



**APTA RT-SC-S-026-03, Rev. 1**

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**Signals and Communication Working  
Group**

# Hand-Operated Switch Machine Inspection and Maintenance

**Abstract:** This standard provides procedures for inspecting and maintaining rail transit mainline and yard hand-operated switch machines.

**Keywords:** hand-operated, inspection, machine, mainline, maintenance, switch, switch machine, yard

**Summary:** This standard intends to ensure that special life/safety equipment is operational and reliable; to help rail transit agencies incorporate safety considerations during the inspection and maintenance process; and to identify inspection criteria and maintenance standards that provide a high level of passenger and personnel safety.



## Foreword

The American Public Transportation Association is a standards development organization in North America. The process of developing standards is managed by the APTA Standards Program's Standards Development Oversight Council (SDOC). These activities are carried out through several standards policy and planning committees that have been established to address specific transportation modes, safety and security requirements, interoperability, and other topics.

APTA used a consensus-based process to develop this document and its continued maintenance, which is detailed in the [manual for the APTA Standards Program](#). This document was drafted in accordance with the approval criteria and editorial policy as described. Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

This document was prepared by the Signals and Communication Working Group as directed by the Rail Standards Policy and Planning Committee.

This document represents a common viewpoint of those parties concerned with its provisions, namely transit operating/planning agencies, manufacturers, consultants, engineers and general interest groups. APTA standards are mandatory to the extent incorporated by an applicable statute or regulation. In some cases, federal and/or state regulations govern portions of a transit agency's operations. In cases where there is a conflict or contradiction between an applicable law or regulation and this document, consult with a legal adviser to determine which document takes precedence.

This document supersedes APTA RT-SC-S-026-03, which has been revised. Below is a summary of changes from the previous document version:

- This document has been updated using the latest document template for the APTA Standards Program (e.g. new sections include a summary, foreword, summary of changes, etc.). This document was revised with new language describing inspection and maintenance of hand-operated switch machines
- The acronym RTS has been replaced with rail transit system and/or rail transit agency throughout the document in addition to minor grammatical corrections.
- Section 1.4 Tools
- It was also noted that any tools marked with an asterisk (\*) should be calibrated in accordance with OEM and/or rail transit agency requirements
- References
- Besides OEM specifications and rail transit agency procedures for hand-operated switch machine inspection and maintenance, this document should be used in conjunction with the following references was added.
- Definitions
- The definition of a frog was added.



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## Introduction

*This introduction is not part of APTA RT-SC-S-026-03, “Hand-Operated Switch Machine Inspection and Maintenance.”*

APTA rail transit safety standards represent an industry consensus on safety practices for rail transit agencies to help achieve a high level of safety for passengers, employees and the general public. This standard provides procedures for inspecting and maintaining rail transit hand-operated switch machines.

APTA recommends the use of this document by:

- individuals or organizations that operate rail transit agencies;
- individuals or organizations that contract with others for the operation of rail transit agencies; and
- individuals or organizations that influence how rail transit agencies are operated (including but not limited to consultants, designers and contractors).

## Scope and purpose

This document establishes standard requirements for inspecting and maintaining rail transit mainline and yard hand-operated switch machines. The purpose of this standard is to verify that hand-operated switch machines are operating safely and as designed through periodic inspection and maintenance, thereby increasing reliability and reducing the risk of hazards and failures.

## Note on alternate practices

Individual rail transit agencies may modify the practices in this standard to accommodate their specific equipment and mode of operation. APTA recognizes that some rail transit agencies may have unique operating environments that make strict compliance with every provision of this standard impossible. As a result, certain rail transit agencies may need to implement the standards and practices herein in ways that are more or less restrictive than this document prescribes. A rail transit agency may develop alternates to 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:

- identify the specific APTA rail transit safety standard requirements that cannot be met;
- state why each of these requirements cannot be met;
- describe the alternate methods used; and
- 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).

