APTA STANDARDS DEVELOPMENT PROGRAM
RECOMMENDED PRACTICE
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Bus Transit Standards Brake System Working Group

Transit Bus Brake Shoe Rebuild

Abstract: This *Recommended Practice* provides guidelines for rebuilding brake shoes, including the disassembly, preparation, inspection and assembly of brake shoes.

Keywords: bolted block, bonded block, bonded brake, brake, brake block, brake shoe, brake shoe roller, brake rebuild, brake reline, rebuild, riveted block, riveted brake

Summary: This document establishes a recommended practice for brake shoe rebuild. Individual operating agencies may modify these guidelines to accommodate their specific equipment and mode of operation. This *Recommended Practice* is to be used in conjunction with the original vehicle equipment manufacturer and brake manufacturer service manuals.

Scope and purpose: This *Recommended Practice* provides guidelines for air drum brake shoe disassembly, preparation, inspection and assembly for heavy-duty transit bus vehicles. This document addresses both steel and cast iron shoes. This document does not cover system maintenance or repairs. The removal and installation of brake shoes from the vehicle are covered in documents referenced with the keyword "brake." The tables and examples in this document are for commonly used transit applications. Not all brakes are included. The purpose of this *Recommended Practice* is to provide a uniform method for brake shoe rebuild. Proper brake shoe rebuild can restore brake performance.

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List of Figures and Tables

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Introduction

This introduction is not part of APTA BTS-BC-RP-003-07, Rev. 1, "Transit Bus Brake Shoe Rebuild."

This *Recommended Practice* reflects the consensus of the APTA Bus Standards Program members on the items, methods and procedures that have provided the best practice based on the experiences of those present and participating in meetings of the program task forces and working groups. *Recommended Practices* are voluntary, industry-developed and consensus-based practices that assist equipment suppliers, vehicle and component manufacturers, and maintenance personnel in the construction, assembly, operation and maintenance of transit bus vehicles. *Recommended Practices* may include test methodologies and informational documents. *Recommended Practices* are non-exclusive and voluntary; they are intended to neither endorse nor discourage the use of any product or procedure. All areas and items included herein are subject to manufacturers' supplemental or superseding recommendations. APTA recognizes that for certain applications, these practices as implemented by operating agencies may be either more or less restrictive than those given in this document.

This *Recommended Practice* provides guidelines for transit bus brake shoe rebuild. APTA recommends the use of this *Recommended Practice* by:

- individuals or organizations that inspect and maintain transit buses;
- individuals or organizations that contract with others for the inspection and maintenance of transit buses; and
- individuals or organizations that influence how transit buses are inspected and maintained.

Test results must meet or exceed federal, state or other local regulatory agency requirements if different from the recommendations outlined in this document.

Transit Bus Brake Shoe Rebuild

1. Safety provisions

Failure to comply with the safety provisions in this section can result in personal injury or death.

1.1 Dust control

Although the health impact of non-asbestos fibers (such as brake blocks with glass, mineral wool, ceramic or carbon fibers) is not specifically covered under current Occupational Safety and Health Administration (OSHA) regulations, transit agencies should take all the necessary precautions prescribed by OSHA for dust control and follow all federal, provincial/state and local laws.

> **HAZARDOUS MATERIAL WARNING:** If there is any uncertainty regarding brake block composition, then follow OSHA regulations for handling asbestos.

Material safety data sheets (MSDS) on brake blocks, as required by OSHA, are available from the manufacturer.

1.2 Personal protective equipment

Personal protective equipment should be worn at all times during the rebuild process as required by the operating agency.

Wear a respirator approved by the National Institute for Occupational Safety and Health (NIOSH) or the Mine Safety and Health Administration (MSHA) during all brake service procedures.

1.3 Training

The operating agency and/or its maintenance contractors should develop and execute training programs that provide employees with the knowledge and skills necessary to perform the tasks outlined in this *Recommended Practice* safely and effectively.

1.4 Tools

The following tools are recommended for the procedures in this document:

- Stretch gauge
- Web gauge
- Rivet-bolt hole gauge
- Shoe table thickness gauge
- Anchor pin hole gauge
- Table arc gauge
- Additional tools as recommended by the OEM or as used by the transit industry

2. Shoe preparation for inspection

2.1 Block removal

Remove excessive grease and contaminants using OSHA-approved procedures from the brake shoe prior to removal of block. Remove the block from the brake shoe while taking care not to damage the shoe.

2.1.1 Bolted block

There are various methods for removing bolted block from the shoe. The order of preference for maintaining shoe integrity is as follows:

- Unbolting.
- Over-torque (solid brass bolts only; not for brass-coated steel bolts). This procedure breaks the fasteners by over-tightening them. Over-torqueing steel bolts may damage the shoe.
- Shearing (individually or machine).

