APTA STANDARDS DEVELOPMENT PROGRAM
RECOMMENDED PRACTICE
American Public Transportation Association
1300 I Street, NW, Suite 1200 East, Washington, DC 20006

APTA RT-VIM-RP-027-17
Published: December 6, 2017

Vehicle Inspection and Maintenance Working Group

On-Track Equipment Periodic Inspection and Maintenance

Abstract: This *Recommended Practice* provides guidance for the periodic inspection and maintenance of systems and components of on-track equipment (OTE). It covers the development of rail transit system (RTS) inspection and maintenance schedules for OTE.

Keywords: on-track equipment, periodic inspection and maintenance, vehicle inspection and maintenance

Summary: This *Recommended Practice* provides guidance for the development of periodic inspection and maintenance schedules for on-track equipment. Individual rail transit systems should tailor these practices to accommodate their specific equipment, mode of operation and operating environment.

Scope and purpose: The purpose of any periodic maintenance inspection schedule is to positively affect equipment reliability, performance and safety while expending the minimum amount of resources to achieve results that are in keeping with RTS operational requirements, budgets and goals. This *Recommended Practice* applies to rail transit systems that operate light rail, heavy rail or rail subway systems. This document does not apply to rail transit systems regulated by the Federal Railroad Administration (FRA). This document should be used by rail transit systems that operate under Federal Transit Administration state safety oversight jurisdiction. This *Recommended Practice* provides recommendations for periodic inspection and maintenance of on-track equipment and is helpful when used in the creation of vehicle inspection schedules. It includes factors that should be considered by the RTS when developing these schedules.

Table of Contents

Participants ..... **iv**

Project Team iv
Charles Joseph, APTA iv

Introduction ..... **v**

1. Background **1**

2. Requirements **1**

3. Safety **1**

4. Equipment procurement contracts **2**

5. Development **2**
5.1 Building an inspection and maintenance schedule with OEM or RAM recommendations 2
5.2 Building an inspection and maintenance schedule without OEM or RAM recommendations 3
5.3 Types of inspection and maintenance schedule intervals 4
5.4 Organizing inspection and maintenance steps for efficiency 4
5.5 Standardization of inspections 4
5.6 Inspection and maintenance on-time performance 4
5.7 Inspection and maintenance document approval and retention 4

6. Implementation **5**
6.1 Documentation 5
6.2 Training 5
6.3 Scheduling 5
6.4 On-time performance of periodic inspection and maintenance 5

7. Contractor on-track equipment **5**

8. Quality assurance **6**

9. Engineering **6**

10. Quality control **6**

Related APTA standards **6**

References **6**

Definitions **6**

Abbreviations and acronyms **6**

Summary of document changes **7**

Document history **7**

List of Figures and Tables

FIGURE 1 Sample Inspection Data Spreadsheet 3

Participants

The American Public Transportation Association greatly appreciates the contributions of the **Rail Transit Standards Vehicle Inspection and Maintenance 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:

Scott Laps, *Chair*
Eric Petersen, *Vice Chair*
Vacant, *Secretary*

Marwan A-Mukhfar
Juan Aristizabal
Dave Barber
Chris Barbour
Sherif Bastawros
Steve Bethel
Jerry Blackman
Stephen Bonina
Gordon Campbell
John Condrasky
Richard Curtis
Henry Davis
Paul Denison
Jeff Dunham
Phil Eberl
Marc Gagne
Mike Ghobrial
Dan Gornstein
John Green
Scott Grogan
Terry Hildebrandt
Ben Holland
Anthony Jones
John Kesich
Rick Kinding
Henry Kolesar
John Kortekaas
Paul Kovacs
David Kowalski
Joseph Kempasky
Gary Lee
John MacEwan
Larry Nye
Eric Petersen
Frank Pierson
John Sadorra
Richard Seaton
Melissa Shurland
James Skaggs
Bill Steinmetz
Narayana Sundaram
Michele Swayzer
Tom Tarantino
Clive Thornes
Wilson Wallace
Michael Wetherell
Evalynn Williams
Daniel Wilson
Cliff Woodbury
Hannie Woodson
Bob Young

Project Team

Charles Joseph, APTA

Introduction

This introduction is not part of APTA RT-VIM-RP-027-17, "On-Track Equipment Periodic Inspection and Maintenance."

