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STANDARD

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Vehicle Inspection and Maintenance (VIM)
Working Group

Friction Brake Equipment Periodic Inspection and Maintenance

Abstract: This standard gives the minimum requirements for the periodic inspection and maintenance of brake cylinders, tread brake units, disc brake units, brake discs, tread brake shoes, disc brake pads and track brakes as used on rail transit vehicles.

Keywords: brake discs, disc brake pads, disc brake units, periodic inspection and maintenance, track brakes, tread brake shoes, and tread brake units

Summary: This document establishes a standard for the minimum inspection and maintenance requirements for friction brake equipment for rail transit vehicles. It covers brake cylinders, tread brake units, disc brake units, brake discs, tread brake shoes, disc brake pads and track brakes inspection.

Scope and purpose: This standard shall be used in conjunction with the rail transit system's instructions and original equipment manufacturer (OEM) recommendations to perform periodic inspection and maintenance of rail transit vehicles. This standard is intended for use by rail transit systems to apply basic procedures to perform periodic inspection and maintenance of brake cylinders, tread brake units, disc brake units, brake discs, tread brake shoes and disc brake pads for rail transit vehicles.

This document represents a common viewpoint of those parties concerned with its provisions, namely operating/planning agencies, manufacturers, consultants, engineers and general interest groups. The application of any standards, recommended practices or guidelines contained herein is voluntary. In some cases, federal and/or state regulations govern portions of a transit system's operations. In those cases, the government regulations take precedence over this standard. The North American Transit Service Association (NATSA) and its parent organization APTA recognize that for certain applications, the standards or practices, as implemented by individual agencies, may be either more or less restrictive than those given in this document.

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Participants

The American Public Transportation Association greatly appreciates the contributions of the **APTA Rail Transit Standards Vehicle Inspection and Maintenance (VIM) Committee**, 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*

David Barber, *Transportation Resource Associates*
Chris Barbour, *Dellner*
Steve Bethel, *RATP-Dev America*
Jerry Blackman, *Miami-Dade Transit*
Stephen Bonina, *Stadler USA*
Timothy Borchers, *SNC-Lavalin Rail & Transit*
John Condrasky, *Wabtec Corporation*
Richard Curtis, *Curtis Engineering Consulting*
Henry Davis Jr., *SEPTA*
Paul Denison, *Sound Transit*
Philip Eberl, *Regional Transportation District*
Marc Gagné, *TDG Transit Design Group*
Michael Ghobrial, *LTK Engineering Services*
Daniel Gornstein, *Nippon Sharyo USA*
John Green, *BEA/Sensorio*
Scott Grogan, *METRO of Harris County*
Benjamin Holland, *BART*
Anthony Jones, *METRO Regional Transit Authority*
John Kesich, *MTA Metro-North Railroad*

Henry Kolesar, *BART*
Paul Kovacs, *Linvale Engineering and Machining*
John Macewen, *SEPTA*
Kenneth Morford, *WMATA*
Larry Nye, *Port Authority of Allegheny County*
Richard Seaton, *TDG Transit Design Group*
Melissa Shurland, *FRA*
Jim Skaggs, *International Electronic Machines*
Bill Steinmetz, *Port Authority of Allegheny County*
Narayana Sundaram, *ENSCO*
Michele Swayzer, *Swayzer Engineering*
Thomas Tarantino, *Dellner*
Brian Turner, *Transportation Learning Center*
Wilson Wallace, *Maryland Transit Administration*
Michael Wetherell, *Metropolitan Transit Authority*
Daniel Wilson, *Miami-Dade Transit*
Clifford Woodbury, *LTK Engineering Services*
Hannie Woodson Jr., *Hitachi Rail USA*
Robert Young, *Bombardier*

Project team

Charles Joseph, *APTA*

Introduction

This introduction is not part of APTA RT-S-VIM-007-02, Rev. 3, "Friction Brake Equipment Periodic Inspection and Maintenance."

