APTA STANDARDS DEVELOPMENT PROGRAM

STANDARD

American Public Transportation Association
1300 I Street, NW, Suite 1200 East, Washington, DC 20006

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APTA Rail Transit Grade Crossings Working Group

Rail Transit Grade Crossing Warning Device Inspection, Testing and Maintenance

Abstract: This standard prescribes minimum requirements for inspecting, testing and maintaining highway rail grade crossing warning devices installed and maintained on rail transit systems.

Keywords: grade crossing, highway rail grade crossing, inspection, maintenance, testing, warning device

Summary: This standard provides guidance for rail transit system staff concerned with the inspection, maintenance and testing of highway rail grade crossing warning devices and includes minimum maintenance practices, testing procedures, and record keeping for rail transit grade crossings. This standard is based on the "Grade Crossing Signal System Safety (49 CFR Part 234) State Action Plans, and the Emergency Notification Systems."

Scope and purpose: This standard applies to rail transit systems that operate and maintain highway rail grade crossing warning devices. Its purpose is to verify that highway rail grade crossing systems are operating safely and as designed through periodic testing, thereby increasing reliability and reducing the risk of hazards and failures. This standard intends to meet the following objectives: to ensure that special life/safety equipment is operational and reliable; to help rail transit systems 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.

Table of Contents

List of Figures and Tables

Participants

The American Public Transportation Association greatly appreciates the contributions of the **Rail Transit Grade Crossing Working Group**, which provided the primary effort in the drafting of this document.

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

Matthew Baaccitich, *Chair*
Aderemi Omotayo, *Vice Chair*
Vacant, *Secretary*

Ed Boni, *Interactive Elements Inc.*
Richard Brown, *Transpo Industries Inc.*
Terry Byrne, *VHB*
Lynda Bybee, *LA Metro*
Rick Campbell, *CTC Inc.*
Mike Choat, *Railroad Controls Ltd.*
Brian Clark, *Parsons Brinckerhoff*
John Cyrus, *Oregon DOT*
Andrew Davis, *Energy Absorption Systems*
Victor Demmons, *MARTA*
Charles Dickerson, *New Jersey Transit*
Gary Ferguson, *Oregon DOT*
Manuel Galdo, *Federal Railroad Administration*
David Genova, *Regional Transportation District*
Susan Gilbert, *Interactive Elements Inc.*
Brian Gilleran, *Federal Railroad Administration*
Dan Guerrero, *CTC Inc.*
Vernon Hartsock, *Maryland MTA*
Zack Hunter, *Oregon DOT*
Michael Hursh, *SCVTA*
John Lech, *Jacobs*
Justin Lee, *TriMet*
Reginald Mason, *MARTA*
Michael Martino, *VTA*
Michael McArdle, *Vanasse Hangen Brustlin*
John McGrevey, *BNC*
John Mitchell, *MBCRC*
Abraham Mooney, *TriMet*
Jim Morrison, *North Carolina DOT*
Paul O'Brien, *independent transportation adviser*
Brent Ogden, *Kimley-Horn Associates*
Lorraine Pacocha, *MBTA*
Ron Ries, *Federal Railroad Administration*
Mark Robinson, *SCVTA*
Joyce Rose, *Operation Lifesaver*
Paul Schneider, *New Jersey DOT*
John Sharkey, *CTC Inc.*
Deirdre Smith, *Jacobs*
Libby Rector Snipe, *Operation Lifesaver*
Bob Stolle, *Oregon DOT*
Drew Thomas, *NCDOT*
Abdul Zohbi, *LA Metro*

Consultant
Phil Olekszyk, *World Wide Rail Inc.*

Project team
Charles Joseph, *American Public Transportation Association*

Introduction

This introduction is not part of APTA RT-RGC-S-001-02, Rev. 2, "Rail Transit Grade Crossing Warning Device Inspection, Testing and Maintenance."

The content of this standard is based on the "Rules and Regulations Governing Signal and Train Control Systems," published by the Department of Transportation, Federal Railroad Administration, Office of Safety. Specific reference is herein made to the Code of Federal Regulations, Title 49, Part 234 – Grade Crossing Signal Safety, Subpart D, as related to Maintenance, Testing and Inspection and Subpart E as related to Emergency Notification Systems.

