

Maintenance Manual MM-0467

# DiscPlus™ EX225 Air Disc Brake

Revised 06-06



# Service Notes

## About This Manual

This manual provides installation and maintenance procedures for the DiscPlus™ EX225 air disc brake.

## Before You Begin

1. Read and understand all instructions and procedures before you begin to service components.
2. Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.
3. Follow your company's maintenance and service, installation, and diagnostics guidelines.
4. Use special tools when required to help avoid serious personal injury and damage to components.

## Hazard Alert Messages and Torque Symbols

### WARNING

A Warning alerts you to an instruction or procedure that you must follow exactly to avoid serious personal injury and damage to components.

### CAUTION

A Caution alerts you to an instruction or procedure that you must follow exactly to avoid damage to components.

 This symbol alerts you to tighten fasteners to a specified torque value.

## How to Obtain Additional Maintenance and Service Information

### On the Web

Visit Literature on Demand at [meritorhvs.com](http://meritorhvs.com) to access product, service, aftermarket, and warranty literature for ArvinMeritor's truck, trailer and specialty vehicle components.

## ArvinMeritor's Customer Service Center

Call ArvinMeritor's Customer Service Center at 800-535-5560.

## Technical Electronic Library DVD

The DriveTrain Plus™ by ArvinMeritor Technical Electronic Library DVD contains product and service information for most Meritor and Meritor WABCO products. Specify TP-9853.

## How to Obtain Tools and Supplies Specified in This Manual

Call ArvinMeritor's Commercial Vehicle Aftermarket at 888-725-9355 to obtain Meritor tools and supplies.

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pg. i	<b>Asbestos and Non-Asbestos Fibers</b>	pg. 23	<b>Section 6: Rotor</b>
1	<b>Section 1: Exploded Views</b>		Inspection
	DiscPlus™ EX225 Air Disc Brake		Cracks
2	Hub and Rotor Assembly		Heat Checking
3	Caliper Sectional View	24	Light Heat Checking
4	Adjuster Sectional View		Heavy Heat Checking
5	<b>Section 2: Introduction</b>		Deep Grooves or Scores
	Description		Blue Marks or Bands
	Operation	25	Measure the Rotor Thickness
	Automatic Adjustment		Measure the Rotor Runout
6	Operation Without Adjustment		Removal and Installation
	Operation with Adjustment		Replace the Rotor
	Manual Adjustment and Deadadjustment During a Pad Change	27	<b>Section 7: Air Chamber</b>
7	<b>Section 3: Roadside Inspection</b>		Introduction
	Intervals	28	Inspection
	Procedures		Cage the Spring Brake Chamber
	Inspection Procedure	29	Installation
	Caliper Adjustment		Spring or Service Brake Chamber
	Lining Wear	31	<b>Section 8: Specifications</b>
	Rotor		Torque Specifications
	Air Chamber	32	<b>Section 9: Diagnostics</b>
8	<b>Section 4: Caliper Assembly and Brake Pad</b>		Troubleshooting
	Inspection		
	Caliper		
	Brake Deadadjustment Procedure		
9	Brake Adjustment Inspection		
	Brake Pad Removal and Inspection		
11	Check Slide Pin Bushing Wear		
12	Brake Pad Installation		
13	Set the Initial Brake Pad-to-Rotor Running Clearance		
14	<b>Section 5: Caliper Components Replacement</b>		
	Introduction		
	Remove the Caliper Assembly		
15	Install the Caliper Assembly		
	Replace the Adjuster Cover		
16	Replace the Piston Boots		
18	Remove the Caliper Bridge		
	Remove the Caliper Housing Assembly		
19	Remove the Slide Pin Boots		
	Replace the Slide Pins		
	Install the Slide Pin Boots		
20	Install the Caliper Housing Assembly		
22	Install the Caliper Bridge		

## ASBESTOS FIBERS WARNING

The following procedures for servicing brakes are recommended to reduce exposure to asbestos fiber dust, a cancer and lung disease hazard. Material Safety Data Sheets are available from ArvinMeritor.

### Hazard Summary

Because some brake linings contain asbestos, workers who service brakes must understand the potential hazards of asbestos and precautions for reducing risks. Exposure to airborne asbestos dust can cause serious and possibly fatal diseases, including asbestosis (a chronic lung disease) and cancer, principally lung cancer and mesothelioma (a cancer of the lining of the chest or abdominal cavities). Some studies show that the risk of lung cancer among persons who smoke and who are exposed to asbestos is much greater than the risk for non-smokers. Symptoms of these diseases may not become apparent for 15, 20 or more years after the first exposure to asbestos.

Accordingly, workers must use caution to avoid creating and breathing dust when servicing brakes. Specific recommended work practices for reducing exposure to asbestos dust follow. Consult your employer for more details.