This standard represents a common viewpoint of those parties concerned with its provisions, namely, transit operating/planning agencies, manufacturers, consultants, engineers and general interest groups. 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 this standard. 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 standard describes the basic maintenance and inspection requirements for the friction brake equipment as used on rail transit vehicles. APTA recommends the use of this standard by:

- Individuals or organizations that maintain brake cylinders, tread brake units, disc brake units, brake discs, tread brake shoes, disc brake pads and track brakes on rail transit vehicles;
- Individuals or organizations that contract with others for the maintenance of brake cylinders, tread brake units, disc brake units, brake discs, tread brake shoes, disc brake pads and track brakes on rail transit vehicles; and

Individuals or organizations that influence how brake cylinders, tread brake units, disc brake units, brake discs, tread brake shoes, disc brake pads and track brakes are maintained on rail transit vehicles.

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).

Friction Brake Equipment Periodic Inspection and Maintenance

1. Frequency of conduct

Periodic inspection and maintenance tasks on friction brake equipment shall be performed on a regular schedule as determined by the rail transit system (RTS). The frequency of any task contained within this standard shall comply with all applicable federal, state and local regulations. Further, in the conduct of a rail transit system's periodic inspection and maintenance programs, frequencies for individual tasks shall be established based on a number of additional factors, including but not limited to:

- OEM-recommended intervals;
- industry experience;
- operating environment/conditions;
- historical data;
- performance requirements;
- failure analysis;
- RTS's testing and experience; and
- Reliability-centered maintenance programs.

2. Requirements and specific tasks

WARNING: Ensure that equipment is secured against uncontrolled movement in accordance with RTS safety procedures before commencing inspection and maintenance procedures. During inspection and maintenance tasks, the brakes may be cycled ON and OFF; ensure that safe operating and maintenance procedures are observed. If any corrective or preventative procedures are required, ensure that brakes are cut out before performing any work.

2.1 Materials

Use materials as recommended by the OEM and in accordance with RTS approved procedures.

2.2 Tools

Use tools as recommended by the OEM and/or in accordance with the RTS approved procedures.

2.3 Safety/personal protective equipment

Appropriate personal protective equipment (PPE) meeting minimum ANSI standards, and as required by the RTS, shall be worn at all times in the performance of these inspection and maintenance tasks.

2.4 Training requirements

Rail transit systems 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 program shall include training as determined by the RTS and in accordance with regulatory requirements.

2.5 Inspection and maintenance

In all of the following procedures, the OEM's maintenance manuals shall be referred to for such items as torque values, voltage settings, condemning limits, clearance measurements and specific procedure methodology.

Devices must be cleaned for proper inspection. These procedures cover only the visible inspection, adjustments and functional testing. Methodologies for the resolution of deficiencies noted while performing these procedures must be tailored by the individual property in conjunction with the OEM's recommendations.

Documentation of the inspection and maintenance process as to interval, deficiencies and resolution of those deficiencies found shall be done in a comprehensive manner so as to create a useful database, which will enhance the reliability and accountability of the process.

2.5.1 Cab brake control equipment (visual/audible and operational inspection)

1. Inspect cab brake equipment for damage, leaks, or loose components. Correct any damage or leaks found and secure loose components. Refer to OEM.
2. Verify that cab gauges are readable and within their calibration period.
3. Apply and release the brakes and verify operation for:
 - proper operation of the master controller or brake valve;
 - no binding of the handle;
 - proper brake cylinder gauge indication; and
 - proper function of brake status indicating lights.
4. Apply a service brake application and verify proper brake cylinder pressure or indication.
5. Apply an emergency brake application and verify proper brake cylinder pressure or indication.
6. Lubricate the brake valve or master controller as recommended by the OEM and in accordance with RTS procedures.
7. Operate all emergency and penalty brake initiating devices in the cab and verify proper operation.

