



AMERICAN PUBLIC TRANSPORTATION ASSOCIATION





APTA Bus Technical Maintenance Committee Webinar Series

Presents

Disc Brake Wheels On Inspection



January 28, 2015



Introduction

- Welcome to today's webinar in which we will cover a wheels on inspection of the bus disc brake system
- My name is Brian Markey and I will be the moderator for this webinar
- Disc Brake General Information
- Disc Brake Overview
- Inspection Points
- Functional and Visual Checks



Introduction

- The information on this webinar is to be used in conjunction with the original equipment manufacturer (OEM) and disc brake manufacturer service manuals
- Proper tools and safety equipment must always be used when working on brake systems

Overview

- *Nomenclature*
- *Caliper Identification*
- *Pad Wear Sensors*
- *Pad Wear Sensor Measurement*
- *Caliper Inspection*
- *Brake Pad Inspection*
- *Tappet Boots and Seals*
- *Brake Rotor Inspection*
- *Caliper Hardware Inspection*
- *Brake Chamber Inspection*
- *Adjustment*
- *Final Inspection and Test*



Nomenclature

Knorr SN7 Caliper

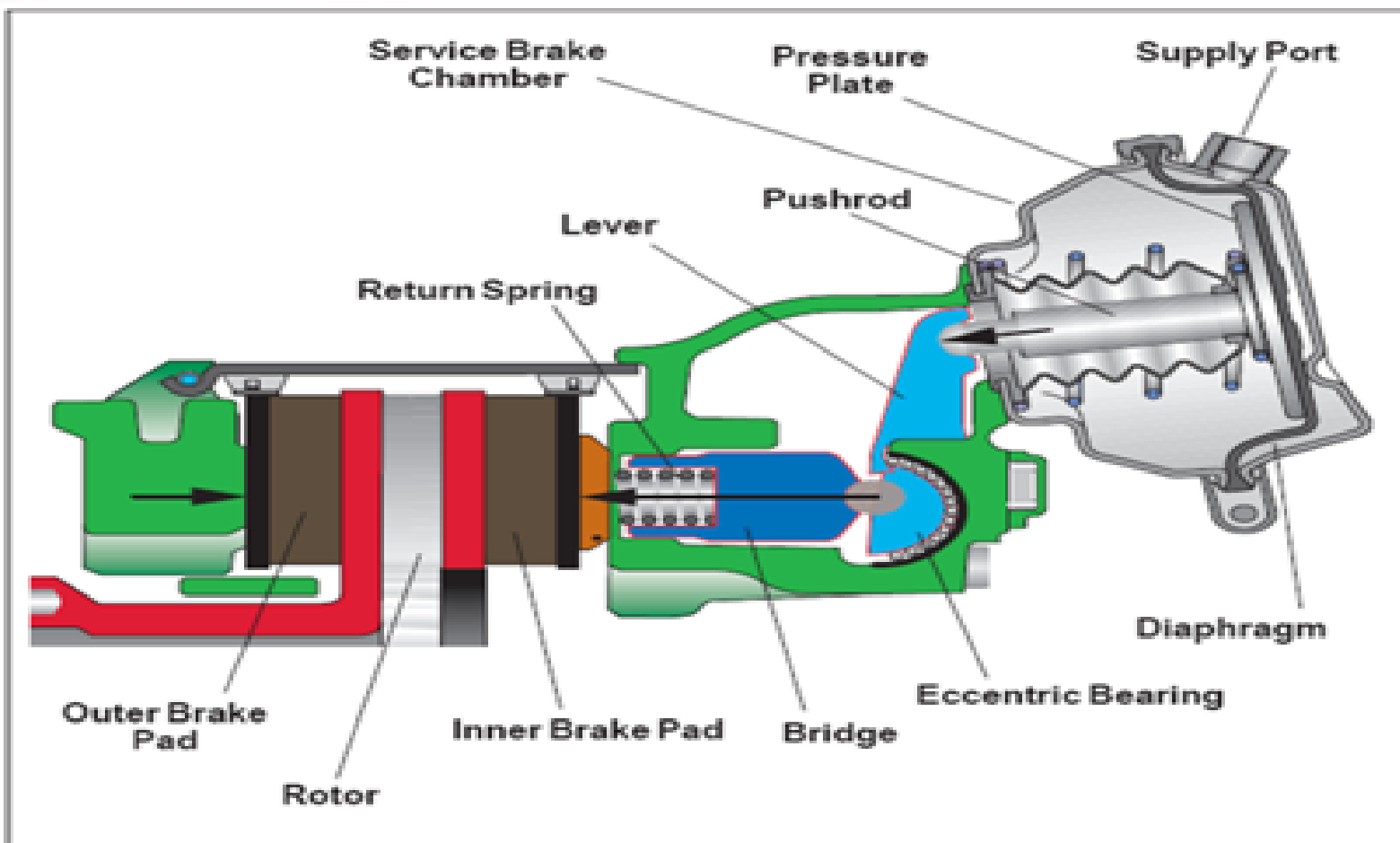


Meritor EX225 Caliper



Nomenclature

Principles of Operation

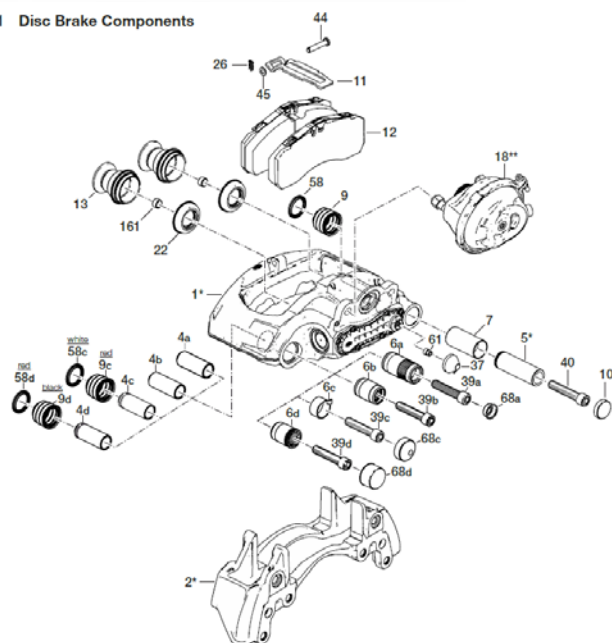


Nomenclature



Knorr SN7 exploded view

1.1 Disc Brake Components



Legend

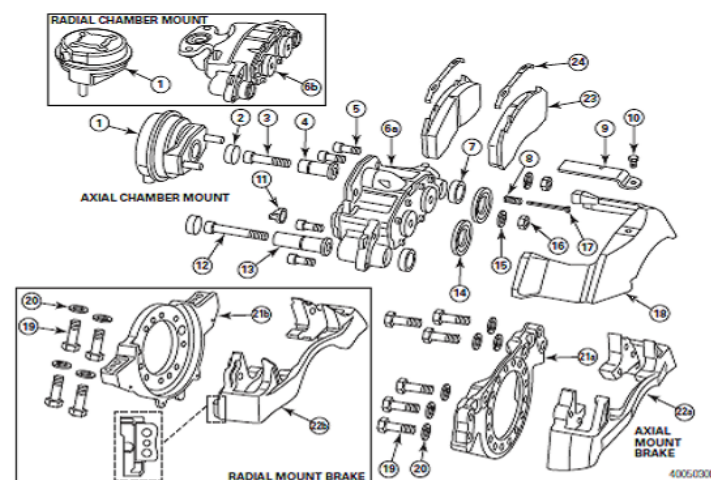
- | | | |
|--------------------------------|-----------------------------|------------------|
| 1 Caliper* | 13 Tappet and Boot Assembly | 61 Shear Adapter |
| 2 Carrier* | 18 Brake Actuator** | 68 Cover* |
