

SECTION 05661

CONTACT RAIL AND APPURTENANCES FOR TRACTION POWER

PART 1 - GENERAL

1.01 SUMMARY

- A. This section specifies designing, fabricating, testing and furnishing a composite contact rail system, including the composite contact rail, splice joints, expansion joints, end approaches, terminal lugs, and all appurtenances as specified.
- B. Related Sections:
 - 1. Section 16123 - Contact Rail Insulation Assembly For Traction Power
 - 2. Section 16124 - Contact Rail Protection Cover Board Assembly For Traction Power
 - 3. Section 16126 - Contact Rail Anchor Assembly For Traction Power
 - 4. Section 16127 - Contact Rail System Installation For Traction Power

1.02 REFERENCES

- A. Codes, regulations, references standards and specifications:
 - 1. AREMA Chapter 4, Part 2, Section 2.1, Specification for Steel Rail.
 - 2. ANSI H35.1, Type A6101-T6
 - 3. ASTM B317, Type B
 - 4. Steel Structure Painting Council, SSPC-SP-6
 - 5. Society of Protective Coating, SSPC-VIS 1
 - 6. ASTM B117
 - 7. ASTM A2, Grade 65-35
 - 8. ASTM A47, Grade 32510
 - 9. ANSI B4.1
 - 10. ASTM A325
 - 11. ASTM A449
 - 12. ASTM B134
 - 13. ANSI B18.8.1
 - 14. ASTM A153
 - 15. B695
 - 16. SAE No. G-18
 - 17. ANSI C37.34
 - 18. NEMA-CC1

1.03 SYSTEM DESCRIPTION

- A. Composite Contact Rail
 - 1. The composite contact rail shall consist of a steel base rail, with one aluminum extrusion fastened to each side of the web area of the base rail, continuously over the finished length.
- B. Appurtenances
 - 1. Appurtenances include expansion joints, end approaches, cast parts, terminal lugs, disconnect switches, nuts, bolts, and miscellaneous hardware.

1.04 SUBMITTALS

- A. Shop Drawings

ATTACHMENT B

1. The Contractor shall submit for approval, shop drawings for fabrication of the components and assemblies of the composite contact rail and appurtenances. No fabrication or manufacturing shall be performed prior to drawing approval.
 2. Complete layout and fabrication details of contact rail system, showing all components, welding, attached hardware, and accessories.
 3. Procedures for cutting and welding end approaches.
 4. List of approximate quantities and lengths of composite contact rail.
- B. Pre-curved Rail: In addition to the requirements for straight rail, provide the following:
1. Shop drawings for pre-curved rail lengths by rail sequence number showing the radius for each rail length and its location in the track.
 2. A description of the method for pre-curving rail.
 3. The method of marking rails for identification for installation.
 4. The method for handling rails, including procedures for shipment.
- C. Certifications
1. Certification that composite contact rail and appurtenances furnished meet or exceed specified requirements.
 2. Certified Test Reports
- D. Product Data: Manufacturer's catalog cuts, material specifications, installation and maintenance instructions, and other pertinent data for all contact rail components.
- E. Inspection and Test Reports
1. Mill Inspection reports
 2. Design verification test reports
 3. Inspection and test reports.
- F. Welders Qualifications:
1. Qualification test records by welders in accordance with AWS D1.1 for the types of welding required
- G. Structural Calculations
1. Submit, for all contact rail, attached hardware, fittings and appurtenances. Forces considered shall include dynamic effects, short circuit overturning forces, gravitational overturning forces on super_elevated track, thermal forces, lateral components of thermal forces on curved track, wind, and earthquakes.

1.05 QUALITY ASSURANCE

- A. Electrical Tests
1. Splice Joint DC Resistance
 - a. Two sections of the composite rail, each 36 inches, shall be joined together. At a constant room temperature, the resistance across the joint shall be measured in accordance with NEMA-CC1 and compared to an equal length of unjointed composite rail at the same temperature. The method used to measure resistance shall be determined by means of a Biddle Digital Low Resistance Ohmmeter or other similar device either of which shall be subject to the approval of the Authority's COTR.

