



APTA STANDARDS DEVELOPMENT PROGRAM

## STANDARD

American Public Transportation Association  
1300 I Street, NW, Suite 1200 East, Washington, DC 20005

APTA PR-IM-S-016-02, Rev. 2

First Published: Jan. 16, 2003

First Revision: February 13, 2004

Second Revision: August 9, 2017

PRESS Inspection & Maintenance  
Working Group

# Pantograph Current Collection Equipment Periodic Inspection and Maintenance

**Abstract:** This standard covers basic procedures for periodic inspection and maintenance of pantograph current collection equipment on locomotives and multiple unit (MU) cars, with emphasis on maintenance of high-voltage current collection devices.

**Keywords:** current collection equipment, maintenance, pantograph, periodic inspection

**Summary:** This document establishes a standard for pantograph current collection equipment periodic inspection and maintenance. Individual railroads should tailor these standards to accommodate their specific equipment and mode of operation.

**Scope and purpose:** This standard includes all essential periodic inspection and maintenance requirements for pantograph current collection equipment used on locomotives/multiple unit (MU) cars. It is intended for use by rail equipment maintenance organizations. It establishes procedures for periodic inspection and maintenance of pantograph current collection equipment used on locomotives/MU cars.

This document represents a common viewpoint of those parties concerned with its provisions, namely operating/planning agencies, manufacturers, consultants, engineers and general interest groups. The application of any standards, recommended practices or guidelines contained herein is voluntary. In some cases, federal and/or state regulations govern portions of a transit system's operations. In those cases, the government regulations take precedence over this standard. The North American Transit Service Association and its parent organization APTA recognize that for certain applications, the standards or practices, as implemented by individual agencies, may be either more or less restrictive than those given in this document.

© 2017 NATSA and its parent organization. No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of NATSA.

# Table of Contents

Participants.....	iii
Introduction.....	iii
<b>1. Frequency of conduct.....</b>	<b>1</b>
<b>2. Requirements and specific tasks .....</b>	<b>2</b>
2.1 Materials .....	2
2.2 Tools .....	2
2.3 Safety/personal protective equipment.....	2
2.4 Training requirements .....	3
2.5 Inspection and maintenance procedures .....	3
Related APTA standards.....	5
References.....	5
Definitions.....	5
Abbreviations and acronyms.....	5
Summary of document changes .....	5
Document history.....	6

## List of Figures and Tables

Table 1 Inspection Intervals.....	1
-----------------------------------	---



## Participants

The American Public Transportation Association greatly appreciates the contributions of the **Passenger Rail Equipment Safety Standards (PRESS) Vehicle Inspection & Maintenance Working Group**, who provided the primary effort in the drafting of the revision of this document.

At the time this standard was revised, the working group included the following members:

**Paul Kovacs, Chair**

*Lea+Elliott*

**Dave Elliott, Vice Chair**

*LTK Engineering Services*

Stephen Bonina, *WSP*

Gordon Campbell, *Interfleet Technology Inc.*

John Condrasky, *WABCO Transit Division*

Joshua Coran, *Talgo, Inc.*

Richard Curtis, *Curtis Engineering Consulting*

Ever Diaz, *Keolis commuter Services*

Marc Gagné, *TDG Transit Design Group*

Ben Holland, *Bay Area Rapid Transit District*

Tony Jones, *Voith Turbo Scharfenberg*

Lloyd Mack, *LTK Engineering Services*

Mike Porter, *LTK Engineering Services*

Martin Schroeder, *CH2M*

Sherman Shreves, *SEPTA*

Richard Seaton, *TDG Transit Design Group*

James Skaggs, *International Electronic Machines*

Jeff Thompson, *SEPTA*

Dan Wilson, *Miami-Dade Transit*

Cliff Woodbury, *LTK Engineering Services*

### Project team

Nathan Leventon, *American Public Transportation Association*

Charles Joseph, *American Public Transportation Association*

## Introduction

*This introduction is not part of APTA PR-IM-S-016-02, Rev. 2, "Pantograph Current Collection Equipment Periodic Inspection and Maintenance."*

This standard describes the basic periodic inspection and maintenance requirements for pantograph current collection equipment on locomotives/multiple unit (MU) cars. APTA recommends the use of this standard by:

- individuals or organizations that maintain pantograph current collection equipment on locomotives/MU cars;
- individuals or organizations that contract with others for the maintenance of pantograph current collection equipment on locomotives/MU cars; and
- individuals or organizations that influence how pantograph current collection equipment is maintained on locomotives/MU cars.