# Hand-Operated Switch Machine Inspection and Maintenance

## 1. Inspection and maintenance requirements

### 1.1 Inspection and maintenance frequency

The inspection and maintenance procedures in this standard shall be performed when hand-operated switch machines are placed in service; when they are modified, repaired or disarranged; or as otherwise deemed necessary by the rail transit agency.

The rail transit agency shall determine the need for additional inspection and maintenance frequencies for hand-operated switch machines. 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
- rail transit agency testing and experience
- regulatory requirements

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

### 1.2 Training

The rail transit agency and/or its 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.

### 1.3 Materials

The following materials are required for inspecting and maintaining hand-operated switch machines:

- grease gun
- rags
- oil can with oil
- switch plate lubricant
- trash bags and ties
- scrapers
- wire brush
- various dusting brushes
- lint-free cloths
- rail transit agency–approved commercial degreaser

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- rail transit agency–approved contact cleaner
- additional materials as required by the OEM and/or rail transit agency

## **1.4 Tools**

The following tools are required for inspecting and maintaining hand-operated switch machines:

- ruler
- multimeter\*
- terminal nut wrench
- post maul
- rail transit agency–approved portable radio
- standard tools carried by signal personnel
- additional tools as required by the OEM and/or rail agency system

**NOTE:** Tools marked with an asterisk (\*) should be calibrated in accordance with OEM and/or rail transit agency requirements.

## **1.5 Personal protective equipment**

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

## **1.6 Safety**

Rail transit agency–established safety rules, procedures and practices shall be followed at all times during inspection and maintenance.

## **1.7 Inspection and maintenance procedures**

Hand-operated switch machine inspection and maintenance procedures may be modified for each rail transit agency’s requirements (see “Note on alternate practices”) but shall contain the steps listed in sections 1.7.1 and 1.7.2 as a minimum.

### **1.7.1 Inspection**

1. Notify the operations control center (OCC) and/or other authorities of the inspection activities to be performed.
2. Disable the switch operation in accordance with rail transit agency instructions.
3. Inspect the switch machine and layout for an accumulation of debris. Remove and bag debris.
4. Inspect wayside drains for blockage or ineffective drainage.
5. Inspect the switch machine and layout for damage caused by standing water, water leaks or retention.
6. Inspect the switch machine and layout for any condition that may interfere with the operation of the equipment. Ensure that switch points and rods are clear of ballast.
7. Inspect the switch machine and layout for damage, rust, corrosion, and missing or loose components and hardware. Inspect rod connecting pins and ensure that cotter pins are in place and spread properly.
8. Inspect switch machine junction boxes and other enclosures for damage; cracks; breaks; defective latches, locks, hinges and covers; and loose, deteriorated or damaged conduit connections and hardware. Holes and unused entrances not used for ventilation shall be sealed.
9. Inspect polyvinyl chloride (PVC), fiberglass, rubber and other cable conduit material for damage, cracks, breaks, loose conduit connections, and missing or loose components and hardware.
10. Inspect switch points, stock rails, ties, tie plates, rail braces, switch rods, tie straps and other associated switch layout components.

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11. Inspect ties to ensure that they are well tamped and point closures to withstand vibration and strain caused by passing trains.
12. Enable switch operation in accordance with rail transit agency procedures.
13. Operate switch in both directions to ensure proper locking and indication.
14. Observe that covers and locks are in place and secured.
15. Notify the OCC and/or other authorities when inspection is complete.