| 3 Guide Pin* | 22 Inner Seal* | 161 Tappet Bush |
| 4 Guide Pin* | 26 Spring Clip | |
| 5 Guide Pin* | 37 Adjuster Cap | |
| 6 Rubber Bush or Guide Sleeve* | 39 Caliper Bolt* | |
| 7 Brass Bush* | 40 Caliper Bolt* | |
| 9 Inner Boot* | 44 Pad Retainer Pin | |
| 10 Cover* | 45 Washer | |
| 11 Pad Retainer* | 58 Ring* | |
| 12 Pad (composite)* | | |

* Variants possible (see also contents leaflet in the service kit)

** Brake chamber or spring brake

Meritor EX225 exploded view

DiscPlus™ EX225 Air Disc Brake



Item	Description	Item	Description
1	Air Chamber	14	Piston Boot (2)
2	Slide Pin Cap (2)	15	Air Chamber Washer (2)
3	Short Slide Pin Bolt	16	Air Chamber Nut (2)
4	Short Slide Pin	17	Visual Wear Indicator
5	Bridge Bolt (4)	18	Bridge
6a	Caliper Housing Assembly — Axial Chamber Mount	19	Carrier Bolt — EX225L (4), EX225H (5-6)
6b	Caliper Housing Assembly — Radial Chamber Mount	20	Washer — EX225L (4), EX225H (5-6)
7	Slide Pin Boot (2)	21a	Torque Plate — Axial Mount
8	Visual Wear Indicator Spring	21b	Torque Plate — Radial Mount
9	Pad Retainer	22a	Carrier — Axial Mount
10	Pad Retainer Bolt	22b	Carrier — Radial Mount
11	Adjuster Cover	23	Brake Pad (2)
12	Long Slide Pin Bolt	24	Pad Spring (2)
13	Long Slide Pin		



Brake Pad Wear Indicators

- Electronic brake pad wear indicators:
 - Warn operator prior to maximum wear limit and end of pad life
 - Account for rotor wear
- Mechanical brake pad wear indicators:
 - Measure pad thickness based on a pre-determined rotor thickness of 45 mm
 - Do not account for rotor wear

