provide areas for general storage and storage trailers or sheds. Provide a dry, weather-tight place for storing materials requiring protection from weather.
- C. Store packaged materials in original undamaged condition with manufacturer's labels and seals intact.
- D. Handle and store materials in accordance with manufacturer's and supplier's recommendations and in manner to prevent damage to materials during storage and handling. Replace damaged materials.
- E. Containers which are broken, opened, watermarked, or otherwise damaged materials are unacceptable and shall be removed from premises.
- F. Provide protection against direct sunlight, rain, snow, wind, ice, or heat for suitable storage of materials or equipment delivered to site to be incorporated into Project.
- G. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Conditions shall be those for which the equipment or materials are designed to be installed. Equipment and materials shall be protected from water, direct sunlight, cold or heat. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.

- H. Damaged, oxidized, warped, or improperly stored material or material with excessive amounts of foreign debris shall be removed from the project and replaced with new materials.

#### 1.07 WARRANTY

- A. The materials, equipment, and workmanship furnished under this section of the specifications shall be guaranteed for a period of 1 year from the date of acceptance. Prior to expiration of the warranty period, the Owner will conduct a System voltage and current output test of the cathodic protection system to determine if the system and equipment are performing in accordance with the plans and specifications and that no significant deterioration of the system or components therein has occurred during the first year of operation.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

##### A. Rectifier:

1. Description: Rectifier shall be air cooled. For multiple circuit units, individual transformers and stacks shall be provided.
2. AC power: 120/240 volts, single phase, 60 Hz. A dedicated 20 ampere circuit is required.
3. DC output: As indicated on the drawings.
4. Taps: 36 tap settings minimum (6 coarse, 6 fine).
5. Stacks: Silicon.
6. Case: Galvanized, stainless steel, or aluminum (painted case is not acceptable).
7. Surge protection: Protect silicon diodes with AC and DC lightning arrestors against over-voltage and with current limiting device against over-current surges.
8. Grounding provisions: Rectifier shall be grounded with grounding terminal in cabinet, No. 6 AWG solid copper wire and copper ground rod (8' length minimum).

##### B. Remote Monitoring:

1. Elecsys Watchdog Scout
  - a. NEMA4x Enclosure: 8" X 10" X 4" with two relay control outputs 4 analog measurement channels, 2 digital dry-contact/pulse accumulator channels and 1 AC detection probe input is a minimum requirement.
  - b. Digital cellular Communications
  - c. GPS synchronized interruption Modules that syncs with other industry leading interrupters.

##### C. MMO (MIXED METAL OXIDE) ANODES:

1. MMO Wire Anode:
  - a. Anode Dimensions (MMO wire only): 1.5 mm (diameter)

- b. Current Rating: 5 milliamperes/lineal foot for 50 years (minimum)
- 2. Anode Lead Wires:
  - a. The header cable for the anodes shall be No. 10 AWG stranded copper wire with Type HMWPE (cathodic type) insulation. Lead wires shall be of sufficient length to extend to the junction box location without splicing.
- D. WIRE, CABLES & SPLICING MATERIAL:
  - 1. Test Wires for Cathodic Protection:
    - a. Structure test wires shall be No. 12 AWG stranded copper wire with THHN / THWN insulation, white in color, of sufficient length to extend to their termination point without splicing.
  - 2. Anode Header, Structure Lead and Bonding Cables for Cathodic Protection:
    - a. Anode header, structure lead and bonding cables shall be No. 8 AWG stranded copper wire with THHN / THWN insulation, black in color, of sufficient length to extend to their termination point without splicing.
  - 3. Anode Feeder Cables for Cathodic Protection:
    - a. Anode feeder cables shall be No. 10 AWG stranded copper wire. Cable under tanks shall have HMWPE insulation; cable in conduits shall have THHN / THWN insulation.
  - 4. Compression Crimp Splice Connectors:
    - a. All underground spliced connections used within the DC cathodic protection circuit shall be made through the use of copper compression crimp connectors.
      - 1) The proper size connectors shall be used in accordance with the manufacturer's recommendations.
      - 2) Connectors shall be crimped with a hand tool capable of delivering a minimum of 12 tons of compressive force.
  - 5. Splice Encapsulation:
    - a. All underground spliced connections used within the DC cathodic protection circuit shall be sealed with a two-part epoxy encapsulation.
    - b. All aboveground spliced connections used within the DC cathodic protection circuit shall be sealed with rubber and plastic tape contained within a waterproof coating.
  - 6. Warning Tape for Buried Cable:
    - a. All underground DC cathodic protection cable shall be installed with a continuous 3" wide plastic line marking tape labeled "Caution – Cathodic Protection Cable Below" or similar.
- E. JUNCTION BOXES:

1. Junction boxes shall be standard duty, non-metallic, post or wall mount (as indicated on drawings), furnished with a non-metallic terminal board equipped with terminal posts to permit ready access and testing and shall be constructed as follows:
  - a. Housing: Non-metallic with hinged cover (stainless steel hardware).
  - b. Terminal Board: Non-metallic.
  - c. Terminal Posts: Stainless Steel.

F. CATHODIC PROTECTION INSTRUMENTS AND ACCESSORIES:

1. Cu/CuSO<sub>4</sub> Reference Electrodes:
  - a. Description: Cu/CuSO<sub>4</sub> electrodes shall be used for soil environments to provide a stable electrical benchmark from which to measure the cathodic protection system's effectiveness. Electrodes shall be constructed as follows:
  - b. Element: Saturated gelled Cu/CuSO<sub>4</sub>.
  - c. Design life of the electrode shall be no less than 20 years.
  - d. Lead Wire: No. 14 AWG (minimum) HMWPE or RHW stranded copper wire. Lead wire shall be sufficiently long to reach its termination point without splicing.
2. Zn/ZnSO<sub>4</sub> Reference Electrodes:
  - a. Description: Zn/ZnSO<sub>4</sub> electrodes shall be used for soil environments to provide a stable electrical benchmark from which to measure the cathodic protection system's effectiveness. Electrodes shall be constructed as follows:
  - b. Element: Saturated gelled Zn/ZnSO<sub>4</sub>.
  - c. Design life of the electrode shall be no less than 20 years.
  - d. Lead Wire: No. 14 AWG (minimum) HMWPE or RHW stranded copper wire. Lead wire shall be sufficiently long to reach its termination point without splicing.

G. EXOTHERMIC WELDS AND ACCESSORIES:

1. All below grade connections to steel structures used within the DC cathodic protection system circuit shall be by exothermic welds. The proper size welders, metal charges, and wire sleeves shall be used in accordance with the manufacturer's recommendations. Mechanical clamps or exothermic welds may be used for above ground connections to steel structures within the DC cathodic protection circuit.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. The Cathodic Protection system shall be installed in accordance with the contract Drawings and contract Specifications.

2. The Contractor shall provide all necessary technical installation documents, such as situation plans and diagrams.
3. The installation of the Cathodic Protection system shall be by a contractor with a minimum of 5 years experience of installing Cathodic Protection systems.
4. The Contractor shall be responsible for the correct location of all equipment. If there are any discrepancies between the details in the shop drawings, contract drawings, or contract specifications the real dimensions of equipment, rooms, or buildings, they shall be reported in writing immediately upon discovery to the Engineer.

**B. MMO ANODES AND ACCESSORIES:**

1. Install anodes as shown on the Drawings.
2. All anode lead wires shall be of sufficient length to extend to their termination point without splicing.
3. Maintain electrical isolation between tank bottom and anodes (and reference electrodes) during construction.

**C. WIRE, CABLES & SPLICING MATERIAL:**

1. Wire and Cable:
  - a. Install wiring as shown on drawings.
  - b. All collector cables and electrode lead wires shall be placed in GRS/PVC conduit when run above-grade.
  - c. No splices shall be permitted inside conduit.
2. Epoxy Splice Encapsulation: Splices not allowed.

**D. EXOTHERMIC WELDS AND ACCESSORIES:**

1. All exothermic welding shall be performed in accordance with the manufacturer's recommendations for welding equipment, weld metal charge size and applicability to the structure.
  - a. Obtain a "Hot Work Permit" before performing any exothermic welding in hazardous (classified) areas.
2. Do not use exothermic weld equipment if the graphite mold is wet.

**E. JUNCTION BOXES:**

1. Attach test/structure wires to the structure using exothermic welds.
2. Route the test/anode header/structure lead/reference electrode wires to the terminal board.
3. Exercise care in backfilling the structure to avoid damaging lead wires or connections.
4. Locate the junction box as shown on the Drawings.

**F. CATHODIC PROTECTION INSTRUMENTS AND ACCESSORIES:**

1. Reference Electrode:
  - a. Install reference electrodes as shown on the Drawings.

- b. Route the reference electrode lead wire to the junction box.

### 3.02 FIELD QUALITY CONTROL

#### A. Field Tests:

1. General: After the cathodic protection system components have been installed, the system shall be inspected and commissioned by the Contractor's Corrosion Engineer (NACE certified Corrosion Specialist or Cathodic Protection Specialist) or by a NACE certified Corrosion Technician under direct supervision of a Corrosion Engineer. Contractor shall include in these services in his Bid.
2. Commissioning:
  - a. The Corrosion Engineer/Corrosion Technician will perform the initial energization of the cathodic protection systems.
3. Method:
  - a. Record native structure-to-electrolyte potential measurements at the permanently installed test points, permanent reference electrodes, and other locations deemed representative by the Corrosion Engineer/Corrosion Technician.
  - b. Determine the effectiveness of all accessible electrical isolation materials.
  - c. Ensure that there is a minimum of 3' of liquid in the tanks. Adjust the rectifier to provide a current density of approximately 0.3 to 0.5 milliamperes/square foot of tank bottom steel. After allowing the metallic structures to sufficiently polarize (amount of time required to be determined by Corrosion Engineer/Corrosion Technician), record 'instant off' and 'on' structure-to-soil potential measurements at the permanently installed test points, permanent reference electrodes, and other locations deemed representative.
  - d. Determine if electrical continuity exists on the underground structures after installation of the test stations.
  - e. Determine if interference exists on the structures under cathodic protection, and if so, take steps to find a satisfactory solution to the problem.
  - f. Prepare a written report to include all test data, an analysis of the data, and necessary recommendations for additional work. The report will be submitted to the Owner.

### END OF SECTION

## **SECTION 40 46 51 - CATHODIC PROTECTION - GALVANIC**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. A complete Cathodic Protection system shall be installed as indicated on the Drawings, including all necessary materials and labor for testing.
2. The Cathodic Protection system shall be installed in accordance with the provisions of the specifications, applicable plans, codes and standards, and is subject to other terms and conditions of the project. Products Furnished by Owner and Installed under this section

##### **B. Design Criteria:**

1. The cathodic protection system has been designed in accordance with the minimum standards established for the structure(s) by the National Association of Corrosion Engineers.
  - a. Theoretical Design Life: 20 years (minimum).
  - b. Criteria for Protection: -850 mV, current applied, to a Cu/CuSO<sub>4</sub> reference electrode.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Section 01 33 00 – Submittals**

##### **B. Section 26 05 00 – Electrical Basic Requirements**

#### **1.03 REFERENCED STANDARDS**

##### **A. National Association of Corrosion Engineers (NACE):**

1. SP 0169-07 (formerly RP 0169-01)

##### **B. Underwriter' Laboratories, Inc. (UL) Publications:**

1. Standards for Safety

##### **C. National Fire Protection Association (NFPA):**

1. No. 70: National Electrical Code (NEC)

##### **D. Institute of Electrical and Electronic Engineers (IEEE):**

1. Standards and Specifications

##### **E. American Society for Testing and Materials (ASTM):**

1. Testing Methods and Materials

#### **1.04 SUBMITTALS**

##### **A. Submit under provisions of Section 01 33 00.**

- B. Manufacturer's Product Data: Submit material specifications and installation data for products specified under Part 2 - Products, to include:
  - 1. Magnesium Anode
  - 2. Reference Electrode
  - 3. Flush Mount Test Station / Above Grade Test Station (Junction Box)
  - 4. Splice Kit
  - 5. Conductors/Cable
  - 6. Copper Crimps
  - 7. Exothermic Weld
- C. Shop Drawings:
  - 1. Submit shop drawings to indicate information not fully described by the product data to indicate compliance with the contract documents.
- D. Record Drawings:
  - 1. Provide a complete set of system manufacturer's product data and shop drawings indicating all post bid revisions and field changes.

#### 1.05 QUALITY ASSURANCE

- A. Coordinate the system installation with the contract documents and other contractors. Adjust installation to eliminate conflicts. Coordinate installation sequence with other contractors to avoid conflicts including equipment access and provide the fastest overall installation schedule.
- B. All materials shall be new.
- C. Where equipment, materials or systems are specified by designation of manufacturer, such designation is intended to convey the minimum requirements for construction, electrical characteristics and ratings, and operating function. Equipment having electrical characteristics and ratings, construction features and operating functions not less than those specified shall be acceptable upon approval of the Engineer.
- D. Design Responsibility:
  - 1. Contractor shall include in his Bid to provide services of a corrosion engineer who is a NACE-certified Corrosion Specialist or Cathodic Protection Specialist. Qualifications of the Corrosion Engineer shall be provided.
  - 2. The Contract Documents establish the design intent of the cathodic protection system and include schedules, notes, and typical details to show the major system components and suggested methods of installation.
  - 3. The installed cathodic protection system shall meet the minimum requirements indicated, include components not indicated but necessary for proper function and performance, and shall be a complete and operational system.



4. Cathodic protection Suppliers shall be firms regularly engaged in the fabrication of the materials required by this Specification whose products have been in satisfactory use in similar service for not less than 5 years. The products of any reputable Supplier regularly engaged in the commercial production of cathodic protection materials required by this Specification will not be excluded on the basis of minor differences, provided all essential requirements of the specification relative to materials, capacity, and performance are met.

E. Contractor's Quality Control System:

1. The Contractor shall implement a quality control system to ensure the cathodic protection system components conform to the applicable plans and specifications established by the Contract Documents.
2. The quality control system shall ensure that standards for materials, workmanship, construction, and functional performance are adhered to throughout the course of the Work.
3. The Contractor's superintendent shall be used to monitor the Contractor's quality control system.

F. DRAWINGS:

1. The drawings indicate the arrangement of cathodic protection equipment. Coordinate installation of cathodic protection equipment with structural system and mechanical equipment and access there to.
2. Do not scale drawings. Obtain dimensions for layout of equipment from Civil, Mechanical or Architectural plans unless indicated on Electrical plans.
3. Bring all discrepancies shown on different drawings, between drawings and specifications or between documents and field conditions to the immediate attention of the Engineer.

G. DEVIATIONS:

1. The Contractor shall provide written notice of any deviations from the requirements of the contract or construction documents that he proposes to undertake. The Contractor remains liable for any deviations unless reviewed and written acknowledgment is received from the Engineer.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Inspect material upon arrival at Project and verify conformance to Contract Documents. Prevent unloading of unsatisfactory material.
- B. Provide trailers or shed for storage of materials, equipment, tools, etc., requiring such a facility. Contractor shall provide areas for general storage and storage trailers or sheds. Provide a dry, weather-tight place for storing materials requiring protection from weather.
- C. Store packaged materials in original undamaged condition with manufacturer's labels and seals intact.
- D. Handle and store materials in accordance with manufacturer's and supplier's recommendations and in manner to prevent damage to materials during storage and handling. Replace damaged materials.

- E. Containers which are broken, opened, watermarked, or otherwise damaged materials are unacceptable and shall be removed from premises.
- F. Provide protection against direct sunlight, rain, snow, wind, ice, or heat for suitable storage of materials or equipment delivered to site to be incorporated into Project.
- G. Equipment and materials shall not be installed until such time as the environmental conditions of the job site are suitable to protect the equipment or materials. Conditions shall be those for which the equipment or materials are designed to be installed. Equipment and materials shall be protected from water, direct sunlight, cold or heat. Equipment or materials damaged or which are subjected to these elements are unacceptable and shall be removed from the premises and replaced.
- H. Damaged, oxidized, warped, or improperly stored material, or material with excessive amounts of foreign debris shall be removed from the project and replaced with new materials.

#### 1.07 WARRANTY

- A. The materials, equipment, and workmanship furnished under this section of the specifications shall be guaranteed for a period of 1 year from the date of acceptance. Prior to expiration of the warranty period, the Owner will conduct a System voltage and current output test of the cathodic protection system to determine if the system and equipment are performing in accordance with the plans and specifications and that no significant deterioration of the system or components therein has occurred during the first year of operation.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

##### A. Sacrificial Anodes and Accessories:

##### 1. High Potential Magnesium Anodes:

- a. Description: Magnesium anodes shall be capable of delivering a minimum efficiency of 500 amp-hours per pound of magnesium and shall have the following metallurgical analysis and physical properties:
- b. Anode Dimensions (approximate): 2.75" (width) x 2.75" (height) x 56.75" (length)
- c. Ingot Weight: 20 pounds
- d. Package Weight (approximate): 72 pounds
- e. Metallurgy:
  - 1) Aluminum: 0.01% (max.)
  - 2) Manganese: 0.50% - 1.3%
  - 3) Copper: 0.02% (max.)
  - 4) Nickel: 0.001% (max.)
  - 5) Iron: 0.03% (max.)
  - 6) Other (each): 0.05% (max.)

- 7) Other (total): 0.30% (max.)
  - 8) Magnesium: Balance
- 2. Packaged Magnesium Anode Backfill:
  - a. Magnesium anodes shall be packaged in a special chemical backfill having the following proportions:
    - 1) Ground Hydrated Gypsum: 75%
    - 2) Powdered Bentonite: 25%
    - 3) Anhydrous Sodium Sulfate: 5%
  - b. Backfill shall have a grain size such that 100% is capable of passing a 20-mesh screen and a 100-mesh screen shall retain 50 %.
  - c. Backfill shall completely surround the anode ingot without voids.
- 3. Anode Lead Wires:
  - a. The standard lead wire for a magnesium anode shall be No. 10 AWG stranded copper wire with 'direct bury' rated insulation (RHW or HMWPE), black in color, of sufficient length to extend to their termination point without splicing.
- 4. Lead Wire Connection to Anode Core:
  - a. Magnesium anodes shall be cast with a minimum 20 gauge galvanized steel core.
  - b. One end of the anode shall be recessed to expose the core for silver-soldering the lead wire.
  - c. The silver-soldered lead wire connection and anode recess shall be filled with an electrical potting compound before packaging.
- B. Wire, Cables & Splicing Material:
  - 1. Test Wires for Cathodic Protection:
    - a. Structure test wires shall be No. 10 AWG stranded copper wire with 'direct bury' rated insulation (RHW or HMWPE), white in color, of sufficient length to extend to their termination point without splicing.
  - 2. Anode Header, Structure Lead and Bonding Cables for Cathodic Protection:
    - a. Anode header, structure lead and bonding cables shall be No. 10 or No. 8 AWG stranded copper wire with 'direct bury' rated insulation (RHW or HMWPE), black in color, of sufficient length to extend to their termination point without splicing.
  - 3. Compression Crimp Splice Connectors:
    - a. All underground spliced connections used within the DC cathodic protection circuit shall be made through the use of copper compression crimp connectors.
      - 1) The proper size connectors shall be used in accordance with the manufacturer's recommendations.

