

# 43. Standard for Impedance Bond Inspection and Maintenance

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**Abstract:** This standard provides procedures for inspecting and maintaining rail transit impedance bonds.

**Keywords:** audio frequency, bond, impedance bond, inspection, maintenance, mini-bond, signal, traction power return cables, tuning unit

## Introduction

(This introduction is not a part of APTA RT-SC-S-043-03, *Standard for Impedance Bond Inspection and Maintenance*.)

APTA rail transit safety standards represent an industry consensus on safety practices for rail transit systems to help achieve a high level of safety for passengers, employees, and the general public. This document was created by and for those parties concerned with its provisions; namely, rail transit systems (operating agencies), manufacturers, consultants, engineers, and general interest groups. This standard provides procedures for inspecting and maintaining rail transit impedance bonds.

APTA recommends this standard for:

- Individuals or organizations that inspect, maintain, and/or operate rail transit systems
- Individuals or organizations that contract with others for the inspection, maintenance, and/or operation of rail transit systems
- Individuals or organizations that influence how rail transit systems are inspected, maintained, and/or operated (including but not limited to consultants, designers, and contractors)

This standard intends to meet the following objectives:

- To ensure special life/safety equipment is operational and reliable
- To help rail transit systems incorporate safety considerations during the inspection and maintenance process
- To identify inspection criteria and maintenance standards that provide a high level of passenger and personnel safety

The application of any standards, practices, or guidelines contained herein is voluntary. In some cases, federal and/or state regulations govern portions of how a rail transit system operates. In such cases, the government regulations override any conflicting practices this document requires or recommends.

## Participants

APTA greatly appreciates the contributions of the following members of the Signals and Communications Subcommittee who provided the primary effort in drafting the *Standard for Impedance Bond Inspection and Maintenance*:

Carlton “Don” Allen, P.E.  
Sal Arceo  
Gabrielle Bayme  
Paul Camera

Lenny De Meyer  
Michael Esford  
Patrick Lavin  
Ruben Madrigal

Thomas Peacock  
Stephen Roberts  
Carey Vaughn

The following members of the Rail Transit Standards Fixed Structures Inspection and Maintenance Committee contributed to the review and approval process of the *Standard for Impedance Bond Inspection and Maintenance*:

**James Dwyer, Chair**  
**Frank Cihak, Vice Chair**

Anthony Adams  
Carlton “Don” Allen, P.E.  
Sal Arceo  
Roger Avery  
Peter Bertozzi  
Steven Bezner, P.E.  
Raymond Borge  
Michael Brown  
John Bumanis  
Clay Bunting  
R. Sean Burgess  
Paul Camera  
David Cappa, P.E.  
Gricelda Cespedes  
Robert Chappell  
Frank Cihak  
Catherine Cronin  
Lenny De Meyer  
Tom Devenny

David Dunderdale  
James Dunn  
James Dwyer  
William Early, P.E.  
Percy Erves  
Michael Esford  
Richard Falcon  
Ray Favetti  
Peter Fedun, P.E.  
Steve Feil  
Robert Fiore  
John Gaito  
Ricky Green  
Mohammad Irshad  
Patrick Lavin  
Harry Lupia  
Frank Machara  
Ruben Madrigal  
Michael Monastero

Bill Petit  
David Rankin  
Pingali Rao, P.E.  
Richard Raschke  
James Redding  
Stephen Roberts  
Charles Slavis, P.E.  
Frederick Smith, P.E.  
Richard Spatz  
Charles Stanford  
F. Brian Steets  
Paul Swanson, P.E.  
Steven Thompson  
Fred Tijan  
Gary Touryan  
Carey Vaughn  
James Wang, P.E.

APTA Rail Transit Standards Fixed Structures Inspection and Maintenance Committee project consultants:

Peter Gentle, P.E., *STV Incorporated*  
Carol Rose, *STV Incorporated*

APTA Rail Transit Standards project team:

Gabrielle Bayme, *Standards Development Program Specialist and Project Editor*  
Saahir Brewington, *Administrative Assistant and Project Editor*  
Antoinette Hankins, *Program Assistant*  
Thomas Peacock, *Director-Operations & Technical Services*  
David Phelps, *Senior Project Manager - Rail Programs*

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# Standard for Impedance Bond Inspection and Maintenance

## 1. Overview

### 1.1 Scope

This document establishes standard requirements for inspecting and maintaining rail transit audio frequency and power impedance bonds.