49 CFR 234 was specifically written to address Class One and other railroads or rail-transit operations that are connected to the general railroad system of transportation and thereby under the jurisdiction of the FRA. Where necessary, these recommended standards have been modified and/or extended to address issues unique to rail transit properties not under FRA jurisdiction.

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 standard provides procedures for inspecting, maintaining, and testing RTS highway rail grade crossings.

APTA recommends the use of this Rail Standard by:

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

This standard intends to meet the following objectives:

- to ensure that special life/safety equipment is operational and reliable;
- to help rail transit systems 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.

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 RTS operates. In such cases, the government regulations override any conflicting practices this document requires or recommends.

Note on 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 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).

It must be noted that rail transit is not directly comparable to railroads (e.g. Amtrak, commuter, freight rail, etc.). Rail transit systems differ greatly in the types of service, vehicles and technology employed, with some systems operating fully automated trains on exclusive rights-of-way and others operating on streets mixed with traffic. Rail transit demands a unique approach to solving its problems, and the APTA Rail Transit Standards Program was enacted to accomplish this complex task.

Rail Transit Grade Crossing Warning Device Inspection, Testing and Maintenance

1. Application

APTA member rail transit systems shall adopt this standard and meet or exceed it within five years from the date of publication. For major modifications, a plan shall be developed within five years to bring the rail transit system (RTS) into compliance with this standard.

2. Provisions for inspection, maintenance and testing

2.1 Training

The RTS 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.

2.2 Responsibility

The RTS shall appoint a specific technically qualified employee or group of employees to be responsible for performing highway rail grade crossing warning device tests.

2.3 Materials

No consumable materials are required for inspecting, maintaining, and testing grade crossing warning devices unless otherwise specified by the original equipment manufacturer (OEM) and/or the RTS.

2.4 Tools

Tools as required by the RTS shall be used at all times during inspection maintenance and testing.

2.5 Personal protective equipment

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

2.6 Safety

Provide appropriate protection and/or de-energize appropriate circuits while performing inspection, maintenance and testing procedures.

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

2.7 Plans

Detailed circuit and layout plans depicting the current “as-in-service” condition are required for inspecting, maintaining and testing rail grade crossing warning systems. Plans shall be kept at each highway rail grade crossing warning system. Plans shall be stored in a waterproof and secure container. Plans shall be legible and correct and contain no more than one set of field revisions.

The RTS shall maintain a complete set of all circuit layouts and other related engineering plans for all RTS-maintained highway rail grade crossing warning device installations and keep the set on file at a central office location.

2.8 Protection of insulated wire

Insulated wire shall be protected from mechanical injury. The insulation shall not be punctured for test purposes.

A splice in underground wire shall have insulation resistance at least equal to that of the wire.

2.9 Normal functioning of system

Inspection, maintenance and/or testing shall not interfere with the normal functioning of any system or device unless alternate safety measures have been implemented for highway users, pedestrians or other personnel whose safety usually depends on the normal functioning of the system or device being inspected, maintained or tested.

2.10 Correction of deficiencies

When any essential component of a highway rail grade crossing warning system fails to perform its intended function, the cause shall be determined and the faulty component adjusted, repaired or replaced without undue delay.

Until repair of an essential component is completed, the RTS shall take appropriate action under a previously developed and approved operating plan to ensure safety.

Deficiencies identified during grade crossing warning system testing shall be corrected and documented in accordance with OEM and/or RTS requirements.

2.11 Documentation (record keeping)

Inspection, maintenance and testing activities (including recording device readings or downloads) and results and repairs shall be documented. Electronic record keeping may be used as an alternative to written records. When using electronic record keeping, a process shall be in place that prevents electronic records from being modified at a later date.

Each record shall show the name of the RTS, AAR/DOT inventory number (if available) or alternate identification means, location and date, equipment tested, results of tests, repairs, replacements, adjustments made, and the condition in which the apparatus was left.

Each record shall include the printed name (and ID number if applicable) of the employee making the test, be signed or electronically coded by the employee making the test, and shall be filed in the office of a supervisory official having jurisdiction. Each record shall be maintained until the next record for that test is filed but in no case for less than one year from the date of the test. Printed names and initials are specifically prohibited from all inspection and test reports.

2.12 Records retention

Records shall be maintained as determined by the RTS and state safety oversight policy.