This standard is intended to satisfy the following objectives:

- Identify those inspection criteria and maintenance standards that provide a high level of passenger safety.
- Incorporate safety considerations during the periodic inspection and maintenance process. Identify those inspection criteria and maintenance standards that provide a high level of workplace safety.

# Pantograph Current Collection Equipment Periodic Inspection and Maintenance

## 1. Frequency of conduct

Maintenance tasks on the pantograph current collection equipment should be performed on a regular schedule to ensure proper operation of the equipment. The schedule shown in **Table 1** is time based; however, the rail agency may determine to use a mileage interval based on its operating experience. The sections listed in **Table 1** provide a guide of detailed procedures for each identified maintenance task.

**TABLE 1**  
 Inspection Intervals

Inspections and Maintenance	Recommended Periodic Inspection Intervals	Referenced Section of This Document (Unless Otherwise Noted)
Daily pantograph inspection	Daily	CFR Part 229.45
Carbon strips	Not to exceed 92 days	2.5 (a)
Head/horns	Not to exceed 92 days	2.5 (b)
Raising and lowering	Not to exceed 92 days	2.5 (c)
Bearings	Not to exceed 92 days	2.5 (d)
Chain/cable and cam	Not to exceed 92 days	2.5 (e)
Contact force	Not to exceed 92 days	2.5 (f)
Shunts	Not to exceed 92 days	2.5 (g)
Shunt connections	Not to exceed 92 days	2.5 (h)
Insulators	Not to exceed 92 days	2.5 (i)
Fuse/circuit breaker	Not to exceed 92 days	2.5 (j)
Safety signage	Not to exceed 92 days	2.5 (k)
Pantograph poles	Not to exceed 92 days	2.5 (l)
Latch-down mechanisms	Not to exceed 92 days	2.5 (m)
Auxiliary pumping systems	Not to exceed 92 days	2.5 (n)
Fiber-optic systems	Not to exceed 92 days	2.5 (o)
Lightning arrester	Not to exceed 92 days	2.5 (p)
Roof cables	Not to exceed 92 days	2.5 (q)
Operating cylinders, springs, hoses and air foils (if equipped)	Not to exceed 92 days	2.5 (r)
Insulation test	1 year, not to exceed 3 years	2.5 (s)
Pantograph change-out	1 year, not to exceed 5 years	2.5 (t)

**APTA PR-IM-S-016-02, Rev. 2**  
**Pantograph Current Collection Equipment Periodic Inspection and Maintenance**

The frequency of tasks in **Table 1** shall comply with all applicable federal, state and local regulations. As part of a railroad's periodic inspection and maintenance program, frequencies for individual tasks may be established based on a number of additional factors, including but not limited to the following:

- original equipment manufacturer (OEM)—recommended intervals
- industry experience
- operating environment/conditions
- historical data
- performance requirements
- failure analysis
- railroad's testing and experience
- reliability-centered maintenance programs
- railroad standard maintenance procedure (SMP)

## **2. Requirements and specific tasks**

**CAUTION:** The following inspection and maintenance procedures must be carried out under overhead wire that is voltage free or in an area where no overhead wire is present. Follow proper lock-out/tag-out and blue flag protection of workers procedures as required by the railroad and in accordance with federal regulations.

**CAUTION:** During the lowering and raising operation, all personnel must remain clear of the pantograph to avoid being struck by the mechanism.

**CAUTION:** Ensure that the vehicle is secured against uncontrolled movement in accordance with local railroad rules before commencing inspection and maintenance procedures.

**CAUTION:** When detaching equipment from the pantograph assembly, ensure that all components are adequately supported to prevent uncontrolled movement.

### **2.1 Materials**

- approved non-conducting cleaning chemical
- approved lubricants
- additional materials as required by the OEM and railroad standard maintenance procedure (SMP)

### **2.2 Tools**

- force gauge (spring scale or digital) or weight
- 1000 VDC megohmmeter (commonly referred to as a megger)\*
- multimeter\*
- stopwatch\*
- standard tools carried by maintenance personnel

**NOTE:** An asterisk (\*) denotes tools that shall be calibrated in accordance with OEM and railroad procedures.

### **2.3 Safety/personal protective equipment**

Personal protective equipment, as required by the railroad, shall be worn at all times in the performance of these inspection and maintenance tasks.