CAUTION: Improper shearing of block may result in excess pressure being placed against the bolt holes, thus causing oversized or egg-shaped bolt holes and raising of the metal around the hole. The raised metal around bolt holes can damage the brake block when it is bolted to the shoe or during brake application. Improper machine shearing may damage the shoe table or webs. To avoid damaging the shoe table or web, make certain that the chisel or brake block removal machine blades are kept sharp.

2.1.2 Riveted block

There are various methods for removing riveted block from the shoe. The order of preference for maintaining shoe integrity is as follows:

- punching
- drilling
- shearing (individually or machine)

CAUTION: Improper shearing of block may result in excess pressure being placed against the rivet holes, thus causing oversized or egg-shaped rivet holes and raising of the metal around the hole. The raised metal around rivet holes can damage the brake block when it is riveted to the shoe or during brake application. Improper machine shearing may damage the shoe table or webs. To avoid damaging the shoe table or web, make certain that the chisel or brake block removal machine blades are kept sharp.

2.1.3 Bonded block

Removing bonded block is a specialized process that should be performed by a qualified vendor only.

2.2 Cleaning

1. Remove the brake shoe rollers from the brake shoe.
2. Remove all rust from the brake shoe surface. Abrasive blasting is preferable; however, if using a wire brush, be certain to remove all rust and scale from the brake shoe surface.

NOTE: Use steel shot size 0.15 to 0.35 in. to remove all residue. When using a tumbler-type blaster, make sure that the tumbler is filled with shoes to minimize damage to the shoes.

3. Inspection

Inspect the brake shoe assembly for wear and distortion after cleaning. In order to obtain maximum brake performance, the geometry of the brake shoe must fit the brake drum and the brake spider.

If the shoe does not meet the tolerances criteria, then discard the shoe.

Brake shoe rejection should be documented on a form similar to the example in Appendix A. This can assist in identifying maintenance and quality problems.

FIGURE 1
Typical Brake Shoe Gauge

The tools used in the inspection of the brake shoe (**Figure 1**) are available from various manufacturers. Contact a brake component supplier for a list of companies that can supply the tools shown in this procedure.

3.1 Checking for stretch

Check both sides of the shoe for stretch. A stretched brake shoe will not allow the brake block to properly mate with the shoe table. A stretched shoe may result in reduced braking performance and a cracked brake block. Excessive bushing wear can affect this inspection procedure. This step does not apply to wedge brakes.

A stretch gauge is the recommended method to measure the shoe.

1. Place the large end of the stretch gauge (**Figure 2**) into the anchor end of the shoe.
2. Rotate the small end of the gauge into the roller cup.
3. If the small end of the gauge does not fit into the roller cup, then the shoe must be replaced.
4. It is recommended to repeat the stretch test after replacing bushing.

FIGURE 2
Stretch Gauge

3.2 Check for table flatness

Check the shoe table for flatness. A shoe that is not flat will not allow the brake block to properly mate with the shoe. This can result in irregular wear and a cracked or broken block.

1. Place a straight edge across the brake surface of the shoe table, as shown in **Figure 3**.
2. Discard the brake shoe if a 0.010 in. feeler gauge can be inserted between the outer edges of the shoe and the straight edge.
3. Discard the brake shoe if a 0.025 in. feeler gauge can be inserted between the center of the shoe and the straight edge.
4. Check the shoe table at three locations (anchor end, center and cam end).

FIGURE 3
Measurement of Shoe Flatness

3.3 Check web for distortion

Check the web for distortion. Use of shoes with spread webs can result in irregular wear on both the shoe and the foundation brake components. It can also reduce brake performance.

FIGURE 4
Using a Go/No-Go Gauge

1. Use a go/no-go gauge as shown in **Figure 4**, or an accurate measuring device, such as Vernier calipers, to measure the web for distortion.
2. Measure the full length of the web.
3. The distance between the webs of the shoe, and the distance between the ears at the anchor pin end, must not exceed the dimensions specified in **Table 1**.

TABLE 1
Shoe Table Web Tolerances for Stamped Steel Shoes[1]

Brake size (in.)	Maximum inner distance between webs on cam end	Maximum outer distance between webs on anchor end
14.5 × 6 W	0.855 in.	1.970 in.
14.5 × 10 W type 1 and 3	1.395 in.	2.167 in.
14.5 × 10 W type 2	1.520 in.	2.914 in.
15 and 16.5 Q-Plus	1.550 in.	1.550 in.

