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Rail Transit Operating Practices Working Group

Crash and Fire Protected Inward and Outward Facing Audio and Image Recorders in Rail Transit Operating Compartments

Abstract: This Recommended Practice (RP) provides minimum requirements for selection, installation, and operating and maintenance requirements for crash and fire protected inward and outward facing audio and image recorders in all rail transit vehicle operating compartments. This RP includes guidance for design criteria, administrative program activities, maintenance and usage, and data management.

Keywords: cameras, crash, crash and fire recording systems, fire, audio recorder, image recorder, NTSB Recommendation R-17-13, operating compartment, microphone

Summary: This RP addresses and strengthens requirements for crash and fire protected audio and image recording systems for rail transit vehicles. In particular, it calls for the design and operation of inward and outward facing audio and image recording systems in rail transit vehicle operating compartments so that the rail transit agency (RTA) can capture data that will be essential in investigating accidents and in managing the safe operations of trains. This RP has been developed in response to key concerns and findings raised by the National Transportation Safety Board (NTSB) in their report on *Inward and Outward Facing Audio and Image Recorders as Investigation and Safety Tools* – dated February 21, 2017 and adopted on August 24, 2017 and in response to NTSB Safety Recommendations R-17-13.

Every RTA experiences events which require investigation as to the causes and contributing factors, and the capture of accurate data can be enhanced with audio and image recordings. While some states have issued rules concerning the installation of audio and image recording systems and many RTAs have begun to install such systems on their existing and new rail transit vehicle fleets, the rail transit industry is in need of a consistent guideline that outlines considerations for the design of systems; the formal operation and maintenance of the systems; and the management of data.

Scope and purpose: Incidents and accidents are investigated by various entities including the RTA, state safety oversight agencies, and the NTSB. Investigations often lead to an understanding of what occurred, and subsequently assist management to identify safety issues and develop methods to prevent accidents. Installation of audio and image recorders on rail transit vehicles greatly enhances the preservation of evidence. This is

particularly helpful when such evidence is not available due to: incapacitation or death of crew members or the lack of eye witnesses; and/or when evidence has been disturbed or otherwise tampered with. In order to improve operational safety and accident investigation, the NTSB has recommended that all rail transit vehicle operating compartments are installed with audio and image recording systems that are capable of providing recordings to verify train crew actions and train operating conditions.

This document will apply to both existing and new rail transit vehicles so that they are equipped with audio and image recording systems that capture information from within the operating compartment and facing out from the compartment.

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Introduction

This introduction is not part of APTA RT-OP-RP-024-19 *Recommended Practice for Crash and Fire Protected Inward and Outward Facing Audio and Image Recorders in all Rail Transit Operating Compartments.*

In 2017, the National Transportation Safety Board (NTSB) recommended that the Federal Transit Administration require the installation of crash- and fire-protected inward- and outward-facing audio and image recorders that can provide recording to verify train crew actions and train operating conditions (R-17-13). The NTSB recognizes there may be privacy concerns regarding public disclosure, and lawmakers have been sensitive to this issue. In 1990 and 2000, Congress enacted provisions of law to protect the privacy of operators of aviation and surface transportation, governing when recordings and transcripts may be disclosed by the NTSB during the course of an accident investigation or public hearing (49 U.S.C. §1114(c) and (d)).

This document recommends that rail transit agencies install operational crash and fire protected audio and image recording systems on their rail cars in the operating compartments. Cameras will be mounted in the operating compartment. The installation of these inward and outward facing cameras improves the quality of accident investigations and provides management with an opportunity to take proactive steps to improve operational safety.

The cameras and microphones of the recording systems should be installed in all operating compartments. The inward facing cameras should be capable of providing recordings verifying the crew actions and the actions of others who may be in the operating cab and the forward-facing cameras the trains' operating conditions

Individual rail transit agencies (RTAs) may modify the practices in this standard to accommodate their specific equipment and mode of operation. APTA recognizes that some RTAs may have unique operating environments that make strict compliance with every provision of this Recommended Practice (RP) impractical. As a result, certain RTAs may implement the RP in ways that are more restrictive than this document prescribes. RTAs may develop alternate practices to this RP so long as the alternates are based on a safe operating history and are described and documented in the System Safety Program Plan (SSPP) and/or the Public Transportation Agency Safety Plan (PTASP).