### **1.7.2 Maintenance**

1. Notify OCC and/or other authorities of the maintenance activities to be performed.
2. Remove covers from switch machine circuit controller, gearbox and lock mechanism. Place covers in a safe area.
3. Clean accumulations of metallic particles, dirt, grease and oil from exterior and interior of switch machine.
4. Clean areas of the switch machine where hardened deposits and/or rust are present, and paint or coat with rail transit agency–approved materials.
5. Remove excess ballast or hardened deposits of metallic particles and mud, as they could not only obstruct switch operation, but could also create dams and in wet locations produce pools of water under and around the switch layout.
6. Clean rods in switch layout.
7. Clean and inspect switch rod insulation.
8. Clean off excessive accumulations of switch lubricant from slide plates, gauge plates and stock rails.
9. Check for and dry any signs of moisture accumulation within switch machine compartments.
10. Inspect switch machine and layout for condition of identification plates and markers, damage, rust, corrosion, and missing or loose components and hardware, including bolts, nuts, cotter pins, lock washers and screws.
11. Inspect cable, wiring and terminal blocks for condition of wire tags; defective insulation; heat; and loose, corroded, rusted, damaged or missing connectors and terminals. Special attention must be given to the condition of the wires connected at the eyelet/ring terminal; excessive movement will eventually cause breakage.
12. Inspect PVC, fiberglass, rubber and other cable conduit material for damage, cracks, breaks, loose conduit connections, and missing or loose components and hardware.
13. Inspect switch machine junction boxes and other enclosures for condition of identification plates and markers; rust; corrosion; damage; cracks; breaks; defective latches, locks, hinges, covers, weather seals and gaskets; loose, deteriorated or damaged conduit connections; and missing or loose components and hardware. Holes and unused entrances not used for ventilation shall be sealed.
14. Inspect junction boxes and enclosures for the presence and condition of stored circuit drawings, terminal list and instructions.
15. Inspect associated wayside signs and hardware for proper location, visibility, damage, rust, corrosion, and missing or loose components and hardware.
16. Lubricate switch components and check lubricant levels per OEM recommendations or rail transit agency instructions.
17. Using a hand throw lever, fully operate switch (normal and reverse) as often as necessary to perform the following:
  - a. Wipe off accumulated dirt or corrosion from indication contacts.
  - b. Check for and clean any accumulation of foreign or conductive material.
  - c. Check that indication contacts and associated cams, segments and linkages are properly adjusted and clean. Check for excessive wear, signs of pitting, corrosion or general deterioration.



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- d. Check the throw of the switch points. The distance between the gauge side of the stock rail and the near side of the open switch point should be  $3\frac{3}{4}$  in. over the #1 switch rod. The minimum opening is  $3\frac{1}{2}$  in., and the maximum opening is 4 in. (or other dimensions as determined by the rail transit agency).
  - e. Check switch throw rod to see that there is sufficient adjustment remaining.
  - f. Check adjustments of switch throw rod to balance the excess throw when each point is against its respective stock rail without excessive pressure on the points. Switch points should be adjusted to meet the rail firmly, but not under a heavy strain. Too much tension creates excessive wear in the switch machine and does not increase the safety of the switch.
  - g. Check the electric lock mechanism for proper operation. Ensure that all fasteners are in place and effective. Ensure that electric lock rod components move freely and are not damaged.
  - h. Check point detector rod to ensure that the rod is securely fastened to each switch point. Ensure that all fasteners are in place and effective. Ensure that the point detector rod moves freely when operated.
  - i. Check for proper and smooth operation of switch machine parts and switch layout parts. Switch points should move without undue drag or spring, and should ride on slide plates.
  - j. Verify normal and reverse indications.
  - k. Check for physical damage, excessive wear, and lost motion of switch machine and layout parts.
- 18. Perform required OEM or local rail transit agency standard tests.
  - 19. Replace covers, locks and other equipment removed for maintenance.
  - 20. Notify the OCC and/or other authorities when maintenance activities are complete.

## **1.8 Correction of deficiencies**

Deficiencies identified during hand-operated switch machine inspection and maintenance shall be corrected and documented in accordance with OEM and/or rail transit agency requirements.

## **1.9 Documentation**

Inspection and maintenance activities shall be documented, reviewed and filed in accordance with rail transit agency procedures.

## References

Besides OEM specifications and rail transit agency procedures for hand-operated switch machine inspection and maintenance, this document should be used in conjunction with the following:

New York City Transit, Division of Signals, Policy Instruction 11.006.2, 3.18 Switch Obstruction Test, 1987.