This *Recommended Practice* is intended to assist rail transit system (RTS) personnel in developing and implementing basic maintenance and inspection procedures for on-track equipment. Since on-track equipment may be different, the procedures and steps described in this document will not necessarily be applied to, nor required for, every RTS inspection and maintenance procedure.

This *Recommended Practice* represents a common viewpoint of those parties concerned with its provisions, namely, transit operating/planning agencies, manufacturers, consultants and engineers. The application of any standards, practices or guidelines contained herein is voluntary. In some cases, federal and/or state regulations govern portions of a rail transit system's operations. In those cases, the government regulations take precedence over these recommended practices. APTA recognizes that for certain applications, the standards or practices, as implemented by individual rail transit systems, may be either more or less restrictive than those given in this document.

This document describes the basic periodic inspection and maintenance requirements for on-track equipment. APTA recommends the use of this document by:

- Individuals or organizations who use On-Track Equipment;
- Individuals or organizations who perform periodic inspection and maintenance for On-Track Equipment;
- Individuals or organizations that contract with others for the performance of periodic inspection and maintenance for On-Track Equipment; and
- Individuals or organizations who influence how periodic inspections and maintenance is performed for On-Track Equipment.

On-Track Equipment Periodic Inspection and Maintenance

1. Background

Because many variations exist in vehicle design, system size and environmental considerations across rail transit systems, no single method of developing and implementing periodic on-track equipment (OTE) inspection and maintenance can be applied to the entire industry.

Each RTS, based on specific equipment design, usage, maintenance facilities and operating environment, must compile and enact specific periodic inspection and maintenance protocols.

2. Requirements

The following are requirements incumbent on an effective OTE periodic inspection and maintenance program. Each of the following is explained more fully in the body of the document:

- Safety is the first consideration in determining inspection intervals, checks and warnings for employees.
- The inclusion of OEM inspection and maintenance tasks as a part of new equipment and technologies procurements.
- Periodic inspection and maintenance tasks need to include the regular inspection and maintenance of all on-track-equipment's safety features.
- Development of periodic inspection and maintenance schedules to use OEM recommendations, engineering principles, and RTS experience.
- Periodic inspection and maintenance tasks are scheduled, tracked, and are performed within the requirements of the RTS.
- Inspection records include date and maintainer information and are maintained for a RTS defined period of time.
- Periodic inspection and maintenance task lists are subject to regular review by the RTS.
- On-track-equipment needs to meet safe operating status requirements defined by the RTS.

3. Safety

Safety considerations by the RTS should be present in the following:

- Conduct task appropriate equipment and safety training.
- Identification and creation of danger, warning and caution elements within the task descriptions through a job hazard analysis (risk mitigations) such that employees are made aware of procedures that could be harmful to either themselves or others.
- Safe operation is an intentional outcome of the OTE's periodic inspection and maintenance program.
- Ensure facilities and equipment are adequate to safely perform the periodic inspection and maintenance tasks.
- Availability and identification of the personal protective equipment necessary to perform each inspection and maintenance task.

- Promote the regular enforcement of rules and procedures to maintain the safety culture within the RTS.
- Use of FMEA and FMECA, or other failsafe methodologies to validate changes to safety critical equipment that the RTS has specified.

4. Equipment procurement contracts

As a minimum the RTS should consider the following, including but not limited to:

- Training.
- Procedures for inspection and maintenance.
- Schedule.
- Spare parts.
- Illustrated Parts Catalog (IPC).
- Hazard analysis.
- RAM (reliability and maintainability) study.

5. Development

Periodic inspection and maintenance schedules should be developed taking into account inspection and maintenance interval recommendations based on:

- RAM studies performed on the equipment during its development
- Original equipment manufacturer (OEM) recommendations
- Warranty considerations
- Subject matter expert (SME) input
- Maintenance history of similar equipment
- Engineering input
- Legal considerations
- Regulatory requirements

5.1 Building an inspection and maintenance schedule with OEM or RAM recommendations

Approaches to inspection and maintenance schedules should be developed for programs such as reliability centered, predictive, preventative and corrective, as determined by the RTS.

