

42. Standard for Fire Detection System Inspection and Testing

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Abstract: This standard provides procedures for inspecting and testing rail transit fire detection systems.

Keywords: alarm, annunciator panel, communication, detection, fire alarm, fire alarm control panel, fire detection, fire detection system, heat detector, inspection, ionization detector, smoke alarm, smoke detector, test, testing

Introduction

(This introduction is not a part of APTA RT-SC-S-042-03, *Standard for Fire Detection System Inspection and 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 inspecting and testing rail transit fire detection systems.

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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Contents

1. Overview	42.1
1.1 Scope.....	42.1
1.2 Purpose.....	42.1
1.3 Alternate practices	42.1
2. References	42.2
3. Definitions and acronyms	42.2
3.1 Definitions	42.2
3.2 Acronyms.....	42.3
4. Inspection and testing requirements.....	42.4
4.1 Inspection and testing frequency	42.4
4.2 Training.....	42.4
4.3 Materials	42.4
4.4 Tools	42.5
4.5 Personal protective equipment.....	42.5
4.6 Safety	42.5
4.7 Inspection and testing procedures.....	42.6
4.8 Correction of deficiencies.....	42.11
4.9 Documentation.....	42.11
Annex A (informative) Bibliography.....	42.12
Annex B (informative) Recommended Procedures for Elevator/Escalator Smoke Detector Testing ...	42.13

Standard for Fire Detection System Inspection and Testing

1. Overview

1.1 Scope

This document establishes standard requirements for inspecting and testing rail transit fire detection systems. These procedures do not cover fire suppression systems.

1.2 Purpose

The purpose of this standard is to verify that fire detection systems are operating safely and as designed through periodic inspection and testing, thereby 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. References

This standard shall be used in conjunction with the most recent version of the following publication.

National Fire Protection Agency, NFPA 72, National Fire Alarm Code, 2002 Edition

American Society of Mechanical Engineers, ASME A17.2-2001, Guide for Inspection of Elevators, Escalators and Moving Walks Local Fire Codes

3. Definitions and acronyms

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

3.1 Definitions

3.1.1 alarm circuit: An electrical path utilized to transmit a signal that indicates an alarm condition from a remote location to a local or central reporting location.

3.1.2 annunciator panel: A device designed to monitor and indicate the status of detection circuits.

3.1.3 battery: A device that converts chemical energy to electrical energy.

3.1.4 battery cell: A unit contained in a battery that produces a direct voltage by converting chemical energy to electrical.

3.1.5 battery string voltage: The total output voltage measured across a group of interconnected batteries.

3.1.6 buss voltage: The voltage measured at an interconnect point for a power source.

3.1.7 bypass mode: A specific system operating condition wherein the standard system outputs and operations are disabled.

3.1.8 city tie: The physical and/or software interconnection between the RTS and public agency or municipal emergency systems. *Syn:* **interface.**

3.1.9 communication circuit: A transmission path that conveys information from one location to another.

3.1.10 detector: A device used to measure or sense a physical property and produce an electrical output or contact closure.

3.1.11 elevator cab control panel: The station located inside an elevator car that is used to operate and control the elevator. *See also:* **elevator home panel, elevator home position.**

3.1.12 elevator home panel: The station located outside an elevator at the home position that is used to operate and control elevators. *See also:* **elevator cab control panel, elevator home position.**

3.1.13 elevator home position: A pre-determined location that an elevator is called to during an emergency evacuation. *See also:* **elevator home panel.**

3.1.14 fire alarm control panel (FACP): The unit that controls, monitors, and reports the status of the fire system detectors.

3.1.15 fire department control key: The key utilized to gain access to and control of elevator operating systems.

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

3.1.17 ionization: The formation of or separation into ions by heat, electrical discharge, radiation, or chemical reaction.

3.1.18 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.**

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

3.1.20 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.

3.1.21 pull station: A manually activated device used to initiate a fire alarm condition.