- b. If the resistance across the jointed rail exceeds the resistance of the unjointed rail the joint design will be rejected.
 - 2. Composite Rail and Splice Joint Thermal Cycle
 - a. Using the same jointed and unjointed sections used in the dc-resistance test, the specimens shall be cycled thermally for a minimum of ten cycles. Each thermal cycle shall consist of lowering the rail temperature to minus 5C and measuring the resistance of the specimens, then raising the temperature of the specimens to plus 117C and measuring the resistance again for a minimum of ten cycles.
 - b. If at any time the resistance of the jointed or unjointed sections exceeds the requirements of these specifications, the design will be rejected.
 - 3. Contact Rail and Splice Bar Heat Rise
 - a. The test specimen shall consist of two sections of the composite rail, spliced together with a standard splice assembly. Each section shall be at least 39 feet long.
 - b. Record the temperature rise at 30 minute intervals until the temperatures become stabilized, for a current value of 5400 amperes, direct current.
 - 4. Composite Rail and Splice Joint Assembly Salt-Spray Test
 - a. Perform the resistance test on a minimum 3-foot rail section. Using jointed and unjointed sections used in the DC resistance test, perform 500-hours of Salt-Spray testing in accordance with the requirements of ASTM B117. The samples shall then be tested for resistance following the salt spray conditioning.
 - b. If, at the end of the test, the resistance of either specimen increases by more than five percent, the design will be rejected.
 - 5. Electrical Characteristics
 - a. The assembled composite contact rail shall have an electrical resistance not greater than 0.002 ohms per 1,000 feet at 20C. The manufacturer shall provide certificates of product conformance.
 - b. Certify by calculations that the composite contact rail shall be capable of withstanding a fault current of 135,000 amperes dc, or equivalent ac, for 100 milliseconds without mechanical or thermal damage.
 - c. The Contractor shall submit certification of all the listed electrical characteristics of the composite contact rail.
 - d. Certified Test Reports
 - e. The composite rail shall be capable of conducting 5,000 amperes dc continuous with a temperature rise not to exceed 40C above 30C ambient in still air.
- B. Support Insulators (Reference Specification Section 16123, Contact Rail Insulator Assembly for Traction Power)
- C. Testing of Terminal Lugs
 - 1. Two assemblies from each lot of terminal lugs shall be tested. Failure of any assembly to pass the following tests will cause rejection of the entire lot.
 - 2. A completed compression connection shall provide electrical resistance not

greater than an equivalent length of uncut cable when measured between the distal end of the cable and the connector tongue.

3. Bare conductors shall be used for performing tests.
 4. Resistance measurements shall be taken before and after the tests specified below.
 5. The test connections shall then be subjected to a sustained tension of 5,000 psi of the nominal conductor cross sectional area for a period of three hours. At the end of three hours, there shall be no increase in electrical resistance of the connection beyond that specified. There shall be no slipping of the conductor in the connector or deformity or loosening of the connection.
 6. Provide certificates of product performance.
- D. For codes, regulation, references, standards and specifications, refer to Article 1.02 above.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Composite Contact Rail

1. Steel Base Rail

- a. The 84 lb. steel base rail shall be new No. 1 rail and manufactured to meet the requirements of WMATA specifications. Rail shall be free of all injurious imperfections:

1.) Chemical Composition of the core steel rail shall be as follows:

<u>Constituent</u>	<u>Percent</u>
Carbon	0.64-0.77
Manganese	0.60-0.90
Phosphorus, Max	0.04
Sulfur, Max	0.05
Silicon	0.10-0.35
Copper, Max	0.50

2.) The Brinell Hardness Number (BHN) of each section of cored steel rail shall be 220 or higher.

