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DESIGN DIRECTIVE

To: Distribution

From: Erik J. Stoothoff, P.E. *EJS*
Chief Engineer

Date: 8/27/2020

RE: Jointed Rail Bonding Details (C-Bonds)

This intent of this Design Directive is to consolidate, reiterate, supplement, and clarify the MBTA's approach, preferences, and requirements for bonding jointed rail for the purpose of customer, employee and civilian safety.

In the event that conditions warrant deviation from this directive, a design waiver signed by the Chief Engineer and department owning the scope of work will be required of the project

MBTA Standards shall apply only where Code does not address a topic or the MBTA requires a standard above and beyond Code. The more stringent shall always apply.

OBJECTIVE

All new track construction shall be continuous-welded rail to the greatest extent possible. In the event that continuous-welded rail construction is not possible then the bonding of jointed, non-insulated rail joint locations shall adhere to the standards of this directive. All main line track and other tracks where Signal or Power circuits are present with jointed-rail locations will require bonding to allow for current to flow around the joint providing no restriction to the Signal or Power systems. Bonds installed at non-insulated rail joints shall be referred to as C-Bonds in this Directive and in MBTA track construction.

STANDARDS

- *AREMA Manual for Railway Engineering*
- *AREMA Communications & Signals (C&S) Manual of Recommended Practices*
- *AWS D1.1 Structural Welding – Steel*
- *ASTM B173 Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors.*
- *ASTM B3 Standard Specification for Soft or Annealed Copper Wire*

DESIGN PRINCIPLES

1. C-Bonds shall consist of rope-lay-stranded copper conductors with steel terminals applied at both ends by the manufacturer via pressed, swaged, or resistance welded connections.
2. Rope-lay-stranded copper conductors shall be size 300 MCM, stranded in Class G ropelay construction per ASTM B173, and constructed of uncoated annealed copper wire conforming to ASTM B3.
3. C-Bonds shall have a minimum amperage rating of 255 amps.
4. C-Bonds shall be installed in accordance with AREMA C&S Manual Part 8.6.40.
5. C-Bond terminals shall be welded to the outside head of the rail by means of shielded metal arc welding (SMAW, stick welding) using E7015, E7016, E7018, or E7028 low-hydrogen electrodes. Each terminal shall be welded to the rail using a single 2-inch long flare-bevel-groove weld filled flush to the top of the terminal.
6. Prior to welding, a minimum preheat and interpass temperature of 225°F in the railhead shall be achieved.
7. Welding shall be performed in accordance with AWS D1.1.
8. C-Bonds shall be double bonded with redundant paths provided in the same configuration. Two separate bonds shall be installed.
9. C-Bonds shall be installed in pairs of 9-inch (4¾-inch formed between terminal centers) and 16-inch long (10½-inch formed) bonds positioned with the 9-inch bond centered interior to the 16-inch bond and both bonds centered at the gap between rail segments. The cable length shall not be to the extent that any portion of the cable can touch the top of the rail.