- 2) Connectors shall be crimped with a hand tool capable of delivering sufficient compressive force.
  4. Split Bolt Splice Connectors:
    - a. All aboveground spliced connections used within the DC cathodic protection circuit shall be made through the use of copper split bolt connectors.
      - 1) The proper size connectors shall be used in accordance with the manufacturer's recommendations.
  5. Splice Encapsulation:
    - a. All underground spliced connections used within the DC cathodic protection circuit shall be sealed with a two-part epoxy encapsulation.
    - b. All aboveground spliced connections used within the DC cathodic protection circuit shall be sealed with rubber and plastic tape contained within a waterproof coating.
  6. Warning Tape for Buried Cable:
    - a. All underground DC cathodic protection cable shall be installed with a continuous 3" wide plastic line marking tape labeled "Caution – Cathodic Protection Cable Below" or similar.
- C. Test Stations and Junction Boxes:
  1. Flush-Type Test Stations:
    - a. Monitoring stations shall be a flush-type station designed for use in heavy traffic areas set in a concrete pad. The bottom of the test station shall be open with access to native soil. Do not fill test station with concrete. Test station shall be furnished with a non-metallic terminal board equipped with labeled terminal posts to permit ready access and testing and shall be constructed as follows:
      - 1) Body: Fiberglass, 1/4" thick, 9" inside diameter, with integral concrete anchors, bottom open to native soil.
      - 2) Cover: Cast aluminum with integral handle cover labeled to display "Cathodic Protection Test Station".
      - 3) Terminal Board: Non-metallic with nickel plated brass or stainless steel hardware.
  2. Above Grade Type Test Stations (Junction Boxes):
    - a. Junction Boxes shall be non-metallic, strut or wall mount (as indicated on drawings), furnished with a non-metallic terminal board equipped with labeled terminal posts to permit ready access and testing and shall be constructed as follows:
      - 1) Housing: Non-metallic (fiberglass) with hinged cover (stainless steel hardware).
      - 2) Terminal Board: Non-metallic with nickel plated brass or stainless steel hardware.

- 3) Mounting hardware: All mounting hardware shall be stainless steel (except strut – shall be stainless steel or aluminum).
- 4) Conduit: GRS with seal fittings installed as required.

D. Cathodic Protection Instruments and Accessories:

1. Cu/CuSO<sub>4</sub> Reference Electrodes:
  - a. Description: Cu/CuSO<sub>4</sub> electrodes shall be used for soil environments to provide a stable electrical benchmark from which to measure the cathodic protection system's effectiveness. Electrodes shall be constructed as follows:
  - b. Element: Saturated gelled Cu/CuSO<sub>4</sub>.
  - c. Design life of the electrode shall be no less than 20 years.
  - d. Lead Wire: No. 14 AWG stranded copper wire with 'direct bury' rated insulation (RHW or HMWPE), yellow in color, of sufficient length to extend to its termination or test station without splicing.

E. Coating Systems:

1. Coating of Wire and Cable Connections to Underground Structures:
  - a. The structure coating shall be repaired using Royston 'Handy Cap IP'. The 'Handy Cap IP' is a prefabricated assembly designed to provide quick, field applied coating repair to test lead wire welds on metal pipe.

F. Exothermic Welds and Accessories:

1. All buried connections to steel structures used within the DC cathodic protection system circuit shall be by exothermic welds. The proper size welders, metal charges, and wire sleeves shall be used in accordance with the manufacturer's recommendations.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

A. General:

1. The Cathodic Protection system shall be installed in accordance with the contract Drawings and contract Specifications.
2. The Contractor shall provide all necessary technical installation documents, such as situation plans and diagrams.
3. The installation of the Cathodic Protection system shall be by a contractor with a minimum of 5 years experience of installing Cathodic Protection systems.
4. The Contractor shall be responsible for the correct location of all equipment. If there are any discrepancies between the details in the shop drawings, contract drawings, or contract specifications the real dimensions of equipment, rooms, or buildings, they shall be reported in writing immediately upon discovery to the Engineer.

B. Sacrificial Anodes and Accessories:

1. Remove paper or cardboard shipping containers from all anodes leaving cotton sack exposed to the soil.
2. Install prepackaged anodes horizontally as shown on the Drawings.
3. Cover anode bag with a minimum of 6" native soil or clay. Wet thoroughly prepackaged anode and dry soils with water prior to backfilling.
4. All anode lead wires shall be of sufficient length to extend to their termination or test station without splicing.

C. Wire, Cables & Splicing Material:

1. Wire and Cable:
  - a. All underground wires, cables, and connections shall be installed at a minimum 18 inches below final grade with a minimum separation of 6 inches from other underground structures.
  - b. All collector cables and electrode lead wires shall be placed in rigid galvanized steel or PVC conduit when run above grade.
  - c. No splices shall be permitted inside conduit.
  - d. All cathodic protection cables (structure, anode, reference electrode, test, other) shall be labeled at the test station/terminal board with permanent metallic or laminated tags.
2. Epoxy Splice Encapsulation:
  - a. Install epoxy encapsulation kits at material temperatures greater than 40° F.
  - b. Ensure that the epoxy material completely covers the copper connectors.
3. Tape Splice Encapsulation:
  - a. Cover the splice with moldable splice putty to round all sharp edges.
  - b. Wrap the splice in a layer of rubber splicing tape with ½ lapping layers.
  - c. Wrap the splice in a layer of vinyl splicing tape with ½ lapping layers.
  - d. Coat the connection with a waterproofing sealant.
  - e. Repeat the process using another layer of rubber tape covered with a layer of vinyl tape and seal the connection with waterproofing sealant.
  - f. Ensure that the taping material completely covers the copper connectors.

D. Exothermic Welds and Accessories:

1. All exothermic welding shall be performed in accordance with the manufacturer's recommendations for welding equipment, weld metal charge size and applicability to the structure.
  - a. Obtain a "Hot Work Permit" before performing any exothermic welding in hazardous (classified) areas.
  - b. Do not use exothermic weld equipment if the graphite mold is wet.

E. Test Stations and Junction Boxes:

1. Flush-Type Test Stations / Above Grade Junction Boxes:

- a. Attach test/structure wires to the structure using exothermic.
    - b. Route the test/anode header/structure lead/reference electrode wires to the terminal board allowing a minimum of 18" of slack.
    - c. Exercise care in backfilling the structure to avoid damaging lead wires or connections.
    - d. Install ring tongue connectors at terminal board for test wires.
    - e. Set the test station enclosure level with final grade in a minimum 24" square, thickness to match existing concrete.
  - 2. Above Grade Junction Box:
    - a. Install junction box as indicated. Mount to existing wall / structure or used galvanized strut as required.
- F. Cathodic Protection Instruments and Accessories:
- 1. Reference Electrode:
    - a. Install reference electrodes 12" from the cathodically protected structure at locations shown on the Drawings.
    - b. Route the reference electrode lead wire to the monitoring station enclosure.
- G. Coating Systems:
- 1. Coating of Wire and Cable Connections to Underground Structures:
    - a. Surface preparation: Clean all weld splatter/slag, mud, dirt, grease, oil and other contaminants from the metal surface which is to be covered.
    - b. Application: Remove the release paper from the bottom of the 'Handy Cap IP'. Bend the plastic sheet inward at the serrations when applying to a small diameter pipe. Position and place the 'Handy Cap IP' on the welded area with the tunnel over the lead wire. Push the dome of the cap firmly into the weld area. Lift the lead wire away from the pipe and squeeze the adhesive compound completely around and underneath the wire. Push the wire back down on the pipe and press the elastomeric compound into the firm contact with the pipe over the entire area. The 'Handy Cap IP' incorporates an integrated primer and does not require the use of a liquid primer prior to application.
    - c. Backfilling: Exercise care in backfilling to avoid damaging the coating repair.

### 3.02 FIELD QUALITY CONTROL

#### A. POST-INSTALLATION TESTING:

- 1. General: After the cathodic protection system components have been installed, the system shall be inspected and commissioned by the Contractor's Corrosion Engineer (NACE certified Corrosion Specialist or Cathodic Protection Specialist) or by a NACE certified Corrosion Technician under direct supervision of a Corrosion Engineer. Contractor shall include in these services in his Bid.
- 2. Commissioning:

- a. The Corrosion Engineer/Corrosion Technician will perform the initial energization of the cathodic protection systems.
- 3. Method:
  - a. Record native structure-to-electrolyte potential measurements at the permanently installed test points, permanent reference electrodes, and other locations deemed representative by the corrosion technician.
  - b. Determine the effectiveness of all accessible electrical isolation materials.
  - c. Connect the anodes to the pipeline through the test stations and after allowing the metallic structures to sufficiently polarize (a minimum period of 12 hours), record the current-applied structure-to-soil potential measurements at the permanently installed test points, permanent reference electrodes, and other locations deemed representative. Measure potentials with the local anodes disconnected. Measure the anode current drain.
  - d. Determine if electrical isolation exists between the pipelines and all other foreign structures.
  - e. Determine if interference exists on the structures under cathodic protection, and if so, take steps to find a satisfactory solution to the problem.
  - f. Prepare a written report to include all test data, an analysis of the data, and necessary recommendations for additional work. The report will be submitted to the Owner.

**END OF SECTION**



## **SECTION 40 50 02 - BASIC MECHANICAL MATERIALS AND METHODS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This Section includes the following basic mechanical materials and methods to compliment other Division 23 Sections:
  - 1. Concrete base construction requirements.
  - 2. Equipment nameplate data requirements.
  - 3. Labeling and identifying mechanical systems and equipment.
  - 4. Non-shrink grout for equipment installations.
  - 5. Field-fabricated metal and wood equipment specification sections.
  - 6. Installation requirements common to equipment specification sections.
  - 7. Mechanical demolition.
  - 8. Cutting and patching.

#### **1.02 REFERENCED STANDARDS**

- A. ASTM International (ASTM):
  - 1. A47, Standard Specification for Ferritic Malleable Iron Castings.
  - 2. A47M, Standard Specification for Ferritic Malleable Iron Castings (Metric).
  - 3. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - 4. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
  - 5. A536, Standard Specification for Ductile Iron Castings.
  - 6. B32, Standard Specification for Solder Metal.
  - 7. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
  - 8. D709, Standard Specification for Laminated Thermosetting Materials.
  - 9. D1785, Standard Specification of Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80 and 120.
  - 10. D2235, Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
  - 11. D2564, Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems.
  - 12. D2657, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.

13. D2661, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
  14. D2672, Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement.
  15. D2846, Standard Specification for Chlorinated Polyvinyl Chloride (CPVC) Plastic Hot-and Cold-Water Distribution Systems.
  16. D2855, Standard Practice for Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings.
  17. D3138, Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Polyvinyl Chloride (PVC) Non-Pressure Piping Components.
  18. F402, Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
  19. F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
  20. F493, Standard Specification for Solvent Cements for Chlorinated Polyvinyl Chloride (CPVC) Plastic Pipe and Fittings.
  21. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Polyvinyl Chloride (PVC) Plastic Pipe and Fittings.
- B. American Society of Mechanical Engineers (ASME):
1. A13.1, Scheme for Identification of Piping Systems.
  2. B1.20.1, Pipe Threads, General Purpose (Inch).
  3. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
  4. B18.2.1, Square and Hex Bolts and Screws Inch Series.
- C. American Water Works Association (AWWA):
1. C110, Ductile-Iron and Gray-Iron Fittings, 3 inch through 48 inch (75 mm through 1200 mm), for Water and Other Liquids..
  2. C111, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- D. American Welding Society (AWS):
1. A8.5, Specification for Filler Metals for Brazing and Braze Welding.
  2. D1.1, Structural Welding Code - Steel.
  3. D10.12, Guide for Welding Mild Steel Pipe.
  4. Brazing Manual.
  5. Soldering Manual.
- E. Copper Development Association Inc:
1. Copper Tube Handbook.

### 1.03 DEFINITIONS

- A. Finished Spaces – Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.
- B. Exposed, Interior Installations – Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations – Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed Interior Installations – Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed Exterior Installations – Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. ABS – Acrylonitrile-Butadiene-Styrene plastic.
  - 2. CPVC – Chlorinated Polyvinyl Chloride plastic.
  - 3. NP – Nylon Plastic.
  - 4. PE – Polyethylene plastic.
  - 5. PVC – Polyvinyl Chloride plastic.
- G. The following are industry abbreviations for rubber materials:
  - 1. CR – Chlorosulfonated polyethylene synthetic rubber.
  - 2. EPDM – Ethylene Propylene Diene Terpolymer Rubber.

### 1.04 SUBMITTALS

- A. Submit as specified in Section 01 33 00.
- B. Submit info for the following:
  - 1. Product Data – For dielectric fittings, flexible connectors, mechanical sleeve seals, and identification materials and devices.
  - 2. Shop Drawings – Detail fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.
  - 3. Coordination Drawings – For access panel and door locations.
  - 4. Coordination Drawings – Details major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Indicate if sequence and coordination of installations are important to efficient flow of the Work. Include the following:
    - a. Planned piping layout, including valve and specialty locations and valve-stem movement.
    - b. Clearances for installing and maintaining insulation.

- c. Clearances for servicing and maintaining equipment, accessories and specialties, including space for disassembly required for periodic maintenance.
  - d. Equipment and accessory service connections and support details.
  - e. Exterior wall and foundation penetrations.
  - f. Fire-rated wall and floor penetrations.
  - g. Sizes and location of required concrete pads and bases.
  - h. Scheduling, sequencing, movement and positioning of large equipment into building during construction.
  - i. Floor plans, elevations, and details to indicate penetrations in floors, walls and ceilings and their relationship to other penetrations and installations.
  - j. Reflected ceiling plans to coordinate an integrate installation of air outlets and inlets, light fixtures, communication system components, sprinklers and other ceiling mounted items.
5. Samples – Of color, lettering style, and other graphic representation required for each identification material and device.

#### 1.05 QUALITY ASSURANCE

- A. Comply with ASME A13.1 for lettering size, length of color field, colors and viewing angles of identification devices.
- B. Equipment Selection – Equipment of higher electrical characteristics, physical dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment bases are increased. Additional costs shall be approved in advance by appropriate Contract Modification for these increases. If minimum energy ratings of efficiencies of equipment are specified, equipment must meet design and commissioning requirements.

#### 1.06 DELIVERY, STORAGE AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps through shipping, storage, and handling to prevent pipe from end damage and prevent the entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties form moisture and dirt.
- D. Store plastic pipes protected form direct sunlight. Support to prevent sagging and bending.

#### 1.07 SEQUENCING AND SCHEDULING:

- A. Coordinate mechanical equipment installation with other building components.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

- C. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components, as they are constructed.
- D. Sequence, coordinate and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate requirements for access panels and doors if mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8.
- G. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.01 GROUT

- A. Non-shrink, non-metallic Grout: ASTM C1107, Grade B.
  - 1. Characteristics – Post-hardening, volume-adjusting, dry, hydraulic cement grout, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix – Five thousand pound per square inch gauge (5000 psig), twenty-eight (28) day compressive strength.

## PART 3 - EXECUTION

### 3.01 GENERAL INSTALLATION

- A. Fire-Barrier Penetrations – Maintain indicated fire rating at walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations, with firestopping materials. Refer to Division 07 for firestopping materials.
- B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Railroad's Engineer.
- C. Install equipment level and plumb, parallel and perpendicular to other buildings systems and components in exposed interior spaces, unless otherwise indicated.
- D. 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.

- E. Install equipment giving right-of-way to piping, installed at the required slope.
- F. Install flexible connectors on equipment side of shutoff valves, horizontally and parallel to equipment shafts if possible.

**END OF SECTION**

## **SECTION 41 22 13 - JIB CRANES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Furnishing and installation of a jib crane, trolley and hoist. The jib crane shall have a push trolley travel, push boom swing, and an electric motor operated lifting and lowering.

#### **1.02 GENERAL**

- A. Equipment and accessories furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operation following instructions and recommendations of the equipment manufacturer, unless exceptions are noted by the Engineer.
- B. General Equipment Stipulations – The General Equipment Stipulations shall apply to the equipment furnished under this section.
- C. Power Supply – Power supply to the equipment will be four hundred-eighty volts (480V) sixty Hertz (60Hz) triple phase (3ph.).
- D. The feeder circuit for the hoist assembly will be furnished and installed under the electrical section to the location indicated on the drawings.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Complete outline and installation drawings, together with detailed specifications and data covering materials used, parts, devices, and other accessories forming a part of the equipment furnished and the operation and maintenance manuals, shall be submitted in accordance with the submittals section.
- C. Drawings shall include electrical connection diagrams and schematics identifying all items requiring electrical control or power in the operation of the hoist, and complete details and information on the power feed and control systems.
- D. Provide structural loading information including; recommended foundation size, overturning moment, bolt loads and sizes, and bolt pattern / locations.

#### **1.04 QUALITY ASSURANCE**

- A. Governing Standards – Equipment furnished under this section shall comply with the applicable requirements of the following:
  1. Occupational Safety and Health Standards of the U.S. Department of Labor; Subpart N, Materials Handling and Storage.
  2. ANSI MH27.1, Specifications for Underhung Cranes and Monorail Systems

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Mast Assembly – Thick-wall seamless steel tubing.
- B. Boom – American Standard steel beam.
- C. Bracket Fitted Type Boom:
  - 1. Pins – High carbon steel.
  - 2. Bearings – Permanently shielded, lifetime-lubricated, anti-friction type.
- D. Mast Head Assembly Type Boom:
  - 1. Upper Pintle Bearing – Sealed ball bearing, lifetime-lubricated.
  - 2. Lower Bearing – Sealed roller anti-friction bearings.
- E. Hoist:
  - 1. Bearings – Anti-friction type; oil lubrication or lifetime-grease packing.
  - 2. Gearing – Spur or helical type; fully enclosed in an oil-tight housing.
  - 3. Wire Rope – As recommended by rope manufacturer for specified drum.
  - 4. Mechanical Load Brake – Fully enclosed in oil-tight housing.
  - 5. Lower Block – Safety type with guarded sheaves.
  - 6. Lifting Hook – Forged steel; slow opening, non-fracturing with safety latch.
  - 7. Sheave Bearings – Anti-friction or sleeve type.
- F. Trolley:
  - 1. Frame – Steel; rigid construction.
  - 2. Wheels – Rolled, forged or cast iron steel with hardened treads.
  - 3. Wheels Axles – High carbon steel; fixed type.
  - 4. Bearings – Permanently shielded, lifetime-lubricated, anti-friction type.
- G. Controls:
  - 1. Pendant Control Cable – Heavy-duty type with extra-flexible stranding and neoprene jacket.
  - 2. Power Feed Cable – Six hundred volt (600V), four (4) conductor, neoprene jacketed, heavy-duty portable cable.

### 2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Service Conditions – The jib crane, hoist, and trolley will be rated for outdoor usage, and will be used intermittently to lift its rated capacity.
- B. Equipment Protection – All equipment shall be delivered, stored, and handled in accordance with the General Equipment Stipulations.



- C. Acceptable Manufacturers – The jib crane, hoist and trolley, with all appurtenances, shall be manufactured by one of the following:
1. Lift-Tech International.
  2. Robbins & Myers.
  3. Spanco (Pharr Better Solutions).
  4. Kone.
  5. Abell-Howe.
  6. Approved Equal.
- D. Design Requirements – The jib crane and hoist shall be designed to the following criteria:
1. Foundation – sleeve mounted.
  2. Overall Capacity (in tons) – 5 tons.
  3. Hoisting Capacity (in tons) – 5 tons.
    - a. Three (3) total hoists:
      - 1) Outside hoists; Two (2) total hoists, one (1) ton capacity each.
      - 2) Center hoist: One (1) total hoist, three (3) ton capacity.
  4. Hoisting speed: 14 FPM (minimum).
  5. Span: 16 FT – 0 IN.
  6. Height under boom: 15 FT – 0 IN.
  7. Provide rotational stops where indicated on plans.

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

**END OF SECTION**

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## **SECTION 41 22 20 - TRAVELLING GANTRY BRIDGE CRANES**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Traveling bridge crane, complete with trolley, and hoist. The crane shall have an electronically-operated bridge, an electronically-operated trolley, and an electrically-operated hoist.

