

5. APTA PR-E-S-005-98

Standard for Grounding and Bonding

Approved January 22, 1998
Reaffirmed June 15, 2006
APTA PRESS Task Force

Authorized March 17, 1999
APTA Commuter Rail Executive Committee

Abstract: This standard provides minimum requirements for grounding and bonding on passenger rail vehicles. It includes grounding return connections, grounding, bonding, and passenger exposure. It does not address ground brush arrangements or equipment ground fault protection which vary according to application.

Keywords: bonding, electrical bonding, electrical grounding, grounding, grounding return connections, passenger exposure

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1666 K Street, N. W.
Washington, DC, 20006, USA

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Standard for Grounding and Bonding

1. Overview

This standard defines a methodology for grounding and bonding for rail passenger vehicles.

The passenger rail industry phased this standard into practice over the six-month period from July 1 to December 31, 1999. The standard took effect January 1, 2000.

1.1 Scope

This standard provides minimum requirements for grounding and bonding on rail vehicles. It includes grounding return connections, grounding, bonding, and passenger exposure. It does not address ground brush arrangements or equipment ground fault protection which vary according to application.

1.2 Purpose

The purpose of this document is to establish minimum safety standards for electrical grounding and bonding for rail passenger vehicles.

2. References

This standard shall be used in conjunction with the following publications. When the following standards are superseded by an approved revision, the revision shall apply.

APTA PR-E-RP-002-98, "Recommended Practice for Wiring of Passenger Equipment."

3. Definitions, acronyms and abbreviations

3.1 Definitions

For the purpose of this recommended practice, the following terms and definitions apply:

3.1.1 bonding: The establishment of a low-impedance current path between two adjacent components through an intimate interface surface.

3.1.2 grounding: The establishment of a low-impedance circuit or path to a designated ground plane or location.

Note: Grounding may involve one or more bonds as well as an additional circuit element such as a cable or strap.

4. Technical requirements

4.1 Grounding return connections

The grounding of electrical circuits shall be in accordance with the requirements of the railroad. In all cases, there shall be ground cables between the truck frame, and the vehicle body. All grounding return connections to the vehicle body shall be made through ground pads. Different voltage classes of circuits (see *APTA PR-E-RP-002-98, "Recommended Practice for Wiring of Passenger Equipment", Section 5.1'*) shall not be grounded to the same ground pad.

Each system or circuit fed from a circuit breaker or fuse shall have its own return wiring. Return wires for each voltage class on a vehicle shall be connected in such a way as to facilitate the troubleshooting of faults. Where the return circuits are grounded, each voltage class shall be grounded to a single point on the vehicle body or directly to ground brushes, as required by the railroad.

4.2 Grounding

All electrical equipment or enclosures shall be grounded using a ground cable or strap or by a bond between a vehicle body grounding pad and the equipment's grounding pad. All shock-mounted electrical equipment shall be grounded using ground cables or straps. The ground termination method shall apply uniform pressure to the conductive surface and the current density shall not exceed the bonding requirements of this standard.

Interior mounted, low voltage equipment shall be grounded according to the needs of the design.

A grounding arrangement shall be provided to prevent currents passing through journal, motor, and truck-center bearings from causing bearing damage.

All circuits shall be isolated from the mechanical structure of the equipment except for power returns as permitted above and circuit-to-structure components for the purpose of transient absorption and Electromagnetic Interference Protection (EMI), where allowed by agreement with the railroad.

4.3 Bonding

The bonding method used shall not produce a dc resistance in excess of 0.0025 ohms across any bond, or more than 0.025 ohms at 150 kilohertz for any applied ac voltage.

4.4 Grounding pads

All grounding connections shall be made through unpainted pads except for interior mounted, low voltage electronic assemblies.

Grounding pads shall be made of copper or copper alloys, sized for the application, and silver soldered or brazed to the respective vehicle body and piece of equipment. The use

¹ For references in Italics, see Section 2.

of nickel or tin plating is recommended to ensure that the requirements of section 4.3 are maintained over time. Transition (base) plates, if used, shall be made from the same alloy group as the respective vehicle body or equipment. The transition plate shall be welded to the vehicle body or equipment. By agreement with the railroad, welded steel grounding pads may be used. If so used, steel pads on the vehicle body shall be either nickel or tin plated carbon steel or stainless steel.

Pads shall include one or more tapped holes for securing connections. Pads using a stud arrangement may be used by agreement with the railroad. An anti-corrosive grease may be applied over connections.

4.5 Grounding jumpers and straps

All grounding jumpers and straps shall be sized to handle the available fault current without failure. Ground brush and truck grounding jumpers shall be sized to handle lightning discharge current once without failure.

All equipment subject to motion relative to the carbody and all shocks mounted equipment shall be grounded with flexible, strap-type grounding leads bolted between the carbody grounding pad and the equipment's grounding pad. Stranding shall be equivalent to or exceed the requirements of Insulated Cable Engineers Association Class M.

All pads shall be visible and accessible for inspection and troubleshooting.

4.6 Passenger and personnel exposure

On new or rebuilt equipment, all receptacles supplying 115 Volt, 60 Hz type power shall have a UL-approved ground fault interrupter and shall have a ground pin that shall be grounded to the vehicle body