### 1.2 Purpose

The purpose of this standard is to verify that impedance bonds are operating safely and as designed through periodic inspection and maintenance, thereby increasing reliability and reducing the risk of hazards and failures.

### 1.3 Alternate practices

Individual rail transit systems may modify the practices in this standard to accommodate their specific equipment and mode of operation. APTA recognizes that some rail transit systems may have unique operating environments that make strict compliance with every provision of this standard impossible. As a result, certain rail transit systems may need to implement the standards and practices herein in ways that are more or less restrictive than this document prescribes. A rail transit system (RTS) may develop alternates to the APTA standards so long as the alternates are based on a safe operating history and are described and documented in the system's safety program plan (or another document that is referenced in the system safety program plan).

Documentation of alternate practices shall:

- a) Identify the specific APTA rail transit safety standard requirements that cannot be met
- b) State why each of these requirements cannot be met
- c) Describe the alternate methods used
- d) Describe and substantiate how the alternate methods do not compromise safety and provide a level of safety equivalent to the practices in the APTA safety standard (operating histories or hazard analysis findings may be used to substantiate this claim).

## 2. Definitions and acronyms

For the purposes of this standard, the following definitions and acronyms apply:

### 2.1 Definitions

**2.1.1 audio frequency impedance bond:** A device of low resistance and low impedance to all frequencies to which it is not tuned, used with jointless audio frequency track circuits to couple inductively and confine the signaling energy to its own track circuit and equalize the return propulsion current between rails without impeding its flow. *Syn:* signal impedance bond.

**2.1.2 hazard:** Any real or potential condition that can cause injury, death, or damage or loss of equipment or property.

**2.1.3 impedance bond:** *See:* audio frequency impedance bond, power frequency impedance bond.

**2.1.4 operations control center (OCC):** That facility from which train control, train dispatching, and/or train supervision takes place for the entire RTS or for specific segments of a system if there is more than one control center. *Syn:* **rail control center, rail operations center, rail service control center, train command center.**

**2.1.5 original equipment manufacturer (OEM):** The enterprise that initially designs and builds a piece of equipment.

**2.1.6 personal protective equipment (PPE):** All clothing and other work accessories designed to create a barrier against workplace hazards. Examples include safety goggles, blast shields, hard hats, hearing protectors, gloves, respirators, aprons, and work boots.

**2.1.7 pin bond:** A rail bond where the conductor is connected to a tapered pin that is driven into a pre-drilled hole in the rail.

**2.1.8 power frequency impedance bond:** An iron core coil of low resistance and relatively high reactance, used on electrified railroad to provide a continuous path for the return propulsion current around insulating joints and to confine the alternating current signaling energy to its own track circuit.

**2.1.9 rail cable clamp:** A mechanical device used to secure large current carrying cables to the running rail.

**2.1.10 rail transit system (RTS):** The organization or portion of an organization that operates rail transit service and related activities. *Syn:* **operating agency, operating authority, transit agency, transit authority, transit system.**

**2.1.11 traction power return cable:** Heavy duty cable of various sizes that are connected to the running rails, impedance bonds, and other track locations and components that provide a path for the negative traction power current to flow and be returned.

**2.1.12 tuning unit:** The portion of a two piece signal impedance bond system that houses the electronic components that are wired in parallel with the bond toroid coils and used to form the resonant circuits required to provide specific ATP functions.

## 2.2 Acronyms

<b>OCC</b>	operations control center
<b>OEM</b>	original equipment manufacturer
<b>PPE</b>	personal protective equipment
<b>RTS</b>	rail transit system
<b>PVC</b>	polyvinyl chloride

## 3. Inspection and maintenance requirements

### 3.1 Inspection and maintenance frequency

The inspection and maintenance procedures in this standard shall be performed when impedance bonds are placed in service, when they are modified, repaired, or disarranged, or as otherwise deemed necessary by the RTS.

The RTS shall determine the need for additional inspection and maintenance frequencies for impedance bonds. A review of the following factors may be useful in making this assessment:

- OEM-recommended intervals
- Industry experience
- Operating environment/conditions
- Historical data
- Reliability-centered maintenance program development
- Failure analysis
- RTS testing and experience
- Regulatory requirements

The frequency of tasks shall comply with applicable federal, state, and local regulations.

### 3.2 Training

The RTS and/or their maintenance contractors shall develop and execute training programs that provide employees with the knowledge and skills necessary to safely and effectively perform the tasks outlined in this standard.