3.1.22 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.**

3.2 Acronyms

OCC	operations control center
OEM	original equipment manufacturer
PPE	personal protective equipment
RTS	rail transit system
FACP	fire alarm control panel
NFPA	National Fire Protection Association
SCADA	supervisory control and data acquisition
ASME	American Society of Mechanical Engineers

4. Inspection and testing requirements

4.1 Inspection and testing frequency

The inspection and testing procedures in this standard shall be performed

- a) annually
- b) when fire detection systems are placed in service
- c) when fire detection systems are modified, repaired, or disarranged
- d) as otherwise deemed necessary by the RTS

The RTS shall determine the need for additional inspection and testing frequencies for fire detection systems. 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.

4.2 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.

The RTS, maintenance contractor, and/or local fire department inspectors shall meet NFPA certification requirements to inspect and test fire detection systems.

4.3 Materials

The following materials are required for inspecting and testing fire detection systems:

- Replacement/detectors and associated bases

- Replacement/horns and strobes
- Compressed air
- Canned smoke
- Additional materials as required by the OEM and/or RTS

4.4 Tools

The following tools are required for inspecting and testing fire detection systems.

- Multi-meter*
- Extension cords
- Magnet
- Heat gun
- Three stage extension pole
- Ladder
- Man lift
- Fire department control keys
- 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.

4.5 Personal protective equipment

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

4.6 Safety

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

4.7 Inspection and testing procedures

Fire detection system inspection and testing procedures may be modified for each rail transit system's requirements (see Section 1.3) but shall contain the steps listed in Sections 4.7.1-4.7.3 as a minimum.

4.7.1 System components to be tested

The following system components, where applicable, shall be inspected and tested:

- a) Heat detectors
- b) Smoke/photo detectors
- c) Ionization detectors
- d) Pull stations
- e) City tie/interface
- f) Fire detection alarm circuits
- g) Annunciation panels
- h) Stand-by power
- i) HVAC circuits
- j) Elevator circuits
- k) Escalator circuits

4.7.2 Elevator inspection and test

Each Rail Transit Standards shall develop elevator fire alarm inspection and test procedures, using the guidance documents listed in Section 2. Local fire codes vary. The guidance given in the NFPA and ASME documents needs to be checked carefully against local fire codes. As a minimum elevator fire alarm inspection and test procedures shall consist of the following steps.

- 4.7.2.1** Notify the operations control center (OCC) and/or other authorities of the inspection and testing activities to be performed.
- 4.7.2.2** From the FACP, disable the communication and alarm circuits in accordance with RTS-approved procedures.
- 4.7.2.3** Place all elevators in bypass mode to prevent service disruptions due to testing.
- 4.7.2.4** Call all elevators to the furthest position from home.

- 4.7.2.5** Insert a fire department control key into the home control panel (home landing or home lobby) located at the home position of each elevator.
- 4.7.2.6** From the home control panel, call each of the elevators to the home position. Verify the elevator arrives and the doors open. Remove the key leaving the switch in the activated position.
- 4.7.2.7** From the elevator cab control panel, insert the fire department control key to gain control of the elevator.
- 4.7.2.8** Move the elevator to each level.
 - a. At each level, press the door open button. Before the elevator doors fully open release the door open button and verify that the elevator doors re-close.
 - b. At each level press and hold the door open button. When the elevator doors are fully open, release the door open button and verify the doors remain in the open position.
- 4.7.2.9** Move the elevator to the home position and remove the fire department control key from the elevator cab control panel.
- 4.7.2.10** Call all elevators to the furthest position from home.
- 4.7.2.11** Initiate a simulated station evacuation alarm in accordance with RTS-approved procedures. Verify the elevators move from their furthest position from home to the home position. Verify that when the elevator arrives at the home position, the doors open and remain open. Check that the cab interior light is on.
- 4.7.2.12** With the elevator in the home position with doors open, insert the fire department control key into the elevator cab control panel to gain control of the elevator.
- 4.7.2.13** Move the elevator to each level. At each level, press and hold the door open button and verify that the doors fully open. Release the door open button and verify the doors remain in the open position.
- 4.7.2.14** Reset the FACP to clear the simulated station evacuation. Return the elevator cab control key switch to the NORMAL position. Verify all elevators resume normal operation.
- 4.7.2.15** Perform a test of the smoke detector(s) in the elevator fire zone. Recommended procedures are given in Annex B.
- 4.7.2.16** From the FACP, enable and test the communication and alarm circuits in accordance with RTS-approved procedures.
- 4.7.2.17** Notify the OCC and/or other authorities when inspection and testing activities are complete.