- b. The standard length of the steel base rail shall be 39 feet at a temperature of 60⁰ F.
- c. A maximum variation of plus-or-minus 2 inch of the stated length for each rail will be permitted.
2. Aluminum Extrusions
- a. The aluminum extrusions shall be of a uniform cross section and shall conform to the alloy and temper requirements of ANSI H35.1, Type A6101-T6 and shall also conform to the requirements of ASTM B317, Type B.
- b. The extrusions shall be formed to permit maximum clamping force with the steel base rail and the cable terminal lugs to create the maximum electrical contact area. In addition, they shall permit rail tongs to grasp the head of the steel base rail for lifting the composite rail without damage to the aluminum extrusions.

- c. Sufficient clearance at the base shall be provided to permit mounting of the contact rail protection cover assembly, clearing insulator ears and other appurtenances. Sufficient clearance shall be provided at the rail head to mount the specified contact rail heater.

3. Splice Joint

- a. The splice joint assembly shall consist of two aluminum alloy extrusions of the same material specified for composite rail aluminum extrusions, except that the internal contour of the splice joint extrusion shall conform to the external contour of the composite rail aluminum extrusion to ensure proper vertical and horizontal alignment of the composite rail sections.
- b. The splice joint assembly shall provide ample contact surface for the transfer of electrical current across the joint and the joint shall have a resistance no greater than that of an equal length of composite rail.
- c. The splice joint extrusions shall be pre-drilled as required to accept four 7/8-inch diameter steel compression fasteners, as manufactured, for example, by the Huck Manufacturing Company, or equal.
- d. The assembled splice joint shall be capable of withstanding a 25,000-pound longitudinal tension force across the joint without exceeding the yield point of its components.

B. Appurtenances

1. Expansion Joints

- a. The expansion joint assembly shall consist of the following;
 - 1) Two bars of medium carbon steel, ASTM A27, Grade 65-35 or malleable iron, ASTM A47, Grade 32510.
 - 2) Two sections of steel base rail as required.
 - 3) Aluminum extrusions.
 - 4) Accessories as required.
- b. The aluminum extrusions shall be bolted to each base rail to allow the attachment of a splice joint assembly on each section.
- c. The internal contour of the expansion joint bars shall conform to the external contour of the modified steel base rail sections to ensure proper alignment horizontally and vertically and to create a smooth passage across the joint for the collector shoe. The assembled modified steel base rail sections shall be pre-drilled as required.
- d. The expansion joint assembly shall be designed to accommodate 12 inches of movement for each 1,000 feet of composite contact rail.

2. End Approaches

- a. The end approaches shall consist of sections of steel base rail as specified, cut and welded to provide a smooth transition for the collector shoe onto the composite contact rail.
- b. The end approaches shall be supplied in lengths of 11 feet and five-feet six-inches as shown. The mating end of each end approach shall contain sufficient length of aluminum extrusion bolted to the web to allow the attachment of a splice joint assembly.
- c. The end approaches shall be pre-drilled.