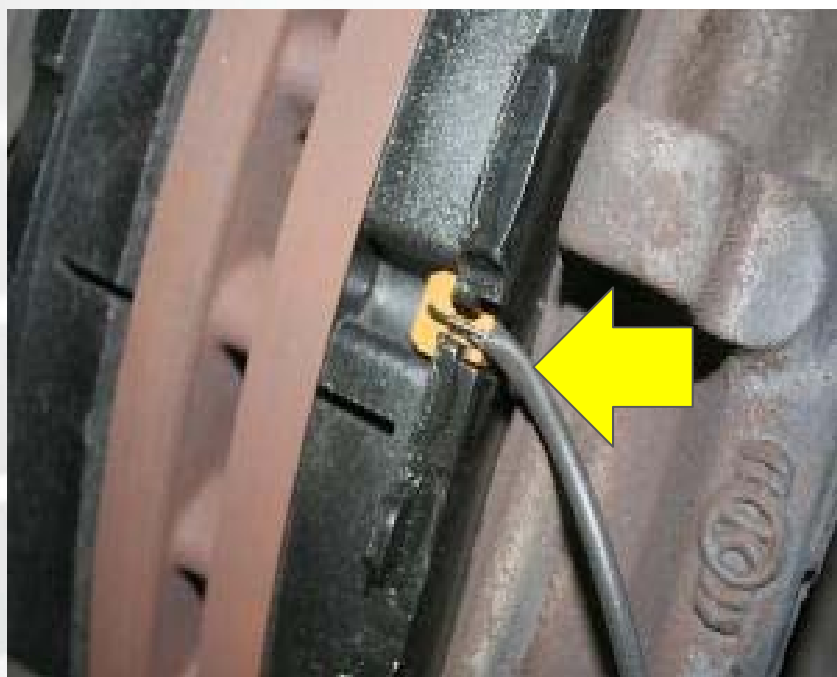


Brake Pad Wear Indicators

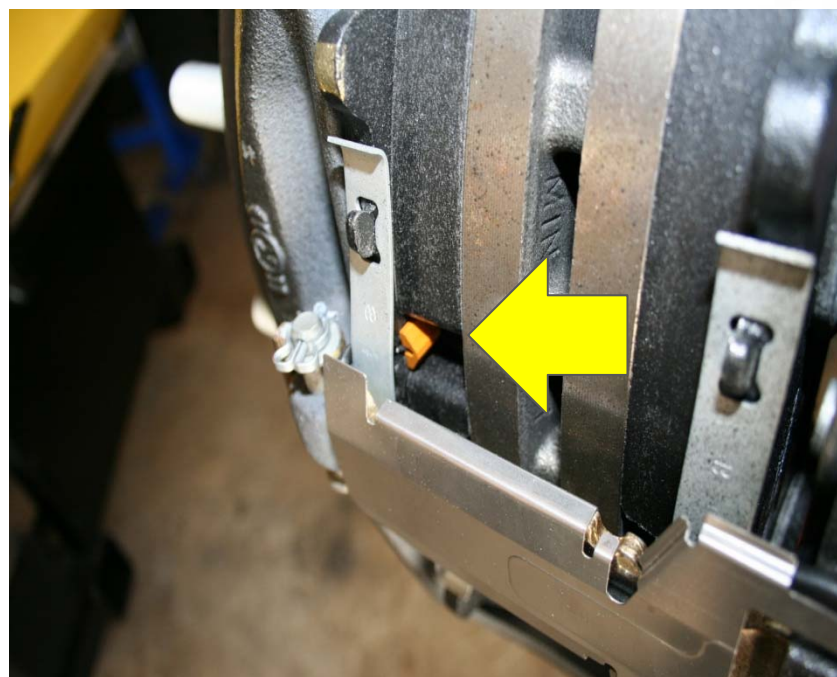
- Electronic brake pad wear indicators
 - Have a sensing wire embedded in the friction material at the minimum service thickness
 - When friction material wears to minimum thickness, sensor wire contacts rotor creating a electrical path to ground and illuminates a service warning requiring further inspection
 - As the friction material wears further the sensor wire breaks creating an open circuit illuminating an end of life warning
 - Brake reline should be performed

Electronic Pad Wear Sensors

In-pad wear sensor and wiring harness



In-pad wear sensor





Brake Pad Wear Indicators

- Mechanical brake pad wear indicators
 - Measure brake pad thickness based on caliper position and new rotor thickness of 45mm
 - As friction material and rotor wear, indicator moves providing a general reference of remaining friction material
 - Don't compensate for rotor wear
 - Are less accurate when new pads are installed on used rotors
 - Require visual inspection of pads and rotor more frequently



Knorr SN-7 Guide Pine Inspection

Knorr SN-7 Disc brakes are equipped with solid rubber bushing style wear indicators, which provide an indication of when to schedule a full wheel removed inspection. The thicknesses of BOTH the pads/rotors will affect the wear indicator position.





Knorr SN-7 Guide Pin Inspection

On both front and rear axle, road and curb sides, inspect the position of the guide pin compared to the solid rubber bushing.

If pad wear indicator protrudes less than 1mm (.040"), then the wheels must be removed to measure pads and rotors on that axle (both sides).





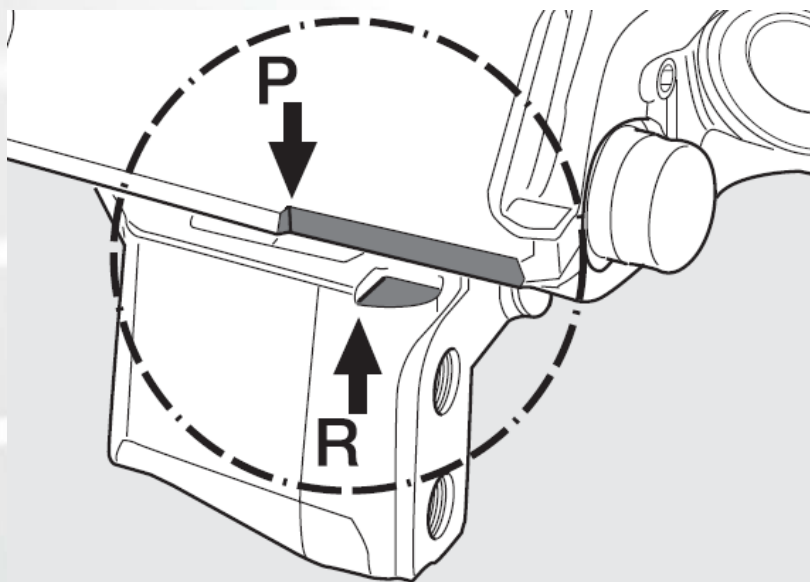
Knorr SN-7 Guide Pin Inspection

- Dirt, road salts, and debris can obstruct view of guide pin
- Care should be exercised to insure solid rubber bushing is not mistaken for stainless steel guide pin
- Pin protrusion can be measured to track pad and rotor wear for determining fleet mileage expectations