#### **1.02 GENERAL**

- A. Equipment and accessories furnished and installed under this contract shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with the drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are approved by the Engineer.
- B. The bridge crane assembly shall consist of double girder structural members fabricated by the crane supplier and components (end wheels, wheels, bridge drive mechanism, trolley, and hoist) manufactured by Whitting, Demag, Lift-Tech International, Robbins and Myers, or Wright. All components shall be the products of a single manufacturer. Equivalent products of other manufacturers regularly engaged in the production of equipment of this type may be furnished subject to the acceptance of the Engineer. All modifications necessary to accommodate the equipment shall be subject to review and acceptance of the Engineer, and shall be made at no additional cost to the Railroad.
- C. The project documents shall identify the following criteria for the Contractor to prepare their design:
  1. Number of Cranes at the Project Location
  2. Capacity in Tons
  3. Approximate Bridge Span Distance, in Feet
  4. Specific Location of Each Crane
- D. Bridge Cranes shall be supported by pre-engineered building columns.
- E. The Crane Manufacturer shall provide the runway beams, crane rails, support brackets, and all other appurtenances required for proper installation and operation.
- F. The Crane Manufacturer shall be responsible for the coordination between the pre-engineered building manufacturer and the bridge crane supplier to ensure proper installation and operations.
- G. The operations of all the bridge cranes, trolleys, and hoist shall be primarily controlled by a remote radio, digital control system. A wired pendant controller shall also be provided as a secondary controller in the event of a lost or damaged remote control unit.

- H. The bridge crane assembly shall be pre-assembled and run in the shop, then matchmarked and disassembled for shipment.
- I. The Bridge Crane Manufacturer shall provide four (4) sets of O&M manuals for all of the bridge cranes and all of the remote radio control systems. The Bridge Crane Manufacturer shall also provide 3 days of on-site classes to the Railroad's personnel on the operations and maintenance of the bridge cranes and the remote radio digital control system.
- J. General Equipment Stipulations – The General Equipment Stipulations shall apply to the equipment furnished under this section.
- K. Governing Standards – Equipment furnished under this section shall comply with the applicable requirements of the following:
  - 1. Occupational Safety and Health Standards of the U.S. Department of Labor, Subpart N. Materials Handling and Storage.
  - 2. Crane Manufacturers Association of America (CMAA) Specification No. 70, Specification for Top Running and Gantry Type Multiple Girder Electric Overhead Traveling Cranes
- L. Power Supply – Power supply to the equipment shall be 480 volts, 60 Hertz, Triple Phase
- M. Labels – The gantry, trolley, and hoist shall each have a conspicuous, easy to read label showing the manufacturers' name, crane serial number, and rated capacity. The rate capacity of the hoist shall also be shown on the load block.
- N. Painting – Shop painting shall be provided. Paint shall be a minimum of two coat high build epoxy enamel. The crane shall be painted Universal Safety Yellow.
- O. Warning Devices – The gantry crane shall be equipped with a warning horn that sounds automatically when the movement is initiated by the controller. The trolley shall be equipped with a bell which is energized by a push button on the radio controller or pendant. The crane shall also have a flashing red light located on the bottom of the crane bridge beam which is activated with the horn.

### 1.03 SUBMITTALS

- A. Submit under provisions of Section 01 33 00.
- B. Complete outline and installation drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, shall be submitted in accordance with the submittals section.
- C. Drawings shall include electrical connection diagram and schematics identifying all items requiring electrical control or power in the operation of the traveling crane assembly, and complete details and information on the power feed system.

## PART 2 - PRODUCTS

### 2.01 PERFORMANCE AND DESIGN REQUIREMENTS

- A. The traveling gantry crane shall be a shop-assembled unit with trolley and hoist. The gantry crane assembly shall be designed for the following conditions, to be specified in the Project Documents:
  - 1. CMAA Classification.
  - 2. Hoisting Capacity (in tons).
  - 3. Distance Center to Center of Runway Beams (in FT).
  - 4. Size of ASCE Crane Rails.
  - 5. Pounds per Yard.
  - 6. Approximate Overall Length of Runway Beams.
  - 7. Maximum available clearance:
    - a. Beyond Centerline of Runway.
    - b. Beams, each side (IN).
    - c. Maximum Available Clearance Above the Top of the Runway Beam.
    - d. Bottom of Runway Beam Elevation.
    - e. Top of Crane Rail Elevation.
    - f. Operating Floor Elevation.
  - 8. Crane speeds at rated capacity (100 percent) of speed control function):
    - a. Gantry (fpm).
    - b. Trolley (fpm).
    - c. Hook (fpm).
  - 9. Required Hook Travel Elevations:
    - a. Hook at highest position – Elevation.
    - b. Hook at lowest position – Elevation.

### 2.02 GANTRY

- A. The bridge shall be double leg type, rigidly supported by end trucks, and shall be designed to run on the top of the crane rail. The gantry shall be constructed to accommodate a single girder trolley and hoist.
- B. Steel design and fabrication shall comply with applicable portions of the specifications of the American Institute of Steel Construction. Loadings, impact allowances, and allowable stresses shall be in accordance with the governing standards. Deflection of the main girder shall not exceed 1/800th of the span, with the maximum hoist load at any point.

### 2.03 END TRUCKS

- A. End trucks, each fabricated from structural steel members, shall be designed to distribute the loading equally to each wheel, shall be securely attached to the beam by welding or with fitted bolts in reamed holes, and shall be provided with heavy gusset plates to ensure rigidity and squareness. Each truck shall have heavy end plates to engage the stops on the runway beams. End trucks shall have a wheelbase of approximately 1/7th the bridge span.
- B. The end trucks and wheels shall be designed to operate on the crane rails and shall clear the standard ASCE crane rail fittings, anchors and splices.
- C. Wheels – Gantry wheel cranes shall be of the double flange type, made of rolled forged, or cast steel, with machined universal crowned or tapered hardened treads, designed to operate, on the specified runway. One wheel in each truck shall have integrally cut spur gear teeth, or machine-cut gears pressed on hubs to serve as drive wheels. The other wheels shall be idlers. Axles may be either rotating or fixed type. Wheel bearings shall be permanently shielded, lifetime-lubricated, antifriction type, adequate for radial and end thrust loading.
- D. Gantry Drive Mechanism – The bridge drive shall consist of a single-speed electric motor, enclosed reduction gearing, and a cross shaft to drive one wheel of each end truck. The shaft shall be designed to withstand torsional strain and shall be supported with self-aligning, lifetime-lubricated bearings at intervals sufficient to prevent distortion of the shaft.
- E. The drive motor contained a built-in adjustable mechanical brake. The bridge brake shall be solenoid operated, adjustable shoe or disc type, acting directly on the bridge drive motor shaft.

### 2.04 TROLLEY AND HOIST

- A. The hoist shall be of the cable winding drum type, and the trolley shall be designed to run on the bottom flange of the gantry bridge.

### 2.05 TROLLEY

- A. The trolley frame shall be rigid, shall contain the hoist, and shall be electrically driven type.
- B. The trolley drive shall be a sealed worm or spur gear unit, permanently lubricated with an oil bath.
- C. Wheels shall be single flanged type, made of rolled, forged, or cast steel with hardened treads. Trolley drive wheels shall have integrally cut spur gear teeth or machine-cut gears pressed on hubs. Wheel gearings shall be permanently shielded, lifetime-lubricated, antifriction type, adequate for radial and end thrust loading.

## 2.06 HOIST

- A. The hoist shall consist of a single speed electric motor, a grooved winding drum, and gearing, all supported from the trolley. Antifriction bearings shall be used throughout. The winding drum shall have right-hand and left-hand machined grooves designed to receive the full run of hoisting cable without over-wrapping, and to provide a true vertical lift. The ratio between the diameter of the drum and the diameter of the hoisting cable shall be at least 20 to 1. At least two laps of cable shall remain on the drum when the lifting hook is in the lowest position.
- B. The hoist shall be provided with mechanical and electrical load brakes arranged so that the load may be raised and lowered by electric power and automatically sustained at any position of the hook when the power is cut off. The mechanical load brake shall prevent acceleration of the load when lowering and shall completely sustain the load when brought to rest, independent of the electric brake. The electric brake shall be released whenever current is flowing to the hoist motor and shall be automatically activated when the current is shut off or interrupted. The mechanical brake shall operate in oil in a sealed enclosure.
- C. The hoist shall be provided with adjustable limit switches to stop the hoisting mechanism at the upper and lower limits of the hook travel.
- D. The lifting tackle shall consist of a lower block and hook, necessary sheaves, and wire rope, especially for hoisting service. Rope shall be as recommended by the rope manufacturer for use on the specified drum. The lower block and hook shall be of the safety type with guarded sheaves, and a slow-opening non-fracturing forged steel hook. The hook shall be supported on a ball or roller thrust bearing for easy turning and shall include a safety latch. See Drawings for Hook Offset. The sheaves shall have anti-friction or sleeve type bearings.
- E. The trolley frame shall be rigid and shall support the hoist. Trolley wheels shall be of the single flange type, of rolled, forged, or cast steel, with machined universal or crowned or tapered treads. Drive wheels shall have integral cut spur gear teeth or machine-cut gears pressed on hubs. Wheel axles shall be of the fixed type, made from high carbon steel, machined and ground to size to receive the wheel bearings. Wheel bearings shall be permanently shielded, lifetime-lubricated, anti-friction type, suitable for radial and end thrust loading. The trolley shall be provided with lug or crosshead with machined seat to receive the mounting hook of the hoist.
- F. The hoisting assembly shall consist of an upper block housing the spur gearing, load chain guide, upper sheaves and equipped with a top hook for attachment directly to the trolley; a load chain equipped with a load hook; and hand chains. The top hook shall be arranged to swivel and shall be of forged steel. Antifriction bearings shall be used throughout, and the assembly shall have facilities for proper lubrication.
- G. The hoist shall be equipped with a self-activating, mechanical load brake that will prevent acceleration of the load when lowering and which will sustain the maximum load at any point. Load brakes shall operate in sealed enclosures.
- H. The hook shall be slow-opening, non-fracturing, forged steel, and shall be provided with a safety latch. The hook shall be mounted on anti-friction bearing to permit easy turning.

## 2.07 BUMPERS AND STOPS

- A. Bumpers and stops in compliance with the governing standards shall be installed on the trolley, and runway beams. The bumpers and stops shall be located so that no part of the bridge or trolley encroaches on the clearances specified or indicated on the drawings.

## 2.08 ELECTRICAL

- A. Furnish electrical equipment including motors, motor starters, variable speed system, and wireless remote control systems, wire, and conduit. Gantry conductors may be removed for shipment. Crane wiring shall be by the crane manufacturer.
- B. Electrical shall be wired in accordance with NFPA 70, NEC Article 610.
- C. Furnish motors compatible with adjustable frequency, variable speed, drive system, 40 to 1 speed range, suitable for hoist, trolley, and gantry drive operations. Controls with one hundred twenty volt (120v) AC, microprocessor based, pulsed with modulation design, withstand 45 Deg. C temperatures, housed in NEMA 12 enclosure, and supplied with a 200 degrees overcurrent protection.
  - 1. Manufacturers and Products:
    - a. Electromotive, Frequency Inverter.
    - b. P&H Smartorque.
    - c. Or approved equal.
- D. Gantry and trolley conductor voltage drops from runway supply taps shall permit the crane motors to operate within voltage tolerances of  $\pm 10$  percent when building supply voltage is at  $\pm 5$  percent of design voltage.
- E. Festooned Flat Cable Conductors: Flexible cable, carried by heavy-duty roller, permanent lubricated roller bearings, with monorail support system that will dispense and retrieve flexible cable without twisting or tangling, and 20 percent spare conductor in each cable assembly.
- F. Grounding: External in accordance with NFPA 70, NEC Article 250.
- G. Pendant Controls:
  - 1. NEMA 3R Pendant pushbutton control stations with reversing type contactors for electric hoists, trolleys and gantry.
  - 2. Suspend control station from trolley.
  - 3. Clearly mark function of each button.
  - 4. Suspend station with stainless steel rope in a manner that will protect the electrical conductors against strain.
  - 5. Control station shall be operable from one-hundred fifteen volt (115V) power supply.
  - 6. Ground control station to hoist.
  - 7. Provide control cable lengths of 1 FT-0 IN less than distance to nearest floor.
  - 8. Control buttons spring-return to off when released.



- H. Radio control of hoist and trolley motions shall be from digital radio control systems as manufactured by Theimeg, 1-800-Theimeg (1-800-843-4634) easy control series with digital radio control system or equivalent subject to approval by the Railroad. The digital radio control receiver shall be mounted near the motor and be power fed from the crane control panel, furnished by the gantry crane manufacturer. The gantry crane manufacturer shall coordinate the power supply requirements with the radio controller manufacturer.
- I. Power Feed System – Typically a suspended conductor is provided for powering the cranes. The Railroad (in this particular application) will consider an alternate proposal. Said alternate shall be noted in the proposal and sufficient manufacturer's information shall be provided to permit evaluation for acceptance by the railroad. The proposer shall not assume automatic acceptance by the Railroad.
- J. The following specification is for a standard 3-conductor system.
  - 1. A complete electrical power feed system for the crane assembly and runway shall be provided. The system shall consist of insulated conductors and insulated collector assemblies with copper-graphite collector shoes and shall be US Safety Trolley's "Span Guard" or "Duct-O-Bar". The conductors shall be the completely enclosed type. The current and voltage rating of the conductors shall be not less than 90 amperes continuous duty, 135 amperes intermittent duty.
  - 2. Stationary conductors shall be installed adjacent to runway, with supports and brackets as required. Cross conductors shall be supported by angles across the top of the bridge. Collectors for hoist operation shall be installed on the hoist trolley and wired to the hoist. Conductors and collectors shall be installed in conformity with the recommendations and instructions of the system manufacturer. Reference project drawings for proposed location of conductors.
  - 3. The feeder circuit for the crane assembly will be furnished and installed under the electrical section to the location indicated on the drawings. A suitable surface-mounted junction box with all hanger brackets and other accessories required for a complete installation shall be furnished and installed under this section at the location indicated, and the feeder circuit wired in.
  - 4. Wiring – All insulated wire shall be heat resistant and shall be insulated for 600V.

## PART 3 - EXECUTION

### 3.01 ERECTION

- A. The crane, hoist, and trolley shall be erected by workers who are regularly engaged in crane erecting and who are acceptable to the crane manufacturer. The orientation of the installation of the hoist and trolley on the crane bridge shall be directed by the Engineer.

### 3.02 WIRING

- A. All wiring on the gantry shall be installed in rigid or intermediate metal conduit in accordance with the National Electrical Code.

### 3.03 INSPECTION AND TESTING

- A. After complete assembly an installation, each crane shall be tested. A manufacturer's representative shall be present during all field inspection and testing. The inspection and testing shall verify that each crane has been assembled properly and that all required adjustments have been made.
1. Acceptance Testing – Each crane shall be subject to operational and rated load testing.
  2. Each crane shall raise, lower, hold in any position, and transport a test load equal to 125 percent of the rated capacity of the crane, with no detrimental effects on the crane. All motions shall be executed satisfactorily. The Contractor shall provide the test weights.
  3. The following functions shall be tested:
    - a. Hoisting and lowering.
    - b. Trolley travel.
    - c. Bridge travel.
    - d. Limit switches, locking and safety devices.
  4. The trip setting of hoist limit shall be determined by test with an empty hook traveling in increasing speeds up to the maximum speed. The actuating mechanism of the limit switch shall be located to trip the switch, under all conditions, in sufficient time to prevent contact of the hook or hook block with any part of the trolley.
  5. Hoisting and lowering tests will be conducted with 0, 50, 100 and 125 percent of the nominal or rated load.
  6. The rated load test shall consist of the following operations:
    - a. The test load shall be lifted to a sufficient distance to ensure that the load is supported by the crane and held by the hoist brakes.
    - b. The test load shall be transported by means of the trolley for the full length of the bridge.
    - c. The test load shall be transported by means of the bridge the full length of the runway in one direction with the trolley as close to the extreme right-hand end of the crane as practical and in the other direction with the trolley as close to the extreme left-hand end of the crane as practical.
  7. The test load shall be lowered, stopped and held with the brakes.
  8. Wiring shall be given an insulation resistance test using a 500V megger.
  9. Following completion of the test, each crane shall be inspected by the Contractor and the Manufacturer's Representative, in the presence of the Engineer for misalignment, breakage, and undue wear. All deficiencies shall be corrected by the Contractor in a manner acceptable to the Railroad.

- B. Test Reports – Field inspection and testing of each crane shall be documented by the Crane Manufacturer's Representative through the Contractor, noting the deficiencies and corrections and certifying that each crane is acceptable for operation. Certification of the inspection shall be submitted to the Railroad.

**END OF SECTION**

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## **SECTION 41 22 23 - HOISTS, TROLLEYS, AND MONORAILS**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Hoists, trolleys, and monorails.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Section 00 07 00 - General Conditions.**

##### **B. Division 01 - General Requirements.**

##### **C. Section 01 61 03 - Equipment: Basic Requirements.**

#### **1.03 REFERENCED STANDARDS**

##### **A. American Bearing Manufacturers Association (ABMA).**

##### **B. American Society of Mechanical Engineers (ASME):**

1. B30.11, Safety Code for Underhung Cranes and Monorail Systems.
2. B30.16, Safety Code for Overhead Hoists.

##### **C. ASTM International (ASTM):**

1. A36, Standard Specification for Carbon Structural Steel.

##### **D. National Fire Protection Association (NFPA):**

1. 70, National Electrical Code (NEC).

##### **E. Comply with ASME B30.11 and ASME B30.16.**

#### **1.04 DEFINITIONS**

##### **A. Hook Height:** The minimum acceptable distance in feet from bottom of hook in full raised position to the nearest floor surface.

##### **B. Lift Height:** The distance in feet from the bottom of the hook in full raised position to the surface of the lowest floor from which items may be hoisted.

##### **C. Total Trolley Capacity:** The ultimate load-carrying capacity of the trolley based on the ultimate strength of the material used (with a 5:1 safety factor) and the bearing life.

##### **D. Ultimate Load-Carrying Capacity:** Live load, weights of all equipment and an allowance for impact.

#### **1.05 SUBMITTALS**

##### **A. Shop Drawings:**

1. Submit under provisions of Section 01 33 00.
2. See Specification Section 01 61 03.

3. Product technical data including:
    - a. Acknowledgement that products submitted meet requirements of standards referenced.
    - b. Manufacturer's installation instructions.
  4. Fabrication and/or layout drawings.
    - a. Track layout including supports, splices, connections, switches, and end trucks.
    - b. Certifications.
  5. Test reports verifying strength of inserts and rail.
  6. Load test results.
- B. Operation and Maintenance Manuals:
1. See Specification Section 01 33 00 for requirements for:
    - a. The mechanics and administration of the submittal process.
    - b. The content of Operation and Maintenance Manuals.

#### 1.06 QUALITY ASSURANCE

- A. Comply with ASME B30.11 and ASME B30.16.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Hoists:
    - a. Yale.
    - b. Acco.
    - c. Robbins and Myers.
    - d. Wright.
  2. Trolleys:
    - a. Yale.
    - b. Acco.
    - c. Wright.
  3. Monorails:
    - a. Spanmaster.
    - b. Twin City Monorail.
- B. Submit request for substitution in accordance with Specification Section 01 33 00.