It must be noted that rail transit is not directly comparable to railroads (Amtrak, commuter, freight rail etc.). RTAs 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.

Crash and Fire Protected Inward and Outward Facing Audio and Image Recorders in Rail Transit Operating Compartments

1. Purpose of this recommended practice

This Recommended Practice (RP) applies to all rail transit vehicles, regardless of mode of operation (e.g. manual and automatic operation), except on-track equipment, unless otherwise determined by the RTA.

While this document is primarily related to the audio and image recording requirements in rail transit vehicle operating compartments, the RTA may wish to consider other camera locations, such as in passenger compartments or exterior vehicle locations. The provisions of this document could also apply to audio and image recording systems outside of the operating compartment.

1.1 Purpose of audio and image recorders in operating compartments

In order to improve operational safety, control and reduce risk, and strengthen rail accident investigations, all rail transit operating compartments should have cameras that produce audio and image recordings capable of providing a means to record and verify train crew actions and outward facing cameras capable of image recordings of the train operating conditions as would be viewed by the train operator. These recordings also provide additional benefits such as serving as an active crime deterrent; aiding in investigations related to crimes; providing data for claims that may result from some other event; and /or providing materials that can be used for training or educational purposes.

1.2 Installation requirements for new rail transit vehicles

New rail transit vehicle procurements initiated after the publication of this RP should have special provisions in the specifications for inward and outward facing crash and fire protected audio and image recorders. Should the RTA elect to install audio and image recording systems after delivery from manufacturers, these systems should be installed and functioning prior to operational testing on any tracks.

1.3 Installation requirements for existing rail transit vehicles without compliant existing audio and image recorders

Inward facing audio and image crash and fire protected recorders should be installed and operational on all existing rail transit vehicles no later than 60 months after this RP is published.

Outward facing image crash and fire protected recorders should be installed and operational on all existing rail transit vehicles no later than 60 months after this RP is published.

For existing rail transit vehicles with compliant existing audio and image recorders, the RTA should ensure that all elements of this RP are formally implemented no later than 36 months after this RP is published.

1.4 Minimum design criteria

Cameras should be equipped with audio and image recording capabilities for each operating compartment and should have manual and/or wireless download capability to collect audio and image recordings. Inward and outward facing audio and image recording systems of the operating compartment should be in recording mode whenever the operating compartment is active. The RTA should consider recording during layover and other periods where actions in and around the operating compartment may contribute to an adverse event. All audio and image recording should have an automatic date and time stamp that is directly linked to the date and time stamp of the train's event recorder and should have the ability to export data that can be played in a standard media format.

The RTA should consult the Institute of Electrical and Electronics Engineers (IEEE) 1482.1 or other relevant standards for more detailed design guidance.

1.4.1 Crash and fire worthiness

The audio and image recording unit and specifically the memory module should be designed to withstand fire and structural damage so that data is protected for retrieval after an event. Crashworthiness-related design criteria should be established by the RTA based on current and projected operating environments.

The FRA has established Crash and Fire Worthiness Criteria tables in 49 CFR Part 229, which may be used as initial guidance by RTAs in developing their own criteria. Tables that are current as of the date of publication of this standard are located in Appendix A of this standard.

As noted in APTA Standard for Rail Transit Vehicle Passenger Emergency Systems (APTA RT-VIM-S-026-12), *The crashworthiness requirements of the event recorder should be considered by the RTA. The crashworthy requirements may be met by the design of the data storage device(s), or by placing the device in a box meeting the requirements, or by judicious placement of the device within the car body envelope (e.g., to take advantage of the crashworthiness and fire-barrier properties of the car body), or by a combination of these approaches.*

Additionally, if the memory module is off-vehicle and data is transferred wirelessly with minimum lag, the data needs to be protected appropriately as per the manufacturers recommendations.