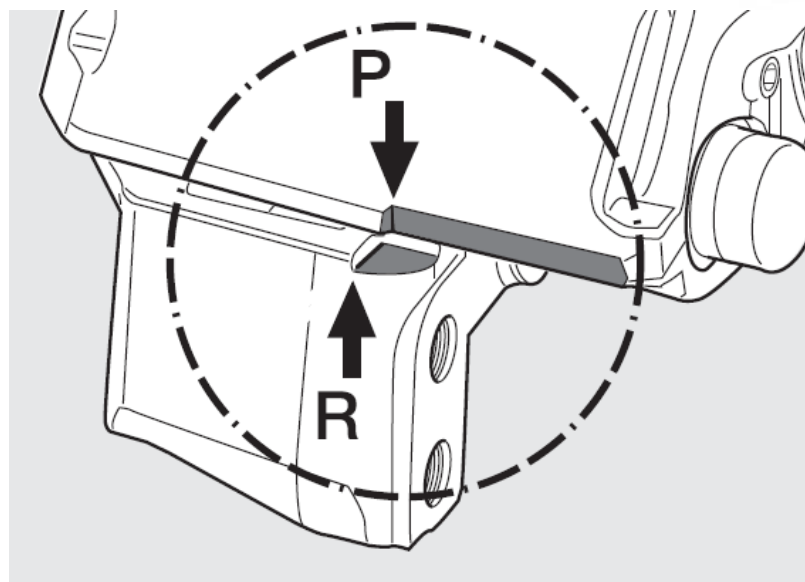


Knorr SN-7 Caliper to Carrier Notch

The pad/rotor wear can be visually determined without removing the wheel by viewing the position of the caliper position “P” compared to the carrier marking “R”



Caliper position with new pads and rotor



Caliper position when pads or rotor require further inspection

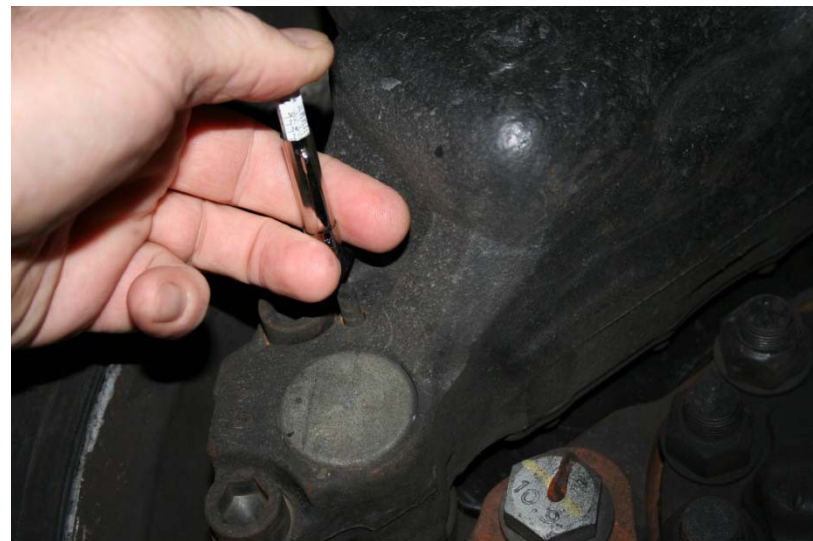


Meritor EX225 Wear Pin Inspection

The pad/rotor wear can be visually determined without removing the wheel by viewing the protrusion of the wear indicator pin. If pin protrusion is less than 0.16 inch (4mm) the pads require further inspection or replacement.



Pad wear indicator pin



Pad wear indicator measurement using a tire tread depth gauge



Caliper Inspection

- Caliper Adjustment
 - Attach dial indicator to torque plate or bus frame.
 - Dial indicator reading should be taken at slide pin bearing cap.
 - Check brake adjustment by sliding caliper back and forth by hand along the slide pins.
 - If caliper slides more than 0.08 inch (2mm) the brake is out of adjustment and requires further inspection or replacement.

Springs



Caliper Inspection

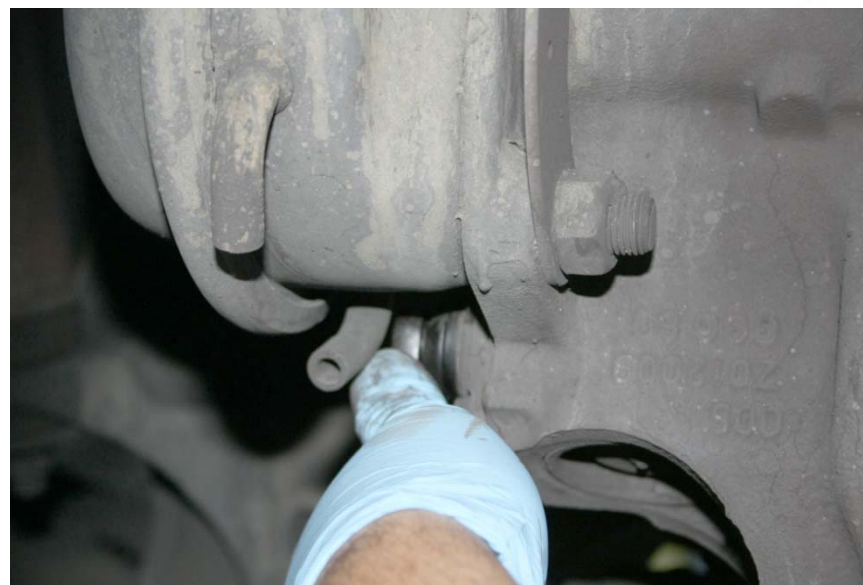
- Inspect caliper mounting bolts for rust, movement, or signs of looseness.
- Inspect caliper for heavy rust and damage which may indicate a non-working or overheated brake
- Check slide pin and bushing wear by pushing up and down checking for excessive movement.
- Caliper should move freely along slide pins with minimum sideways or vertical movement.
- Excessive movement is a sign of worn or loose bushings and slide pins.