2.5.2 Brake control equipment (visual/audible and operational inspection)

1. Inspect air brake operating control equipment for damage, leaks, or loose components. Correct any damage or leaks found and secure loose components. Refer to OEM.
2. Verify proper position of all cutout valves and seals as required.
3. Inspect brake control unit for damaged or loose components and air leaks. Correct any damage found and secure loose components. Refer to OEM.
4. Inspect hydraulic pressure control unit for damaged or loose components, hydraulic leaks and fluid level. Correct any damage found, secure loose components, and refill and bleed as required. Refer to OEM.
5. Inspect mounting hardware, torque stripes and safety/tamper proof seals. Repair or replace as required.
6. Inspect the hydraulic accumulator for damaged or loose components. Pressure-test the accumulator as recommended by the OEM.
7. Clean or replace filters/breathers as recommended by the OEM and in accordance with rail transit system procedures.
8. Verify operation of trip valve/trip switch, if equipped, and lubricate as recommended by the OEM.
9. Verify proper pressure with a test gauge in all modes of brake and release conditions.
10. Perform self-tests and verify proper brake operation.
11. Review on-board recording equipment for recorded faults.

2.5.3 Hand brake equipment/parking brake equipment (visual/audible and operational inspection)

1. Inspect hand brake equipment/parking brake equipment for damage, leaks, or loose components. Correct any damage or leaks found and secure loose components. Refer to OEM.
2. Apply and release the hand brake equipment/parking brake equipment; verify proper operation and inspect for interference and damage.
3. Lubricate the hand brake equipment/parking brake equipment as recommended by the OEM and in accordance with the RTS procedures.
4. Verify manual quick-release mechanism.

2.5.4 Tread brake equipment (visual/audible and operational inspection)

1. Inspect brake cylinder or tread brake units for damage, leaks, loose or missing components and mounting hardware. Correct any damage or leaks found; secure loose and replace missing components. Refer to OEM.
2. Inspect brake lines and hoses for leaks, longitudinal cracks, mounting and chafing. Repair/replace as required.
3. Inspect for missing tread brake shoes and replace all missing tread brake shoes.
4. Inspect the thickness of the tread brake shoes. Replace the tread brake shoe if remaining wear material is less than the condemning limit established by the RTS to ensure that there will be useful life to the next inspection interval. Make sure that the brake shoe key is fully inserted through the brake shoe key slot.

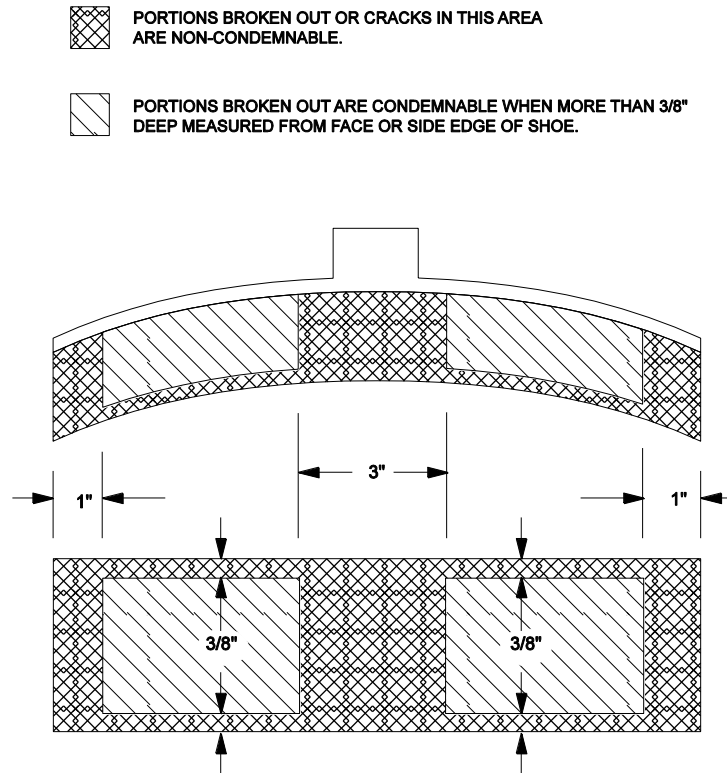
NOTE: Because of taper of the wheel tread, care must be taken to ensure that the inspection measurement is performed at the thinnest point of the brake shoe.