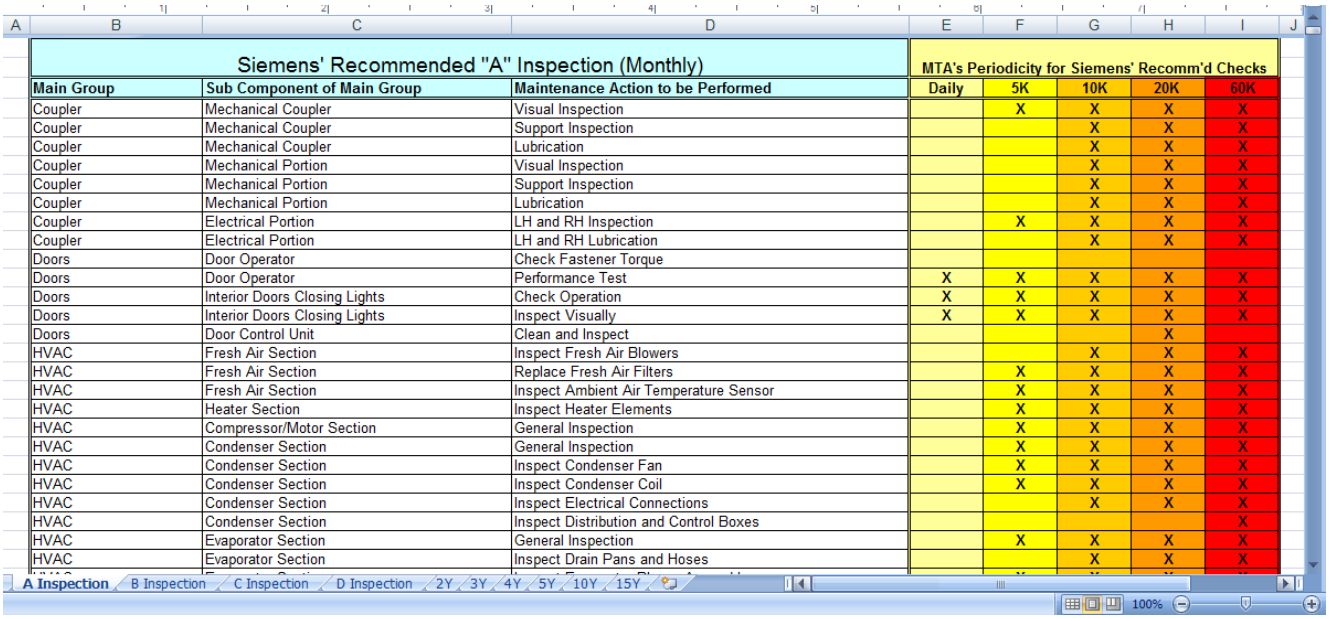
Schedules should be developed using RAM and OEM information regarding intervals for inspection and maintenance. Identify and record all suggested component, sub-component, system and sub-system maintenance tasks required for a particular inspection type.

See Figure 1. All suggested component, sub-component, system and sub-system maintenance requirements for the recommended inspection (“A” inspection, in this example) are listed.

Based on the OEM recommendations, RAM data, SME input, historical data, engineering input, regulatory, legal requirements and warranty considerations, the columns to the right of the systems and subsystems represent each RTS-assigned inspection and maintenance interval for the fleet. These RTS inspection intervals are subject to adjustment to best suit agency conditions.

Some equipment, such as hi-rail equipment and track equipment, will not include RAM studies and may only include the inspection and maintenance interval recommendations of the sub-component suppliers, if anything. In either event, the creation of a spreadsheet is useful in tracking RAM, OEM and sub-supplier recommendations to the initial inspection and maintenance interval sheet.

