27. Standard for Switch Inspection and Obstruction Testing

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Abstract: This standard provides procedures for rail transit switch inspection and obstruction testing.

Keywords: inspection, obstruction test, signal, switch, switch inspection, switch machine, switch obstruction test, test, testing

Introduction

(This introduction is not a part of APTA RT-SC-S-027-03, *Standard for Switch Inspection and Obstruction Testing*.)

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 rail transit switch inspection and obstruction testing.

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.

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Standard for Switch Inspection and Obstruction Testing

1. Overview

1.1 Scope

This document establishes standard requirements for testing power and hand operated switch machines with mechanical locking and point detection. In addition, this standard addresses point detection of hand-operated switches not equipped with mechanical locking. This standard does not address electro-hydraulic switch machines.

1.2 Purpose

The purpose of this standard is to verify that switch machines and associated indication circuitry are operating safely and as designed through periodic inspection and testing, thereby increasing reliability and reducing the risk of hazards and failures.

The obstruction test is performed to test the mechanical switch locking of switch machines.

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

2.1.2 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.

2.1.3 current overload protection: A feature in an electrical circuit that automatically disconnects the circuit whenever the current exceeds a specified level.

2.1.4 cut out contact: A set of contacts that when opened disables an electrical device. *See also:* **latch block.**

2.1.5 hand crank: (A) A tool designed for the manual operation of a switch machine. (**B)** The action of using a hand crank.

2.1.6 hand operated switch: A non-interlocked switch that can only be operated manually. *Syn:* **hand throw switch, switch stand**.

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

2.1.8 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.

2.1.9 junction box: An enclosure that contains electrical connections and/or hardware.

2.1.10 latch block: The assembly that latches the crank cut out contacts in the open position when engaged by a hand crank. *See also:* **cut out contact**.

2.1.11 lock bar: A bar containing a locking dog that mechanically locks the switch in the full reverse or full normal position.

2.1.12 lock rod: A rod attached to the front rod or lug, through which a locking plunger (dog) may extend when the switch points or derail are in the normal or reverse position. *See also*: **switch rod**.

2.1.13 locking dog: A steel block that is automatically positioned in the switch and lock movement at the completion of a machine's throw to effect mechanical switch locking of the points.

2.1.14 mechanical switch locking: An arrangement of locking bars, dogs, and other apparatus within a switch machine that locks the point in place at the end of the stroke of the switch machine.

2.1.15 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.**

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

2.1.17 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.

2.1.18 post maul: A large sledgehammer.

2.1.19 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**.

2.1.20 slip switch: A combination of a crossing and a single connecting track that is located within the limits of the crossing and is made up of a right hand switch from the one track and a left hand switch from the other track which unite to form the connecting track without additional frogs.

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

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

2.1.23 switch indication relay: A relay that indicates whether a switch machine is in or out of position.

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

2.1.25 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.

2.1.26 switch obstruction gauge: A thickness gauge (1/8”, 1/4”, 3/8”) used in switch points to test switch locking and point detector adjustments.

2.1.27 switch point: A movable tapered track rail with a point designed to fit against the stock rail.

2.1.28 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.

2.1.29 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.

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

2.1.31 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. *Syn*: **crosstie**.

2.2 Acronyms

ac	alternating current
OCC	operations control center
OEM	original equipment manufacturer
PPE	personal protective equipment
RTS	rail transit system
US&S	Union Switch and Signal Corporation
PVC	polyvinyl chloride

3. Inspection and testing requirements

3.1 Inspection and testing frequency

The inspection and obstruction test procedures in this standard shall be performed when switch machines are placed in service, when they are modified, repaired, or disarranged, or as otherwise deemed necessary by RTS.

The RTS shall determine the need for additional inspection and obstruction test frequencies for 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
- 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

No consumable materials are required for inspecting and testing switch machines unless otherwise specified by the OEM and/or RTS.

3.4 Tools

The following tools are required for inspecting and testing switch machines:

- Switch obstruction gauge
- Switch adjustment wrenches
- Current measuring equipment (if applicable)
- Post maul
- 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 testing.

3.6 Safety

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

3.7 Inspection and obstruction test procedures

Switch inspection and obstruction test 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 Perform a radio check with OCC and/or other authorities to ensure radio is functioning properly

3.7.1.3 Disable the switch operation in accordance with RTS instructions.

3.7.1.4 Inspect the switch machine and layout for an accumulation of debris. Remove and bag debris

3.7.1.5 Inspect wayside drains for blockage or ineffective drainage.

3.7.1.6 Inspect the switch machine and layout for damage caused by standing water, water leaks, or retention.

3.7.1.7 Inspect the switch machine and layout for any condition that may interfere with the operation of the equipment. Ensure ballast is clear of the switch points and rods.