1.4.2 Audio recording capabilities

Built-in microphones installed inside the operating compartment should capture and record ambient sound. Systems should be designed so that each microphone's data can be isolated so that sound captured from different locations can be analyzed independently. The RTA may choose to install exterior microphones, but this RP does not require exterior audio recording capabilities

1.4.3 Image recording capabilities

The positioning of the inward-facing camera view should be capable of providing recordings to verify the actions of the train crew and any other person in the operating compartment and outward-facing camera views should be focused to record the train operating conditions. Forward-facing camera lens size and field of view should be designed so that all necessary visual information, such as signals, signal indications, and directional signage, are captured.

1.4.4 Audio and image recording synchronization

The audio and image recordings should be synchronized with each other and automatically date and time stamped. Where feasible, the synchronization of these recordings should also be linked to the train event recorder.

1.4.5 Minimum duration

Audio and image recording equipment should have the capacity for a minimum recording duration of forty-eight (48) hours as established in APTA Standard RT-VIM-S-026-12. This minimum should include consideration for general operational needs and a percentage of spare capacity (25 percent or more) to account for variations in data transmission. The duration of time that is recorded before being overwritten should be considered. The duration may not be commensurate with total capacity of the hardware. Other factors for audio and image data usage and retention, such as the requirements or needs of internal and external requestors should be considered.

1.4.6 Spare equipment

The RTA should determine an appropriate spare ratio of audio and image recording equipment based on fleet size, audio and image recording system reliability, and frequency of need to remove equipment for audio and image retrieval. The RTA should ensure that the vehicle has continuity of operations of its audio and image equipment.

1.4.7 Image recording frame rate

Image recording frame rate and resolution should be based on current technological capabilities and industry best practices. At a minimum, image recording requirements of 30 frames per second or greater should be used. Also, an alarm tagging feature and different recording and streaming capabilities for primary and alternate streams should be considered.

1.4.8 Various lighting scenarios

Camera systems should have specifications for true day and night functionality and built-in infrared illuminations for capturing images in various lighting scenarios.

The RTA should recognize that the functionality of image recorders in various light scenarios are not necessarily representative of what an operator would likely have the capability to identify in real time operating conditions.

1.4.9 Optimum placement of image recording equipment

Image recording systems should be installed and configured so that other elements of the car design, such as windshield wipers, mirrors, or other elements, or environmental conditions, including snow or ice, do not obstruct the ability of the camera to capture the appropriate images.

Any placement of the system equipment should not obstruct the view of the train operator.

1.4.10 Secure design considerations

Audio and image recording systems should be designed and installed with security of the equipment in mind.

Considerations for securing the physical equipment should include: restricted access location, doors or panels with tamper-proof locks and seals; secured cabinets or compartments; and other protective measures.

1.4.11 Other design criteria for consideration

The following should be considered in establishing its design criteria:

- Data encryption for data integrity
- Solid state drive versus spinning mass drives
- Digital images

- Protection from environmental issues, such as: shock, vibration, acceleration, temperature, humidity, contaminants and corrosion, as well as electromagnetic interference / electromagnetic compatibility
- Digital signatures
- Secure streaming capability to the remote locations with restricted access as designated by the RTA
- Secure interface with mobile device applications
- Cyber security requirements to prevent hacking of data collected
- After an incident, a provision should be provided to lock the images and data from being overwritten

2. Administrative and program requirements

2.1 Policy for use of onboard camera systems

A policy should be developed which identifies usage requirements for onboard audio and image recording systems and the appropriate use of data gathered by the systems, in accordance with the provisions of this Recommended Practice.

2.2 Procedures

The roles and responsibilities of all personnel tasked with operating or maintaining the onboard audio and image system should be evaluated. The RTA should use this evaluation to develop and implement operating and maintenance procedures in accordance with the audio and image recording system policy.

2.3 Rules

The roles and responsibilities of all personnel tasked with operating and maintaining the onboard camera system should be evaluated. Rules should be developed and implemented in accordance with the audio and image recording system policy.

2.4 Tampering

As defined by the RTA, a zero-tolerance policy for tampering with or disabling audio and image recording systems should be established.

3. Maintenance, inspections, operations, and training

The RTA should ensure it has internal and/or external resources to service, maintain, and retrieve audio and image recording equipment.

Requirements for documenting the repair and/or replacement of audio and image recording equipment should be developed and implemented.

3.1 Inspections

Inspection procedures should be developed for audio and image recording systems that are aligned with original equipment manufacturer recommendations. Requirements for documenting inspections should be developed and implemented.