Springs



Knorr Caliper Adjuster Test

- Turn adjuster three clicks counter clockwise to back off using a box wrench or socket
- If the sheer adapter fails, replace and attempt a second time
- If the sheer adapter fails again, the adjuster is seized and the caliper needs to be replaced



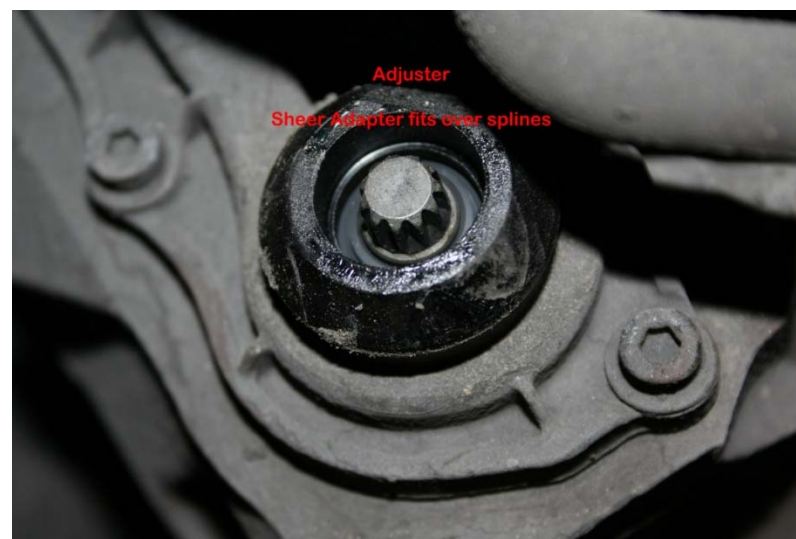


Knorr Bremse Sheer Adapter

The Knorr Bremse sheer adapter is designed to shear if excessive torque is required to turn the adjuster



Sheer Adapter





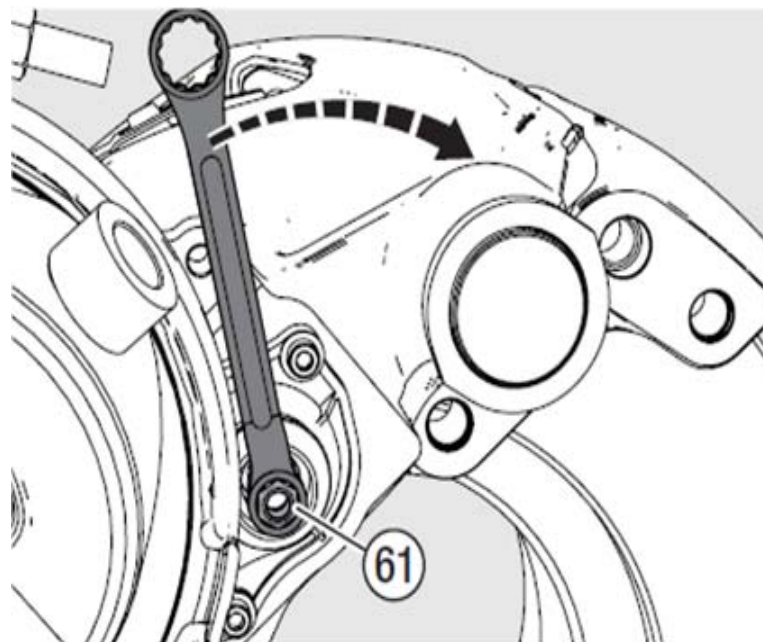
Meritor Caliper Adjuster Test

- Turn adjuster counter clockwise to back off using a 10mm box wrench or socket
- Do not exceed 30 FT/LBS torque in either direction.
- If higher torque is required. Caliper is seized and must be replaced.



Caliper Adjuster Test

- Leave wrench on sheer adapter (Knorr) or adjuster (Meritor)
- Make sure wrench is positioned so that it can move clockwise without obstruction
- Apply brakes with about 2 bar (30 psi) air pressure five to ten times
- The wrench should turn clockwise
- If the wrench does not turn, turns only on first application, or turns forward and backward with every application, the adjuster has failed and the caliper must be replaced



Knorr Bremse pictured above



Meritor pictured to the left

Caliper Inspection

- *Nomenclature*
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- *Final Inspection and Test*





Tappet Boots and Seals

- Visually inspect tappet boots and slide pin seals for damage.
- Damaged boots and seals require further inspection and replacement
- Damaged, improperly seated, loose or worn boots and seals can allow moisture to enter the caliper.
- Rust and contamination of the internal caliper mechanism can cause the caliper to malfunction and not adjust or release, resulting in dragging or slack brakes.