1. Reference OEM maintenance manuals for illustrations.

3.4 Check table arc

Check the shoe table for proper arc. A shoe that does not have a suitable arc will not allow the brake block to properly mate with the shoe and the shoe with the drum. This can result in irregular wear and a cracked or broken block.

1. Place a suitable arc gauge on the center of the shoe table, as shown in **Figure 5**.
2. Try to insert a 0.030-in. feeler gauge between the shoe table and the arc gauge. If there is an opening through which a 0.030-in. feeler gauge can be inserted, then replace the shoe. Do not attempt to salvage.
3. Repeat steps 1 and 2 on both outer sides of the shoe.

FIGURE 5
Table Arc Measurement

3.5 Check table thickness

Check the brake shoe table thickness. Each manufacture's shoe may have a different thickness, so care must be taken to select the proper gauge for determining this wear. A thin shoe table may cause uneven wear of the block and poor drum-to-shoe contact.

- Attempt to insert a suitable gauge (see **Table 2**) over the shoe table. An example is shown in **Figure 6**.
- If the shoe table slides into the gauge, then discard the shoe.

TABLE 2
Recommended Shoe Dimensions for Stamped Steel Shoes

Type	Dimension (in.)
S-Cam Q Plus	0.171
S-Cam W Brake	0.186
Wedge RDS	0.216

FIGURE 6
Measuring Stamped Steel Shoe Table Thickness

3.6 Check bolt/rivet holes

Check the bolt/rivet holes. Shoes with bolt/rivet holes that are elongated or damaged should be discarded. Use of shoes with large or distorted bolt/rivet holes, burrs or raised areas may result in a cracked or broken block.

NOTE: This is especially true with cast shoes, as the metal can deform, creating an opening that will result in a loose rivet.

1. Insert a go/no-go gauge into each bolt/rivet hole as shown in **Figure 7**.
2. The gauge should fit snugly in the hole. Discard any shoe with enlarged or distorted holes.

FIGURE 7
Bolt/Rivet Hole Measurement

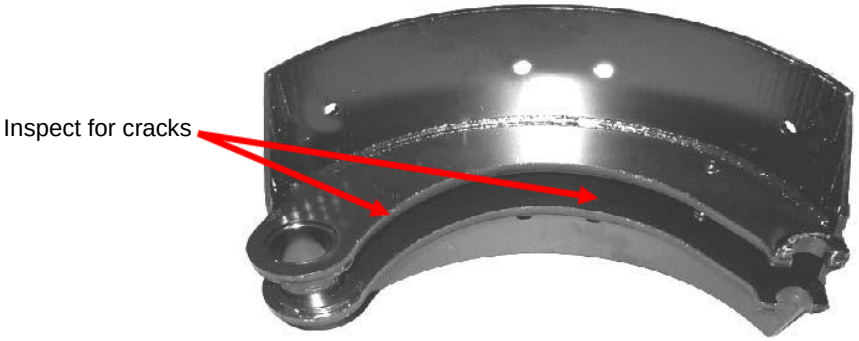
GOOD BAD

3.7 Check for cracked welds

Visually check the web-to-table welds for cracks, as shown in **Figure 8**. A broken weld or crack can result in irregular wear, a broken or cracked block, and poor brake performance. Discard shoe if any cracks are found.

CAUTION: Do not attempt to repair the shoe.

FIGURE 8
Shoe Weld Inspection

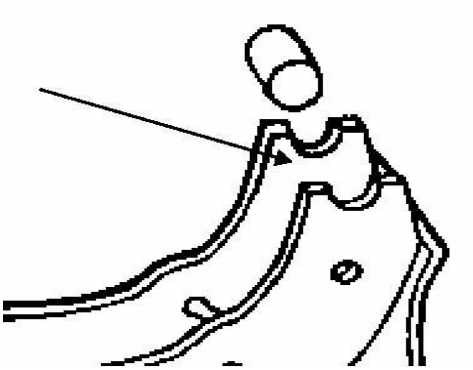


3.8 Check roller seat

Check roller seat (see **Figure 9**) for the following:

1. Wear
2. Out-of-roundness
3. Flared condition

FIGURE 9
Roller Seat



Worn roller seats can cause uneven braking and damage to S-cams.

3.9 Check return spring pin

Inspect the brake shoe for return spring pin wear, damage or looseness. If the pin is missing or loose, then check holes with a new pin. Discard the shoe if the new pin is loose. If serviceable, follow the replacement procedure in Section 6.

IMPORTANT: Wedge-style and Q Plus brake shoe pins are designed to be loose.

3.10 Inspect cast iron shoes

Cast iron shoes can and will exhibit wear and damage that will result in the shoes being rejected for rebuild. Like pressed steel shoes, the standard criteria, such as stretch, spring pin and roller pocket wear, should be inspected. Additional items that are exhibited in cast shoes are as follows (see **Figure 10**).