4.7.3 Escalator inspection and test

Escalator fire alarm inspection and test is not currently required by National Codes or many local codes. If the RTS escalators are tied to the fire alarm system, then the escalator fire alarm inspection and test shall consist of the following steps or their equivalent:

- 4.7.3.1** Notify the OCC and/or other authorities of the inspection and testing activities to be performed.
- 4.7.3.2** From the FACP, disable the communication and alarm circuits in accordance with RTS-approved procedures.
- 4.7.3.3** Command the escalator to operate in the direction specified in the RTS-approved procedures.
- 4.7.3.4** Initiate a simulated station evacuation alarm in accordance with RTS-approved procedures. Verify escalator operation is in accordance with RTS-approved procedures.
- 4.7.3.5** Reset the FACP to clear the simulated station evacuation alarm. Using RTS-approved procedures, return the escalators to normal operation. Verify all escalators resume normal operation.
- 4.7.3.6** Perform a test of the smoke detectors in the escalator's fire zone. Recommended procedures are given in Annex B
- 4.7.3.7** From the FACP, enable the communication and alarm circuits in accordance with RTS-approved procedures.
- 4.7.3.8** Notify the OCC and/or other authorities when inspection and testing activities are complete.

4.7.4 Fire detection system back-up battery load inspection and test

- 4.7.4.1** Notify the OCC and/or other authorities of the inspection and testing activities to be performed.
- 4.7.4.2** Using RTS-approved procedures, disconnect normal A.C. power source from the FACP.
- 4.7.4.3** Record start time, date, and any alarms that occur at the FACP panel and OCC.
- 4.7.4.4** Using RTS-approved procedures, remove the power source to the battery charger for the fire detection system.
- 4.7.4.5** Record the individual battery cell voltage and average temperature.
- 4.7.4.6** Allow fire detection system to operate on standby power for a minimum of four hours, not to exceed four and one half hours.
- 4.7.4.7** At the end of the standby period, record the battery cell voltage and temperature.

- 4.7.4.8 From the FACP, disable the communication and alarm circuits in accordance with RTS-approved procedures.
- 4.7.4.9 Place all elevators and escalators in bypass mode to prevent service disruptions due to testing.
- 4.7.4.10 Initiate a simulated station evacuation alarm in accordance with RTS-approved procedures. Allow all visual and audio alarm devices to operate continuously for a minimum of fifteen minutes.
- 4.7.4.11 Perform a site inspection and verify all audio and visual alarm devices are functioning properly.
- 4.7.4.12 Using RTS-approved procedures, reset the FACP to clear the simulated station evacuation alarm to acknowledge the alarms.
- 4.7.4.13 Record the individual battery cell voltage and average temperature.
- 4.7.4.14 Using RTS-approved procedures, restore normal A.C. power source to the FACP.
- 4.7.4.15 Verify that alarms have cleared. Record any anomalies.
- 4.7.4.16 Using RTS-approved procedures, restore the power source to the battery charger for the fire detection system.
- 4.7.4.17 Record the time, date, battery string voltage, buss voltage, and load current for the battery charger and individual cell voltage and temperature. Verify that battery parameters are within OEM and/or RTS specifications. Repeat this step of the procedure after a time lapse of 24 to 48 hours or until the voltages stabilize.
- 4.7.4.18 Notify the OCC and/or other authorities when inspection and testing activities are complete.

