

1.3.4 Testing and commissioning documentation

1.3.4.1 Submit testing and commissioning documentation in accordance with Section 01810, TESTING AND COMMISSIONING.

1.3.5 Operation and Maintenance Manuals

1.3.5.1 Submit manuals in accordance with Section 01830, OPERATION AND MAINTENANCE MANUALS, with comprehensive descriptions and illustrations of equipment, including configuration, operation, overhaul, adjustments, part numbers, and other pertinent purchasing information.

**1.4 QUALITY REQUIREMENTS**

1.4.1 Quality requirements are described in Section 01400, QUALITY REQUIREMENTS.

**2 PRODUCTS**

**2.1 DESIGN**

2.1.1 All terminals and terminal blocks for signal system shall be in conformance with Section 14 of the AREMA Communications & Signals Manual.

2.1.2 Terminals: Shall meet the AREMA Communications & Signals Manual Part 14.1.1.

2.1.3 Terminal Blocks: Provide sufficient terminals for terminating all wires and cables including spare conductors. Use a maximum of two (2) wires per terminal. Provide at least 10% terminals as unused spares on each terminal block, with a minimum of two (2) per block.

2.1.4 Molded Terminal Blocks: Shall be in conformance with the AREMA Communications & Signals Manual Parts 14.1.5 and 14.1.6. Acceptable manufacturers are Safetran, GRS and US&S, or Approved Equal.

2.1.5 Solderless Cage Clamp Terminal Blocks: Shall be in conformance with the AREMA Communications & Signals Manual Part 14.1.2. Acceptable Manufacturer is WAGO, or Approved Equal.

2.1.6 Binding Posts: Shall be in conformance with the AREMA Communications & Signals Manual Part 14.1.1 and 14.1.12.

2.1.7 Numbering of Terminal Blocks: All terminals on terminal blocks shall be numbered with vinyl tags.

2.1.8 Nuts and Washers: Shall be in conformance with the AREMA Communications & Signals Manual Part 14.1.11. For molded terminal blocks, supply two (2) binding nuts, one (1) clamp nut and three (3) washers for all terminals, including spares, in instrument cases, junction boxes and on equipment racks.

- 2.1.9 Terminals for Telephone Type Cable: Supply screw type terminals for each wire connection between incoming and outgoing cables. Acceptable manufacturer is Weidmuller, or Approved Equal.
- 2.1.10 Provide a means of disconnecting the wires connected to the AREMA type terminals that leave either a room, junction box, instrument case or other housing. Such means shall not require the removal of any wire from a terminal. Special nuts and special ring terminals designed for this purpose shall be provided at all AREMA type terminals having wires that leave a room, junction box, instrument case or other housing.
- 2.1.11 Insulated test links shall be Type 14.1.15-9 per the AREMA Communications & Signals Manual, complete with gold nuts, insulated washers, and copper bars in accordance with AREMA Communications & Signals Manual 14.1.15-11, 14.1.15-12, and 14.1.15-13.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- 3.1.1 Install equipment in accordance with the AREMA Communications and Signals Manual, Section 14, and with the manufacturer's installation and adjustment procedures.
- 3.1.2 Terminal Blocks: The placement of terminal blocks is dependent upon their function and should be located as follows wherever possible:
  - 3.1.2.1 Terminals for cable termination should be mounted vertically inside remote signal and terminal cases or on main terminal board racks in relay rooms;
  - 3.1.2.2 Terminals designated for energy bus connection should be mounted horizontally inside signal cases or above the relays on relay racks; and
  - 3.1.2.3 Terminals for inter-rack connections should be mounted horizontally above the relays and energy bus terminals on relay racks.
- 3.1.3 Binding Posts: Number binding posts in a manner subject to Acceptance by GO Transit.
- 3.1.4 Molded Terminal Block Spare Terminals: Install two (2) binding nuts, one (1) clamp nut and three (3) washers.
- 3.1.5 Telephone Type Cable Terminals: Install screw clamp type terminals for each wire connection between incoming and outgoing cables.
- 3.1.6 Use only AREMA type terminals for vital wiring.
- 3.1.7 All terminal posts, located on terminal boards in the wayside cases and signal instrument house used to terminate circuits of 100 volts and greater shall be provided with a protective insulator.
- 3.1.8 The type of insulator shall be individual for each terminal post, fire-resistant, similar to Safetran Type 023408 Insulated Nut, or Approved Equal. Use of fiber tube type insulators will not be permitted.