3.10.1 Broken casting

Check for cracks and obvious broken casting.

3.10.2 Rust jacking

Rust jacking or excessive rust will result in table wear and distortion of the rivet holes. The table surface of the shoe should be flat, and the rivet holes must be round with no elongation.

3.10.3 Roller pocket wear

Excessive pocket wear will cause a % reduction in the drum to shoe contact. A difference from the top to bottom shoe on pocket wear will cause uneven torque load on the shoe and uneven wear of the brake.

FIGURE 10
Shoe Inspection – Damage


Rust jacking


Broken casting


Roller pocket wear

4. Anchor pin bushing replacement

Replace the anchor pin bushings at each rebuild. Bushing wear increases the spacing between the shoe and the anchor pin. This may affect cam rotation and brake chamber push rod stroke. Worn bushings can cause uneven braking and prevent automatic brake adjusters from maintaining proper push rod travel.

FIGURE 11
Brushing Removal/Installation Tool

Insert a new bushing on the removal/installation tool, as shown in **Figure 11**. Using the proper bushing driver, drive out the old bushing while concurrently inserting the new bushing. It is important to support the web of the brake shoe when installing bushing. Failure to support the web may result in bent, damaged or broken webs. Verify sliding fit of the anchor pin, and ream if necessary.

5. Corrosion inhibitor treatment of brake shoes

After cleaning and inspecting the brake shoe, apply the corrosion inhibitor prior to installation of the brake block.

Minimum specifications for corrosion inhibitor include the following:

- ASTM B117 salt spray test for 96 hours. (It is recommended that properties with operating conditions that are conducive to severe corrosion should consider using a product that passes a 168-hour salt spray test.)
- ASTM D3359 crosshatch adhesion test.

CAUTION: To avoid getting corrosion inhibitor on the working surface of the bushings, mask the bushing with tape or a thin layer of grease, or install the bushing after the corrosion inhibitor process.

6. Install return spring pin

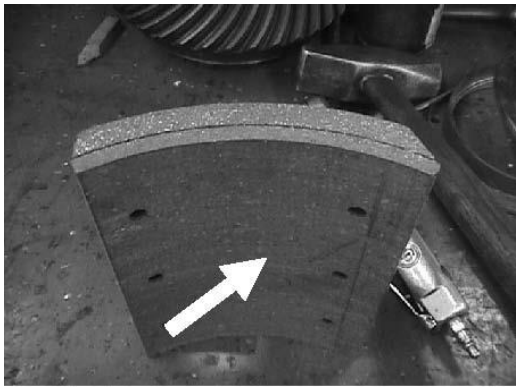
Use a brass hammer to install the brake return spring pin. Do not damage the pin or the shoe. See **Figure 12**.

FIGURE 12
Installation of Brake Shoe Return Spring Pin

7. Brake block installation

Inspect the brake block by visually checking it for cracks, chipped edges and corners, as shown in **Figure 13**. The surface that mounts on the brake shoe table should be clean and free of loose material. Brake blocks that show any sign of damage or imperfection should not be used.

FIGURE 13
Brake Block Inspection



7.1 Combination brake block installation

There are multiple methods of installing combination blocks. Refer to the manufacturer's instructions for your application.

7.2 Brake block fastening procedure

Block and fastening hardware must be compatible.

7.2.1 Installing riveted brake block

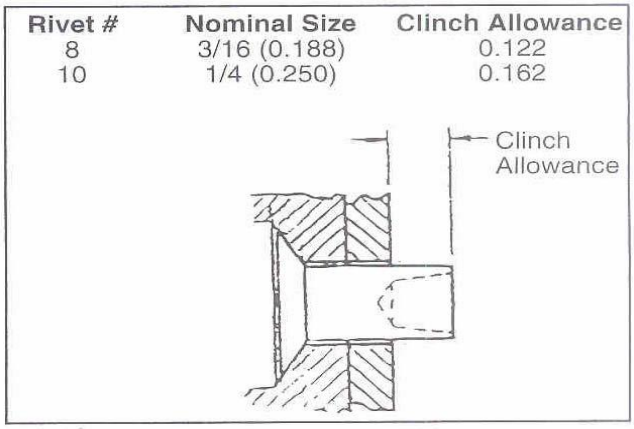
Cracks in the rivet curl can be avoided by doing the following:

- Inspecting and maintaining the rivet setting equipment and tools
- Utilizing brass-plated steel rivets with a wax coating
- Inspecting the concentricity of rivet hole to shank
- Utilizing riveting equipment that compensates for variations in rivets, counter-bores and table thickness

7.3 Rivet lengths

Rivet lengths are measured from the underside of the head to the end of the shank. See **Figure 14** for an example of a rivet length calculation.