3. Frequency of inspection and testing

Grade crossing warning system inspection, maintenance and testing shall be performed as specified in **Table 1** below or as otherwise deemed necessary by the RTS. For details on tasks for the systems, devices or components listed in the table, see the corresponding section of this document.

TABLE 1
Minimum Frequencies for Inspection, Maintenance and Testing Tasks

System, Device or Component	Action	Minimum Frequency of Action	Section
Grade crossing warning system	Test for proper operation	• When systems are placed in service • Monthly • When systems are modified, repaired or disarranged	4.1, 4.2
	Test for prescribed warning time **NOTE:** Electronic devices that accurately determine actual warning time may be used in performing such tests	• Annually • When the system is modified because of a change in train speeds, change in train detection system or other major alterations to the grade crossing	4.1
Standby power	Test for proper operation.	• Annually	4.3
Grounds on energy buses that furnish power to circuits that affect the safety of warning system operation	Test for proper operation.	• When the energy bus is placed in service • Monthly thereafter	4.5
LED unit and lamp operating voltages	Test for proper operation and voltages.	• When units are installed • Annually	4.8
Warning bells and other stationary audible warning devices	Test for proper operation.	• When the devices are placed in service • Monthly • When devices are modified, repaired or disarranged	4.10
Highway traffic signal preemption interconnections (if applicable)	Test or observe in operation for proper operation (see FRA Technical Bulletin S-12-01 dated July 25, 2002 or the latest publication).	• Monthly **NOTE:** Preferably, the highway authority will participate in joint testing at least annually.	4.11
Highway traffic signal operation (when used for controlling highway traffic movement across a highway rail grade crossing)	Test for proper operation (see FRA Technical Bulletin S-12-01 dated July 25, 2002 or the latest publication).	• Monthly in conjunction with the appropriate highway authority	
Vehicle intrusion detection systems	Test for proper operation.	• Monthly **NOTE:** Where the highway authority has maintenance responsibility for testing vehicle intrusion detection systems, this test shall be made in conjunction with the appropriate highway authority.	4.22
Alternating current centrifugal type relays	Test for proper operation.	• Annually	4.23
Alternating current vane-type relays	Test for proper operation.	• Once every two years	4.23

TABLE 1
Minimum Frequencies for Inspection, Maintenance and Testing Tasks

System, Device or Component	Action	Minimum Frequency of Action	Section
Direct current polar -type relays	Test for proper operation.	• Once every two years	4.23
Relays with soft iron magnetic structure	Test for proper operation.	• Once every two years	4.23
All other relays that affect the proper functioning of a crossing warning system	Test for proper operation.	• Once every four years	4.23
Cutout circuits (includes both switch cutout circuits and devices that enable personnel to manually override the normal operation of automatic warning systems)	Test for proper operation.	• Quarterly	4.17
Hold-clear devices	Test for proper operation.	• Annually	
Timing relays and devices (including solid-state timers)	Test for proper operation.	• Annually	4.23
Insulation	Test for proper resistance.	• When wires or cables are installed • Every 10 years thereafter **NOTE:** When insulation resistance of wire or cable is found to be less than 500,000 ohms, prompt action shall be taken to repair or replace the defective wire or cable. Until such defective wire or cable is replaced, insulation resistance tests shall be made annually.	4.24
Flashing light units	Inspect for proper alignment.	• When units are installed • Annually	4.6
	Check frequency of flashes.	• When units are installed • Annually	4.6
	Inspect for proper visibility, dirt and damage to roundels and reflectors.	• Monthly	4.6
Gate arms and gate mechanisms	Inspect and/or observe movement for proper operation.	• Monthly	4.9
Insulated rail joints	Visually inspect condition.	• Quarterly	4.16
Bond wires	Visually inspect condition.	• Quarterly	
Track connections	Visually inspect condition.	• Quarterly	

4. Requirements

Observe the operation of the warning devices under actual train movements as often as possible. Note the results, direction, track and train, if known, in the comments section of the inspection report. Prior to testing, obtain permission of the operation control center (OCC). When tests are complete, make sure all circuits and

equipment are operable and in the normal state. After completion of work on safety-related equipment, the center authorizing the work shall be informed of the completion.

The inspections and tests set forth in this section are the minimum requirements for highway rail grade crossings located on in-service tracks and shall be made to determine if the warning system and its component parts are maintained in a condition to perform their intended function.