3.1.1 Routine maintenance inspection

Routine inspections should be performed according to manufacturer specifications to ensure proper operation of audio and image recording systems. This may include the periodic review of exception reports automatically generated by the audio and image recording systems that are designed with such capabilities.

A daily maintenance inspection procedure should be considered requiring performance of a health and functionality inspections for the audio and image recording system and the onboard camera system.

Documentation of audio and image recording system inspections should be established and maintained for a period of time to be determined by the RTA.

3.1.2 Pre-trip check

A pre-trip procedure should be developed for designated employees on how and what to check and verify if the audio and image recording equipment is functioning. Where applicable, this may include checks of camera systems for visible obstructions or damage.

3.2 Health check reports

A clearly identifiable and user-friendly indicator inside the operating compartment should be provided, which indicates the following conditions:

- System active/functioning
- System inactive/component fault

3.3 Operational criteria

A procedure should be developed for inoperative audio and image recording systems in the operating compartment of rail transit vehicles. The procedure should include decisions for use of rail transit vehicles with inoperative audio and image recording equipment in the following conditions:

- Inoperative equipment before entering service
- Inoperative equipment while vehicles are in service

For example, one mitigation strategy may include placing the defective operating compartment in a non-controlling position.

3.4 Training

Contractor and employee training programs should include applicable policies and procedures related to the use of audio and image recording equipment.

Authorized personnel should be trained on the method for the download, collection, storage, handling, and distribution of audio and image recordings. Training should include familiarization with rules and procedures and hands-on components, as applicable.

Training records should be documented and retained in accordance with the RTA's document retention policy.

4. Management of audio and image recording data

4.1 Chain of custody

A procedure should be developed and implemented that addresses the process for handling data and the documentation of who has requested, viewed, and/or received audio and image recordings. This procedure should apply to both internal and external requests for information.

4.1.1 Access to audio and image data

The RTA should ensure the physical security and integrity of audio and image recording devices. Only authorized personnel, as determined by the RTA, should have the ability to access and retrieve audio and image recordings promptly after an accident, incident, crime, or other adverse event.

Data capturing of events should be made available to the designated individuals as soon as possible after, and at a minimum, the following types of events have occurred.

- derailment
- security event
- any impact between a rail transit vehicle and any other vehicle, object or person
- any reported complaint or observation of rule violation
- personal injury or property damage event

4.1.2 Authority for data handling and distribution

Authority for the handling and distribution of data should be assigned to designated individuals, with responsibilities described in accordance with RTA requirements. Authority should be described for the following types of individuals, who, at a minimum:

- Have custodial responsibilities for the secured data
- Have authority to request data
- Have authority to release data
- Have authority to handle data

4.1.3 Process for data handling and distribution

A process should be formalized that describes the handling, distribution and retention of data.

4.2 Retention of audio and image data

Audio and image recordings should be saved and retained in accordance with the RTA data retention policy. The RTA should consider how data retention needs may differ between routine audio and image recordings and specific accident and incident related audio and image data.

4.2.1 Data availability

The RTA should establish parameters for the time period for which such information is to be made available.

4.3 External requests

A policy or mutual understanding or agreement on external requests for information relative to audio and image recordings should be developed. Consideration should be made for different types of individuals, agencies, and organizations that may request audio and image recordings and what information can be shared. Authority for data distribution should be identified in the policy. Considerations should also be made for the process for responding to public records requests for such data.

Related APTA standards

APTA IT-CCTV-RP-001-11 *Selection of Cameras, Digital Recording Systems, Digital High-Speed Networks and Trainlines for Use in Transit-Related CCTV Systems*

APTA RT-VIM-S-026-12 *Rail Transit Vehicle Passenger Emergency Systems*

References

California Public Utilities Commission, General Order 172 *Rules and Regulations Governing the Use of Personal Electronic Devices by Employees of Rail Transit Agencies and Rail Fixed Guideway Systems* Dated August 10, 2007 and Adopted October 6, 2011

NTSB Safety Recommendation Report on *Inward and Outward-facing Audio and Image Recorders as Investigative and Safety Tools* Dated February 21, 2017 and Adopted August 24, 2017

NTSB Safety Recommendation R-17-13

49 CFR Part 229

49 U.S.C. § 1114(c)) - Public Law 101-641, the Independent Safety Board Act Amendments of 1990

49 U.S.C. § 1114(d)). Public Law 106-424, the National Transportation Safety Board Amendments Act of 2000

U.S.C. § 1154.