FIGURE 14
Rivet Length Calculation



Combined material thickness	.500
Clinch allowance (¼ in.)	+.162
Rivet length	.662 = 11/16 in. long

European brake shoes utilize metric rivets. The OEM brake shoes utilize an 8 mm hollow rivet (see **Figure 15**).

FIGURE 15
8 mm Hollow Rivet

An 8 mm semi tubular rivet can also be used for lining attachment.

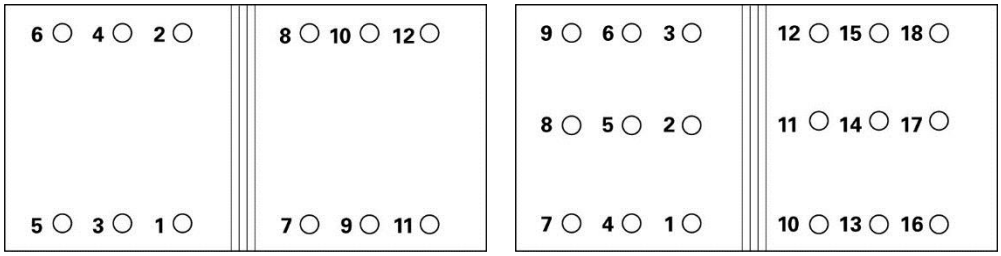
> **NOTE:** An 8 mm rivet requires a riveter with more power than the normal riveter for the 8 and 10 rivets. In addition, a compensator or other means of obtaining the proper clinch is required. See Section 7.3.1.3 for additional information.

The clinch allowance for both the semi-tubular rivet are the same

7.3.1.1 Fastening sequence

Follow the block manufacturer's recommended fastening sequence to minimize the flex on the brake block and thus reduce block breakage. See **Figure 16** for an example of a typical fastening sequence.

FIGURE 16
Typical Fastener Attachment Sequence



7.3.1.2 Rivet installation quality standard and inspection criteria

It is recommended that the quality of the riveting be checked at regular intervals. One quality control method is to inspect every 20th shoe.

To test rivet tightness, attempt to manually turn the rivet. One method is to use a screwdriver bit or a bolt extraction tool and a small torque wrench to try to turn rivets (from the underside of the shoe). If any of the rivets turn at less 32 inch pounds, then that shoe and the 19 previous need to be fully inspected and possibly reworked. Riveting equipment must be inspected and corrected before proceeding.

FIGURE 17
Ideal Rivet Installation Condition

A single hairline radial crack, provided it does not extend into the solid or "hole" portion of the rivet shank, is acceptable.

Any of the following are unacceptable (see **Figure 18**):

- Non-radial cracks
- "Slice of pie" cracks
- Cracks that extends into the solid or "hole" portion of the rivet shank

FIGURE 18
Unacceptable Rivet Conditions

"Slice of pie" cracks or cracks that extend into the solid or "hole" portion of the rivet shank

Multiple hairline cracks

Variation in the table thickness and countersink of cast shoes

Most North American brake blocks designed for riveted installation have 150-degree counterbore. European blocks may have 180-degree counterbore. Most North American brake blocks designed for bolted installation have either an 82-degree counterbore and a ⅜-in. bolt or 150-degree counterbore and a ¼-in. bolt. When using a different fastener, be sure to use the appropriate counterbore angle.

A variation in the table thickness and/or the countersink can result in improper rivet clinch. A riveter compensates for this variation.

7.3.1.3 Compensator

Compensators (**Figure 19**) enable riveting machines to accommodate varying work thicknesses. Anvil arm compensators allow the anvil to move vertically as the rivet is driven down through the work, supporting the anvil with spring or air pressure. Top-pin compensators work in a similar fashion, except that they use a spring-loaded top pivot pin. With either model, pressure can be adjusted so that each rivet is set with the same amount of pressure regardless of part thickness.

FIGURE 19
Compensator

7.3.1.4 Flywheel riveter

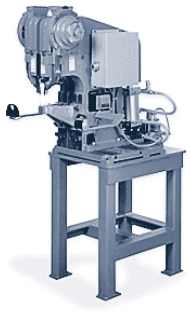
A flywheel riveter (**Figure 20**) applies pressure to the rivet and works on the setup of the machine to the standard thickness of the brake shoe table. The standard flywheel riveter does not compensate for a variation in the thickness. A spring compensator can be added to some machines to allow for the proper clinching of the rivet.

FIGURE 20
Flywheel Riveter

7.3.1.5 Hydraulic riveter

Like pneumatic riveters, a hydraulic riveter (**Figure 21**) can automatically compensate for minor variances in the parts being fastened. Variances could include work thickness, part orientation or rivet length.