### **3.2 TESTING AND COMMISSIONING**

- 3.2.1 Perform Factory Acceptance Testing in accordance with Section 01452, FACTORY ACCEPTANCE TESTING.
- 3.2.2 Test and commission terminals and terminal blocks in accordance with Section 01810, TESTING AND COMMISSIONING.

### **3.3 ACCEPTANCE**

- 3.3.1 Terminals and terminal blocks will be accepted when put into operational service by GO Transit.

**END OF SECTION**

## **1 GENERAL**

### **1.1 SUMMARY**

- 1.1.1 This Section includes the requirements for the design, supply, installation, testing and commissioning of equipment and furnishings necessary for miscellaneous components and Products requirements.

### **1.2 RELATED SECTIONS**

- 1.2.1 01330 SUBMITTALS;
- 1.2.2 01340 SHOP DRAWINGS;
- 1.2.3 01400 QUALITY REQUIREMENTS;
- 1.2.4 01422 REFERENCE STANDARDS;
- 1.2.5 01450 SYSTEMS ASSURANCE;
- 1.2.6 01810 TESTING AND COMMISSIONING;
- 1.2.7 01830 OPERATION AND MAINTENANCE MANUALS;
- 1.2.8 16133 CONDUITS AND FITTINGS; and
- 1.2.9 16075 ELECTRICAL IDENTIFICATION.

### **1.3 SUBMITTALS**

- 1.3.1 Submit the following in accordance with Section 01330 SUBMITTALS
- 1.3.1.1 Product data
- 1.3.1.1.1 Submit complete performance data for each type of miscellaneous components or Products, including as a minimum, parts lists, circuit drawing and component drawings and data in accordance with Section 01330, SUBMITTALS.
- 1.3.1.1.2 Submit two (2) samples of each type of component or Product proposed as an equivalent to those herein specified in this Section.
- 1.3.1.2 Shop drawings

- 1.3.1.2.1 Submit shop drawings for each type of components and Products in accordance with Section 01340, SHOP DRAWINGS.
- 1.3.1.3 Testing and commissioning documentation
  - 1.3.1.3.1 Submit testing and commissioning documentation in accordance with Section 01810, TESTING AND COMMISSIONING.
- 1.3.1.4 Operation and Maintenance Manuals
  - 1.3.1.4.1 Submit manuals in accordance with Section 01830, OPERATION AND MAINTENANCE MANUALS, with comprehensive descriptions and illustrations of each type of components and Products including configuration, operation, overhaul, adjustments, part numbers, and other pertinent purchasing information.

## **1.4 QUALITY ASSURANCE**

- 1.4.1 Quality requirements are described in Section 01400, QUALITY REQUIREMENTS.

## **2 PRODUCTS**

### **2.1 DESIGN**

- 2.1.1 All electrical components shall be rated to operate at power, voltage, current, and temperature levels exceeding by 50 percent or more than those the components will be subject to in service, unless Accepted by GO Transit.
- 2.1.2 Diodes
  - 2.1.2.1 Diodes shall carry a JEDEC number, be available from more than one (1) manufacturer and shall be used within the published specifications for such number. All diodes shall be silicon type, unless otherwise Accepted by GO Transit.
- 2.1.3 Resistors
  - 2.1.3.1 Resistors, other than those required for electronic circuits, shall be in accordance with AREMA Communications and Signals Manual, Part 14.2.15.
- 2.1.4 Reactors
  - 2.1.4.1 Reactors, other than those required for electronic circuits, shall be in accordance with AREMA Communications and Signals Manual, Part 14.2.20.
- 2.1.5 Pressure sensitive labels

2.1.5.1 The rows and columns on entrance racks shall be identified by pressure-sensitive labels bearing the relational coordinates e.g. Row 1, Rack 1 would be 1-1, Row 2, Rack 1 would be 2-1.

2.1.6 Hardware

2.1.6.1 All mounting hardware exposed to the elements and used for signal equipment, such as conduit, hangers, brackets, clamps, shall be hot-dip galvanized, except as otherwise Accepted by GO Transit.

2.1.6.2 The hot dip process of galvanizing shall be used. All parts shall be pickled so that all scale and adhering impurities will be removed. The zinc coating shall be of commercially pure zinc, and shall be continuous and thorough. It shall not scale or blister or be removable by any of the processes of handling or installation. The finished surface shall be free from fine line cracks, holes, or other indications of faulty galvanizing. It shall be smooth and free from adhering flux and other impurities. The edges and ends of parts shall be free from lumps and globules. Parts shall be coated with at least two (2) ounces of zinc per square foot of galvanized surface, after all bending, cutting, welding, drilling, and final fabrication.