Any electronic device, relay or other electromagnetic device or other component that fails to meet the requirements of tests required by this part shall be removed from service and shall not be restored to service until its operating characteristics are in accordance with the limits within which such device or relay is designed to operate. Proper precautions must be taken during inspection and testing to ensure railway and highway safety.

For specific instructions regarding the inspection and maintenance of the highway rail grade crossing equipment, see the OEM installation specification and manuals.

4.1 Activation of warning system

A highway rail grade crossing warning system shall be maintained to operate in accordance with the design of the warning system, but in no event shall it provide less than 20 s warning time for the normal operation of through trains before the grade crossing is occupied by rail traffic.

Alternative warning times may be authorized by the RTS for special conditions such as near-side station stops. For these conditions, the train operator must be able to stop the train prior to entering the intersection until it is verified that the warning system is active; gates, if so equipped, are in the fully horizontal position; and the intersection is clear of highway and/or pedestrian traffic.

4.2 Warning system apparatus

The electromagnetic, electronic and/or electrical apparatus of each highway rail grade crossing warning system shall be maintained to operate as designed in accordance with OEM and/or RTS requirements.

Highway rail grade crossing warning system apparatus shall be secured against unauthorized entry.

4.3 Standby power system

The RTS shall provide a backup power supply with the capacity to operate the warning system for a reasonable length of time during a period of primary power interruption, where that power interruption does not affect normal train operations. The designated capacity shall be specified on the plans required in Section 2.7. Determining the capacity of the standby source will be at the discretion of each individual RTS.

Reviewing the following factors as a minimum may be useful in determining the standby source capacity:

- the power demands of each particular location (taking into account urban or rural)
- the likelihood of discovery of the primary power outage (electronic notification devices, power-off indication, employee discovery, etc.)
- the availability and proximity of maintenance employees (including time of day)
- the number of trains that are operated over the crossing

4.4 Control circuits

All control circuits that affect the safe operation of a highway rail grade crossing warning system shall operate on the fail-safe principle. All equipment and control circuit design shall be in strict compliance with the

AREMA "Communications & Signals Manual," Volume I, Section 3, and other applicable sections of Volumes 1, 2, 3 and 4. Where electronic or processor-based systems are used, they shall conform to AREMA "Communications & Signals Manual," Section 3 and/or IEEE 1483-2000. Where new or novel technology is being used, or where highway-rail grade crossing equipment provides safety-critical data to a signal or train control system, rail transit properties should consider guidance provided by 49 CFR 234.275.

4.5 Grounds

Each circuit that affects the proper functioning of a highway rail grade crossing warning system shall be kept free of any ground or combination of grounds that will permit a current flow of 75 percent or more of the release value of any relay, electromagnetic device or electronic device in the circuit. This requirement does not apply to circuits that include running rail, alternating current power distribution circuits that are grounded in the interest of safety, and common return wires of grounded common return single break circuits.

4.6 Flashing light units

Each flashing light assembly shall include light-emitting diode (LED) units or approved lamps designed for railway signal use and be properly positioned, aligned and visible to a highway user approaching the crossing, in accordance with the "Manual on Uniform Traffic Control Devices" and/or the AREMA "Communications & Signals Manual."

Each flashing light or LED unit shall be maintained to prevent dust and moisture from entering the interior of the unit and may be equipped with side "tell-tale" indicators. If equipped with roundels and reflectors, they shall be kept clean and in good condition at all times to ensure maximum light unit visibility.

All light or LED units shall flash alternately. The number of flashes per minute for each light unit shall be 35 minimum and 65 maximum.

4.7 Gate arm lights and light cable

Each gate arm light or LED unit shall be designed specifically for use on a gate arm and maintained in such condition to be properly visible to approaching highway users. Light or LED units and required wire shall be properly secured to the gate arm.

4.8 Lamp or LED unit voltage

The voltage at each LED or lamp unit shall be maintained within the OEM-recommended value. However, in no case shall the voltage be less than 85 percent of the prescribed rating for the lamp.

4.9 Gate arms

The gate should cover the approaching highway to block all highway vehicles from being driven around the gate without crossing the center line.

Each gate arm shall start its downward motion not less than 3 s after the flashing lights begin to operate and shall assume the horizontal position at least 5 s before the arrival of any normal train movement through the crossing. At those crossings equipped with full closure (four quadrant gates), the timing requirements of this section apply to entrance gates only.