## 2.4 Training requirements

Railroads and/or their maintenance contractors shall develop and execute training programs consistent with the requirements of 49 CFR, Section 238.109 (see References) that provide employees with the knowledge and the skills necessary to safely and effectively perform the tasks outlined in this standard.

## 2.5 Inspection and maintenance procedures

- a) Visually inspect the carbon strips for thickness and condition. Replace the carbon strips if the remaining material is less than manufacturer's recommendations or railroad's practice. Carbon strips shall be replaced if cracks are detected.

**NOTE:** Carbon strips can be replaced as a complete set, or grooving or chipping may be corrected by matching or grinding, providing that proper safety precautions are taken.

**NOTE:** Carbon strips can wear and deteriorate at an accelerated rate, particularly during freezing conditions. It is recommended that all carbon strips be inspected immediately following the completion of each run during such conditions.

- b) Check pantograph head for freedom of movement (rotation and/or vertical movement in relationship to pantograph arm). Check pantograph horns for damage or wear. Check leaf springs for cracks or damage.
- c) Visually inspect the pantograph during raising and lowering for freedom of operation. Record the time required for movement in both directions. If required times are not met, then make necessary adjustments per OEM recommendations and railroad SMP. In addition, check the manual raise and lower mechanism and lockdown mechanism. Make sure a manual raise handle is on board the vehicle if so equipped.
- d) Inspect the bearings for freedom of movement and excessive play. Replace as required. Clean the exterior of the bearing assembly and lubricate with approved lubricants.
- e) Visually inspect the chain/cable and cams for wear and freedom of movement. Replace as required. Lubricate the chain/cable with the approved lubricant.
- f) Measure the contact force, using a force gauge or weights, ascending and descending through the specified operating range. Compare the average of the two readings to that specified by the railroad. If necessary, make required adjustments to obtain the desired contact force.
- g) Visually inspect all shunts for frayed, broken, cut, burnt or otherwise defective conditions. If any of these conditions exist, then replace the shunt. When replacing shunts, make sure the contact surfaces are clean and free from dirt or corrosion.

**NOTE:** If required by railroad or OEM recommendations, use colloidal copper coating material between connections.

**NOTE:** Ensure that the shunts do not rub against each other or a frame member. Adjust shunts as required to provide clearance.

- h) Visually inspect all shunts for loose connections, and tighten as required.
- i) Clean insulators with an approved non-conductive grease-dissolving solvent. Visually inspect for damage, and replace if required.
- j) Visually inspect ribbon/cartridge fuse and/or circuit breakers for deterioration and burning, if so equipped. Functional testing of all grounding switches, current transformers, vacuum breakers, etc. should be done at this time, using the safety precautions already established. Using a multimeter, check the continuity of the fuses. Replace if required.
- k) Visually inspect all safety-related signage. Replace/clean if missing/obscured.

**Pantograph Current Collection Equipment Periodic Inspection and Maintenance**

- l) Pantograph poles should be checked for cracks and delamination. Check for broken end horns or other damage.
- m) Inspect and test latch-down mechanisms for effective locking devices. Check the manual locking hook and grounding blade for correct operation. Clean and lubricate the grounding blade in accordance with OEM instructions and railroad SMP.
- n) Check auxiliary pumping devices (if applicable) for ease of operation. Inspect for leaks.
- o) If so equipped, clean and service fiber-optic system in accordance with OEM instructions and railroad SMP.
- p) Visually inspect the lightning arrester for cracks, damage or oil leakage. Clean with an approved non-conductive grease-dissolving solvent. Replace if required.
- q) Visually inspect all roof-mount cables for condition and tightness of connections. Make certain that cables are not lying over objects that will cause them to chafe.
- r) Inspect condition of all operating cylinders, springs, hoses and air foils (if so equipped). Replace as necessary.
- s) Perform an insulation test using a megger set at 1000 VDC. Ensure that the knife switch or main breaker is in the open position. Connect the megger negative lead to carbody ground and the positive lead to the line side of the main knife switch or circuit breaker. An insulation level sufficient to ensure freedom from tracking, arcing, fire and other electrical hazards shall be achieved and maintained. Equipment shall meet a minimum level of 5 megohms.
- t) Follow OEM recommendations and railroad SMP for pantograph change out. Check roof insulators for cracks and chips. Replace as necessary. Clean with approved cleaning agent.
- u) Check and verify the minimum and maximum height and adjust in accordance with OEM instructions and railroad SMP.
- v) Check for air leaks on automatic drop systems in accordance with OEM instructions and railroad SMP.