2.1.6.3 All nuts, bolts, and washers used for the mounting of equipment within finished enclosures shall be cadmium plated or stainless steel.

2.1.6.4 Cadmium plating shall be an impervious, dense, hard, fine grained, continuous, closely adhering coating of commercially pure cadmium, free from capillaries and shall completely cover the surface of the part in a smooth, bright layer. Plating on raised or prominent portions shall show no evidence of blackness or loose crystalline structure. It shall have a minimum thickness of six (6) ten-thousandths of an inch and shall withstand the salt spray test for at least 1000 hours or an equivalent test Accepted by GO Transit.

2.1.7 Sealing compound

2.1.7.1 Sealing compound for use in sealing cable entrances shall be fire retardant, and in accordance with AREMA Communications and Signals Manual, Part 15.2.15.

2.1.8 Cable entrance conduits

2.1.8.1 Cable entrance conduits for houses and cases shall be in accordance with Section 16133, CONDUITS AND FITTINGS and provided complete with cable entrance bushings and secure to the housings. One (1) spare entrance pipe assembly shall be furnished for each ground mounted wayside housing.

2.1.9 Tagging for equipment

2.1.9.1 Identification for all electrical equipment and materials shall be in accordance with Section 16075, ELECTRICAL IDENTIFICATION.

- 2.1.9.2 Tags for identification of transformers, resistors, reactors and other components shall meet the following requirements and shall be subject to Acceptance of GO Transit.
- 2.1.9.3 Tags for identification of individual transformers, resistors, reactors, terminals, and other miscellaneous components within the instrument housings shall be the flat, plastic laminated, high-temperature adhesive type.
- 2.1.9.4 These tags shall be one and one-half inches long by three-quarter inch wide. The distance from the edge of a tag to the hole shall be approximately nine (9) thirty-seconds of an inch. The untreated tag shall be milk white "vinylite", or Accepted equivalent.
- 2.1.9.5 Lettering shall be typed, with the tag manufacturer's accepted device and ribbon or ink. The height of the lettering shall be not less than one-eighth inch.
- 2.1.9.6 After lettering, both the face and back side of the tag shall be covered with a clear plastic coating, "vinylite", or accepted equal, of at least one-hundredth of an inch thick.
  - 2.1.9.6.1 The identifying nomenclature space shall allow for three (3) rows of lettering, and the tag material shall be capable of receiving typed-on characters by conventional means.
- 2.1.9.7 Terminal posts on racks shall be identified by their relational coordinates, such as rack, row, and post number, progressively from the top down, and from left to right.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- 3.1.1 All miscellaneous components and Products shall be new and free of manufacturing defects, clearly and permanently labeled with value or type identification.
- 3.1.2 All material and apparatus specified herein shall be installed in accordance with the Contract Documents.

#### **3.2 TESTING AND COMMISSIONING**

- 3.2.1 Test and commission miscellaneous component and Product in accordance with Section 01810, TESTING AND COMMISSIONING, and as specified in the Contract Documents, and in accordance with Accepted test plans.
- 3.2.2 Perform factory acceptance tests, post installation check-out, and final operational tests.

### **3.3 ACCEPTANCE**

- 3.3.1 Miscellaneous components and products will be accepted when put into operational service by GO Transit.

**END OF SECTION**



## **1 GENERAL**

### **1.1 SUMMARY**

- 1.1.1 This Section includes the requirements for the design, supply, testing and commissioning of equipment and furnishings necessary for rail bonds, fouling bonds, frog bonds, track circuit connections and all other material required for bonding rail track joints, track frogs, track switches, and track circuit connections.

### **1.2 RELATED SECTIONS**

- 1.2.1 01330 SUBMITTALS;
- 1.2.2 01340 SHOP DRAWINGS;
- 1.2.3 01400 QUALITY REQUIREMENTS;
- 1.2.4 01422 REFERENCE STANDARDS;
- 1.2.5 01810 TESTING AND COMMISSIONING; and
- 1.2.6 01830 OPERATION AND MAINTENANCE MANUALS.