5. Inspect tread brake shoes for broken or missing friction braking material. **Figure 1** shows inspection criteria. If the tread brake shoe is found condemnable, replace.
6. During tread brake shoe replacement, the brake shoe key is to be inspected and replaced if broken, worn or damaged. Ensure that any brake shoe keys replaced are secured in place.
7. Apply and release the brakes and verify operation for:
 - proper operation of the brake cylinders or tread brake units per the OEM;
 - proper piston travel per the OEM
 - no indication of binding or fouling of the tread brake equipment levers and/or pins.
8. Lubricate the brake cylinder levers or linkages as recommended by the OEM and in accordance with RTS procedures.

FIGURE 1

Tread Brake Shoe Condemning Limits

Note: Figure 1 shows the standard condemning limits for tread brake shoes unless a different criteria is specified by the OEM or by RTS procedures



2.5.5 Disc brake equipment (visual/audible and operational inspection)

1. Inspect disc brake units for damage, leaks, loose or missing components. Correct any damage or leaks found and secure loose and replace missing components. Refer to OEM.
2. Visually inspect brake lines and hoses for leaks, longitudinal cracks, mounting and chafing; repair as required.
3. Apply and release the brakes and verify operation for:
 - proper operation of the disc brake unit per OEM;
 - proper piston travel per the OEM
 - no indication of binding or fouling of the disc brake unit's levers and/or pins.
4. Lubricate the disc brake unit as recommended by the OEM and in accordance with RTS procedures.
5. Inspect the brake disc faces for damage, cracks or nicks along the outer periphery of the brake disc. Some radial and thermal checks and cracks occur during operation. Refer to the OEM for condemning and inspection requirements.
6. Inspect the hub for lateral movement on axle seat, cracks, broken or missing tangs, or damage. Refer to the OEM for condemning and inspection recommendations.
7. Inspect brake disc mounting hardware, such as bolts, nuts, washers and retaining mechanisms, for proper attachment. Refer to the OEM for condemning and inspection recommendations.
8. Measure the brake disc at the greatest wear locations for proper thickness and improper wear patterns such as scoring or excessive dishing. Refer to the OEM for condemning and inspection recommendations and in accordance with RTS procedures.



9. Inspect the brake disc for any fin obstructions or damage. Refer to the OEM for condemning and inspection recommendations
10. Inspect for missing disc brake pads. Replace missing disc brake pads and ensure that the disc brake pad is properly secured. Note: Repair/replace damaged brake equipment as a result of a missing brake pad in accordance with OEM or RTS procedures.
11. Inspect the thickness of the disc brake pads. Replace the disc brake pad if remaining wear material is less than the condemning limit set by the RTS to ensure that there will be useful life to the next inspection interval. Ensure that the disc brake pad is properly latched and/or secured. Note: Uneven pad wear may be the result of caliper failure. Refer to OEM manual or RTS procedures for further evaluation.

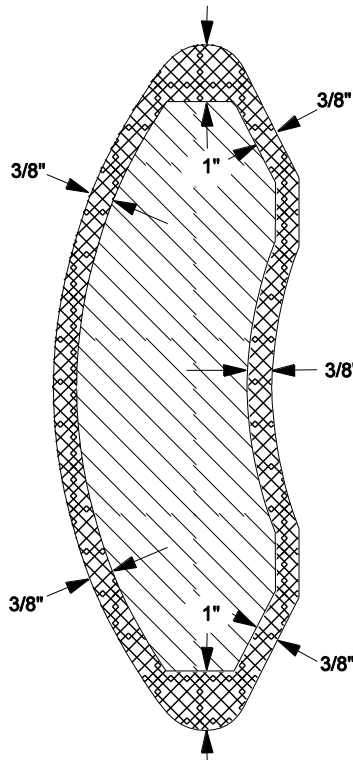
NOTE: Because of taper wear, care must be taken to ensure that the inspection measurement is performed at the thinnest point of the disc brake pad.