American Railway Engineering and Maintenance of Way Association, Communications and Signals Manual of Recommended Practices, Part 2.4.1 Section P; Switches, Derails and Switch Operating Mechanisms. 2000.

Rules and Regulations Governing Railroad and Train Control Systems, Department of Transportation Federal Railroad Administration Office of Safety, Latest Revision February 14, 2000. Interlocking Standards: 236.342 Switch Circuit Controller.

Rules and Regulations Governing Railroad and Train Control Systems, Department of Transportation Federal Railroad Administration Office of Safety, Latest Revision February 14, 2000 Inspection and Tests: 236.382 Switch obstruction Tests.

## Definitions

**ballast:** Granular material placed in the track bed to support and restrain the track in line and surface.

**circuit controller:** A device for opening and closing electric circuits operated by a rod connected to a switch, derail or moveable point frog.

**cotter pin:** A short strip of soft, folded metal that is inserted through a bolt head or nut to prevent rotation and/or disengagement of that bolt or nut from its connection.

**frog:** Common crossing point of two rails.

**gauge plate:** A metal plate that is typically insulated, extending from rail to rail, used to maintain gauge of track.

**hand-operated switch:** A non-interlocked switch, which can only be operated manually.

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

**indication contact:** A conducting part that co-acts with another conducting part to open or close an electric circuit for the purpose of providing and removing voltage to an indication device.

**linkage:** A mechanical arrangement for transferring motion in a desired manner.

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

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

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**personal protective equipment:** 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.

**post maul:** A large sledgehammer.

**rail brace:** A device that provides lateral support on the field side of stock rails to maintain the track gauge.

**rail transit agency:** The organization or portion of an organization that operates rail transit service and related activities. Also called *operating agency*, *operating authority*, *transit agency*, *transit authority*, *transit system*.

**ring terminal:** A closed loop fastener used to secure wire to a terminal post. Also called *eyelet*.

**slide plate:** A flat plate contained in the switch layout that provides a surface for the movement of the switch points from one position to the opposite position. Also called *wear plate*.

**stock rail:** The rail against which the point of a switch, derail or moveable point frog rests.

**switch:** A pair of switch points with their fastenings and operating rods, providing the means for establishing a route from one track to another.

**switch layout:** A complete track assembly that includes the switch machine, the switch points, rails, frogs and other related components.

**switch machine:** A device that performs the mechanical function of controlling the movement of switch points or a derail from one position to the other.

**switch obstruction gauge:** A thickness gauge ( $\frac{1}{8}$  in.,  $\frac{1}{4}$  in.,  $\frac{3}{8}$  in.) used in switch points to test adjustments of switch locking and point detectors.

**switch point:** A movable tapered track rail, the point of which is designed to fit against the stock rail.

**switch rod:** A rod connecting the two points of a switch or moveable point frog, by means of which the relative distance between the points is maintained.

**switch rod insulation:** Nonconductive material used to electrically isolate the two sections of a switch rod.

**switch throw bar:** The mechanical part in a switch machine, which is driven by the main gear and which is connected to the switch throw rod. See also *switch throw rod*; also called *throw bar*.

**switch throw rod:** The connecting rod that transfers motive force from the switch machine throw bar to the switch points. See also *switch throw bar*; also called *throw rod*, *switch operating rod*.

**tie:** The transverse member of the track structure to which the running rails are fastened, which is centered on the track and designed to cushion, distribute and transmit the stresses of traffic from the rail to the ballast. Also called *crosstie*.

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**tie plate:** A plate that is used to provide a bearing area for the rail base that distributes the rail vehicle load to the tie and prevents lateral movement of the rail.

**tie strap:** A steel bar used to maintain tie spacing and prevent movement.

## Abbreviations and acronyms

**OCC**        operations control center  
**OEM**        original equipment manufacturer

## Document history

Document Version	Working Group Vote	Public Comment/ Technical Oversight	Rail CEO Approval	Policy & Planning Approval	Publish Date
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