## 2.02 MANUFACTURED UNITS

### A. Trolleys:

1. Motor-driven.
2. Completely compatible with hoists, cranes, and monorails specified.
3. Meet NEC standards according to classifications shown on Drawings.
4. Capable of maneuvering curves without binding or scraping the track.
5. Minimum ABMA L-10 bearing life of 5000 HRS based on 75 percent of the wheel load, excluding impact.
6. Motor Driven:
  - a. Operate at a single speed as scheduled.
  - b. Enclose internal gears in oil-tight housing.
  - c. Design motors to operate with 460 V, 3 PH, 60 Hz power supply.
7. Plain trolleys:
  - a. Frame consisting of thick rolled steel sections extending beyond wheel flanges to protect wheels.
  - b. Alloy steel hardened axles, ball-bearings and pressed steel wheels.
    - 1) Carburized and hardened ball tread wheels.
    - 2) Factory lubricated requiring no additional lubrication.

### B. Hoists:

1. Electric wire rope hoists:
  - a. Low headroom models.
  - b. Hoist frames of welded heavy-steel plate construction.
  - c. Oil-tight gear casing for oil bath lubrication of gears.
  - d. Construct rope drum and surrounding units to minimize abrading, crushing or jamming of the rope during usage.
  - e. Drum diameter not less than 18 times the diameter of the rope used.
  - f. Assure that two (2) complete wraps of rope remain on the drum after lowering the load hook through its rated lift distance, unless a lower limit device is provided, in which case provide a minimum of one (1) complete wrap.
  - g. Double revving for hoists with total lift height greater than hook height.
  - h. Sheave and drum grooves: Smooth and free from surface irregularities which could cause rope damage.
  - i. Provide running sheaves with means for lubrication.
  - j. Bearings:
    - 1) Antifriction type.

- 2) Minimum ABMA L-10 life of 1250 HRS for Class H1, 2500 HRS for Class H2, and 5000 HRS for Class H3, based on full rated speed and mean effective load K of 0.65.
- k. Mechanical load brake.
- l. Lower limit switch to stop hoist when hook reaches its lower limit.
- m. Motor:
  - 1) Motor brake.
    - a) Internal disc magnetic type.
    - b) Rated for 150 percent of motor torque.
    - c) Delivers rapidly with 4 IN max hook drift.
  - 2) TENV motors operable on 460 V, 3 PH, 60 Hz power.
  - 3) Meet specified area classification.
  - 4) Permanently lubricate and seal motor ball-bearings.
  - 5) Provide an upper limit switch to stop the hoist motor and apply the holding brake when the hook reaches its upper limit.
- n. Controls:
  - 1) Motor starters, electric conduit, control stations, magnetic reversing contactors and low-voltage transformer, necessary for a complete and totally functional conveying system.
- o. Mark the hoist with the following information:
  - 1) Name and address of manufacturer.
  - 2) Manufacturer's unit identification number.
  - 3) Rated load.
  - 4) Voltage of AC or DC power supply and phase and frequency of AC power supply.
  - 5) Rated amperage.
2. For Class I, Division 1 or 2, Group D locations, provide spark and corrosion-resistant models with bronze hooks, stainless steel load chains, bronze or aluminum hand chain, and bronze trolley wheels.
3. Mark each hoist with the following information:
  - a. Name and address of manufacturer.
  - b. Manufacturer's unit identification number.
  - c. Rated load.
- C. Monorails:
  1. Straight track: ASTM A36 steel I beams.
  2. Where track curves are required, supply straight track and curves which are standard items of monorail manufacturer.



3. Design track to support hoist capacity plus 25 percent for impact load plus the weight of hoist and accessories without exceeding allowable working stress of track material with maximum deflection of 1/450 of span.
4. Brace track to prevent sideways movement under full load conditions.
5. Provide end stops at all track ends.
6. Assure that track splices have been designed by track supplier and are located at support points.

## 2.03 ACCESSORIES

- A. Trolley stops designed to engage the trolley frame rather than trolley wheels.
- B. Furnish chain containers for hand hoists.
- C. Electrification and Controls:
  1. Provide electrical power to the motor-driven hoists and trolleys using one (1) of the following methods as scheduled:
    - a. Festoon tagline system:
      - 1) Equip with plastic wheels in areas with an NEC classification of Class I, Division 1 or 2, Group D.
      - 2) Include all components needed for a complete and operable system.
    - b. Cable reel system:
      - 1) 360-degree swivel base.
      - 2) Full working length of cable plus 25 percent.
      - 3) Include all components needed for a complete and operable system.
  2. Controls:
    - a. Pendant pushbutton control stations with reversing type contactors for electric hoists and/or trolleys.
    - b. Single station if hoist and trolley are both motor-driven.
    - c. Suspend control stations from trolleys.
    - d. Clearly mark function of each button.
    - e. Suspend station in a manner that will protect the electrical conductors against strain.
    - f. Control station: Operable from 115 V power supply.
    - g. Ground control station to hoist.
    - h. Provide control cable lengths of 1 FT less than distance to nearest floor.
  3. Switches:
    - a. Manual switches.
    - b. Completely compatible with hoists, trolleys, and monorails specified.
    - c. Provide switch chain to within 6 FT of floor.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Support track as shown on Drawings.
- B. Arrange supports for easy removal of track for repair or replacement.
- C. Align track true and level.
- D. Warning Signs:
  - 1. Affix to the hoist or the lower load block or the controls in a readable position a durable label or labels displaying the following information concerning safe operating procedures:
    - a. The word WARNING or other legend designed to bring the label to the attention of an operator.
    - b. Cautionary language against:
      - 1) Lifting more than rated load.
      - 2) Operating hoist when hook is not centered under hoist.
      - 3) Operating hoist with twisted, kinked or damaged rope or chain.
      - 4) Operating damaged or malfunctioning hoist.
      - 5) Operating hoist with a rope that is not properly seated in its groove (if applicable).
      - 6) Lifting people or lifting loads over people.
      - 7) Removing or obscuring warning label.

### 3.02 FIELD QUALITY CONTROL

- A. Test each hoist, trolley, and monorail using 110 percent rated load.
- B. 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-start-up adjustments, installation checks and all field tests.
  - 3. Conduct initial start-up of equipment and perform operational checks.
  - 4. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.
  - 5. Instruct Owner's personnel for 8 HRS at jobsite on operation and maintenance of the hoist, trolley, monorail and crane equipment.

### 3.03 SCHEDULE

- A. Hoist, trolley, and monorail systems include but are not necessarily limited to the following:

TAG	LOADING	HOIST	TROLLEY	HOOK	LIFTING	HP	OPERATING
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NUMBER	(TONS)		HEIGHT (FT)*	HEIGHT (FT)*	G SPEED FPM
HumpAir-1	1 Ton	WR, 2 HP, 18 FPM	1/4 HP, 75 FPM	2, HP and 1/4 HP	18 FPM and 75 FPM

\* Distances are to the finish floor and as indicated on the drawings..

C = Chain

HG = Hand Geared

WR = Wire Rope

NA = Not Applicable

**END OF SECTION**

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## **SECTION 41 24 40 - LOCOMOTIVE SAND SYSTEM (FOUR ARM GANTRY SYSTEM)**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This section covers supplying and installing one (1) 50 ton sand storage silo and one (1) double leg gantry sanding crane to be used in servicing locomotives, hereinafter referred to as the System.
- B. The System(s) shall be suitable for installation and operation out-of-doors at specified railroad yard described in these specifications. The System shall be provided with lubricants suitable to meet or exceed temperature extremes of the yard stated in these specifications.
- C. System drive mechanisms shall be sized to operate against an average wind velocity of 11 mph and at intervals of 30 mph during straight line winds. The parking break shall be able to withstand and hold against and 80 mph wind.

#### **1.02 REFERENCED STANDARDS**

- A. Crane Manufacturers Association of America (CMAA):
  - 1. 70-00, Specifications for Top Running Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes.
- B. Occupational Safety and Health Administration (OSHA):
  - 1. 29 CFR 1900, Occupational Safety and Health Standards.
- C. Society for Protective Coatings – (Formally: Steel Structures Painting Council (SSPC)):
  - 1. SP-10, Near White Blast Cleaning – At least 95% of each square inch shall be free of all visible residues.

#### **1.03 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Shop drawings to the Engineer for approval prior to fabrication.
- C. Three (3) sets of operation, maintenance and repair manuals.
- D. The Contractor shall submit the following along with their submittal:
  - 1. General drawings and details for their proposed equipment.
  - 2. Certification that the sanding crane meets or exceeds CMAA Class D or Class F service as applicable.
  - 3. Itemized differences between Class D and Class F as pertains to reliability and maintenance.
  - 4. Location of an operational Class D sanding crane along with the company name, contact person, and telephone number.

5. Calculations verifying equipment has been designed to Class D and Class F service stamped by a professional engineer in the state of manufacture.
6. Certificate of Conformance shall be issued by the equipment manufacturer stating that the equipment meets the specifications.
7. Provide information as required in the Equipment Description Table.

#### 1.04 GUARANTEE

- A. The equipment shall be guaranteed by the fabricator / supplier for one year after start-up.

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. A.T. Moeller Company.
- B. Whiting Corporation.
- C. Approved Equal.

#### 2.02 DESCRIPTION

- A. The System shall conform to the latest CMAA No. 70 specification for electric gantry cranes Class D as it pertains to structural design and Class F as pertains to reliability and maintenance. The CMAA specification shall be considered as part of this document.
- B. The operator shall ride in a “pulpit” at the end of a motorized telescoping mast with a maximum of 13 FT of vertical travel and capable of transverse movement over the distance required. The high point of the sand door shall be 16 FT-6 IN with the low point at 7 FT-9 IN above the top of the rail. Maximum speed shall be 50 fpm with a hand operated 5-step speed control for vertical and transverse directions.
- C. The operator control console shall consist of weatherproof hand operated controls to permit up, down, forward, back, left and right movement control. When not under operator use, the control shall automatically assume a neutral or idle condition. Controls and interlocks shall restrict the gantry and carrier to the following:
  1. Bridge longitudinal travel in a lane 7 FT wide, located at the span mid-point, except under manual override.
  2. No bridge longitudinal travel in a lane 7 FT wide, located at the span mid-point, except under manual override.
  3. Transverse carrier travel only with the lift platform fully raised, except under manual override.
  4. The trolley will be equipped with a limit switch that will be actuated when the hopper is in position for filling, only then can the gantry crane be moved into filling position. As the gantry moves into filling position, the sliding door on the bin will be moved back permitting the sand valve to be aligned with the opening. Operator can then reach the push button on the sand hopper to activate the sand filling valve.

5. An electrical signaling device will be finished on bin to signal operator when bin has reached the low level.
- D. The bridge crane will be equipped with limit switches which will be actuated with the trips located on the gantry rail, which will decelerate crane to permit it to travel in area for filling of sand bin. These switches will be interlocked with operation of crane.
- E. The carrier shall be provided with a 240 CU FT sand hopper and equipped with four (4) sand dispensing hoses and weatherproof nozzles, emergency shutoff valves, a sliding door fill opening, high and low sand level indicators, a service walk with handrails and bumpers. Sliding door shall be designed to eliminate or minimize “failure to operate” problems due to freezing rain or snow build up.
- F. The trolley shall incorporate a 1-1/2 to 2 ton lifting hoist at the approximate center of the trolley on the bridge beam.
- G. The operator’s platform shall be equipped with a safety device to prevent the platform from dropping in the event of failure of the hoisting mechanism or cable break.
  1. Operator’s platform shall be equipped with a roof and removable storm closure.
  2. The leg of the gantry shall be equipped with access stairs for the operator.
- H. The bridge shall be supported by double legs running on ground anchored crane rail. The bridge speed shall be a maximum of 150 fpm with a five (5) step variable speed control. The bridge shall have: Three (3) 250 watt mercury vapor lights, two (2) double headed warning horns, wheels to be double flanged, a collector assembly, a service walkway with handrail the length and both sides of the beam, and an electrically operated locking device. Braking to be with a system, that is a direct acting system proportionate to the pressure applied by the operator, a foot pedal is desirable. There shall also be a parking brake with a variable timer to lock in after of each crane ail for installation by the Railroad’s general contractor.
- I. Each truck wheel to be provided with a flangeway sweep for removal of snow and/or sand.
- J. The supplier shall provide crane rail stop, bumper and locking device anchor to installer.
- K. Equipment shall be shop primed and painted with a safety yellow paint.
- L. Equipment shall be provided with an OSHA compliant operators dismount the platform and access the stair attached to the gantry leg, width no to exceed clearance dimension of drive motors.
- M. The supplier/fabricator shall also be responsible for:
  1. Providing the electrical conductor(s), mounting brackets and weather cover (length of crane rail)
  2. Providing touch-up paint for all scars due to shipping and erection.
  3. Start-up personnel to check, test, start-up and commission the installation.
  4. Three (3) days of training of Railroad personnel.

5. Coordinating with structural designer and/or silo manufacturer to determine crane rail centers, crane rail weight, location, configuration support of the conductors, and all other items pertinent to the installation of system.
6. Coordinating delivery and installation with the Railroad's contractor.

## 2.03 POWER SUPPLY

- A. The power supply shall be 460 V, 3 ph, 60 Hz. All motors shall be Totally Enclosed Fan Cooled (TEFC). The service factor of 1.15 shall not be used when determining the require horsepower. Wiring and controls shall comply with current National Electrical Code (NEC) standards.

## 2.04 SAND STORAGE SILO

- A. The quotation shall provide the costs to furnish a 50 ton, 1,000 CU FT capacity tank. The tank shall be complete with support structure, gravity drop spout with pneumatic valve, dust eliminator, level controls, drop spout weather hood, automatic valve and level controls to be compatible with gantry controls, fabricator to also provide anchor bolt template and anchor bolts to Railroad general contractor.
- B. Tank shall be of welded steel construction assembled at the factory. Support structure to be bolted construction for ease of assembly on site.
- C. Tank and support structure shall be sand blasted and primer coated at the factory. Minimum surface preparation to be SSPC SP-10. Prime coat to be fish oil modified alkyd, Rust-Oleum 1069 heavy duty red primer or equal 2 to 3 mils DFT. Finish coat to be Rust-Oleum New Color Horizon Gray No. 906 2-3 mils DFT or equal.
- D. Support structure and tank to be designed for the appropriate seismic zone four (4) and for 100 MPH straight line winds (with tank empty). Supplier to provide loading factors for anchor bolt sizing.
- E. The tank shall be filled from the delivery truck via the use of a compressed air sand pump system. Sand fill pipe, fittings, and connections to be provided by the supplier. The gravity drop spout shall provide sand to the hopper of a sanding gantry system.
- F. The storage silo shall be provided with an access ladder and fall protection device (slide bar) in accordance with OSHA.

## PART 3 - EXECUTION

### 3.01 HOPPER FILLING OPERATION

- A. When the Operator receives a signal that the sand in the crane hopper has reached the low limit, the Operator will proceed to the supply silo. The Operator will spot the crane on the limit switch in the fill position and also spot the carrier on the limit switch in the fill position. This places the hopper opening under the valve of the supply silo. With the crane and carrier properly positioned, the operator can push the button mounted at the fill location and proceed to fill the sand hopper. When the sand reaches the upper limit the operator will be signaled by a light and the valve from the silo can be closed.



### 3.02 INSTALLATION AND MAINTENANCE REQUIREMENTS

- A. Supplier shall include personnel required to supervise, install, erect, and start-up of the equipment provided under this contractor. The Supplier shall verify shipment and receipt of all components furnished under this contract.
- B. The Supplier will provide a one year maintenance service for the provided equipment. The name, address and telephone number of the service/maintenance company shall be provided to the Railroad prior to the final payment invoice.
- C. The Railroad's general contractor will:
  - 1. Provide the foundations for the sand silo and install fabricator provided anchor bolts.
  - 2. Provide the gantry crane rail foundation with crane rail.
  - 3. Provide the electrification supports.
  - 4. Install the end bumpers provided by sand gantry suppliers and bring power to the electrification conductors furnished and installed by the sand gantry supplier.

#### **END OF SECTION**

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## **SECTION 41 50 10 - PRE-ENGINEERED TIMBER COLUMN STRUCTURE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Pre-Engineered factory- and field-fabricated Timber Column Structure.
2. Prefinished metal roofing and siding panels.
3. Prefinished metal trim items.
4. Prefinished soffits.
5. Prefinished gutters and downspouts.
6. Insulation, interior framing, and liner package.

#### **1.02 REFERENCED STANDARDS**

##### **A. Preservative Treated Lumber:**

1. American Wood Protection Association (AWPA):
  - a. Commodity specification C2 (2001).
  - b. Use category system: user specification for treated wood: UC4B (ground contact for fresh water).
  - c. Treated item shall bear the quality mark of an independent testing agency or service certified by the AWPA to inspect preservative-treated wood.
2. Federal Specification TT-W-571-J.

##### **B. Framing Lumber:**

1. Lumber Grading Rules and Wood Species:
  - a. National Design Specification for Wood Construction, current edition.
  - b. Northeastern Lumber Manufacturer's Association Inc. (NELMA).
  - c. Southern Pine Inspection Bureau (SPIB): Southern Pine.
  - d. West Coast Lumber Inspection Bureau (WCLIB): Douglas Fir.
  - e. Western Wood Products Association (WWPA): Douglas Fir and Ponderosa Pine.

##### **C. Wood Trusses:**

1. All lumber used in the design of wood trusses shall be kiln dried and graded in accordance with the current grading rules. Design stresses allowed are those listed in the current editions of the respective Lumber Association's grading rules.
2. The design of wood members shall be in accordance with the formulas published in the 2001 edition of the National Design Specification for Wood Construction.

3. Light-metal toothed connector plates and joint design shall conform to specifications as set forth in the 2002 edition of Truss Plate Institute's Design Specification for Metal Plate Connected Wood Trusses. (TPI-2002).
  - a. Connector plates shall be fabricated from ASTM A 653, Grade A, or better, 18 and 20 gauge steel sheets with a G80 or better, metallic (zinc) coating.
4. Truss members and joints shall be designed in accordance with TPI-2002. All truss designs shall be accompanied by complete and accurate shop drawings and contain the following information:
  - a. Slope or depth, span and spacing of the truss.
  - b. Heel bearing height.
  - c. Design loading to include:
    - 1) Top chord live load.
    - 2) Top chord dead load.
    - 3) Bottom chord dead load.
    - 4) Concentrated loads and their points.
  - d. Adjustments to lumber and plate design values for conditions of use.
  - e. Plate type, thickness of gauge, and size.
  - f. Lumber size, species and grade for each member.

#### 1.03 SYSTEM DESCRIPTION

- A. Clear Span.
- B. Bay spacing of 7 FT-6 IN OC.
- C. Primary Framing:
  1. Columns.
  2. Trusses.
  3. Wind Bracing.
- D. Secondary Framing:
  1. Perimeter baseboards.
  2. Wall Girts.
  3. Purlins.
  4. Overhang rafters and fascia.
  5. Ancillary blocking, furring, and grounds as required.
- E. Roof Covering:
  1. Prefinished ribbed metal panels.
- F. Wall Covering:
  1. Prefinished ribbed metal panels.

G. Insulation and liner package:

1. Wall insulation.
2. Ceiling insulation.
3. Air deflectors
4. Vapor retarder.
5. Wall stripping
6. Prefinished ribbed metal panels.

1.04 DESIGN REQUIREMENTS

A. Roof Design Loads:

1. Top Chord Live Load: 20 PSF.
2. Top Chord Dead Load: 4 PSF.
3. Bottom Chord Dead Load: 4 PSF.
4. Bottom Chord Point Load:
5. Unbalanced Snow Loads: Design in accordance with local building codes.