FIGURE 21
Hydraulic Riveter



7.3.1.6 Hybrid air/oil riveter

The hybrid air/oil riveter is less expensive and has a higher operation speed than the hydraulic riveter. It compensates for variations in part thickness or rivet length to ensure tight settings without crushing the part.

7.3.2 Installing bolted blocks

Refer to manufacturers' instructions for alternate installation

7.3.2.1 Specifications for brake bolts (SAE J663)

The standard bolt for bolted blocks is brass or plated steel, slotted, flathead screw. The dimension, thread size and angle of the countersink are dependent on the style of brake. Refer to **Table 5** in Appendix B for the bolt dimensions.

Refer to SAE Specification J478 or ANSI Specifications 18.6.1, 18.6.2, 18.6.3 and 18.6.4 for additional details of dimensional specifications.

7.3.2.2 Specifications for lock washers

Use a hardened carbon steel helical spring lock washer. Refer to **Table 6** in Appendix B.

Refer to SAE Specification J489B for additional details of dimensional specifications.

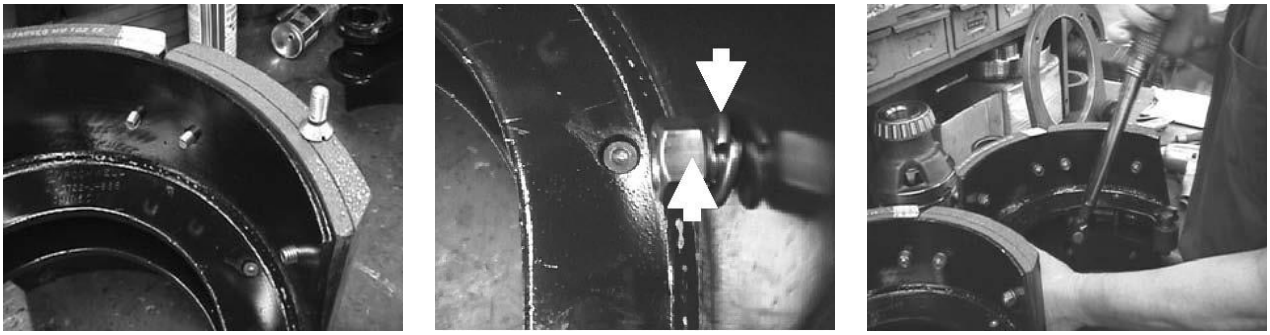
7.3.2.3 Specifications for nuts

Use zinc-coated or brass nuts with the appropriate dimensions and thread size, as noted in **Table 7** of Appendix B.

7.3.2.4 Fastening sequence

Install all the bolts through the block and the shoe table. Install the lock washers and nuts. Tighten all fasteners finger tight. See **Figure 22**.

FIGURE 22
Block Fastener Installation



Follow block manufacturer's recommended torque pattern sequence to minimize the flex of the brake block and to reduce block breakage. Using a torque wrench, tighten ¼-in. fasteners to 80–100 in.-lb, ⅜-in. fasteners to 18–23 ft-lb, and 10 mm fasteners to 22 ft-lb (see **Table 3**).

NOTE: Refer to **Figure 16** for an example of proper torque sequence.

TABLE 3
Brake Torque

Size	Fastener Torque (ft-lb)	Fastener Torque (in.-lb)
¼ in. × 28 UNF	7–8	80–100
5/16 (8 mm)	11–12	133–144
⅜ × 24 UNF	13–15	156–180
⅜ × 24 UNC	18–23	216–240

7.3.3 Bonded blocks

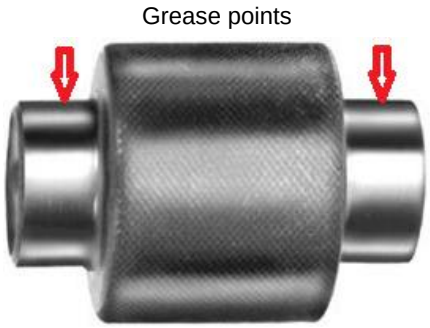
Attaching bonded block is a specialized process that should be performed only by a qualified vendor.

8. Final assembly

Lubricate and install roller at time of brake shoe installation to prevent contamination (**Figure 23**).

CAUTION: Take care not to get any grease on the surface of the roller that contacts the S-cam.

FIGURE 23
One-Piece Roller



NOTE: Apply OEM-recommended grease only to the axles of the roller. *Do not* apply grease to the roller face.