IEEE 1482.1-2013 *Standard for Rail Transit Vehicle Event Recorders*

IEC 62625-1 2013 *Electronic railway equipment – On board driving data recording system – Part 1: System specification*

Definitions

chain of custody: Chain of custody in legal contexts, refers to the chronological documentation or paper trail, showing the seizure, custody, control, transfer, analysis, and disposition of physical or electronic evidence.

inward facing camera: A camera installed in the operating compartment of a rail transit vehicle that has the capability of electronically capturing audio and image recordings to verify train crew actions.

operating compartment: Also referred to as the controlling compartment, this is the location at the end of a rail transit vehicle where a train operator directly controls and has responsibility for the movement of the train. The operating compartment is typically an enclosed or separate compartment or area, but in some cases, such as on fully automated, driverless trains, where a control panel can be opened for manual operation of the rail transit vehicle.

outward facing camera: A camera installed on a rail transit vehicle that has the capability of electronically capturing image recordings of the train operating conditions.

train: A rail mounted vehicle such as any motorcar, locomotive, or other self-propelled vehicle, with or without cars coupled.

train operator: A qualified and authorized employee having direct control and responsibility for the movement of a train.

Abbreviations

APTA American Public Transportation Association
IEEE Institute for Electrical and Electronics Engineers
NATSA North American Transit Services Association
NTSB National Transit Safety Board
PTASP public transportation agency safety plan
RTA rail transit agency
SSPP system safety program plan

Summary of changes

This is a new document, hence there are no changes.

Document history

Document Version	Working Group Vote	Public Comment/ Technical Oversight	Rail Transit CEO Approval	Rail Standards Policy & Planning Committee Approval	Publish Date
First published	Nov. 14, 2018	January 7, 2019	March 16, 2019	April 12, 2019	April 12, 2019

Appendix A: FRA CFR 49 Crash and Fire Worthiness

The Federal Railroad Administration provides two options for Crash and Fire Worthiness Criteria as shown in the following tables. Either option is viable for an RTA to consider.

FRA CFR 49 Crash and Fire Worthiness Criteria Option A

(Identical to the IEEE 1482.1 criteria)

Parameter	Value	Duration	Remarks
Fire, High Temperature	750 °C (1400 °F)	60 minutes	Heat source: Oven.
Fire, Low Temperature	260 °C (500 °F)	10 hours	
Impact Shock	55 g	100 ms.	½ sine crash pulse.
Static Crush	110kN (25,000 lbf)	5 minutes.	
Fluid Immersion	#1 Diesel, #2 Diesel, Water, Salt Water, Lube Oil	Any *single* fluid, 48 hours.	
	Fire Fighting Fluid	10 minutes, following immersion above	Immersion followed by 48 hours in a dry location without further disturbance.
Hydrostatic Pressure	Depth equivalent = 15 m. (50 ft.)	48 hours at nominal temperature of 25 °C (77 °F)	

FRA CFR 49 Crash and Fire Worthiness Criteria Option B

Parameter	Value	Duration	Remarks
Fire, High Temperature	1000 °C (1832 °F)	60 minutes	Heat source: Open flame.
Fire, Low Temperature	260 °C (500 °F)	10 hours	Heat source: Oven.
Impact Shock—Option 1	23 gs	250 ms	
Impact Shock—Option 2	55 gs	100 ms	½ sine crash pulse.
Static Crush	111.2kN (25,000 lbf) 44.5kN (10,000 lbf)	5 minutes. (single “squeeze”)	Applied to 25% of surface of largest face.
Fluid Immersion	#1 Diesel, #2 Diesel, Water, Salt Water, Lube Oil, Fire Fighting Fluid	48 hours *each.*	
Hydrostatic Pressure	46.62 psig (= 30.5 m. or 100 ft.)	48 hours at nominal temperature of 25 °C (77 °F)	