B. Wind speed:

1. Minimum 100 MPH (V3s), Exposure “C”, or based on local codes, whichever is higher.

C. Roof and wall system shall be able to withstand the imposed loads with maximum allowable deflection of  $L/270$ .

D. Seismic: Designed in accordance with local building codes.

E. Assembly shall permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.

F. Size and fabricate wall and roof systems to be free of distortion or defects that would be detrimental to appearance or performance.

1.05 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Provide (2) sets of the following, bearing the seal of a Professional Engineer registered in the State that the building is being constructed.

1. Complete and detailed shop and erection drawings showing size and location of each part and component, certifying that the building design meets specified roof and wind loading requirements.
2. Truss Engineering analysis and design data which includes the following:
  - a. Axial forces and bending moments for each member.
  - b. Basic plate design value.
  - c. Design analysis of each joint showing that proper plates have been used.

C. Manufacturer's standard color chart for the Railroad to choose from.

1.06 PROJECT RECORD REQUIREMENTS

- A. Submit under provisions of Section 01 33 00.

1.07 QUALITY ASSURANCE

- A. Fabricate members in accordance with standard industry practices.

1.08 QUALIFICATIONS

- A. Contractor shall have a minimum of forty years documented experienced in the manufacture and erection of this type of structure.
- B. Design structural components under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State that the building is being constructed.
- C. Employ adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods needed for proper performance of the work.
- D. Contractor shall be responsible for all materials, whether furnished by himself or a subcontractor, and proper storage of the same.

1.09 REGULATORY REQUIREMENTS

- A. Contractor shall be responsible for compliance with all applicable building codes and/or ordinances covering the work.
- B. Cooperate with regulatory agency or authority to provide data as requested.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store prefabricated components (trusses, columns, steel sheeting and other items) so that they will not be damaged or deformed.
- B. Stack materials on platforms, pallets, or other structures covered with tarpaulins or other suitable weather tight ventilated covering. Handle and or subjecting parts to excessive stresses.
- C. Store roofing and siding panels so that water will drain freely.
- D. Do not store panels in contact with other materials which may cause staining or discoloration.

1.11 PROJECT CONDITIONS

- A. Coordination:
  - 1. Fit carpentry work to other work, scribe, and cope as required for an accurate fit. Correlate location of furring, nailers, blocking, grounds and similar supports to allow for attachment of other work.

1.12 CERTIFICATIONS

- A. To be submitted for approval prior to building order:
  - 1. Certification of sheet steel supplier stating:

- a. Minimum thickness of metallic coated steel IN INCHES.
  - b. Identification of all metallic coatings.
  - c. Coating weight range.
  - d. Verification that material supplied is in conformance with the applicable ASTM standard as stated in the technical specification.
2. Certification of paint supplier stating:
    - a. Generic chemistry of top coat.
    - b. Trade name of top coat.
    - c. Percentage of Polyvinylidene Fluoride in resin.
  3. Certification of sheet steel coater stating:
    - a. Nominal paint film thickness IN MILS.
  4. Certification of treated lumber supplier stating:
    - a. Preservative type.
    - b. Preservative retention in pounds per cubic foot of wood.
    - c. Depth of assay zone.
    - d. Treatment is in accordance with AWWA standard C2 and Federal Specification TT-W-571J.
  5. Warranty:
    - a. Sample copy of warranty to be issued at completion of project.
    - b. Verification that warranty meets or exceeds the requirements stated in the technical specification.
- B. FAILURE TO SUPPLY THE REQUIRED SUBMITTALS WILL RESULT IN THE BIDDER'S PROPOSAL BEING REJECTED AS NON-RESPONSIVE.**

#### **1.13 WARRANTY**

- A. The Building Manufacturer shall supply a warranty to the Railroad which shall provide that the Manufacturer will:**
1. For a period of 50 years:
    - a. Absorb repair or replacement costs, including material and labor, if any preservative-treated lumber fails due to decay or insect attack.
    - b. Repair, or at its discretion, replace free of charge the building framework, including and roofing and / or siding panels, if directly damaged by snow loads.
  2. For a period of 35 years:
    - a. Repaint any roofing or siding panel on which, under conditions of normal weathering, the paint has separated from the panels, if directly damaged by snow loads.

- b. Repaint any roofing or siding panels on which, under conditions of normal weathering, chalking greater than a rating of 8 (ASTM D4212 Method “A”) or color change greater than five (5) units (ASTM D2244) has occurred.
- 3. For a period of 20 years:
  - a. Repaint any roofing or siding panel on which, under conditions of normal weathering, exhibit corrosion resulting in red rust greater than 1/2 IN from any sheared edge which is clearly visible in casual observation.
- 4. For a period of 5 years:
  - a. Repair, or at its discretion, replace free of charge the building framework, including roofing and / or siding panels, if directly damaged by wind loads, unless damage is caused by flying or falling objects.
  - b. Repair any roof leaks due to defects in materials or workmanship.
- 5. For a period of 1 year:
  - a. Repair other building parts that prove to be defective in materials or workmanship.
- 6. The Manufacturer shall NOT be liable for damage due deterioration caused by interior chemical vapors and / or dust, damage by flying or falling objects, or collateral damage to interior walls, ceiling, partitions, equipment, and / or contents, or cost of preparation of the site.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS – BUILDING SYSTEM

- A. Morton Buildings Inc.  
252 W. Adams St.  
Morton, Illinois 61550-1804  
309-263-7474
- B. Morgan Buildings & Spas Inc.  
2800 McCree Rd.  
Garland, Texas 75041
- C. Lester Building Systems, LLC  
1111 2nd Avenue South  
Lester Prairie, Minnesota 55354  
800-826-4439
- D. Cleary Building Corp.  
P.O. Box 930220  
Verona, Wisconsin 53953  
800-373-5550

### 2.02 MATERIALS – FRAMING

- A. Columns (Built on Concrete Foundation – see also 2.04):
  - 1. Factory fabricated from minimum three (3) ply No. 1 or better SYP.
  - 2. Provide factory installed blocking on outside face of column between nailers.

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B. Columns (Columns in ground).

C. Wood Trusses:

1. Lumber:
  - a. Top Chord: No. 1 or better SYP.
  - b. Bottom Chord: 1950 MSR or better SPF.
  - c. Webs: No. 1 or better SYP.
2. Trusses shall be constructed of surfaced lumber, smooth and free of all cracks, checks, and blemishes.
3. Plates: Connector plates shall be fabricated from ASTM 653, Grade A or better 18 and 20 gauge steel sheets with a G60, or better, metallic (zinc) coating.
4. Design and Fabricate trusses and connectors to withstand snow and wind loads and all dead loads.
5. Fabricate trusses in plant, using mechanical or hydraulic fixtures as required to bring members into contact. Install plates in accordance with manufacturer's instructions.

D. Baseboards

1. 2 x 8 No. 2 or better SYP with 1/2 IN x 3/4 IN notch in top.
2. Pressure treated with a wood preservative to a retention commensurate with applicable AWPAs standards and kiln dried after treating to 19 percent maximum moisture content.
3. The preservative shall penetrate 100% of the sapwood.

E. Wall Girts:

1. First nailer above baseboard: 2 x 6 No. 2 or better SPF with 1/2 IN x 3/4 IN notch in bottom.
2. Balance of nailers: 2 x 4 2100f MSR or better SPF.
3. Overhang top nailer: 2 x 6 No. 2 or better SPF.

F. Base Reinforcement:

1. 7/16 IN x 32 IN OSB panels installed between the baseboard and first nailer.

G. Purlins and Truss Ties:

1. 2 IN x 4 IN No. 2 or better SPF.

H. Overhang Framing:

1. Provide factory fabricated rafter frames.
2. Provide 2 IN x 6 IN No. 2 or better SPF factory beveled fascia boards.

I. Wind Bracing:

1. 2 IN x 6 IN No. 2 or better SPF from endwall column to first truss back.

J. Framing Around Openings:

1. 2 IN x 4 IN No. 2 or better SPF around personnel doors.

2. 2 IN x 6 IN No. 2 or better SPF around overhead door openings.

K. Headers:

1. Provide built-up headers as required for a proper installation.

L. Incidental Framing:

1. 2 IN x 4 IN and or 2 IN x 6 IN No. 2 or better SPF.

M. Interior Framing:

1. 2 IN x 4 IN No. 2 or better SPF.

2.03 MATERIALS – PREFINISHED METALS

A. Roofing Panels (Fluoroflex 1000):

1. Panel substrate shall be .019 minimum thickness commercial steel sheet with a AZ55 Aluminum / Zinc (Galvalume) coating (ASTM A792).
2. The weather side of the panel shall receive a thick Polyurethane primer and a nominal one mil topcoat of 70 percent Polyvinylidene Fluoride Resin (Fluoroflex 2000).
3. The non-weather side paint system shall consist of a two coat finish with a total nominal thickness of 1/2 mil.

B. Siding Panels:

1. Panels substrate shall be .019 IN minimum thickness commercial steel sheet with a G90 (Zinc) coating (ASTM A653) or AZ55 Aluminum / Zinc (Galvalume) Coating (ASTM A792).
2. The weather side of the panel shall receive a nominal 2/10ths mil Polyurethane primer and a nominal (8/10ths mil topcoat of 70 percent Polyvinylidene Fluoride Resin (Fluoroflex 1000) to achieve a total nominal paint film thickness of one (1) mil.
3. The non-weather side paint system shall consist of a two-coat finish with a total nominal thickness of 1/2 mil.

C. Wainscot Panels:

1. Panel Substrate shall be .019 IN minimum thickness commercial steel sheet with a G90 (Zinc) coating (ASTM A653) or AZ55 Aluminum / Zinc (Galvalume) Coating (ASTM A792).
2. The weather side of the panel shall receive a nominal 2/10ths min Polyvinylidene Fluoride Resin (Fluoroflex 1000) to achieve a total nominal paint film thickness of 1 mil.
3. The non-weather side paint system shall consist of a two coat finish with a total nominal thickness of 1/2 mil.

D. Metal Trim Items:

1. Die-formed steel from the same quality material as the siding panels.

E. Interior Panels:

1. Panel substrate shall be .019 MINIMUM thickness commercial steel sheet with a AZ50 (Galvalume) coating (ASTM A792).
2. The weather side of the panel shall receive a nominal 2/10ths mil acrylic primer and a nominal 8/10ths mil topcoat of white polyester paint to achieve a total nominal paint film thickness of 1 mil.
3. The non-weather side paint system shall consist of a two coat finish with a total nominal thickness of 1/2 mil.

F. Metal Trim Items:

1. Die-formed steel from the same quality material as the siding panels.

G. Soffits:

1. Prefinished aluminum soffit as manufactured by Alcoa Building Products.
  - a. Provide solid soffit for end overhangs.
  - b. Provide perforated soffit for vented side overhang.

H. Ridge Vent:

1. Prefinished aluminum Vent-A-Ridge as manufactured by Alcoa Building Products.

I. Gutters and Downspouts:

1. Provide 5 IN ogee (style "K") .030 minimum thickness 3004 H36 tempered aluminum alloy gutters on both sides of the building. Gutters shall be coated with KYNAR 5000 / HYLAR 5000 paint system with a total nominal thickness of one (1) mil on the visible side.
2. Interior paint finish shall be a nominal 1/2 mil polyester wash coat.
3. Silicone sealant and silicone rubber gaskets shall be used at laps to maintain leak protection and to relieve stress due to thermal movement.
4. Provide one (1) 3 IN x 4 IN downspout with appropriate elbows and conductor bands per 1800 SQ FT of roof area.

## 2.04 MATERIALS – OTHER

A. Column Sockets:

1. Fabricate socket from minimum 4 gauge hot rolled steel.
2. Factory paint socket to inhibit corrosion.

B. Socket Fasteners:

1. 1/2 IN DIA x 10 IN galvanized "J" bolts cast 8 IN into concrete foundation.
2. 1/2 IN DIA machine bolts to secure column to socket.
3. Ancillary washers and nuts.

C. Corner Bracing:

1. Provide 1-1/2 IN wide high tensile steel strapping of all unobstructed corners in an "X" configuration.

D. Roofing and Siding Fasteners:

1. EPDM washered, painted, center drive stainless steel screws for ribbed steel panels.
2. EPDM washered, galvanized ring-shank nails for ribbed steel panels.

E. Closure Strips:

1. Closed cell foam.

F. Sealant:

1. Paintable silicone.

G. Insulation:

1. Minimum 6 IN thick, R19 fiberglass blankets in walls.
2. Minimum R30 blown fiberglass in ceiling.

H. Vapor Retarder:

1. 4 mil thick polyurethane sheets.

### PART 3 - EXECUTION

#### 3.01 ERECTION – FRAMING – GENERAL

- A. Erect framing in accordance with manufacturers established construction procedures.
- B. Make all components and building plumb, square, straight, and true to lines.
- C. Provide adequate temporary bracing to assure structure remains plumb and square until permanent bracing is installed.
- D. Alerting of structural members will not be permitted.

#### 3.02 ERECTION – FRAMING

A. Column:

1. Attach steel column socket to the concrete foundation with 1/2 IN x 10 IN plated “J” bolts, washers, and nuts.
2. Attach the column to the column socket with four (4) 1/2 IN bolts and eight (8) twenty penny (20d) galvanized R. R. nails.

B. Baseboards:

1. Install 2 x 8 treated plank, sealed to the concrete foundation with pre-compressed Ultra-seal, using manufacturer recommended fasteners.

C. Wall Girts:

1. Install 2 x 6 notched nailer to receive OSB panel.
2. Install 2 x 4 nailers at 32 IN OC.
3. Install 2 x 6 overhang nailer at the top.

D. Trusses:

1. Set trusses in plane with the center member of the upper column using lifting methods as approved by the manufacturer.
2. When properly positioned, install two (2) 1/2 IN DIA machine bolts and manufactured recommended twenty penny (20d) ring shank nails through two of the upper column laminates and the truss heel.
3. Brace trusses as recommended by manufacturer.

E. Purlins:

1. Install 2 x 4 purlins at 24 IN OC and attach to trusses with sixty penny (60d) ring shank nails.

F. Truss Ties:

1. Install 2 x 4 truss ties at location recommended by manufacturer.
2. Truss ties shall be run from endwall to endwall.

G. Wind Bracing:

1. Install 2 x 6 angled bracing at locations recommended by manufacturer.

H. Incidental Framing:

1. Install 2 x 4 or 2 x 6 blocking as required according to building manufacturers recommendations.

I. Interior Framing:

1. Install 2 x 4 baseboard at 4 IN above grade and case in metal trims.
2. Install 2 x 4 horizontal stripping at 36 IN OC maximum in areas receiving ribbed steel panels.
3. Install 2 x 4 horizontal stripping at 16 IN OC in areas receiving gypsum board if applicable.

### 3.03 ERECTION – PREFINISHED METALS - GENERAL

A. Roofing Panels:

1. Install panels perpendicular to supports, aligned straight with end fascias.
2. Fasten panels to purlins with screw fasteners.

B. Siding and Wainscot Panels:

1. Install panels perpendicular to supports, aligned level and plumb.
2. Fasten panels to wall girts with screw fasteners.

C. Trim Items:

1. Install Trim items at the base, wainscot transition, corners, top of steel siding, fascias, gables, and ridge using appropriate fasteners.

D. Vent-A-Ridge:

1. Install over ridge trim using screw fasteners.
2. Ensure that a minimum of 2 IN clear throat opening is maintained.

- E. Soffits:
    - 1. Install soffits to interlock with trim items at top of steel siding and at fascias.
    - 2. Use solid soffit at end overhang.
    - 3. Use a combination of solid and perforated soffits to provide balanced ventilation at side openings.
  - F. Gutters and Downspouts:
    - 1. Install gutters with spikes and ferrules spaced 24 IN OC.
    - 2. Silicone sealant and silicone rubber gaskets shall be used at laps to maintain leak prevention and to relieve stress due to thermal movement.
  - G. Filter Strips:
    - 1. Provide closed cell foam filler strips at the top and bottom of the roofing panels.
  - H. Interior Panels:
    - 1. Install panels perpendicular to supports, aligned level and plumb.
    - 2. Fasten panels to wall girts with 1 IN painted screws.
    - 3. Fasten panels to lower truss chords with 1 IN painted screws.
- 3.04 TOLERANCES
- A. Framing Members:
    - 1. 1/4 IN from level.
    - 2. 1/8 IN from plumb.
  - B. Siding and Roofing:
    - 1. 1/8 IN from true position.

**END OF SECTION**

## **SECTION 41 52 20 - PREFABRICATED SALT STORAGE DOME**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Contractor furnishing all labor, materials, and equipment necessary and incidental to provide the salt storage dome for the purpose of stockpiling de-icing material to be used in the ice and snow program for the intermodal yard and automotive facility as specified herein.
2. Furnishing all plant and site labor, equipment, appliances and materials, and in performing all operations in connection with the purchase, delivery and erection of the prefabricated salt storage domes.

##### **B. All building permits and associated fees shall be the responsibility of the Contractor.**

#### **1.02 LOCATION AND INSTALLATION**

- A. Prefabricated salt storage dome shall be located at the yard shown on the site drawings.
- B. The Contractor shall coordinate the prefabricated salt storage dome's final footprints and exact site location and confirm that the paving on which the dome is to be constructed meets the minimum manufacturer's requirements for pads prior to installation. Footing depth shall be 42 IN minimum.

#### **1.03 SUMMARY OF WORK**

- A. These specifications specify the minimum requirements of the prefabricated salt storage domes and foundation.
- B. Provide a one (1) year minimum warranty for the building that includes material and labor and a roof warranty as specified later in this Section.
- C. The roof slope, except for the doorway canopy, shall prevent snow and ice build-up, roof leaking, and ensure longevity of the shingles and building as a whole.

#### **1.04 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Manufacturer's shop and erection drawings and design calculations; prepared by or under direct supervision of a Registered Professional Engineer, licensed to practice in the State that the building is being constructed, with all drawings and calculations bearing his seal.
- C. Product Data: Two (2) copies of manufacturer's specifications and descriptive literature.
- D. Relevant Experience: Three (3) locations, listing names of the owners, addresses, and telephone numbers where the manufacturer has completed similar work in the past two (2) years.

- E. Certification: Two (2) copies of written certification, prepared and signed by a Registered Professional Engineer licensed to practice in the State that the building is being constructed, attesting that the building design meets all required load bearing requirements, requirements of codes and authorities having jurisdiction at the project site, and other requirements.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURER

- A. The building to be furnished shall have a storage capacity of approximately 1500 tons as provided by one of the following manufacturers or an approved equal.
  - 1. Dome Corporation of America  
5450 East Street  
Saginaw, Michigan 48601  
Tel. (517) 777-2050
  - 2. Bulk Storage Inc.  
2801 South Yates Ave  
Beecher, Illinois 60401  
Tel. (708) 946-9595

### 2.02 DESIGN CRITERIA

- A. These specifications provide for a high quality bulk storage structure. As further noted in these specifications, as a minimum the building shall provide a 12 IN thick sealed concrete base wall with two faces of steel reinforcement, minimum 5/8 IN DIA panel connection bolts, #1 structural Douglas Fir plywood no structural panels members with a cross-section less than 2 x 6 (8.25 SQ IN), protective canopied entrance way with concrete wingwalls, and 25 year warranted roofing.
- B. Base Wall: The base wall shall be a minimum of 12 IN thick sealed concrete wall 9 FT-0 IN above finished grade. The retaining wall shall be a reinforced concrete ring, 1 FT-0 IN thick with two mats of reinforcing steel designed to withstand the pressure of the stored material and the dome structure's dead and live loads. After curing, the inside of the retaining wall shall be coated with two (2) applications of a mixture of 50 percent mineral spirits and 50 percent linseed oil.
- C. Structure: The dome structure shall be designed to withstand the minimum ground snow load and a wind load required by BOCA Building Code, latest edition. Coefficients shall be applied to the ground snow load to change it to roof snow load and further adjustments made to allow for the slope of the dome panels. Also the wind load shall be adjusted to allow for the slope of the dome panels. An entrance opening shall be provided with a width of 18 FT-0 IN and a height of approximately 18 FT-0 IN.
- D. Roofing: The roofing material shall be standard asphalt roofing shingles either fiberglass or organic mat carrying a minimum manufacturer's warranty of 25 years. Rolled roofing shall be used where applicable at opening locations.