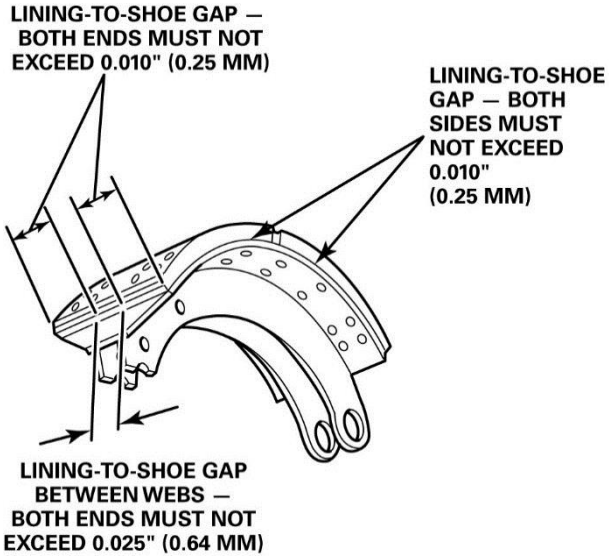
If continuing with installation, refer to APTA *Recommended Practice* BT-RP-009-06, "Transit Bus Front and Rear Axle S-Cam Brake Reline."

If equipped, install wear sensor per manufacturer's instructions.

9. Final inspection

1. Use a feeler gauge to measure at the outer edges between the shoe table and the brake block (**Figure 24**).
2. A gap of 0.010 in. maximum is acceptable between the shoe and linings along the sides and the ends of the assembly, except between the webs, where a 0.025-in. gap is acceptable at the web of a stamped steel shoe. (This inspection is not applicable to bonded shoes.)
3. Visually inspect and replace any cracked blocks.

FIGURE 24
Measuring for Gap



10. Documentation

Brake shoe rebuild and inspection should be documented on a standard form (electronic or paper) and be reviewed and filed in accordance with operating agency procedures. See Appendix A for an example.

Related APTA standards

APTA RP-xxx-00x-16, Rev. xx, "Name name name name" [Body Text with Body bold style applied to number, hanging indent of .25 inches]
APTA RP-xxx-00x-16, Rev. xx, "Name name name name"

References

American National Standards Institute (ANSI), Standards 18.6.1 18.6.2, 18.6.3 and 18.6.4.
www.ansi.org/default.aspx#.UVMoohdwq6U

ASTM International, ASTM B117, "Standard Practice for Operating Salt Spray (Fog) Apparatus."
www.astm.org/Standards/B117.htm

ASTM International, ASTM D3359, "Standard Test Methods for Measuring Adhesion by Tape Test."
www.astm.org/Standards/D3359.htm

Society of Automotive Engineers, SAE J478, "Slotted and Recessed Head Screws."
http://sae.nufu.eu/std/J478

This standard shall also be used in conjunction with the most recent edition of the following publications:

- OEM manuals
- OSHA regulations
- Brake manufacturer service manuals (example: Meritor Maintenance Manual 23B Bus and Coach Cam Brakes)
- Technology and Maintenance Council of the American Trucking Association Recommended Practices

Definitions

original equipment manufacturer (OEM): The vehicle manufacturer.

brake block: For the purposes of this document, all friction material and/or brake lining will be referred to as brake block.

combination brake blocks: Brake blocks with more than one formulation identification for each wheel.

Abbreviations and acronyms

ASTM	formerly the American Society for Testing and Materials
DOT	Department of Transportation
FMCSA	Federal Motor Carrier Safety Administration
FMVSS	Federal Motor Vehicle Safety Standard
HEPA	High-Efficiency Particulate Air
MSDS	material safety data sheets
MSHA	Mine Safety and Health Administration
NIOSH	National Institute for Occupational Safety and Health
OEM	Original Equipment Manufacturer
OSHA	Occupational Health and Safety Administration
SAE	Society of Automotive Engineers

Summary of document changes

Document history

Document Version	Working Group Vote	Public Comment/ Technical Oversight	CEO Approval	Policy & Planning Approval	Publish Date
First published				April 30, 2007	May 5, 2007
First revision	May 1, 2016	July 7, 2016	Sept. 6, 2016	Sept. 30, 2016	Oct. 6, 2016
Second revision					

Appendix A: Quality control sample form

Brake shoe inspection repair and block replacement

Batch No: _____ Part No. _____

Description: _____

Inspection	Rejected Quantity
Stretch	
Table flatness	
Web distortion	
Table arch	
Bolt holes	
Table thickness	
Welds	
Roller seats	
Anchor pin holes	
Broken casting	

Quantity of shoes inspected _____ Quantity of shoes rejected _____

Inspected by _____

Maintenance _____

Material control _____

Appendix B: Rivets and bolts for brake blocks (SAE J663B)

Brass tubular rivets for brake blocks

Table 4 gives dimensions for brass tubular rivets used for brake blocks.