Tappet Boots and Seals

- Tappet boots and seals can be inspected using a mirror and flashlight



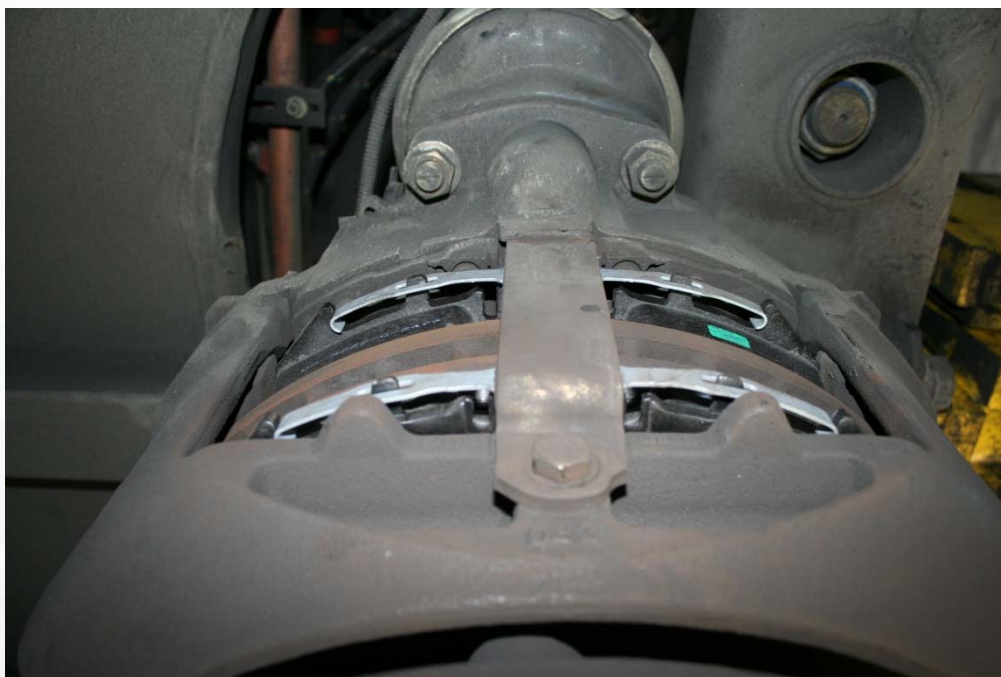
Adjusting Screw Seal and Cap

- Inspect adjusting screw cap for missing, damage and tight seal.
- Visually inspect adjusting screw internal seal for damage.



Brake Pad Retaining Strap

Inspect caliper brake pad retaining strap and fastener.



Brake pad retaining strap correctly installed with pad anti-rattle springs in place.



Brake Pad Retaining Strap

Missing brake pad retaining strap.



Damaged rim and brake chamber



Missing brake pad retaining strap can allow brake pads to climb out of caliper and wear on rim resulting in rim and brake failure



Brake Pad Inspection

- Inspect caliper for:
 - Missing brake pads
 - Loose friction material on pad backing plate
 - Brake pad thickness
 - Overheated brake pads
- Note: Brake pad thickness of 1/16 inch (1.6mm) or worn to wear indicator if pad is marked requires immediate reline.
- Caliper mounted wear indicator or electronic wear indicator is acceptable for measuring pad thickness.

Brake Pad Inspection

Brake pads can be inspected using a mirror and flashlight



Brake Rotor Inspection





Brake Rotor Inspection

- Visually inspect rotor for:
- Wear
- Overheating
- Heat checks
- Cracks
- Grooves
- Discoloring
- Damage
- Contamination



Brake Rotor Inspection

Visually inspect swept area of rotor for defects and damage

Only the inner side of the rotor can be visually inspected so extra care should be exercised to check as much of the rotor as possible





Thermal Overload

Below are examples of Thermal Overload which is an indication of excessive heat caused by dragging brakes. The cause must be identified and corrected



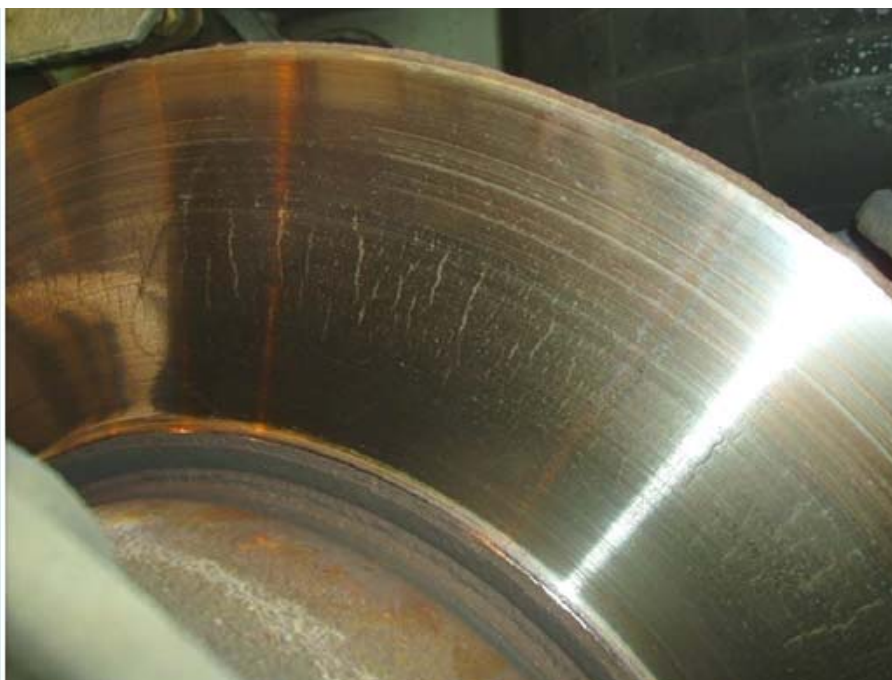
Below are examples of brake assemblies exhibiting normal operating conditions