- E. **Rated Capacity:** The prefabricated salt storage dome shall be sufficient size to store approximately 1500 tons of de-icing salt based on weight of 80 LBS/CU FT. Storage of piled salt shall not exceed a repose angle of 32 degrees. The building shall include a built-in fan dormer for a 30 IN exhaust fan as included in the electrical specification Section and noted on the Drawings. See electrical section at end of specification for fan designation. The dome shall be designed for future conveyor loads. The conveyor shall be 24 IN wide roof supported fixed type salt loading conveyor and run from the underside of the unloading hopper to the center of the dome above the material pile. Dome design shall allow for the installation of a sidewall penetration dormer at the salt conveyor location. Provisions shall also be made for the installation of a bulkhead at the entryway to allow for full utilization of the dome's rated capacity.
- F. **Lumber:** The outside framing members shall be SPF species or better, grade #2 or better, dried to maximum moisture content of 15 percent. The internal studs shall be 4 x 4 southern pine species or better, #2 or better, and dried to a maximum moisture content of 19 percent. All lumber shall conform to American Softwood Lumber Standard PS-20-74.
- G. **Plywood:** The plywood shall be five (5) ply, 5 layers, Douglas fir plywood exterior and grade one structural #1. No lower grade or other species of plywood will be acceptable. All plywood shall be a minimum of 1/2 IN CDX agency rated and conform to PS-1-83.
- H. **Adhesive:** The adhesive glue used in the fabrication of the dome's panels shall be recommended for the intended use, water resistant, mixed and applied in accordance with the manufacturer's recommendations.
- I. **Hardware:** The hardware used to assemble the stress skin panels on site shall be a minimum 5/8 IN DIA hot dip galvanized bolts with 2-3/4 IN square washers, also hot dipped galvanized. No smaller than 5/8 IN DIA bolts will be accepted to connect the structural panels together. All nails and staples used in the manufacture of the panels shall be galvanized.

## PART 3 - EXECUTION

### 3.01 SPECIAL PROVISIONS

- A. The building furnished by the Contractor is to be erected and assembled at the site specified and as per the approved manufacturer's shop and erection drawings approved by the City in which the building is being constructed. The Contractor shall be responsible for the safe loading and unloading of the prefabricated panels. It will also be the responsibility of the Contractor to make any minor adjustments necessary in the footings and foundation to accomplish a plumb vertical building access and level horizontal foundation lines.

### 3.02 DESIGN AND CONSTRUCTION

- A. **Concrete Reinforcing:**
  - 1. **General:** Furnish all labor, materials, related equipment and supervision necessary for the complete reinforcement of the concrete as required by the manufacturer's drawings and specifications.

2. Products:

- a. Reinforcing Steel: Deformed epoxy coated steel reinforcing bars conforming to ASTM A615 Grade 60. Metal shall be clean and free of loose rust, scale or coatings that will reduce bond.
- b. Anchor Bolts: Shall be unfinished ASTM A307 5/8 IN minimum diameter designation with a minimum yield strength of  $f_y = 36$  KSI. The anchor bolts shall be hot-dipped galvanized.
- c. Metal Accessories: Include all spacers, chairs, ties and other devices necessary for the proper spacing, supporting and fastening of the reinforcing steel in place.

3. Execution:

- a. Place reinforcement accurately, in position shown on the manufacturer's drawings; securely fasten and support to prevent displacement before and during pouring. Cleaning, bending and placing of reinforcement shall be done in accordance with the requirements of the American Concrete Institute codes.

B. Cast-In-Place Concrete

1. General:

- a. Furnish all labor, materials, related equipment and supervision necessary for the complete concrete work as required by the manufacturer's drawings and specifications.
- b. All concrete used for footings, foundation and pier or post supports below and above grade shall have a minimum compressive strength of 4000 PSI at twenty-eight (28) days. Mix design shall be submitted and approved by the Engineer. All concrete above grade shall have a 4 - 6 percent air entrainment.

2. Portland Cement: Supply concrete made with air-entrained portland cement ASTM C150 Type 2 cement or as approved by the Engineer.

3. Mixing Water: Mixing Water shall be clean and free from oil, acid and injurious amounts of vegetable matter, alkalis and other salts.

4. Execution:

- a. It shall be the Contractor's responsibility to check all dimensions and accuracy of the formwork and reinforcing steel prior to placing the concrete. The Contractor shall follow the normal and recommended practice for placing and protection of the concrete as outlined in the ACI.
- b. Finished surfaces of the concrete wall shall be free of voids or other surface blemishes. The outside of the foundation wall shall be ground smooth of any ridges and given a brush coat of cement paste to produce a uniform appearance. The interior of the wall shall have voids or other irregularities filled with cement paste.

C. Framing and Sheathing:

1. Execution:

- a. Provide all labor, materials and equipment necessary to complete all carpentry work and related work under this Section. All carpentry shall be installed by skilled carpenters working under proper supervision. The Work shall be carried out in a thoroughly high grade and workmanlike manner. The framework shall be assembled using 3-1/4 IN galvanized spiral nails. All joints shall be tight and present a smooth surface for gluing. The plywood sheathing shall be attached to the frame using glue. 1-3/4 IN galvanized staples shall be used to hold the plywood in place until the glue cures. The plywood shall then be beveled to suit the framework.
- b. Assembly and erection of pre-fabricated panels, installation of doorway trusses, canopy and all related work must be done in accordance with the manufacturer's drawings and specifications. Adjustments may be made on site if found to be necessary and shall be carried out in a workmanlike manner conforming to good building practices.

D. Moisture Protection Asphalt Shingle Organic/Fiberglass Mat:

1. General:

- a. The Contractor shall furnish all labor, materials, tools, equipment and supervision to properly install the asphalt roofing shingles to all surfaces designated for shingles on the manufacturer's drawings

2. Product:

- a. The asphalt shingle shall be organic or fiberglass mat and provide a minimum manufacturer's prorated warranty as per earlier stated in the specifications. The shingles shall be of American manufacture. The shingles shall be installed with large head galvanized roofing nails as per the manufacturer's instruction.
- b. Material for underlayment of shingles shall be non-perforated. The felt shall be attached directly to the plywood sheathing with large flat head galvanized roofing nails.
- c. The color of shingles shall be selected from standard colors by the Owner or his or her representative.

3. Execution:

- a. Surface to be covered with asphalt shingling shall be smooth and free from defects of every description, all such surfaces shall be dry and clean from dirt, rubbish and other foreign materials before roofing is started. All projecting nails shall be set flush to the roof sheathing.
- b. The roofing shall be installed in strict accordance with the manufacturer's instructions in the conventional manner after the complete building has been erected. At no time should roofing felt or shingles be stored or applied on the building until all internal bracing has been installed.
- c. Flashings shall be installed where called for on the approved manufacturer's drawings and shall be of aluminum non-corrosive or non-metallic material.

- d. The roofing felt shall be applied in such a manner that each panel joint is overlapped to prevent leakage and installed with large head galvanized roofing nails.
- e. The roofing shingles shall be applied with large head galvanized roofing nails, the number and location of the nails to be governed by the manufacturer's directions.
- f. Roof vents and other openings in the roof shall be properly installed in such a manner to prevent leakage.

E. Finishes:

- 1. General: The Contractor shall furnish all materials, tools, and equipment and supervision to apply three coats of paint to all exterior exposed wood surfaces.
- 2. Product:
  - a. The paint selected shall be first quality materials as manufactured by a company list below or an approved equal:
    - 1) Sherwin Williams.
    - 2) Pittsburgh Paints.
    - 3) Devoe Paint.
  - b. Color shall be as selected by the Owner or approved representative.
- 3. Surface Preparation:
  - a. The surface to be painted shall be sanded smooth, all dust and dirt must be removed and surfaces must be completely dry.
  - b. All painting shall be performed within the actual and anticipated ambient temperature ranges specified by the paint manufacturer.
- 4. Application:
  - a. The material selected shall be applied in strict compliance with the manufacturer's specifications.
  - b. The painting shall consist of one coat primer and 2 finish coats.

F. Clean-up:

- 1. The Contractor shall be responsible for all drops and spots of paint on all other surfaces and shall leave the Work in a clean and acceptable condition.
- 2. All paint and debris for the working process of the painting shall be removed from of the property and be legally disposed of.

### 3.03 ELECTRICAL SPECIFICATIONS

A. Summary:

- 1. All electrical work shall be performed per applicable codes and shall be inspected and approved by the City that the building is being constructed. The power shall be brought to the dome by the Site Electrical Contractor and stubbed outside of the concrete wall to one side of the entranceway. Electrical underground conduit should be placed prior to commencement of asphalt pad construction.

2. The electrical work shall consist of the following:
  - a. The salt dome contractor shall install a 100 AMP, 240 V breaker and switch box and PVC wiring to power all electrical fixtures and equipment identified in the Contract Drawings and Specifications.
  - b. The salt dome contractor shall install high-pressure sodium, corrosion resistant light fixtures with all necessary switches and wiring to fixtures and to the electrical fan. Light fixtures shall be positioned as follows on the appropriate location:
    - 1) Two (2) each 400 w interior fixtures.
    - 2) One (1) each 250 W exterior fixture mounted over the canopy of the entranceway. Exterior fixture shall have integral photocell switch.
  - c. The Contractor shall supply slope drainage to conform to local and state electrical codes. All exterior conduits shall be galvanized metal. All interior conduit to be PVC schedule 40 or galvanized metal.
  - d. An electrical fan shall be furnished and installed. The fan shall be corrosion resistant coated, completely enclosed motor. Gravity shutter shall be corrosion resistant coated. Fan and shutter shall be a heavy-duty industrial exhaust fan, HERESITE phenolic salt spray resistant coated with two coats. The fan shall be:
    - 1) Bayley Type JBP-30 IN-6U5-I, 1 HP.
    - 2) Single-phase electrical service.

#### **PART 4 - MEASUREMENT AND PAYMENT**

##### **4.01 MEASUREMENT**

- A. Measurement of the prefabricated salt storage dome shall be the Contract unit price per each (EA) and shall include labor, equipment and incidentals for a complete salt dome in accordance with these Specifications and the Contract Drawings.
- B. If an alternate bid is being requested, the work and costs shall be divided as noted in the Schedule of Prices.

##### **4.02 PAYMENT**

- A. Payment for the prefabricated salt storage dome complete shall be by the Contract unit price per each (EA) and shall constitute full payment of labor, equipment, and incidentals necessary to install the prefabricated salt storage dome complete. The price shall include all costs for unloading and handling materials, construction of the prefabricated salt storage dome and all incidental work in accordance with the Contract Drawings and Specifications.

#### **END OF SECTION**

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## **SECTION 43 21 00 - PUMPING EQUIPMENT**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Pumping equipment.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Union Pacific Railroad (UPRR) Contract Section.
- B. Division 01 - UPRR General Conditions.
- C. Section 01 61 03 - Equipment: Basic Requirements.
- D. Section 09 90 01 - Paint and Protective Coatings.
- E. Section 43 23 52 - Positive Displacement Pump (Rotary).
- F. Section 43 23 71 - Air-Operated Diaphragm Pump.
- G. Section 43 25 13 - Submersible Non-Clog Pump.
- H. Section 43 25 14 - Submersible Slurry Pump.

#### **1.03 REFERENCED STANDARDS**

- A. Hydraulic Institute (HI): Standards for Centrifugal, Rotary and Reciprocating Pumps.
- B. Building Code: International 2001 California Building Code

#### **1.04 DEFINITIONS**

##### **A. The abbreviations are defined as follows:**

1. IPS – Iron Pipe Size.
2. NPSHR – Net Positive Suction Head Required.
3. TDH – Total Differential Head.
4. TEFC – Totally Enclosed Fan Cooled.
5. VFD - Variable Frequency Drive.

- B. Pump Surface Category: Pump or pumps having identical names (not tag numbers) used for specific pumping service.

#### **1.05 SUBMITTALS**

##### **A. Shop Drawings:**

1. Submit under provisions of section 01 33 00.

2. Product technical data including -
  - a. Performance data a curves with flow (gpm), head (FT), horsepower, efficiency, HPSH requirements, submergence requirement.
  - b. Pump accessory data.
  - c. Bearing supports, shafting details and lubrication provisions.
  - d. Solid passage information.
3. Certifications - Certified pump performance curves as described in Article 2.04.
4. Test Reports - Factory hydrostatic test.
- B. Operation and Maintenance Manuals: See Section 01 33 04.
- C. Miscellaneous: Certifications – Statement relative to installation and start-up per paragraph 3.2-A.4.

#### 1.06 QUALITY ASSURANCE

- A. Fully coordinate all mechanical seal systems specified to ensure pump and seal compatibility.
- B. For variable speed pumping applications, the pump manufacturer is designated to have single source responsibility for coordination of the pump and VFD drive system.

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Pumps - See individual pump specifications sections.
  2. Mechanical Seals:
    - a. Chesterton.
    - b. Carlock.
- B. Submit requests for substitution in accordance with Specification Section 01 33 00.

#### 2.02 CENTRIFUGAL PUMP DESIGN

- A. Provide units with increasing head characteristics from the end run out portion of the curve to shut-off condition.

#### 2.03 ACCESSORIES

- A. See Section 01 61 03.
- B. Each Unit:
  1. Lifting eye bolts or lugs.
  2. Plugged gauge cock connection at suction and discharge nozzles.



3. Tapped and plugged openings for casing and bearing housing vents and drains.
4. Fittings for properly adding flushing lubricant.
5. Pressure relief fittings for grease lubrication.

C. Packing Seals:

1. Provide packing seal unless mechanical seal is specified in the narrow-scope pump sections.
2. Minimum of five (5) graphite impregnated synthetic packing.
3. provide minimum 1/4 IN DIA supply tap and 1/2 IN DIA minimum drain tap.
4. Provide split Teflon or bronze water ring seal.
5. Adjustable split follower cast iron or bronze gland.
6. Materials – As specified in narrow scope pump sections.

D. Seal Water Systems:

1. Pressure Reducing Sections (PRS):
  - a. Individual (local) PRS for each drop leg off seal water header to individual pumps.
  - b. See drawings for system components and arrangements.

## 2.04 FABRICATION

A. Pump Support:

1. Design base to support weight of drive, shafting and pump.
2. Comply with HI vibration limitations.
3. Mount horizontal pump, motor, and coupling on single piece drip lip type baseplate.
4. Mount vertical pumps on single piece pedestal baseplate.
5. Fabricate to withstand all operating loads transmitted from the pump and drive.

## 2.05 SOURCE QUALITY CONTROL

A. If specifically required in the individual pump specification sections, provide factory tests:

1. Units – Hydrostatic test at 150 percent of shutoff head for a minimum of 5 minutes.
2. Adjustable speed unit:
  - a. Head (FT) verses flow (gpm) pump curves:
    - 1) Maximum, minimum and two equally spaced intermittent speeds.
    - 2) Efficiencies along each curve.
    - 3) Brake horsepower along each curve.

3. Constant speed unit:
  - a. Head (FT) versus flow (gpm) pump curves:
    - 1) Efficiencies along curve.
    - 2) Brake horsepower along each curve.
  4. Results certified by a registered professional engineer.
- B. Statically and dynamically balance each pump per HI standards.

## 2.06 SEISMIC DESIGN

- A. Equipment (400 LBS or greater) and its anchorage to be designed to resist the total design seismic forces prescribed in the 2001 California Building Code.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. See Section 01 61 03.
- B. Floor or Pad-Mounted Units (Non-Submersible):
  1. Align vertically and horizontally level, wedge and plumb units to match piping interfaces.
  2. Assure no unnecessary stresses are transmitted to equipment flanges.
  3. Tighten flange bolts at uniform rate and manufacturer's recommendation torque for uniform gasket compression.
  4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe flange and equipment.
  5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
  6. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
  7. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange. Realign as necessary, install flange bolts and make equipment connection.
  8. Field paint units as defined in Section 09 90 01.
  9. Provide pressure gauge on discharge of all pumps and of suction of all non-submersible units.
- C. Submersible Units: Comply with requirements defined in Paragraphs 3.01-B.7, 8 and 9.

### 3.02 FIELD QUALITY CONTROL

- A. Provide services of equipment manufacturer's field service representative(s) to:
1. Inspect equipment covered by these Specifications.
  2. Supervise pre-start adjustments and installation checks.
  3. Conduct initial startup of equipment and perform operational checks.
  4. Provide a written statement that manufacturer's equipment has been installed properly.
  5. Instruct Owner's personnel for the specified minimum number of hours at jobsite on operation and maintenance of each of following pumping equipment.
    - a. Section 43 25 13 - Submersible Non-Clog Pump, 4 HRS.
    - b. Section 43 25 14 - Submersible Slurry Pump, 4 HRS.
    - c. Section 43 23 52 - Positive Displacement Pump (Rotary) 4 HRS.
    - d. Section 43 23 71 - Air-Operated Diaphragm Pump, 4 HRS.

**END OF SECTION**

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## **SECTION 43 23 32 - END SUCTION CENTRIFUGAL PUMP**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Recovered Oil.
2. Recirculation Pump.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Contract Section.
- B. Division 01 - UPRR General Conditions.
- C. Section 01 61 03 - Equipment: Basic Requirements.
- D. Section 43 21 00 - Pumping Equipment.

#### **1.03 REFERENCED STANDARDS**

- A. Anti-Friction Bearing Manufacturers Association (AFBMA).
- B. American Iron and Steel Institute (AISI):
  1. Steel Products Manual
- C. ASTM International (ASTM):
  1. A48 Standard Specification for Grey Iron Castings.
  2. B584 Standard Specification for Copper Alloy Sand Castings for General Applications.
- D. Hydraulic Institute (HI):
  1. Standards for Centrifugal Rotary and Reciprocating Pumps.

#### **1.04 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.
- B. Shop Drawings:
  1. See Section 43 21 00.
- C. Operation and Maintenance Manuals:
  1. See Section 01 33 04.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. End Suction Centrifugal Pumps:
    - a. Gould.
    - b. Paco.
    - c. Or approved equal.
- B. Submit requests for substitution in accordance with Specification Section 01 33 00.

### 2.02 MATERIALS

- A. Recovered Oil Recirculation, P-207:
  - 1. Pump casing: Cast iron, ASTM A48, Class 30.
  - 2. Impellers: Bronze ASTM B584 (836).
  - 3. Shaft: Carbon Steel.
  - 4. Impeller Wear Rings: Bronze, ASTM B584 (836).
  - 5. Shaft Sleeve: Bronze, ASTM B584 (831).
  - 6. Baseplate: Cast Iron.

### 2.03 EQUIPMENT

- A. Performance and Configuration Requirements:
  - 1. Recovered Oil Recirculation, :
    - a. Design Condition: ## gpm. @ ## psi. TDH.
    - b. Pump Configuration: End Suction.
    - c. Maximum Pump Speed: ##### rpm.
    - d. Nameplate Driver Horsepower: #.
    - e. Drive Type: Constant.
    - f. Drive Configuration: Direct Coupled.
- B. Operating Conditions:
  - 1. Fluid Pumped: Recovered oil from wastewater treatment process.
    - a. Viscosity: ##### SSU.
    - b. Design Temperature: ## DegF.
    - c. Specific Gravity: 0.## - 0.##.
  - 2. Location: Exterior/Interior

## 2.04 ACCESSORIES

- A. See Section 43 21 00.
- B. Mechanical Seals:
  - 1. Provide carbon rotating face, ceramic seat and EPR type O-rings.
  - 2. Construct metal parts of Type 316 stainless steel.
- C. Motor:
  - 1. 480v, 3 Ph, 60 Hz.
  - 2. See Section 01 61 03.