12. Inspect disc brake pad for broken or missing friction braking material. **Figure 2** shows inspection criteria. If the disc brake pad is found condemnable, measure the dishing of disc, replace the disc brake pad. Make sure that the brake pad is properly secured.
13. During disc brake pad replacement, the disc brake pad securing mechanism shall be visually inspected and replaced if broken, worn, or damaged.
14. Inspect disc brake unit for worn bushings and pins. Refer to OEM for condemning and inspection recommendations.

FIGURE 2
Disc Brake Pad

Note: Figure 2 shows the standard condemning limits for disc brake pads unless different criteria is specified by the OEM or by RTS procedures

-  PORTIONS BROKEN OUT OR CRACKS IN THIS AREA ARE NON-CONDEMNABLE.
-  PORTIONS BROKEN OUT ARE CONDEMNABLE WHEN MORE THAN 1/4" DEEP MEASURED FROM FACE OR 3/8" FROM SIDE EDGE OF PAD.



2.5.6 Track brake equipment

1. Inspect for slag buildup on the contact surface. Remove slag buildup if found.
2. Inspect components for proper attachment, signs of damage or corrosion, or missing parts. Correct any damage found, and secure loose and replace missing parts. Refer to the OEM.
3. Inspect magnet contact surface height with approved gauge, and adjust suspension as necessary. Refer to the OEM.
4. Inspect electrical cable connections for cracks, kinks and abrasions. Repair/replace as required.
5. Inspect pole shoes for wear. If wear is beyond condemning limits, replace pole shoe. Refer to the OEM, and comply with RTS procedures.
6. Inspect condition of suspension and related components. Replace as required.
7. Inspect track brake stops for looseness or damage. Check buffer pads for wear, and replace as required.
8. Inspect condition of compression spring. Replace as required. Refer to OEM.
9. Inspect attaching bolts and ensure that locking wire or cotter pin, if used, is securely attached. Replace as required.
10. Verify proper operation of track brakes and suspension by energizing and de-energizing the track brake.

11. Verify all light annunciations where applicable.

2.6 Correction of deficiencies

Any deficiencies uncovered during the inspections required in Section 2.5.1 through 2.5.6 shall be corrected and documented in accordance with the RTS procedures and OEM recommendations.

Definitions

brake control unit: A device that controls and transmits pressure to brake units in response to control commands.

brake cylinder: A cylinder in which compressed air acts on a piston that transmits the force of the compressed air to the associated brake rigging.

brake disc: A circular solid or finned plate that rotates with respect to the disc brake pads that are brought into contact with it to provide retarding force. Usually mounted to the wheel, hub or axle. Also known as a friction ring.

brake head: A holder that carries the detachable brake shoe or brake pad.

brake shoe key: A key by which a brake shoe is fastened to a brake head.

caliper: The assembly on disc brakes that holds the disc pads and straddles the disc.

disc brake pad: A replaceable friction element secured to a brake head for the purpose of producing a retarding force onto the face of a disc.

disc brake unit: A friction brake in which the brake pads create retarding force by rubbing on a separate disc or discs mounted on the wheel hub or the axle.

dishing: the amount of concavity of the surface of a brake disc due to wear.

hydraulic pressure control unit: A device that controls and transmits hydraulic pressure to disc brake units in response to control commands.

track brake: A magnetic friction brake that compresses against the running rail and is activated by an electrical signal.

tread brake shoe: A replaceable friction element secured to a brake head for the purpose of producing a retarding force onto the tread of the wheel.

tread brake unit: A friction brake in which the brake shoes create retarding force by rubbing on the wheel treads.

Abbreviations and acronyms

ANSI	American National Standards Institute
NATSA	North American Transportation Services Association
OEM	original equipment manufacturer

Summary of document changes

- Committee membership updated.
- Added one new section at the end of the document ‘Summary of Changes’.
- Deleted reference to BCU (Brake Control Unit) in the Abbreviations and Acronyms section as it is not used in the document.
- Some global changes to section headings and numberings resulted when sections dealing with references and acronyms were moved to the end of the document.
- There were other cosmetic changes, such as capitalization, punctuation, spelling and grammar.

Document history

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First Published	April 9, 2002	-	Sept. 12, 2002	Sept. 22, 2002	Sept. 22, 2002
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