4.10 Highway crossing bell or audible warning system

Where required, each highway rail grade crossing shall be equipped with at least one crossing bell or other audible warning system (mechanical or electronic) mounted on one of the flasher/gate masts.

4.11 Highway traffic signal preemption

A clear and known demarcation point shall be employed in the grade crossing instrument cabinet to quickly determine whether a problem is caused by the traffic signal system or the highway rail grade crossing warning device system.

All serial digital interconnections between the highway subsystem and the rail subsystem shall comply with IEEE 1570-2002.

4.12 Train detection apparatus

Train detection apparatus shall be maintained to detect a train or (shunting) railcar in any part of a train detection circuit as designed in accordance with OEM requirements.

If the presence of sand, rust, dirt, grease or other foreign matter is known to prevent effective shunting, then the RTS shall take appropriate action, per a previously approved RTS system safety plan, to safeguard highway users.

4.13 Shunting

Each highway rail grade crossing train detection circuit shall detect the application of a shunt of 0.06-ohm resistance (or greater if determined by the authority having jurisdiction) when the shunt is connected across the track rails of any part of the circuit.

4.14 Fouling wires

Each set of fouling wires in a highway rail grade crossing train detection circuit shall consist of at least two discrete conductors. Each conductor shall be maintained to ensure sufficient conductivity and proper operation of the train detection apparatus when the train detection circuit is shunted. Installation of a single duplex wire with a single plug acting as fouling wires is prohibited. Existing installations with single duplex wires and a single plug for fouling wires may continue to be used until they require repair or replacement.

4.15 Non-insulated rail joints

Each non-insulated rail joint located within the limits of a highway rail grade crossing train detection circuit shall be bonded by means other than joint bars, and the bonds shall be maintained to ensure electrical conductivity.

4.16 Insulated rail joints

Each insulated rail joint used to separate train detection circuits of a highway rail grade crossing shall be maintained so that current cannot flow between rails separated by the insulation in an amount that may cause a train detection circuit failure.

4.17 Reverse switch cutout circuit

A switch, when equipped with a switch circuit controller connected to the point and interconnected with warning system circuitry, shall be maintained so that the warning system can be cut out only when the switch point is within 0.5 in. of full reverse position.

4.18 Wire tagging

Each wire shall be tagged or otherwise marked so that it can be identified at each terminal. Tags and other marks of identification shall be made of insulating material and arranged so that the tags and wires do not interfere with the moving parts of the apparatus. This requirement applies to each wire at each terminal in all

housings, including switch circuit controllers and terminal or junction boxes. This requirement does not apply to flashing light units, gate arm light units and other auxiliary light units. The local wiring on a solid-state crossing controller rack does not require tags if the wiring is an integral part of the solid-state equipment.

4.19 Wire on pole line and aerial

Each wire on a pole line shall be securely attached to an insulator that is properly fastened to a cross arm or bracket supported by a pole or other support. Wire shall not interfere with, or be interfered with by, other wires on the pole line. Aerial cable shall be supported by messenger wire. An open-wire transmission line operating at voltage of 750 V or more shall be placed not less than 4 ft. above the nearest cross arm carrying active warning system circuits.

4.20 Signs visible to highway users

Each sign mounted on a highway rail grade crossing signal post (or otherwise under the jurisdiction of the RTS) shall meet MUTCD or other applicable standards, be maintained in good condition and be visible to the highway user.

Signs not under the jurisdiction of the RTS that are not maintained in good condition shall be reported to the appropriate highway authority (or authority having jurisdiction).

4.21 Signs or light units visible to railway users

Signs or light units designed to be visible to the rail vehicles shall be maintained in good condition and be visible to the rail vehicle operator.

4.22 Vehicle intrusion circuits

If applicable and the responsibility of the RTS, vehicle intrusion circuits shall be maintained in accordance with OEM requirements.

4.23 Timing relays and timing devices

The timing of each timing relay and timing device (including solid-state timers) shall be maintained between 90 and 110 percent of the predetermined time interval. The predetermined time interval shall be shown on the plans or marked on the timing relay or timing device. Timing devices that perform internal functions associated with motion detectors, motion sensors and grade crossing predictors are not subject to the requirements of this section.

All relays used shall be classified for use in railway signal applications and meet the specifications of the AREMA “Communications & Signals Manual.”