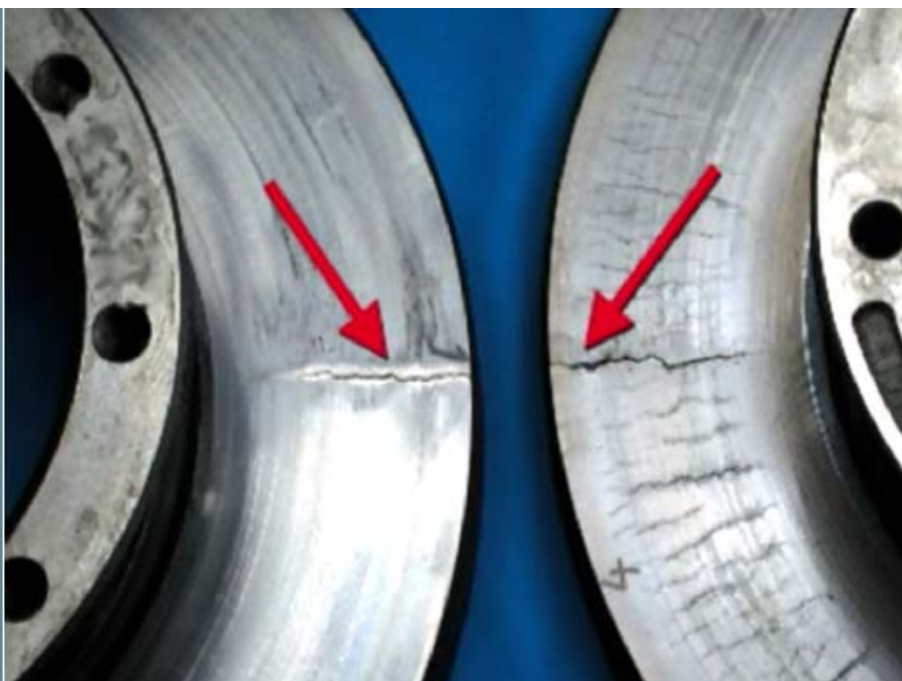
Brake Rotor Inspection

Small heat check
are allowable (as
shown)



Brake Rotor Inspection

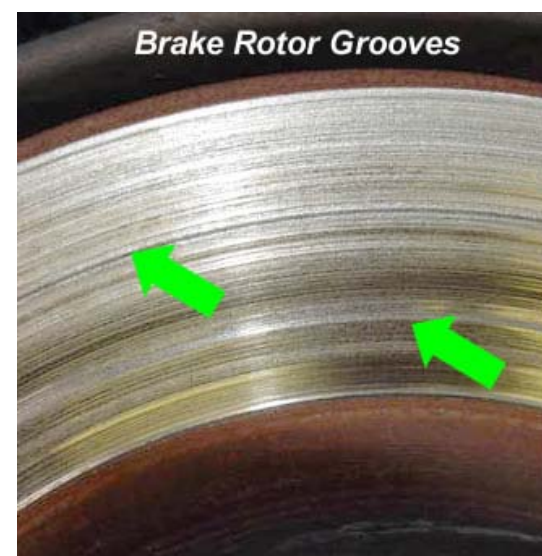
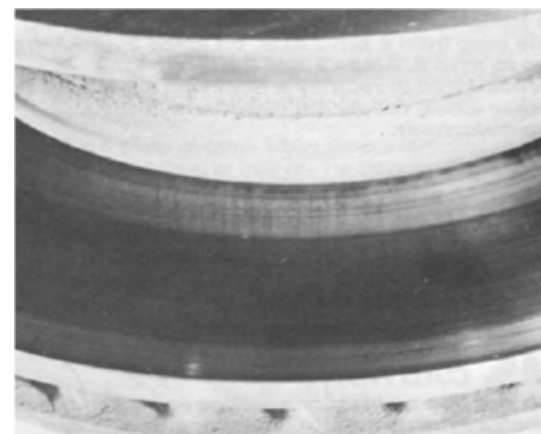
Large cracks creating a split in the rotor is not acceptable and requires rotor replacement





Brake Rotor Inspection

- Blue bands or marks indicate that the rotor was very hot.
- Determine the cause and correct. Replace the rotors and pads
- If the rotor thickness measured across any groove is less than the minimum discard thickness found on the rotor casting, discard and replace the rotor





Brake Rotor Inspection

Check rotor for damage and excessive wear





Brake Rotor Inspection

- Brake rotors should be checked for contamination from:
 - Leaking axle grease seals
 - Leaking axle oil seals
 - Road debris and contaminants
 - Rust indicating inoperative brake
- Note: Oil and grease contaminated rotors should be replaced as the oil and grease can never be fully removed from the metal and will cause unbalanced brakes



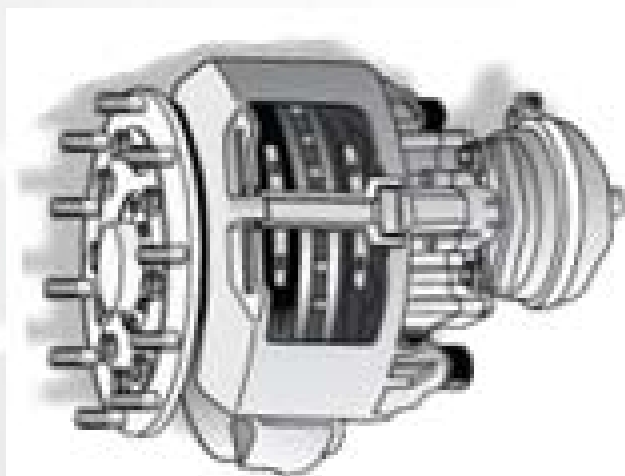
Brake Rotor Inspection

- Some Meritor rotors have different swept area thickness with the inboard swept area thicker than the outboard and should not be confused for wear.