### **3.3 Materials**

The following materials are required for inspecting and maintaining impedance bonds:

- RTS-approved lubricants
- RTS-approved cleaning solutions
- Additional materials as required by the OEM and/or RTS

### **3.4 Tools**

The following tools are required for inspecting and maintaining impedance bonds:

- RTS-approved portable radio
- Standard tools carried by maintenance personnel
- Additional tools as required by the OEM and/or RTS

\* Calibrate in accordance with OEM and/or RTS requirements.

### **3.5 Personal protective equipment**

Personal protective equipment, as required by the RTS, shall be worn at all times during inspection and maintenance.

### **3.6 Safety**

RTS safety rules, procedures, and practices shall be followed at all times during inspection and maintenance.

### **3.7 Inspection and testing procedures**

Impedance bond inspection and maintenance procedures may be modified for each rail transit system's requirements (see Section 1.3) but shall contain the steps listed in Sections 3.7.1-3.7.2 as a minimum.

#### **3.7.1 Inspection**

- 3.7.1.1** Notify the operations control center (OCC) and/or other authorities of the inspection activities to be performed.
- 3.7.1.2** Inspect the impedance bond for an accumulation of debris. Remove and bag debris.
- 3.7.1.3** Inspect wayside drains for blockage or ineffective drainage.



- 3.7.1.4 Inspect the impedance bond for damage caused by standing water, water leaks, or retention.
- 3.7.1.5 Inspect the impedance bond for any condition that may interfere with the operation of the equipment.
- 3.7.1.6 Inspect the impedance bond and traction power return cables, rail cable clamps, pin bonds and welds, wiring, bonding, and hardware for defective insulation, rust, corrosion, missing components, damage and loose or broken connections.
- 3.7.1.7 Inspect bond tuning unit for rust, corrosion, damage, cracks, breaks, defective latches, hinges, locks, covers, seals, gaskets, loose conduit connections and missing or loose components and hardware. Holes and unused entrances not used for ventilation shall be sealed.
- 3.7.1.8 Inspect junction boxes and enclosures for the presence and condition of stored circuit drawings, terminal list, wire tags, and instructions.
- 3.7.1.9 Inspect the encapsulated transformer portion of the bond for rust, corrosion, damage, cracks, and breaks, and for damaged J-Bars, connectors, and missing or loose components and hardware.
- 3.7.1.10 Inspect impedance bond insulated joints for bridging, broken or deteriorated insulation, metal shavings, loose or missing hardware.
- 3.7.1.11 Inspect the impedance bond for damage, cracks, breaks, defective latches, locks, hinges, covers, and loose, deteriorated, or damaged conduit connections, and hardware.
- 3.7.1.12 Inspect polyvinyl chloride (PVC), fiberglass, rubber and other cable conduit material for damage, cracks, breaks, loose conduit connections, missing or loose components, and hardware.
- 3.7.1.13 Ensure covers, doors, and locks are in place and secured.
- 3.7.1.14 Notify the OCC and/or other authorities when inspection is complete.

### **3.7.2 Maintenance**

- 3.7.2.1 Notify the OCC and/or other authorities of the maintenance activities to be performed.
- 3.7.2.2 Clean and lubricate bond layout hardware and/or components in accordance with RTS procedures.
- 3.7.2.3 Verify that bond and/or tuning unit are mounted securely.
- 3.7.2.4 Verify bond fluid and or compound levels are in compliance with RTS specifications.
- 3.7.2.5 Verify bond air gaps are in compliance with RTS specifications.

**3.7.2.6** Verify that clearance between top of bond and/or tuning unit case and lowest rail is in accordance with RTS specifications.

**3.7.2.7** Ensure covers and locks are in place and secured.

**3.7.2.8** Notify the OCC and/or other authorities when maintenance activities are complete.

### **3.8 Correction of deficiencies**

Deficiencies identified during impedance bond inspection and maintenance shall be corrected and documented in accordance with OEM and/or RTS requirements.

### **3.9 Documentation**

Inspection and maintenance activities shall be documented, reviewed, and filed in accordance with RTS procedures.

## **Annex A**

(informative)

### **Bibliography**

- [B1] Original equipment manufacturer (OEM) specifications for impedance bond inspection and maintenance.
- [B2] Rail transit system (RTS) procedures for impedance bond inspection and maintenance.