4.24 Insulation resistance test

Insulation resistance tests shall be made between all conductors and ground, between conductors in each multiple conductor cable, and between conductors in trunking.

Wires, cables and insulation shall be dry when insulation resistance tests are performed. A circuit with a conductor having an insulation resistance of less than 200,000 ohms shall not be used.

Related APTA standards

APTA RT-SC-RP-001-02, "Wayside Signal AC Power System Inspection and Testing"
APTA RT-SC-RP-002-02, "Wayside Signal DC Power System Inspection and Testing"
APTA RT-SC-RP-017-03, "Signal Equipment Room Inspection"
APTA RT-SC-RP-018-03, "Vented Standby Battery Backup System Inspection and Maintenance"
APTA RT-SC-S-028-03, "Vital Relay Testing"
APTA RT-SC-RP-031-03, "Signal Maintenance Personnel Hiring Qualifications, Training and Competencies"
APTA RT-SC-S-034-03, "Supervisory Control and Data Acquisition (SCADA) System Inspection, Testing and Maintenance"
APTA RT-SC-RP-038-03, "Signal System Event Recorder and Data Logging Equipment Inspection and Maintenance"

References

This standard shall be used in conjunction with the latest edition of the following publications. In the event that a conflict between this standard and a referenced document exists, this standard shall take precedence, to the extent not preempted by law. Provisions of the referenced documents not in conflict with this standard shall apply as referenced herein.

AREMA, "Communications & Signals Manual," 2005. https://www.arema.org/publications/cs/index.aspx.
The following manual parts are specifically referenced in this standard.
Volume I, Section 3: Highway Rail Grade Crossing Warning Systems
Volume I, Part 3.3.5, Recommended Instructions for Aligning Highway Grade Crossing Signal, Reflector Type Light Units.
Volume I, Part 17.3: Safety Assurance of Vital Electronic/Software Based Equipment Used in Signal Applications.

Federal Highway Administration (FHWA), "Manual on Uniform Traffic Control Devices (MUTCD)." http://mutcd.fhwa.dot.gov/

IEEE Std. 100-1996, "IEEE Standard Dictionary of Electrical and Electronic Terms," Sixth Edition.

IEEE Std. 1483-2000, "IEEE Standard for Verification of Vital Functions in Processor-Based Systems Used in Rail Transit Control."

IEEE Std. 1570-2002, "Standard for the Interface Between the Rail Subsystem and the Highway Subsystem at a Highway Rail Intersection."

Definitions

For the purposes of this standard, the following definitions apply. IEEE Std. 100-19961 and the AREMA signal manual should be referenced for terms not defined in this section.

active grade crossing warning system: The system used to inform road users of the approach or presence of trains at highway-rail grade crossings, which includes flashing light signals and necessary control equipment and may or may not include warning gates.

authority having jurisdiction: The entity that defines the contractual (including specification) requirements for the procurement of the highway-rail grade crossing equipment. Also, the entity responsible for maintenance and upkeep of the equipment.

cutout circuit: Any circuit that overrides the operation of automatic warning systems, including switch cutout circuits and devices that enable personnel to manually override the normal operation of automatic warning systems.

entrance gate: A highway rail crossing traffic control gate that is used on the approach lanes of traffic toward a highway rail grade crossing.

exit gate: A highway rail crossing traffic control gate that provides full closure of the exit lanes of traffic from a highway rail grade crossing.

fail-safe: A design philosophy applied to safety critical systems that prohibits hardware failures or software errors from causing a system to assume or maintain an unsafe state.

fail-safely: The implementation of a function in a fail-safe manner.

gate down: A crossing gate is in the "down" or lowered position when it is horizontal in accordance with the predetermined design from vertical (typically 85 to 92 deg. depending on specific gate mechanism adjustment and other factors).

gate up: A crossing gate is in the "up" or raised position when it is vertical in accordance with the predetermined design from horizontal.

highway: A public way for purposes of travel, including the entire area within the right-of-way. Also called street.

highway-rail grade crossing: 1) A location where a public highway, road, street or private roadway, including associated sidewalks and pathways, crosses one or more railroad tracks at grade. 2) The general area where a highway and a railroad's right-of-way cross at the same level, within which are included the railroad tracks, highway and traffic control devices for highway traffic traversing that area.

highway-rail intersection: See *highway-rail grade crossing*.

interconnection: The electrical connection between the railroad active warning system and the traffic signal controller assembly for the purpose of preemption.

operations control center (OCC): That facility from which train control, train dispatching and/or train supervision takes place for the entire rail transit system 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.