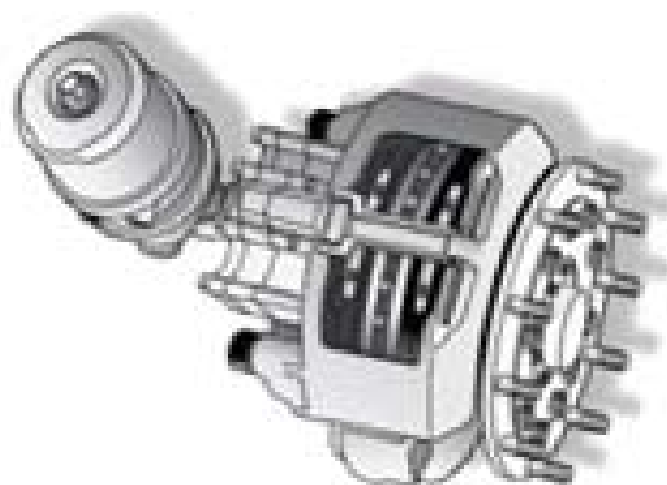


Brake Chambers

Two mounting positions for brake chambers



Axial



Radial



Brake Chambers

- With the brake system at governor full cut-out, release parking brake (when applicable) then apply service brakes and listen for air leak
- Any air leaks will deem the vehicle out of service until repairs are made
 - Chambers must:
 - Be same size
 - Contain cage tool and sealing plug
 - Display no evidence of contact with wheel, body, suspension, or frame
 - Mounting nuts are tight and chamber is secure



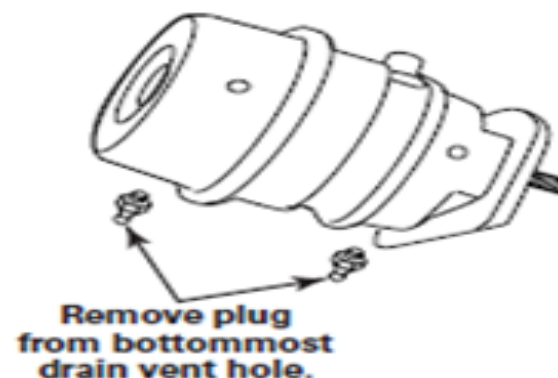
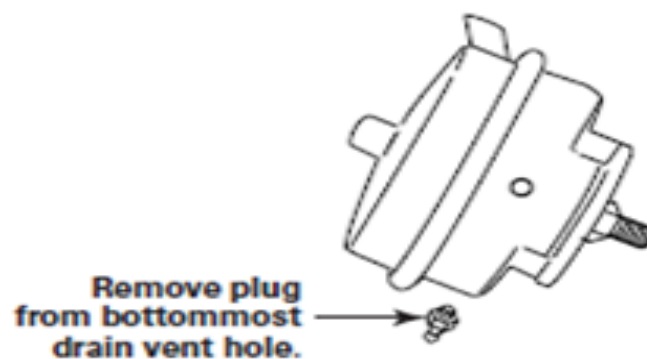
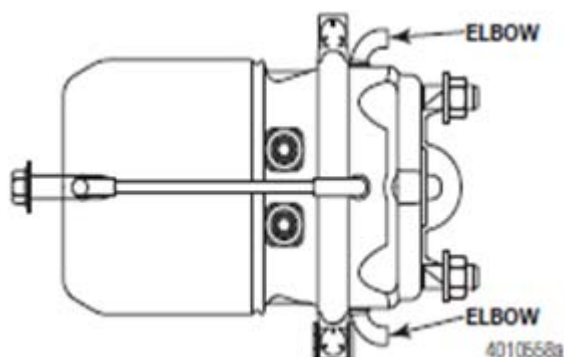
Front Service Brake Chamber



Rear Spring Brake Chamber

Brake Chambers

- Ensure the bottommost housing plug is removed
- Failure to remove a plug from the non-pressure housing will cause a slow releasing, dragging brake
- For brake chambers equipped with elbows, the chamber must be oriented in such a way that the two elbows will easily allow water and contaminants to drain from the chamber





Final Inspection and Test

- Perform a brake performance test to verify satisfactory brake operation
- Document inspection results
- Return bus to service if no repairs are needed
- Schedule repairs if required

Frequency of wheel on inspections will vary depending on the operating environment but should not be limited to pad change intervals



Any Questions?

Please e-mail the questions to.....

***The APTA Brake and Chassis Work Group and
the APTA Bus Standards Committee would like
to thank you for joining our Webinar.***

Pictures and drawings and technical information courtesy of MAN, ZF, Meritor, Knorr-Bremse, Bendix, Omnitrans, MBTA, Custom Training Aids, and other members of the APTA Brake and Chassis Work Group