## 2.05 FABRICATION

- A. Fabricate pump case to withstand 175 psig or 200 percent of maximum working pressure specified by pump performance, whichever is greater.
- B. Furnish anti-friction type bearing rated for minimum B-10 life of 20,000 HRS at 24 HR continuous operation per AFBMA.
- C. Provide grease lubrication.
- D. Furnish rigid, one piece cast bearing housing with catch reservoir.
- E. Provide pump case with case rings at impeller skirt. Lock ring in place with pin.
- F. Statically and dynamically balance impellers per Hydraulic Institute Standards.
- G. Key impeller to driven shafts and secure impeller to shaft with stainless steel locking screw.
- H. See Section 43 21 00.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. See Section 43 21 00.

### 3.02 FIELD QUALITY CONTROL

- A. See Section 43 21 00.

## END OF SECTION

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## **SECTION 43 23 33 - CENTRIFUGAL PUMPS FOR PETROLEUM SERVICE**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. This specification includes pumps and associated equipment used for pumping diesel fuel.
2. Equipment manufacturer shall certify that all equipment is compatible with the service and product it will handle. Example

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Section 01 33 00 – Submittal Procedures
- B. Section 33 05 26 – Mechanical Identification
- C. Section 43 21 00 – Pumping Equipment

#### **1.03 REFERENCED STANDARDS**

- A. American National Standards Institute (ANSI)
- B. American Society of Mechanical Engineers (ASME)
- C. Anti-Friction Bearing Manufacturers' Association (AFBMA)
- D. National Electrical Manufacturers' Association (NEMA)
- E. National Fire Protection Association (NFPA)
- F. National Electrical Code (NEC)

#### **1.04 SUBMITTALS**

- A. Submit under provisions of Section 01 33 00.
- B. Shop drawings and product data required by this Section include, but are not limited by, the following:
  1. Shop drawings showing pump and motor layout, connections and anchorages.
  2. Product data including performance curves and rated capacities of selected models, weights, furnished specialties, and accessories. Indicate pump's operating point on curves.
  3. Coupling data.
  4. Motor product data and efficiencies.
  5. Wiring diagrams showing wiring for power, signal, and control systems and differentiating between manufacturer-installed wiring and field-installed wiring.
  6. Product certificates signed by manufacturers of pumps, certifying accuracy and compliance under operating conditions.

- 7. Pump pre-alignment report for new installations. As found and final report for existing installations where only the pump is replaced.
- 8. Manufacturer's qualification data.
- C. Operational and Maintenance data for pumps including startup information and replacement parts lists.

#### 1.05 QUALITY ASSURANCE

- A. Obtain all pumps from one source and by a single manufacturer.
- B. Manufacturer's Qualification: Firms regularly engaged in manufacture of equipment, of types and capacities required, whose products have been in satisfactory service for not less than 5 years.
- C. Field quality control per section 43 21 00.

#### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage. Store pumps in a dry location.
- B. Protect bearings and couplings against damage from sand, grit, and foreign matter.

### PART 2 - PRODUCTS

#### 2.01 GENERAL

- A. Provide pumps to meet operational requirements as shown on pump schedules and indicated on drawings or within these specifications.

#### 2.02 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Centrifugal Pumps:
    - a. Aurora
    - b. Byron Jackson
    - c. Gould
    - d. Ingersoll-Dresser
    - e. Approved equal
  - 2. Couplings:
    - a. Omega

#### 2.03 MATERIALS

- A. CENTRIFUGAL PUMPS

1. Pump shall be radially split case, single-stage, horizontal, end suction, centrifugal design manufactured specifically for handling petroleum products. Pumps shall be complete with pump, motor, coupling, mounting base, accessories, and all other parts and materials necessary for a complete installation.
2. Performance Characteristics:
  - a. Pumps shall be suitable for operation at the fluid temperature and suction head conditions listed at any flow between 25% and 125% of design flow.
  - b. Performance shall be identical for all similar pumps. Performance curves shall permit stable parallel operation of multiple pumps of the same type.
  - c. Pumps shall be designed for both continuous and intermittent operation.
3. Construction:
  - a. Pumps shall meet the requirements of ANSI/ASME, latest edition.

**B. Pump Motors:**

1. Motors will be installed in an NEC Class I, Division 2, Group D hazardous location. Sliding contacts, centrifugal, or other type switching mechanisms (including motor over current, overloading, and over temperature devices), or integral resistance devices that may be provided shall be approved for installation conditions in accordance with the NEC.
2. Motors one (1) hp and smaller shall be 120 volt, single phase, 60 Hz. Motors larger than one (1) hp shall be 480 volt, three phase, 60 Hz..
3. Shall have sufficient capacity to drive the pump through the entire operating range of the pump performance curve without exceeding nameplate data.
4. Shall have a service factor of 1.15.
5. Motors shall be capable of delivering rated horsepower output successfully and continuously under conditions of voltage variations of 10% above and below rated voltage.
6. Shall be NEMA Design B squirrel-cage induction type suitable for use with across-the-line starter.
7. Insulation shall be NEMA Class F.
8. Enclosure shall be totally enclosed, fan cooled (TEFC) suitable for outdoor installation. Furnish with automatic drain/breather assembly.
9. Bearings shall be oil-lubricated ball bearings with AFBMA L10 life of 60,000 hours when running at the specified operation conditions.
10. Pump motors shall be furnished with lifting lugs on the motor casing. Motor terminal box shall be suitably sized for a 1-inch conduit entrance.

**PART 3 - EXECUTION**

**3.01 INSTALLATION**

- A. Comply with requirements of 43 21 00.**

- B. Install pumps where indicated on the drawings and in accordance with manufacturer's recommendations. Provide all mounting hardware and accessories as required for proper operation and as recommended by the manufacturer.
- C. Set and align all equipment in accordance with manufacturer's recommendations. Retighten all bolted connections after installation and alignment.
- D. Check all motors and drives carefully for correct rotation and alignment before placing equipment into operation. Pump shaft shall be laser aligned prior to being placed into service.

### 3.02 FIELD QUALITY CONTROL

- A. All testing and checkout procedures of the manufacturer shall be carried out completely.
- B. Shop tests shall be conducted on all electric motor driven pumps in the manufacturer's shop.
- C. Protect all equipment and surrounding areas from damage resulting from testing operations. Clean up any spills or leakage from testing.

### **END OF SECTION**

## **SECTION 43 23 52 - POSITIVE DISPLACEMENT PUMP (ROTARY)**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. Section Includes: Positive Displacement Rotary Vane Pumps.
- B. Equipment manufacturer shall certify that all equipment is compatible with the service and product it will handle.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Union Pacific Railroad (UPRR) Contract Section.
- B. Division 01 - UPRR General Conditions.
- C. Section 01 61 03 - Equipment: Basic Requirements.
- D. Section 43 21 00 - Pumping Equipment.
- E. Division 13 - Special Construction.

#### **1.03 REFERENCED STANDARDS**

- A. American Bearing Manufacturing Association (ABMA).
- B. American Gear Manufacturing Association (AGMA).
- C. American National Standards Institute (ANSI).
- D. American Petroleum Institute (API):
  - 1. 676, Positive Displacement Pumps: Rotary.
- E. ASTM International (ASTM):
  - 1. A48, Standard Specification for Gray Iron Castings.
  - 2. A126, Gray Iron Castings for Valve Flanges and Pipe Fittings
  - 3. A743, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant for General Application.
- F. National Electrical Code (NEC).
- G. National Electrical Manufacturers Association (NEMA).

#### **1.04 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.
- B. Shop Drawings: Requirements in Section 43 21 00.
- C. Operation and Maintenance Manuals: See Section 01 33 04.

## PART 2 - PRODUCTS

### 2.01 ACCEPTABLE MANUFACTURES

- A. Subject to compliance with the contract documents, the following manufacturers are acceptable:
  - 1. Rotary Pumps:
    - a. Blackmer.
    - b. Roper.
    - c. Viking.
  - 2. Couplings
    - a. Omega
- B. Submit requests for substitution in accordance with Specification Section 01 33 00.

### 2.02 MATERIALS AND LUBRICATION

- A. Lubricating Oil or Journal Oil as Scheduled:
  - 1. Equipment manufacturer shall certify that all equipment is compatible with the service and product it will handle.
  - 2. All pumps to be provided with preliminary coupling alignment and ready for installation onto foundation.
  - 3. Provide with flexible coupling and coupling guard.
  - 4. Pump shall be a self-priming, constant speed unit.
  - 5. Pumps and pump motors to be designed for outdoor application.
- B. Pump Construction (Journal and Lubricating Oil Pumps):
  - 1. All parts to have standardized dimensions for 100 percent repair part interchangeability.
  - 2. Pump body and pressure containing parts such as heads, valve, cover: Cast iron, ASTM A48, or ductile iron.
  - 3. Stuffing Box – Cast Iron ASTM A48.
  - 4. Mechanical Seal:
    - a. ANSI Labyrinth tape ceramic and steel with self-adjusting wear compensators.
    - b. Single inside seal cast iron and carbon primary seals and Viton secondary seals.
  - 5. Shaft:
    - a. Each drive shaft shall be fully machined or ground to size and polished. The drive shaft shall have ample size to transmit the maximum applied power at the maximum specified differential pressure and carry all applied radial loads without excessive deflection.
    - b. Tool steel.

6. Bearings:
  - a. Two anti-friction bearings shall be provided.
  - b. Bearings shall be isolated from pump liquid.
  - c. Bearings shall have an ABMA L10 Life Rating of 40,000 HRS at maximum differential pressure.
  - d. Grease Lubricated.
  - e. Shaft speed shall not exceed the limits specified by the bearing manufacturer.
7. Vanes – Vane material shall be Duravane with ANSI type 316 stainless steel wearplate.
8. Baseplate:
  - a. Fabricated steel, common baseplate designed to support the equipment and handle the maximum torque as generated between the pump and reduction unit without base distortion.
  - b. Plate shall have rounded corners with all exposed seams and contact surfaces of steel plates and shapes shall be continuously welded and ground smooth.
  - c. Openings shall be provided in top of the base to facilitate grouting.
  - d. An opening shall be provided, as necessary for electrical conduit to the drive unit.
9. Gear Reducer:
  - a. Commercial Grade.
  - b. Independently bolted to baseplate with coupling connection to driver and pump.
  - c. Assembly shall feature hardened steel gears, immersed in oil, mounted on shafts supported on both ends by ball bearings and enclosed in a weatherproof housing.
10. Anchor Bolts:
  - a. Anchor bolts shall be accurately located and centered in pipe sleeves having inside diameter approximately 2-1/2 times the bolt diameter and length approximately 8 times the bolt diameter.
  - b. A square anchor plate with thickness of approximately 1/2 the bolt diameter and side dimensions 4 times the bolt diameter shall be welded to the bottom of each sleeve, with the anchor bolt extended through the plate and welded thereto.
11. Pressure Relief Valve – Integral corrosion resistant relief valve with stainless steel spring capable of maintaining a constant discharge pressure with the full capacity of the pump being bypassed.
12. Motors:

- a. Sliding contacts, centrifugal, or other type switching mechanisms (including motor overcurrent, overloading, and overtemperature devices) or integral resistance devices that may be provided shall be approved for installation conditions in accordance with the NEC.
- b. Motors 1/2 Horsepower and smaller shall be 120 Volt, Single phase, 60 Hertz. Motors larger than 1/2 Horsepower shall be 480 Volt, Three Phase, 60 Hertz.
- c. Shall have sufficient capacity to drive the pump through the entire operating range of the pump performance curve without exceeding nameplate data.
- d. Shall have a service factor of 1.15.
- e. Motors shall be capable of delivering rated horsepower output successfully and continuously under conditions of voltage variations of 10 percent above and below the rated voltage.
- f. Shall be NEMA Design B squirrel-cage induction type suitable for use with across-the-line starter.
- g. Insulation shall be NEMA Class F.
- h. Enclosure shall be Totally Enclosed – Fan Cooled (TEFC) suitable for outdoor installation. Furnish with automatic drain / breather assembly.
- i. Bearings shall be oil-lubricated ball bearings with ABMA L10 life of 60,000 HRS when running at the specified operation conditions.
- j. Pump motors shall be furnished with lifting lugs on the motor casing. Motor terminal box shall be suitably sized for a 1 IN conduit entrance.

C. Controls per Division 26.

## 2.03 EQUIPMENT

A. Performance and Configuration Requirements:

- 1. Lubricating oil and journal oil distribution pumps –
  - a. Suction and discharge sizes:
    - 1) Pump shall be arranged for side suction and top discharge.
    - 2) 150 PSI raised-face flanged connections on suction and discharge.
  - b. Gear Reducer: Reducer shall be capable of reducing drive motor shaft speed required to drive pump over the entire range of operating conditions.
- 2. Performance Schedule located at end of this Section.
  - a. Use the following fluid properties for equipment selection:
    - 1) Journal Oil: Specific gravity of 0.88 and viscosity of 1000 SSU.
    - 2) Lube Oil: Specific gravity of 0.93 and viscosity of 1000 SSU.

## 2.04 SOURCE QUALITY CONTROL

- A. Hydrostatically test each pump body of 150 percent of rated discharge pressure. Supply documentation of test.



## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Comply with requirements of Section 43 21 00.
- B. Set and align all equipment in accordance with manufacturers recommendations. Retighten all bolted connections after installation and alignment.
- C. Check all motors and drives carefully for correct rotation and alignment before placing equipment into operation.
- D. Provide all mounting hardware and accessories as required for proper operation and as recommended by the manufacturer.
- E. Protect all mounting hardware and accessories as required for proper operation and as recommended by the manufacturer.
- F. All testing and checkout procedures of the manufacturer shall be carried out completely.
- G. Field install packing.

### 3.02 FIELD QUALITY CONTROL

- A. See Section 43 21 00.

**END OF SECTION**

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## **SECTION 43 23 71 - AIR OPERATED DIAPHRAGM PUMP**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Air-operated diaphragm pumps.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. UPRR Contract Section.
- B. Division 01 - UPRR General Conditions.
- C. Division 13 - Special Construction.
- D. Section 43 21 00 - Pumping Equipment.

#### **1.03 REFERENCED STANDARDS**

##### **A. American Iron and Steel Institute (AISI):**

1. Steel Products Manual.

##### **B. American National Standards Institute (ANSI).**

##### **C. American Society for Testing and Materials International (ASTM):**

1. A48, Standard Specification for Gray Iron Castings.
2. A108, Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
3. A276, Standard Specification for Stainless Steel Bars and Shapes.
4. A536, Standard Specification for Ductile Iron Castings.
5. A753, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application and Wrought.
6. A744, Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.

#### **1.04 SUBMITTALS**

##### **A. Submit under provisions of section 01 33 00.**

##### **B. Shop Drawings:**

1. Requirements in Section 43 21 00.
2. Chemical compatibility charts, provide verification that pump parts are compatible with fluid handled.
3. Air flow and pressure requirements.
4. Technical data on mufflers, lubricants and air supply appurtenances.

C. Operation and Maintenance Manuals:

1. See Section 01 33 04.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

1. Ingersoll-Rand Aro.
2. Warren Rupp Pump Co.

B. Submit requests for substitution in accordance with Specification Section 01 33 00.

2.02 MATERIALS

A. Waste Oil Pumps:

1. Air operated non-stalling double-diaphragm type.
2. Pump body non-wetted parts: Aluminum or 316 stainless steel.
3. Pump body wetted parts: Aluminum or 316 stainless steel.
4. Ball valves: Viton.
5. Valve Seats: 316 stainless steel.
6. Diaphragms: Viton.

B. Soap Dispensing Pumps:

1. Air-operated non stalling double-diaphragm type.
2. Pump body non-wetted parts: Painted aluminum.
3. Pump body wetted parts: Kynar – Polyvinylidene Fluoride (PVDF).
4. Ball (check) valve: Kynar (PVDF).
5. Valve Seats: Kynar (PVDF).
6. Diaphragms: Santoprene.

2.03 PERFORMANCE AND DESIGN REQUIREMENTS

A. Performance Requirements:

1. Waste oil pumps:
  - a. Waste oil specific gravity: 0.88 – 0.93.
  - b. Maximum solids passage: 1/4 IN DIA.
  - c. Suction and discharge size: 1-1/2 IN DIA.
  - d. Self-priming up to loft suction lift.
  - e. Liquid pumped: Waste oils (journal and lubricating).
  - f. Non-stalling type air motor design, double-diaphragm.

2. Soap Dispensing Pumps:
  - a. Maximum solids passage: 1/4 IN DIA.
  - b. Suction and discharge size: 1-1/2 IN DIA.
  - c. Liquid pumped: Alkaline detergent.
    - 1) 3 percent sodium hydroxide.
    - 2) 5-7 percent mono butyl glycol (ethylene glycol monobutyl ether.)
  - d. Non-stalling type air motor design, double-diaphragm.
3. Performance schedule located at end of this Section.

#### 2.04 ACCESSORIES

- A. Air Pressure Regulator / Filter Assembly”
  1. Provide air pressure regulation between 5 and 125 psig.
  2. 40 micron replaceable element with standard drain.
  3. Provide pressure gauge, 4-1/2 IN face, 0 - 160 psig.
- B. Lubricator:
  1. Provide as required.
- C. Muffler:
  1. Reduce exhaust to less than 80 decibels.
- D. Controls:
  1. Waste oil pumps:
    - a. Pushbutton control per Division 13.
    - b. Mount in location approved by Owner.
  2. Soap dispensing pumps:
    - a. Provide connection to soap system inside pump house and activate pump(s) upon low level setpoint signal from inside soap storage tank.
    - b. Shut-off pumps at predetermined max fill point.
- E. Air connection shall be flexible air hose and necessary couplers.

#### 2.05 FABRICATION

- A. Factory assemble pump complete with air valve.
- B. Coat all steel and cast iron materials with a factory-applied epoxy.
- C. Pump to be capable of running dry indefinitely without damage.
- D. Pump and components shall be explosion proof and suitable for use in hazardous areas.

2.06 MAINTENANCE MATERIALS

A. Maintenance Manuals:

1. Furnish the Owner with the following extra parts for each pump service category:
  - a. Two diaphragms.
  - b. Two valve seats.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. See Section 43 21 00.
- B. Install flexible couplings on suction and discharge of pumps.

3.02 FIELD QUALITY CONTROL

- A. See Section 43 21 00.

**END OF SECTION**

## **SECTION 43 25 13 - SUBMERSIBLE NON-CLOG PUMP**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Submersible non-clog pumps – wet pit application.
2. Sanitary wastewater lift station pumps.
3. Industrial wastewater pump station.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

- A. Union Pacific Railroad (UPRR) Contract Section.
- B. Division 01 - UPRR General Conditions.
- C. Section 01 61 03 - Equipment Basic Requirements.
- D. Section 43 21 00 - Pumping Equipment.