### **1.3 SUBMITTALS**

- 1.3.1 Submit the following in accordance with Section 01330 SUBMITTALS.
- 1.3.1.1 Product data
- 1.3.1.1.1 Submit complete Product data including catalogue cuts or other descriptive literature for all bonding material, track circuit connectors, special installation tools, reliability analysis report, railway names and working status of the bonding used in the past.
- 1.3.1.1.2 Submit plans showing detailed final design for bonding of track Work to ensure that all pieces of the special track Work are properly connected electrically.
- 1.3.1.2 Shop drawings
- 1.3.1.2.1 Submit shop drawings including installation drawings and procedure for the bonding installation, identifying the Work including site preparation, blockout temporary protection, rail termination and test, and blockout infill process in accordance with Section 01340, SHOP DRAWINGS,

1.3.1.2.2 Submit documentation of the locations of all bonding required for the proposed signal design. Indicate additions, deletions, or relocations, if required.

1.3.1.3 Testing and commissioning documentation

1.3.1.3.1 Submit testing and commissioning documentation in accordance with Section 01810, TESTING AND COMMISSIONING.

1.3.1.4 Operation and Maintenance Manuals

1.3.1.4.1 Submit manuals in accordance with Section 01830, OPERATION AND MAINTENANCE MANUALS, with comprehensive descriptions and illustrations rail bonding including configuration, operation, overhaul, part numbers, special installation tools and other pertinent purchasing information.

## **1.4 QUALITY ASSURANCE**

1.4.1 Quality requirements are described in Section 01400, QUALITY REQUIREMENTS.

## **2 PRODUCTS**

### **2.1 DESIGN**

2.1.1 Bonds shall be furnished for all non-insulated rail joints within the limits of the USRC.

2.1.2 Track circuit bonding shall be in accordance with AREMA Communications and Signals Manual, part 8.1.20, plug type, and the Contract Documents.

2.1.3 Rail connections and track circuit connectors shall be in accordance with AREMA Communications and Signals Manual, part 8.1.25, single conductor plug. Connectors shall be composed of 133 cadmium bronze wires, tinned, 3/16 inch bare finished diameter. Track circuit connector shall have a compression type sleeve to connect to bond strand S-8 bond strand.

2.1.4 S-8 bond strand for track circuits connection shall be 133 cadmium bronze wires, tinned, 3/16 inch bare finished diameter, with black 6/64 PVC insulation.

2.1.5 Track circuit rail connectors shall be with a standard tapered plug terminal on one (1) end and compression sleeve on the other end, for a direct crimp type connection to S-8 bond strand which uses a crimp type connection to track wire in the track circuit junction box in accordance with the Contract Documents. The length of the S-8 bond strand shall permit termination within the track circuit junction box, with sufficient slack within the junction box for three (3) re-terminations. Alternative plan which allows the connections between plug terminal and bond strand to be removed and resecured without compromising the integrity of the connection shall be submitted to GO Transit for Acceptance along with detailed working status and failure analysis report in product submittal stage.

- 2.1.6 Fouling, switch heel, and frog bonds shall be installed at all turnouts, crossovers, double slip switches, as indicated in the Contract Documents.
- 2.1.7 The fouling wires shall be sized to permit installation of one (1) end of the wire on the outside of the far rail and the other end on the inside of the opposite far rail. The second wire installation shall be the reverse of the first wire.
- 2.1.8 Furnish clips and fasteners for securing the wires on the rails, and along and across ties. Use of staples for securing the wires will not be allowed.
- 2.1.9 Connection between bonds, connectors and wires shall use the special tools provided by the manufacturer.
- 2.1.10 Rail bonding may be exothermic weld type at the place where drilling a hole on the rail is impossible, and shall be in accordance with the requirements of AREMA Communications and Signals Manual, part 8.1.30. Finished nominal diameter shall be 5/16 inches.
- 2.1.11 The welding material shall be in accordance with AREMA Communications and Signals Manual, part 8.1.34.

### **3 EXECUTION**

#### **3.1 INSTALLATION**

- 3.1.1 Deliver, store and handle rail bonding in accordance with manufacturer's recommendations and AREMA C&S Manual Part 8.1.34.
- 3.1.2 All bonding will be undertaken by the TTR to the Contractor's design. The Contractor shall assume responsibility for testing and commissioning of TTR installed work.
  - 3.1.2.1 All pieces of the special track Work shall be bonded in accordance with the Accepted plans in order to establish electrical continuity and conductive capacity for signal track circuits.

#### **3.2 TESTING AND COMMISSIONING**

- 3.2.1 Test and commission rail bonding in accordance with Section 01810, TESTING AND COMMISSIONING, and as specified in the Contract Documents, and in accordance with Accepted test plans.

#### **3.3 ACCEPTANCE**

- 3.3.1 Rail bonding will be accepted when put into operational service by GO Transit.

**END OF SECTION**