4.7.5 Annunciator panel inspection and test

- 4.7.5.1 Notify the OCC and/or other authorities of the inspection and testing activities to be performed.
- 4.7.5.2 From the FACP, disable the communication and alarm circuits in accordance with RTS-approved procedures.
- 4.7.5.3 Place all elevators and escalators in bypass mode to prevent service disruptions due to testing.
- 4.7.5.4 If equipped with lamps, perform a lamp test. If equipped with a display, verify that display operates properly.
- 4.7.5.5 Initiate a fire alarm from each of the fire zone modules in the FACP. Verify the annunciator panel indications correspond to each fire alarm zone activated.

- 4.7.5.6 From the FACP, enable the communication and alarm circuits in accordance with RTS-approved procedures.
- 4.7.5.7 Notify the OCC and/or other authorities when inspection and testing activities are complete.

4.7.6 Communication and alarm circuit inspection and test

- 4.7.6.1 Notify OCC and/or other authorities of the inspection and testing activities to be performed and the identification number of the interface to be tested.
- 4.7.6.2 Disable all alarm, elevator, and escalator control circuits for the interface location identified.
- 4.7.6.3 Place all elevators and escalators in bypass mode to prevent service disruptions due to testing.
- 4.7.6.4 Initiate a fire alarm from each zone module in the FACP. Verify that the OCC and/or central reporting location receive the correct location identification. Acknowledge the alarm and clear the fire zone module on the FACP.
- 4.7.6.5 Reset communication and alarm circuit to normal operation in accordance with RTS procedures.
- 4.7.6.6 Notify the OCC and/or other authorities when inspection and testing activities are complete.

4.7.7 Fire detector and pull station inspection and test

- 4.7.7.1 Notify the OCC and/or other authorities of the inspection and testing activities to be performed.
- 4.7.7.2 From the FACP, disable the communication and alarm circuits in accordance with RTS-approved procedures.
- 4.7.7.3 Place all elevators and escalators in bypass mode to prevent service disruptions due to testing.
- 4.7.7.4 Test each detector and pull station and verify the corresponding zone module alarm indicates in the FACP.
- 4.7.7.5 Acknowledge each alarm received and reset the FACP panel.
- 4.7.7.6 Reset communication and alarm circuit to normal operation in accordance with RTS procedures.
- 4.7.7.7 Notify the OCC and/or other authorities when inspection and testing activities are complete.

4.8 Correction of deficiencies

Deficiencies identified during fire detection system inspection and testing shall be corrected and documented in accordance with OEM and/or RTS requirements.

4.9 Documentation

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

Annex A

(informative)

Bibliography

- [B1] Original equipment manufacturer (OEM) specifications for fire detection inspection and testing.
- [B2] Rail transit system (RTS) procedures for fire detection inspection and testing.

Annex B

(informative)

Recommended Procedures for Elevator/Escalator Smoke Detector Testing

The following recommended procedure for performing elevator smoke detector tests is used by several Rail Transit Systems. This procedure can serve as a starting point for Rail Transit Systems to develop equivalent procedures that better fit their specific operating environment.

- 1) Notify OCC that a zone is going to be tested and to disregard alarms from that zone.
- 2) Alert the station manager so that he/she can watch for people going through open fare gates. (fare gates open and remain open through fire alarm period so that patrons have an unobstructed exit.)
- 3) Isolate the fire zone to be tested so that any other zones do not react to signal. This is done by pulling the I/O boards in the fire control panel (all except the zone to be tested).
- 4) Smoke is introduced into the smoke head.
 - a) Verify that an alarm signal is sent to fire control panel.
 - b) Verify the alarm signal is then forwarded to the kiosk panel in the station manager's kiosk and initiates warning light.
 - c) Verify the alarm signal is forwarded to appropriate elevator or escalator controllers.
 - d) Verify that the affected escalator(s) shut down and/or elevators go into Fire Service Phase 1.
- 5) After successful completion of the test, all boards are re-seated and OCC is notified of the test completion and to regard all further alarms.