#### **1.03 REFERENCED STANDARDS**

- A. American Iron and Steel Institute (AISI) – Steel Products Manual.
- B. American National Standards Institute (ANSI).
- C. ASTM International (ASTM):
  1. A48, Standard Specification for Grey Iron Castings.
- D. FM Global (FM).
- E. Hydraulic Institute (HI):
  1. Standards for Centrifugal, Rotary, and Reciprocating Pumps.
- F. National Electrical Manufacturer's Association (NEMA):
  1. 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
  2. ICS 6, Enclosures for Industrial Controls.
- G. National Fire Protection Agency (NFPA):
  1. 70, National Electrical Code (NEC).
- H. Underwriters Laboratories, Inc. (UL):
  1. 1449, Safety Transient Voltage Surge Suppressors.

#### **1.04 SYSTEM DESCRIPTION**

- A. Sanitary wastewater pumps and industrial wastewater pumps.
- B. Provide single source coordination responsibility through the pump manufacturer for the entire system including but not limited to the following:
  1. Pumps.

2. Motors.
3. Float switches.
4. Control panel.
5. Lift station hardware, access doors, jib cranes and winches.

#### 1.05 SUBMITTALS

- A. Submit under provisions of section 01 33 00.
- B. Shop Drawings:
  1. Requirements in Section 43 21 00.
  2. Source quality control test reports.
- C. Operation and Maintenance Manuals: See Section 01 33 04.

### PART 2 - PRODUCTS

#### 2.01 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the contract documents, the following manufacturers are acceptable:
  1. Submersible non-clog pumps – wet pit applications:
    - a. Power-Flo.
    - b. Fairbanks Morse.
    - c. Gorman Rupp.
    - d. Wemco.
    - e. Barnes.
  2. Submersible low shear.
    - a. Wemco Hidrostat.
    - b. Discflo.
  3. Submit requirements for substitution in accordance with Specification Section 01 33 00.

#### 2.02 MATERIALS

- A. Submersible Non-Clog, Wet Pit Applications Sanitary Wastewater Lift Station Pumps:
  1. Pump case – Cast iron, ASTM A48, Class 30.
  2. Motor housing – Cast iron ASTM A48, Class 25 or Class 30.
  3. Impeller – Cast iron ASTM A48, Class 30.
  4. Shaft – Stainless steel, ANSI, Series 300 or 400.
  5. Wear rings – Corrosion and wear resistant materials.



6. O-rings – Nitrile (Buna-N).
  7. Fasteners – Stainless steel.
  8. Guide rails – Stainless steel.
  9. Lifting cables – Stainless steel.
  10. Lower ring seal – Tungsten-carbide both faces.
  11. Upper ring seal – Tungsten-carbide both faces or carbon and ceramic or carbon Ni-resist.
  12. Seal metal parts – Stainless steel.
- B. Submersible Non-Clog, Wet Pit Applications Industrial Wastewater Pumps:
1. Pump case – Cast iron, ASTM A48, Class 30.
  2. Motor housing – Cast iron, ASTM A48, Class 25 or Class 30.
  3. Impeller – Cast iron, ASTM A48, Class 30.
  4. Shaft – Stainless steel, ANSI, Series 300 or 400.
  5. Wear rings – Corrosion and wear resistant materials.
  6. O-rings – Nitrile (Buna-N).
  7. Fasteners – Stainless steel.
  8. Guide rails – Stainless steel.
  9. Lifting cables – Stainless steel.
  10. Lower ring seal – Tungsten-carbide both faces.
  11. Upper ring seal – Tungsten-carbide both faces or carbon and ceramic and Ni-resist.
  12. Seal metal parts – Stainless steel.
- C. Submersible Low Shear, Industrial Wastewater Process Pumps:
1. Pump case – Cast iron, ASTM A48, Class 30.
  2. Motor housing – Cast iron, ASTM A48, Class 25 or Class 30.
  3. Impeller – Cast iron, ASTM A48, Class 30.
  4. Shaft – Stainless steel, ANSI, Series 300 or 400.
  5. Wear rings – Corrosion and wear resistant materials.
  6. O-rings – Nitrile (Buna-N).
  7. Fasteners – Stainless steel.
  8. Guide rails – Stainless steel.
  9. Lifting cables – Stainless steel.
  10. Lower ring seal – Tungsten-carbide both faces.
  11. Upper ring seal – Tungsten-carbide both faces or carbon and ceramic or carbon and Ni-resist.

12. Seal metal parts – Stainless steel.

## 2.03 EQUIPMENT

### A. Performance and Configuration Requirements:

#### 1. Sanitary Wastewater Lift Station Pumps:

- a. Design condition – 100 gpm. at 47 ft. TDH.
- b. Secondary condition – 140 gpm. at 40 ft. TDH.
- c. Maximum shutoff condition – 0 gpm. at 85 ft.
- d. Pump configuration – Submersible wet pit.
- e. Maximum pump speed – 3,450 rpm.
- f. Nameplate driver horsepower – 3.8.
- g. Drive type – Constant Speed.
- h. Minimum solids passage – 2-1/2 IN.
- i. Maximum Discharge – 3.0 IN DIA.
- j. Motor requirements:
  - 1) Service factor – 1.15.
  - 2) Minimum 10 starts per hour.
- k. Ambient conditions – Wastewater maximum temperature: 104 DegF.

#### 2. Industrial Wastewater Pumps:

- a. Design condition – 950 gpm at 56 FT TDH.
- b. Secondary condition – 650 gpm at 72 FT TDH.
- c. Maximum shutoff condition – 0 gpm at 108 FT.
- d. Pump configuration – Submersible wet pit.
- e. Maximum pump speed – 1,770 rpm.
- f. Maximum driver horsepower – 20.
- g. Drive type – Constant speed.
- h. Minimum solids passage – 3 IN.
- i. Maximum discharge – 6 IN DIA.
- j. Motor requirements:
  - 1) Service factor – 1.15.
  - 2) Minimum 10 starts per hour.
- k. Ambient Conditions:
  - 1) Industrial wastewater maximum temperature: 80 DegF.
  - 2) Industrial wastewater contains free and/or emulsified petroleum products.

3. Industrial Wastewater Process Pumps:
  - a. Design condition – 80 gpm at 33 FT TDH.
  - b. Secondary condition – 100 gpm at 33 FT TDH.
  - c. Maximum shutoff condition – 0 gpm at 48 FT.
  - d. Pump configuration – Submersible wet pit.
  - e. Maximum pump speed – 1,770 rpm.
  - f. Maximum driver horsepower – 7.5.
  - g. Drive type – Constant speed.
  - h. Minimum solids passage – 2-1/4 IN.
  - i. Maximum discharge – 3 IN IDA.
  - j. Motor requirements:
    - 1) Service factor – 1.15.
    - 2) Minimum 10 starts per hour.
  - k. Ambient conditions:
    - 1) Industrial wastewater maximum temperature – 80 DegF.
    - 2) Industrial wastewater contains free and/or emulsified petroleum products.

## 2.04 COMPONENTS

### A. General:

1. Provide pump capable of handling raw, unscreened sewage or industrial wastewater.
2. Where watertight sealing is required, machine and fit mating surfaces with O-rings.
3. Provide with heavy duty lift lugs or hoisting bail designed for lifting the entire pump and motor assembly.
4. For industrial wastewater process pumps provide a low shear design pump so as to not emulsify petroleum hydrocarbons.

### B. Impeller:

1. Provide non-clog type dynamically balanced impeller in accordance with HI Standards.
2. Provide impeller and volute wear rings as necessary to assure efficient sealing between volute and impeller.

### C. Shaft:

1. Design pump shaft of sufficient size to transmit full driver output.
2. Use shaft which is accurately machined and constructed with sufficient materials.
3. Design shaft for a maximum deflection of 0.002 IN measured at stuffing box.

D. Shaft Seal:

1. Seal shaft with two independent, tandem mounted seals running in an oil filled chamber.
2. Provide seals requiring neither routine maintenance nor adjustment, but capable of being easily inspected and replaced.
3. Hold interface in contact by its own spring system.

E. Bearings:

1. Support shaft on upper and lower permanently lubricated bearings with a minimum L-10 life of 50,000 HRS.

F. Motors:

1. Provide pump with FM and UL listed motor designed for area classification shown on drawings.
2. Provide motor of totally submersible design, construction with epoxy or poly-seal encapsulated windings, air-filled or dielectric oil filled, with Class F insulation and rated for continuous duty operation.
3. Motors shall be 3HP, 60 cycle, 460 Volts.
4. Assure motor is capable of running dry for extended periods without damage to motor or seal.

G. Power and Control Cables:

1. Provide power cable and control cable to pump suitable for submersible applications in wastewater and indicate same by a code or legend permanently embossed on cables.
2. For industrial wastewater power and control cable, provide cable suitable for immersion in petroleum products.
3. Size cables in accordance with applicable NEC specifications.
4. Provide 50 ft. power cable and control cable.
5. Provide each cable with a strain relief, cord grip, and explosion-proof seal installed in accordance with NEC Article 500.

H. Temperature and Moisture Monitor:

1. Furnish each phase of the motor with a temperature monitor embedded in the motor windings.
2. Arrange controls so as to shut the pump down and sound alarm should any one of the monitors detect high temperature and automatically reset once the stator temperature returns to normal.
3. Set temperature of the temperature monitors at not higher than 90 percent of insulation temperature rating.
4. Provide electrical probe as needed for detecting the presence of water in the seal chamber.
5. If water enters the probe shall energize electrical circuit to shut down pump and sound alarm circuit for external alarm.

I. Coatings:

1. For all applications, apply polyamidoamine epoxy system to the exterior of the pump casing and motor housing that is equal to or better than that specified in Specification Section 09 90 01.
2. Protect all metallic surfaces coming into contact with sewage or industrial wastewater except stainless steel and bronze by a corrosion-resistant coating.

J. Guide Bracket, Rails, Discharge Connector:

1. Provide sliding guide bracket integral to pump unit which properly aligns the pump discharge with the discharge connection elbow for watertight seal during pumping.
2. Provide guide brackets to support guide rails.
3. Guide the entire weight of the pumping unit by guide rail(s).
4. The guide rail(s) shall not support any portion and portion of the weight of the pump.
5. Provide chains or cable of sufficient strength to lift pumps from sump.
6. Furnish guiding rail assembly and discharge flange assembly of non-sparking components.
7. Design pump to allow for removal without entering the wet well, and without removal of bolts, nuts or other fastenings.
8. Provide pump unit connecting to discharge connection with a simple downward motion without rotation.
9. Provide necessary sliding guide bracket and discharge connection which, when bolted to the floor of the sump and to the discharge line, will receive the pump discharge connecting flange without need of adjustment, fasteners, clamp, or similar devices.
10. No portion of the pump shall bear directly on the floor or the wet well.

2.05 ACCESSORIES

A. See Section 43 21 00.

B. Controls:

1. Provide sealed float-type mercury switches to control pumps and provide alarm signal as follows –
  - a. Sanitary Wastewater Lift Station Pumps: 4 float switches.
  - b. Industrial Wastewater Pumps: 5 float switches.
  - c. Industrial Wastewater Process Pumps: 4 float switches.
2. Seal mercury tube switches in a solid polypropylene float for Sanitary Lift Station Pumps.
3. For industrial wastewater, seal mercury tube switches in material suitable for immersion in petroleum products.

4. Provide float with large radius top at electrical cable connection to assure trouble-free operation.
5. Suspend floats on their own pole.
6. Provide floats to operate at elevation shown on drawings.
7. Design floats to be field-adjustable.
  - a. For Sanitary Wastewater Lift Station Pumps, three floats are to control pumps:
    - 1) One for lead pump start.
    - 2) One for lag pump start.
    - 3) One for low water cutoff.
    - 4) An additional switch provides the signal for high level alarm.
  - b. For Industrial Wastewater Pumps, three floats are to control pumps:
    - 1) One for pump start.
    - 2) One for pump stop.
    - 3) Two additional switches for high and low level alarm.
  - c. For Industrial Wastewater Process Pumps, two floats are to control pumps:
    - 1) One for pump start.
    - 2) One for pump stop.
    - 3) Two additional switches for high and low level alarm.
8. Provide a intrinsically safe relay for each level control circuit to reduce the energy in the circuit to the point that no spark is created by switching.

C. Control Panel:

1. Include combination magnetic motor starter(s) with Motor Circuit Protector (MCP) type circuit breaker, NEMA full size contractor with three overload relays and control power transformer (CPT) with two fuses on the primary side and one fuse on the secondary side, for 120 VAC control circuits.
2. Furnish and install locally mounted automatic control panel at location shown on drawings and rated for area classification.
3. Include a terminal board for connection of level sensors.
4. Provide the following features:
  - a. NEMA 4X stainless steel watertight enclosure with continuous hinge, neoprene gasket in cover and continuous seam weld. Include locking mechanism complete with padlock.
  - b. All exposed components NEMA 4X.
  - c. LEAD1 – LEAD2 – ALTERNATE selector switch for Industrial Wastewater Process Pumps and Industrial Wastewater Pumps.
  - d. PUMP1 – PUMP2 – ALTERNATE selector switch for Industrial Wastewater Process Pumps.

- e. HAND-OFF-AUTOMATIC selector switches.
- f. High and/or low level alarm light.
- g. Pump lights – Red running light and green off lights, push-to-test type.
- h. Elapsed time meters.
- i. Overload reset button to reset overload relays.
- j. Condensation heater
- k. Moisture detector alarm light and pump shutdown.
- l. 100 watt utility light outlet.
- m. Rack mountable.
- n. Motor over-temperature alarm light and pump shutdown.
- o. Horn with silence pushbutton and reset pushbutton for described alarm conditions.

D. Access Doors and Frames (Where Shown on Drawings):

- 1. Furnish and install single hinged door constructed of aluminum.
- 2. Furnish size shown on Drawings.
- 3. Equip with non-sparking upper guide rail support, float bracket, and flush locking mechanism.
- 4. Door shall be able to remain in open position while work is being performed.
- 5. Securely place frame above pump(s).
- 6. Provide doors of skidproof design.
- 7. Provide doors with snap locks and removable handle.
- 8. Provide door hardware including latching mechanism and hinges of stainless steel materials.

E. Winch/Jib Crane:

- 1. Secure a manually operated, cable-type winch capable of lifting the pumps and/or trash basket.
- 2. Provide winch with a fabricated steel support frame (jib crane) with a minimum capacity of 1.5 times the pump weight for Sanitary Wastewater Pumps and Industrial Wastewater Pumps.
- 3. Provide winch and fabricated steel support frame for Industrial Wastewater Pumps:
  - a. Designed to lift 1.5 times pump weight or manually cleaned trash basket (500 LBS) as shown on drawings, whichever is greater, without moving winch and steel frame (jib crane) from base.
  - b. Designed to lift manually cleaned trash basket a minimum of 65 IN above the wet pit top when measured from the bottom of the trash basket.
  - c. Designed to swing 360 degree on base.

4. Fit cable end with a grab hook to properly link up with the lifting chain.
5. Designed for foundation shown on drawings.

#### 2.06 SOURCE QUALITY CONTROL

- A. Secure from the pump manufacturer the following inspections and tests on each pump before shipment from factory:
  1. Check impeller, motor rating and electrical connections for compliance with specification.
  2. Test motor and cable insulation for moisture content or insulation defects.
  3. Prior to submergence, run pump dry to establish correct rotation, and mechanical integrity.
  4. Run pump for 30 minutes submerged, a minimum of 6 FT underwater.
  5. After operational test #4, perform insulation test (#2) again.

### PART 3 - EXECUTION

#### 3.01 INSTALLATION

- A. See Section 43 21 00.
- B. For wet pit pumps, permanently install discharge connection elbow in wet well along with discharge piping.
- C. Seal pump cable end with a high quality protective covering, to make it impervious to moisture or water seepage prior to electrical installation.

#### 3.02 FIELD QUALITY CONTROL

- A. See Section 43 21 00.

**END OF SECTION**



## **SECTION 43 25 14 - SUBMERSIBLE SLURRY PUMP**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

##### **A. Section Includes:**

1. Submersible slurry pumps.

#### **1.02 RELATED REQUIREMENTS (SECTIONS)**

##### **A. Union Pacific Railroad (UPRR) Contract Section.**

##### **B. Division 01 - UPRR General Conditions.**

##### **C. Section 43 21 00 - Pumping Equipment.**

#### **1.03 REFERENCED STANDARDS**

##### **A. American Iron and Steel Institute (AISI):**

1. Steel Products Manual.

##### **B. ASTM International (ASTM):**

1. A48, Standard Specification for Gray Iron Castings.
2. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
3. C1018, Standard Test Method for Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete (Using Beam with Third-Point Loading).

##### **C. National Electrical Manufacturer's Association (NEMA).**

##### **D. Underwriters Laboratories Inc. (UL).**

#### **1.04 SUBMITTALS**

- A. Submit under provisions of section 01 33 00.

### **PART 2 - PRODUCTS**

#### **2.01 ACCEPTABLE MANUFACTURERS**

##### **A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable for submersible slurry pumps for wheel truing and drop table sump pits:**

1. Galigher.
2. Hazleton.

##### **B. Submit requests for substitution in accordance with Specification Section 01 33 00.**

#### **2.02 MATERIALS**

##### **A. Submersible Slurry Pump:**

1. Pump Casing – High chrome iron and other abrasion resistant metals.

2. Impeller – High chrome iron and other abrasion resistant metals.
3. Shaft – Carbon Steel, AISI.
4. Strainer – Cast Iron, ASTM A48, Class 35A.
5. Impeller Wear Wings – High chrome iron and other abrasion resistant metals
6. Mechanical Seals:
  - a. Tandem seals for added protection.
  - b. Tungsten carbide or silicon carbide for leakfree seal in abrasive liquids.
7. Motor:
  - a. UL Listed.
  - b. NEMA T frame with rugged cast iron housing.
  - c. NEMA Design R torque curve for quick starting.

## 2.03 EQUIPMENT

### A. Performance and Configuration Requirements:

1. Abrasive handling sump pumps:
  - a. Pump configuration: Vertical.
  - b. Drive type: Constant Speed.
  - c. Drive Configuration: Direct Coupled.
  - d. Minimum Solids Passage: 7/16 IN through strainer and 9/16 IN through pump.
2. Performance schedule located at end of this section.

## 2.04 ACCESSORIES

### A. See Section 43 21 00.

### B. Controls:

1. Float switch assembly:
  - a. Direct acting mercury float.
  - b. Provide start, high alarm and pump stop floats.
2. Provide float mounting bracket for attachment to sump wall.
3. Provide float levels:
  - a. Pump stop at bottom of pump motor housing.
  - b. Pump start at 4 FT-6 IN above sump pit floor.
  - c. High alarm at 5 FT above sump pit floor.
  - d. Adjust height of floats as required to avoid excessive start/stop operation of pump.

### C. Chemical resistant casing.

1. Electrical connections watertight and impact resistant.
2. Connect float wiring to starter and disconnect at MCC.

## 2.05 FABRICATION

### A. General:

1. Pump casing uniform and free from blowholes or other defects and designed to withstand 150 percent of shut-off head.
2. Equipped with bolt-on strainer with solids passage as scheduled.
3. Double suction design all metal pump for handling heavy slurries.

### B. Suction and Discharge:

1. Abrasive Handling Sump Pumps
  - a. Suction: 1-1/2 IN.
  - b. Discharge: 1-1/2 IN.

### C. Impeller:

1. Semi-open.
2. Key to pump shafts with same material as shaft.
3. Provide positive means of external axial adjustment of shaft and impeller.

### D. Mechanical Seals:

1. Tandem seals for increased protection of electrical components.
2. Provide thermal protection and moisture detection to alert maintenance and shut pump down.

### E. Bearings:

1. Oil permanently lubricated type.

### F. Connections:

1. Provide cables in length required for proper assembly.
2. Provide complete set of float controls.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Comply with requirements of Section 43 21 00.

### 3.02 FIELD QUALITY CONTROL

- A. See Section 43 21 00.

**END OF SECTION**

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