3. Cast Parts
 - a. Cast parts for the composite rail assembly, including expansion joints, shall be manufactured as specified.
 - b. Castings shall be free of cracks, flaws, blemishes, scales, or any other defect that would be detrimental to the service for which they are intended. The finished surface shall be smooth and shall fit all adjoining parts accurately. Grinding will be permitted to ensure the specified fit.
 - c. Medium Steel Castings
 - 1) Steel for casting shall be medium steel made by the open-hearth, basic oxygen or electric-furnace process, ASTM A27, Grade 65-35.
 - 2) All castings shall be fully annealed by heating to a temperature above the transformation range and, after being held for a proper time at this temperature, cooled slowly and uniformly in the furnace.
 - 3) Steel castings shall be free from defects such as cracks, machining flaws, porosity or excessive shrinkage and shall be finished to a true and homogenous surface.
 - d. Malleable-iron castings
 - 1) Parts cast from malleable iron shall conform to ASTM A47, Grade 32510.
4. Terminal Lugs
 - a. Terminal lugs shall be compression-type lugs compatible with 2000V, 1,000-KCMIL, 427-strand cable. Terminal lugs shall be 98 percent pure copper. The entire lug shall be hot-dip, tin-coated, 0.3 mils minimum thickness. Tongues shall not be less than two inches square by 2 inch thick and drilled for a 5/8-inch diameter fastener.
5. Disconnect Switch
Not Included in this Procurement.
6. Nuts, Bolts, and Miscellaneous Hardware
 - a. All nuts, bolts, and flat washers shall be manufactured in accordance with ASTM A325. Where necessary, bolts may be provided in accordance with ASTM A449.
 - b. The dimensional data and type hardware for all nuts, bolts and miscellaneous parts shall be as shown on the manufacturing drawings. Steel bolts, nuts, and washers shall be galvanized as specified below.
 - c. Cotter pins shall conform to ASTM B134, and ANSI B18.8.1
7. Galvanizing
 - a. Bolts and miscellaneous hardware to be hot-dip galvanized after fabrication and shall be coated in accordance with ASTM A153
 - b. Before galvanizing, the finished parts shall be pickled or sandblasted and the scale and adhering impurities thoroughly removed. The pickling shall be done in properly diluted sulfuric acid, after which the parts shall be thoroughly cleaned in cold, running water.
 - c. Sand-blasting shall meet or exceed Steel Structure Painting Council

- SSPC-SP-6, except that the maximum grit size shall be SAE No. G-18.
- d. The parts shall then be immersed in a solution of either zinc chloride or hydrochloric acid. Immediately following thorough drying, the parts shall be dipped into the zinc bath before corrosion starts again.
8. Tolerances for Fits.
- a. Tolerances for fits shall be in accordance with ANSI B4.1.

PART 3 - EXECUTION

3.01 FABRICATION

- A. Composite Contact Rail
 - 1. Method of Assembly
 - a. Prior to final assembly of the aluminum extrusions to the steel base rail, the contact surfaces of the steel base rail shall be sandblasted to a minimum commercial blast finish in accordance with Steel Structures Painting Council SSPC-SP-6.
 - b. After sandblasting, the surfaces of both the steel base rail and the aluminum extrusions shall be cleaned of all oil, grease and other foreign matter.
 - c. Following the cleaning process, all mating surfaces shall receive a liberal and evenly distributed coating of oxide-inhibiting paste, for example, Dearborn Chemical Product NO-OX-1D or equal. Oxide-inhibiting paste shall also be applied to all interface surfaces of the fasteners.
 - d. The aluminum extrusions shall be free of aluminum oxide at the time of application of the oxide-inhibiting paste.
 - e. After application of the oxide-inhibiting paste, the aluminum extrusions shall be permanently attached to the steel base rail on maximum 19-inch centers with 5/8-inch diameter steel compression fasteners, as manufactured, for example, by the Huck Manufacturing Company or equal.
 - f. The installed fastener shall provide a minimum 19,000-pound clamping force. The fastening system shall maintain the aluminum extrusions in stable, intimate electrical contact with the steel base rail under all conditions of thermal expansion and contraction from zero degrees to 150 degrees F.
 - g. The assembled composite rail sections shall be pre-drilled on each end to accept a splice joint assembly as required. After assembly, all excess oxide-inhibiting paste shall be removed from each rail.
 - h. After final assembly, cut any excess length of the aluminum extrusions of standard sections even with the steel rail ends to a tolerance of minus 3/16 inches plus zero inches.

3.02 PRODUCTION INSPECTION AND TESTING

- A. General: Unless otherwise directed, failure of a specimen to pass the inspections and tests specified shall be cause for rejection of the entire lot represented by that specimen.

- B. Composite Contact Rail: The Contractor's QC Staff shall select at random one length of composite contact rail from each 3,000-ft produced, and perform a dc resistance test and a physical dimension test on each sample in accordance with these specifications.
- C. Splice Joint Assembly: The Contractor's QC Staff shall select at random one composite splice joint assembly from each 200 assemblies produced. Test and inspect each assembly in accordance with these specifications.

END OF SECTION