3.7.1.8 Inspect the switch machine, and layout for damage, rust, corrosion, and missing or loose components and hardware. Inspect rod connecting pins and ensure cotter pins are in place and spread properly.

3.7.1.9 Inspect switch machine junction boxes and other enclosures for damage, cracks, breaks, defective latches, locks, hinges, covers, and loose, deteriorated, or damaged conduit connections, and hardware. Holes and unused entrances not used for ventilation shall be sealed.

3.7.1.10 Inspect polyvinyl chloride (PVC), fiberglass, rubber and other cable conduit material for damage, cracks, breaks, loose conduit connections, missing or loose components, and hardware.

3.7.1.11 Inspect switch points, stock rails, ties, tie plates, rail braces, switch rods, tie straps, and other associated switch layout parts.

3.7.1.12 Inspect ties to ensure they are well tamped to withstand vibration and strain caused by passing trains.

3.7.1.13 If inspection activities have been completed and no further work is to be performed, enable switch operation in accordance with RTS procedures.

3.7.1.14 If inspection activities have been completed and no further work is to be performed, operate switch in both directions to ensure proper locking and indication.

3.7.1.15 Observe that covers and locks are in place and secured

3.7.1.16 Notify the OCC and/or other authorities when inspection is complete.

3.7.2 Obstruction test

3.7.2.1 Notify OCC and/or other authorities of the test activities to be performed.

3.7.2.2 Disable the switch operation.

3.7.2.3 Hand operate switch to the full normal locked position and full reverse locked position. Check that switch points face up/tuck to stock rails properly and that switch moves freely so that no strain is placed on moving parts.

3.7.2.4 Verify that lock rods are adjusted so that locking dogs are centered in lock bar notches with equal clearance on each side.

3.7.2.5 On power operated and hand operated switch machines with mechanical switch locking and point detection, place switch obstruction gauge between the stock rail and inside of the open switch point. Position the obstruction gauge 6 inches from the tip of the point or at the RTS specified distance. Hand crank switch machine to close the point firmly against the gauge and verify switch does not lock. If switch locks, determine cause and correct. Perform test for both normal and reverse positions.

3.7.2.6 While gauge is inserted in between point and stock rail, verify contacts that indicate switch point position are open a minimum of 1/16 of an inch or as specified by RTS and verify switch machine is not mechanically locked. Verify switch position indication relays are in the de-energized state. Perform test for both normal and reverse positions.

3.7.2.7 On hand operated switches not equipped with mechanical switch locking, place switch obstruction gauge between the stock rail and inside of the open switch point. Position the obstruction gauge 6 inches from the tip of the point or at the RTS specified distance. Position the hand operated switch points by using the hand-operated lever to move the point firmly against the obstruction gauge. Ensure the switch indication contacts are open a minimum of 1/16 of an inch or as specified by the RTS and the switch indication relay is de-energized. If the switch indication contacts are closed, determine cause and correct. Perform test for both normal and reverse positions.

3.7.2.8 When obstruction test has been completed and no further work is to be performed, enable switch operation in accordance with RTS procedures. Operate switch in both directions to ensure proper locking and indication.

3.7.2.9 If required by the RTS, verify that switch machine current overload protection will perform properly with the switch obstruction gauge inserted in the points.

3.7.2.10 Notify the OCC and/or other authorities when testing is complete.

NOTE – At slip switches the test must be performed on both the primary and secondary sets of switch points.

3.8 Correction of deficiencies

Deficiencies identified during switch inspection and obstruction tests shall be corrected and documented in accordance with OEM and/or RTS requirements.

3.9 Documentation

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

Annex A

(informative)

Bibliography

[B1] WMATA procedures for switch inspections and obstruction tests.

[B2] New York City Transit, Division of Signals, Policy Instruction 11.006.2, 3.18 Switch Obstruction Test, 1987.

[B3] 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 & Section R: Switch Circuit Controllers. 2000.

[B4] Original equipment manufacturer (OEM) specifications for switch inspection and obstruction tests.

[B5] Rail transit system (RTS) procedures for switch inspection and obstruction tests.

[B6] 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.

[B7] 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.