## Related APTA standards

**APTA PR-E-RP-004-98**, “Gap and Creepage Distance”

**APTA PR-E-RP-009-98**, “Wire used on Passenger Equipment”

**APTA PR-IM-S-014-99**, “Modification Methodology for the Periodic Inspection and Maintenance of Passenger Coaches” (previously numbered as APTA SS-I&M-014-99)

## References

Code of Federal Regulations:

49 CFR, Part 229, “Railroad Locomotive Safety Standards,”

49 CFR, Part 238, “Passenger Equipment Safety Standards,”

This standard also shall be used in conjunction with the following publications (when the following standards are superseded by an approved revision, the revision shall apply):

- OEM specifications for pantograph current collection equipment inspection and maintenance
- local operating property procedures for pantograph current collection equipment inspection and maintenance
- railroad procedures for providing blue flag protection of workers

## Definitions

**carbon strip:** The current-collector strip mounted to the top of the pantograph, which slides along the contact wire.

**calendar day inspection:** An inspection performed each calendar day as prescribed by 49 CFR, Parts 229 and 238.

**periodic maintenance:** The performance of selected inspection and maintenance actions on systems or subsystems. The frequency of these actions may be set by regulatory agencies or by the railroad. The frequency may be expressed as a function of time (i.e., days, weeks or months) or in mileage or cycles.

**pantograph:** On a locomotive or MU car, the device that connects to the voltage supply through the catenary or contact wire to supply the power for propulsion and auxiliary systems, typically consisting of a linked framework, mounted on top of a rail vehicle.

## Abbreviations and acronyms

<b>APTA</b>	American Public Transportation Association
<b>CFR</b>	Code of Federal Regulations
<b>MU</b>	multiple unit
<b>NATSA</b>	North American Transportation Services Association
<b>OEM</b>	original equipment manufacturer
<b>PRESS</b>	Passenger Rail Equipment Safety Standards
<b>SMP</b>	standard maintenance procedure
<b>VDC</b>	voltage direct current

## Summary of document changes

- Document formatted to the new APTA standard format.
- Sections have been moved and renumbered.
- Scope and summary moved to the front page.

**APTA PR-IM-S-016-02, Rev. 2**  
**Pantograph Current Collection Equipment Periodic Inspection and Maintenance**

- Definitions and Abbreviations and Acronyms moved to the rear of the document.
- Two new sections added: “Summary of document changes” and “Document history.”
- Some global changes to section headings and numberings resulted when sections dealing with references and acronyms were moved to the end of the document, along with other cosmetic changes, such as capitalization, punctuation, spelling, grammar and general flow of text.
- Addition of a weight to Section 2.2.
- Addition of a leaf spring check to Section 2.5 b).
- Addition of manual locking hook and grounding blade steps to Section 2.5 m).
- Addition of SMP to Sections 2.5 o) and t).
- Addition of pantograph heights to Section 2.5 u).
- Addition of a leak check to Section 2.5 v).
- **Table 1** last entry for pantograph change-out amended from “1 year, not to exceed 3 years” to “1 year, not to exceed 5 years.” The change was made to accommodate some properties where testing and experience, along with their maintenance procedures, are able to use the pantographs for up to five years.
- References updated to reflect current (as of May 1st, 2017) information.
- Addition of APTA and PRESS to “Abbreviations and acronyms.”
- Participants list updated.

**Document history**

Document Version	Working Group Vote	Public Comment/ Technical Oversight	CEO Approval	Policy & Planning Approval	Publish Date
First published	Oct. 30, 2002	—	—	Jan. 16, 2003	January 2003
First revision					Feb. 13, 2004
Second revision	April 28, 2017	May 1, 2017	July 19, 2017	Aug. 1, 2017	Aug. 91,2017