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.

preemption: The transfer of normal operation of traffic signals to a special control mode that interrupts the normal sequence of traffic signal phases to accommodate train operation at, or adjacent to, the traffic signal controlled intersection.

rail transit system (RTS): 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.

road/roadway: That portion of a highway improved, designed or ordinarily used for vehicular travel and parking lanes, but exclusive of the sidewalk, berm or shoulder even though such sidewalk, berm or shoulder is used by people riding bicycles or other human-powered vehicles. In the event that a highway includes two or more separate roadways, the term "roadway" as used herein refers to any such roadway separately but not to all such roadways collectively.

safe: Having acceptable risk of the occurrence of a hazard.

safety: Freedom from those conditions that can cause death, injury, occupational illness, damage to the environment, or damage to or loss of equipment or property.

safety assurance: A characteristic of system implementation that ensures a level of safe operation.

safety-critical: A term applied to a system or function for which correct performance is critical to the safety of personnel and/or equipment or a system or function for which incorrect performance may result in an unacceptable risk of a hazard. See *fail-safe*.

> **NOTE:** Such a designation may require the incorporation of additional special safety design features.

> **NOTE:** Vital functions are a subset of safety-critical functions.

street: See *highway*.

Abbreviations and acronyms

AAR	Association of American Railroads
AC	alternating current
AFLS	automatic flashing light signals
APTA	American Public Transportation Association
AREMA	American Railway Engineering and Maintenance of Way Association
CFR	Code of Federal Regulations
DC	direct current
Deg.	degrees
DOT	United States Department of Transportation
ft.	feet
IEEE	Institute of Electrical and Electronics Engineers
in.	inches
ITE	Institute of Transportation Engineers
FHWA	Federal Highway Administration (of the DOT)
FRA	Federal Railroad Administration (of the DOT)
LED	light-emitting diode
MUTCD	Manual of Uniform Traffic Control Devices
NATSA	North American Transit Services Association
OEM	original equipment manufacturer
RTS	rail transit system
s	seconds
V	volts

Summary of document changes

- Document formatted to the new APTA Rail Transit format.
- Document title changed from *"Standard for Rail Transit Systems Highway Rail Grade Crossing Warning Device Inspection, Testing and Maintenance"* to *"Rail Transit Grade Crossing Warning Device Inspection, Testing and Maintenance".*
- Sections to reflect APTA Rail Transit format added to Table of Context.
- Sections have been moved and renumbered.
- Four new sections added: Note on alternate practices, Related APTA standards, Summary of document changes, and Document history.
- References, Definitions, and Abbreviations and Acronyms moved to the rear of the document.
- Some global changes to section headings and numberings resulted when sections dealing with references, definitions, abbreviations and acronyms were moved to the end of the document along with other cosmetic changes such as capitalization, punctuation, spelling and grammar and general flow of the text.
- Technical editing to previous sections 4.4, 4.6, and 4.7 (now section 2.4, 2.6. and 2.7) were made.
- Section 2.11.1 "Records retention," was added.
- Section 3. "Frequency of inspection and testing," was added.
- Technical editing to previous sections 6.4, 6.6, 6.8, 6.9, 6.10, 6.23, and 6.24 (now sections 4.4, 4.6, 4.8, 4.9, 4.10, 4.23 and 4.24) was made.
- Within definitions, "exit gate" was changed from, "A highway rail crossing traffic control gate that is used on the exit lanes of traffic from a high rail grade crossing." to "A highway rail crossing traffic control gate that provides full closure of the exit lanes of traffic from a highway rail grade crossing."
- Working group membership updated.
- Annexes A, B, C, and D were deleted. Appendix A, B, C, because they were examples and may not apply to every property and D was removed because the designers of the grade crossing should be the ones calculating the crossing warning time and the required approach distance.
    - Annex A, "Example test procedures for automatic highway grade crossing warning systems".
    - Annex B, "Example for recording tests."
    - Annex C, "Normal battery voltage limits."
    - Deleted Annex D, "Warning times vs. speed and required approach distance."

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