FIGURE 1
Example Inspection Data Spreadsheet



Siemens' Recommended "A" Inspection (Monthly)			MTA's Periodicity for Siemens' Recomm'd Checks				
Main Group	**Sub Component of Main Group**	**Maintenance Action to be Performed**	**Daily**	**5K**	**10K**	**20K**	**60K**
Coupler	Mechanical Coupler	Visual Inspection		X	X	X	X
Coupler	Mechanical Coupler	Support Inspection			X	X	X
Coupler	Mechanical Coupler	Lubrication			X	X	X
Coupler	Mechanical Portion	Visual Inspection			X	X	X
Coupler	Mechanical Portion	Support Inspection			X	X	X
Coupler	Mechanical Portion	Lubrication			X	X	X
Coupler	Electrical Portion	LH and RH Inspection		X	X	X	X
Coupler	Electrical Portion	LH and RH Lubrication			X	X	X
Doors	Door Operator	Check Fastener Torque					
Doors	Door Operator	Performance Test	X	X	X	X	X
Doors	Interior Doors Closing Lights	Check Operation	X	X	X	X	X
Doors	Interior Doors Closing Lights	Inspect Visually	X	X	X	X	X
Doors	Door Control Unit	Clean and Inspect				X	
HVAC	Fresh Air Section	Inspect Fresh Air Blowers			X	X	X
HVAC	Fresh Air Section	Replace Fresh Air Filters		X	X	X	X
HVAC	Fresh Air Section	Inspect Ambient Air Temperature Sensor		X	X	X	X
HVAC	Heater Section	Inspect Heater Elements		X	X	X	X
HVAC	Compressor/Motor Section	General Inspection		X	X	X	X
HVAC	Condenser Section	General Inspection		X	X	X	X
HVAC	Condenser Section	Inspect Condenser Fan		X	X	X	X
HVAC	Condenser Section	Inspect Condenser Coil		X	X	X	X
HVAC	Condenser Section	Inspect Electrical Connections			X	X	X
HVAC	Condenser Section	Inspect Distribution and Control Boxes					X
HVAC	Evaporator Section	General Inspection		X	X	X	X
HVAC	Evaporator Section	Inspect Drain Pans and Hoses			X	X	X

5.2 Building an inspection and maintenance schedule without OEM or RAM recommendations

OEM and RAM recommendations, when available, should be used to build inspection schedules. However, when they are not available, inspection and maintenance schedules can be built using inspection and reliability data from similar RTS equipment, sub-component supplier information and subject matter expert input. This method will necessitate heavy post-inspection quality, reliability and engineering oversight to verify whether or not the interval estimates need to be adjusted, and to make new interval recommendations when the original estimates have not provided for the adequate maintenance of the related piece of equipment. A sample fleet should be tested using the intervals developed to determine areas where the initial intervals should be adjusted. A method is to start with safety devices/equipment; braking equipment, stopping mechanisms, propulsion and ancillary equipment; finishing up with hoses, pipes, tanks, wiring, gauges, lighting, indicators, chassis, and cab.

5.3 Types of inspection and maintenance schedule intervals

Inspection and maintenance schedules typically use either distance, calendar time or equipment hours of operation as the units of measure for intervals. Some use combinations of these parameters.

- **Distance based:** As stated, intervals follow set distance requirements. This method has the advantage of allowing for easy "special event" budgeting and for bringing vehicles in for inspection when the designated distance has been travelled. This method does not account for time when a piece of equipment is keyed "on" (powered up), in a ready status, but not moving.

- **Calendar time:** This method follows the time elapsed since a vehicle has been placed in service. One advantage to this approach is that vehicles are inspected at regular intervals, regardless of distance. This method does not take into account service use variations between vehicles run as "trippers" when compared with those used for "regular" service. Also, this method does not account for time when the vehicle is keyed "on" (powered up), in a ready status, but not moving.

- **Equipment hours of operation:** This method tracks the "on" time (powered up) for the equipment and therefore is the only method capturing both the time a vehicle is moving down the tracks and the time that it is in a "ready," keyed-on status, not moving.

5.4 Organizing inspection and maintenance steps for efficiency

After the types of service and intervals of the periodic inspection and maintenance tasks have been determined, list inspection tasks together on the inspection sheet based on inspection action characteristics that will allow for the most efficient and effective completion of the work. Typical grouping can be done by the inspection step's location, power/operational requirements or tools used. There are both safety and efficiency benefits to be gained through the structured organization of inspection steps.

5.5 Standardization of inspections

Additional efficiencies can be achieved through the standardization of inspections across multiple types of vehicles. Inspection groupings can be standardized fleet to fleet, shop to shop, allowing maintainers, to be familiar with the inspection protocols of different fleets or locations.

Standardization of inspections across fleets and locations may promote the ability to standardize inspection times at properties. The standardization of times can be achieved by creating procedural and tracking documentation that detail the work that can consistently be achieved in a shift or regular unit of time. Creating standardized times for the completion of periodic inspections and maintenance allows for greater efficiency in the scheduled use of inspection facilities and personnel.