NOTE: For drill and countersink dimensions for rivet and bolt holes, see SAE J660.

TABLE 4
Typical Dimensions for Common Brake Block Semi-Tubular SAE Rivets

Rivet Number	#10	#20	⅜	8 mm (full table)
Rivet Shank Diameter, nominal	0.250 in.	0.200 in.	0.375 in.	.307 in (7.8 mm)
Clinch allowance	0.162 in.	0.162 in.	0.218 in.	4.5 mm minimum
Diameter of hole in shoe	17/64 in.	14/64 in.	25/64 in.	8.2 mm
Rivet Length in increments of	1/16 in.	1/16 in.	1/16 in.	2 mm
Rivet Length	**10/16**	**10/16**	**1 in.**	**18-20 mm**

Bolts for brake blocks

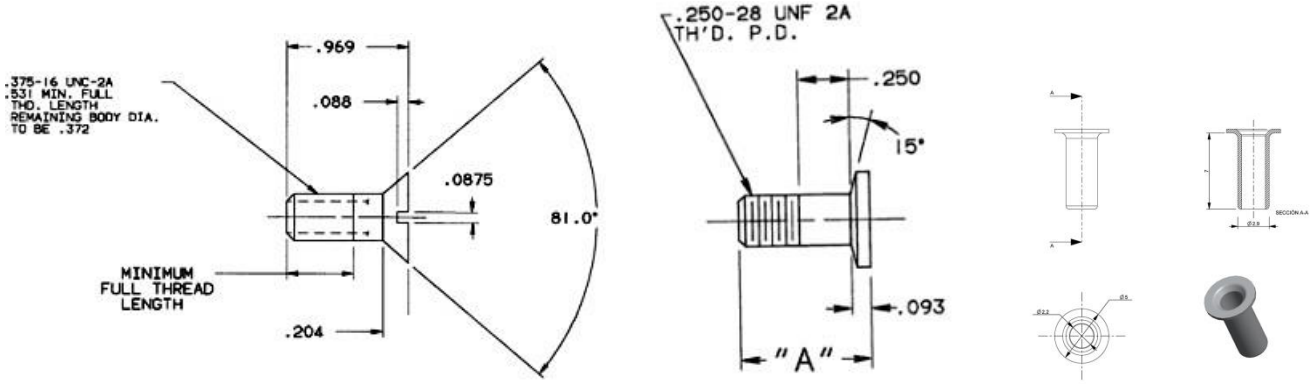
The standard bolt for bolted blocks is brass or brass-plated, slotted, flathead screw. The dimension, thread size and angle of the countersink are dependent on the style of brake. Refer to **Table 5** and **Figure 25** for the bolt dimensions.

TABLE 5
Brake Bolt Specifications (SAE J663, July 2001)

Brake Type	**Size**	**Threads per Inch**	**Body Diameter**	**Depth of Head**	**Width of Slot**		**Depth of Slot**		**Material**	**Torque**
				Max	**Max**	**Min**	**Max**	**Min**		
W-series	⅜ in.	⅜-16 UNC-2A	0.375	0.219	0.094	0.081	0.106	0.070	EJ461 (brass)	18-23 ft-lb
Cast plus	¼ in.	¼-28 UNF-2A	0.25	0.108	0.061	0.031	0.0385	0.0235	UNSM C27000 (brass)	7-8 ft-lb
MAN	5/16-18 × 1 in. Slotted 180 Degree Countersink Full Shoulder	18	5/16	X	.075	.005	,073	+ -005	Brass	10-11 ft lb

FIGURE 25

Xxx Xxxx Xxxxx



W-type brake bolt | Cast Plus brake bolt | Hollow rivet

TABLE 6

Lock Washer Specifications

Brake Type	Nominal Size		Inside Diameter		Outside Diameter	Section Width	Material	Process
			Max	Min		Min		
W-series	⅜ in.	0.375	0.375	0.219	0.68	0.141	SAE 1055-1056	38–46 HRC
Cast Plus	¼ in.	0.250	0.25	0.108	0.487	0.109	SAE 1055-1056	38–46 HRC

TABLE 7

Zinc Coated and Brass Nut Specifications

Brake Type	Nominal Size		Thread	Thickness		Flat Width		Corner Width		Material
				Max	Min	Max	Min	Max	Min	
W-series	⅜ in.	0.375	⅜-16 UNC-2B	0.337	0.320	0.562	0.551	0.650	0.628	38–46 HRC
Cast Plus	¼ in.	0.250	¼-28 UNF-2B	0.226	0.212	0.438	0.428	0.505	0.488	38–46 HRC