5.6 Inspection and maintenance on-time performance

RTS should develop an on-time performance criteria for periodic inspection and maintenance schedules. On-time performance requirements are typically tracked as a percentage of the inspection and maintenance intervals such as time, distance, and condition. For example, if the inspection was a 5,000-mile inspection, and the tolerance for on-time performance is 10 percent, then inspections starting between the distances of 4,500 and 5,500 miles are considered to be on time.

5.7 Inspection and maintenance document approval and retention

Federal, state, local and RTS oversight groups, and counsel, will have guidelines that define the retention period and appropriate signatories required to approve the inspection documents. These will be specific to each RTS. Typically these could include appointed representatives from engineering, maintenance, safety, security, quality and, in some instances, law enforcement.

The RTS should develop a hierachial process governing the types of changes required and the level and type of signature needed for approval. Documents that are re-formatted and does not change the intent of the document may require a lower level of authorization, whereas a change to a safety-sensitive process may entail a higher level of authorization.

6. Implementation

The RTS should implement the use of on-track equipment inspection and maintenance procedures. The implementation program may include but not limited to:

- Documentation
- Training
- Scheduling
- On-time performance of periodic inspection and maintenance

6.1 Documentation

The RTS's document control process should ensure that the latest version of the maintenance inspection procedure should be used. Clear documentation of the requirements and parameters of each periodic inspection and maintenance procedure should be readily available to any employee performing the associated task. The mechanism by which the task information is available could be a planned maintenance document, or an electronic device with links to each task.

6.2 Training

The RTS should implement training designed to support the inspection changes.

6.3 Scheduling

The RTS should implement an electronic maintenance tracking system that typically involves initiating a fleet, a series, or a single piece of on-track equipment, corresponding to a series of inspection templates arranged into a schedule. Some type of cross-checking against an electronic scheduling system, which will verify on a regular basis the integrity of the scheduling process, should be developed and used. Pen-and-paper type scheduling systems should also incorporate a regular mechanism that will verify that all on-track equipment is regularly meeting the requirements of the periodic inspection and maintenance schedule.

6.4 On-time performance of periodic inspection and maintenance

The RTS should implement on-time performance requirements over the periodic inspection and maintenance program. This statistic should be tracked within any periodic inspection and maintenance program.

7. Contractor on-track equipment

Contractors should be required to demonstrate that their equipment can pass an RTS daily safety test, based upon similar equipment already in use by the RTS. Contractors should also be required to perform a daily safety test on days when the equipment will be in use, and they must be able to demonstrate that the required inspection and maintenance of the equipment has been performed, documented, and approved by the RTS.

8. Quality assurance

The RTS should ensure quality assurance processes are used in the development, implementation, review, and approval of periodic inspection and maintenance programs. The outcome of a quality assurance program is to ensure equipment reliability goals are achieved.

9. Engineering

The RTS may engage engineering personnel in determining solutions to recurring periodic inspection and maintenance issues, and in identifying reliability issues that may have periodic inspection and maintenance root causes or solutions.

10. Quality control

The RTS should use quality control processes in the periodic verification of inspection and maintenance completion and the validation that the tasks are being completed as written in the inspection and maintenance tasks' descriptions.

Related APTA standards

APTA RT-OP-S-021-15 (Published October 30, 2015) - *Standard for On-Track Equipment Safety Requirements*

References

None at this time.

Definitions

On–track equipment (OTE) - A rail mounted vehicle or equipment including high-rail vehicle and equipment that is not used for revenue service but is used to inspect, maintain and repair the rail system.

Rail transit system (RTS) – The organization that operates rail transit service and related activities. Also known as the transit system, transit agency, operating agency, operating authority, transit authority and other similar terms.

Abbreviations and acronyms

FMEA	failure mode and effects analysis
FMECA	failure mode and effects criticality analysis
FRA	Federal Railroad Administration
NATSA	North American Transportation Services Association
OEM	original equipment manufacturer
OTE	on-track equipment
RAM	reliability and maintainability
RTS	rail transit system
SME	subject matter expert

Summary of document changes

This is a new document – hence no previous changes.

Document history

Document Version	Working Group Vote	Public Comment/ Technical Oversight	Rail CEO Approval	Rail Standards Policy & Planning Approval	Publish Date
First published	July 14, 2017	August 1, 2017	Sept. 18, 2017	November 2, 2017	December 6, 2017