### Recommended Work Practices

1. **Separate Work Areas.** Whenever feasible, service brakes in a separate area away from other operations to reduce risks to unprotected persons. OSHA has set a maximum allowable level of exposure for asbestos of 0.1 f/cc as an 8-hour time-weighted average and 1.0 f/cc averaged over a 30-minute period. Scientists disagree, however, to what extent adherence to the maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling asbestos dust. OSHA requires that the following sign be posted at the entrance to areas where exposures exceed either of the maximum allowable levels:

DANGER: ASBESTOS  
CANCER AND LUNG DISEASE HAZARD  
AUTHORIZED PERSONNEL ONLY  
RESPIRATORS AND PROTECTIVE CLOTHING  
ARE REQUIRED IN THIS AREA.

2. **Respiratory Protection.** Wear a respirator equipped with a high-efficiency (HEPA) filter approved by NIOSH or MSHA for use with asbestos at all times when servicing brakes, beginning with the removal of the wheels.

3. **Procedures for Servicing Brakes.**

a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.

b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

c. If an enclosed vacuum system or brake washing equipment is not available, employers may adopt their own written procedures for servicing brakes, provided that the exposure levels associated with the employer's procedures do not exceed the levels associated with the enclosed vacuum system or brake washing equipment. Consult OSHA regulations for more details.

d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.

e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

4. **Cleaning Work Areas.** Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos. When you replace a HEPA filter, wet the filter with a fine mist of water and dispose of the used filter with care.

5. **Worker Clean-Up.** After servicing brakes, wash your hands before you eat, drink or smoke. Shower after work. Do not wear work clothes home. Use a vacuum equipped with a HEPA filter to vacuum work clothes after they are worn. Launder them separately. Do not shake or use compressed air to remove dust from work clothes.

6. **Waste Disposal.** Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

### Regulatory Guidance

References to OSHA, NIOSH, MSHA, and EPA, which are regulatory agencies in the United States, are made to provide further guidance to employers and workers employed within the United States. Employers and workers employed outside of the United States should consult the regulations that apply to them for further guidance.

## NON-ASBESTOS FIBERS WARNING

The following procedures for servicing brakes are recommended to reduce exposure to non-asbestos fiber dust, a cancer and lung disease hazard. Material Safety Data Sheets are available from ArvinMeritor.

### Hazard Summary

Most recently manufactured brake linings do not contain asbestos fibers. These brake linings may contain one or more of a variety of ingredients, including glass fibers, mineral wool, aramid fibers, ceramic fibers and silica that can present health risks if inhaled. Scientists disagree on the extent of the risks from exposure to these substances. Nonetheless, exposure to silica dust can cause silicosis, a non-cancerous lung disease. Silicosis gradually reduces lung capacity and efficiency and can result in serious breathing difficulty. Some scientists believe other types of non-asbestos fibers, when inhaled, can cause similar diseases of the lung. In addition, silica dust and ceramic fiber dust are known to the State of California to cause lung cancer. U.S. and international agencies have also determined that dust from mineral wool, ceramic fibers and silica are potential causes of cancer.

Accordingly, workers must use caution to avoid creating and breathing dust when servicing brakes. Specific recommended work practices for reducing exposure to non-asbestos dust follow. Consult your employer for more details.

### Recommended Work Practices

1. **Separate Work Areas.** Whenever feasible, service brakes in a separate area away from other operations to reduce risks to unprotected persons.

2. **Respiratory Protection.** OSHA has set a maximum allowable level of exposure for silica of 0.1 mg/m<sup>3</sup> as an 8-hour time-weighted average. Some manufacturers of non-asbestos brake linings recommend that exposures to other ingredients found in non-asbestos brake linings be kept below 1.0 f/cc as an 8-hour time-weighted average. Scientists disagree, however, to what extent adherence to these maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling non-asbestos dust.

Therefore, wear respiratory protection at all times during brake servicing, beginning with the removal of the wheels. Wear a respirator equipped with a high-efficiency (HEPA) filter approved by NIOSH or MSHA, if the exposure levels may exceed OSHA or manufacturers' recommended maximum levels. Even when exposures are expected to be within the maximum allowable levels, wearing such a respirator at all times during brake servicing will help minimize exposure.

3. **Procedures for Servicing Brakes.**

a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.

b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

c. If an enclosed vacuum system or brake washing equipment is not available, carefully clean the brake parts in the open air. Wet the parts with a solution applied with a pump-spray bottle that creates a fine mist. Use a solution containing water, and, if available, a biodegradable, non-phosphate, water-based detergent. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.

d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.

e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

4. **Cleaning Work Areas.** Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA, to minimize exposure. When you replace a HEPA filter, wet the filter with a fine mist of water and dispose of the used filter with care.

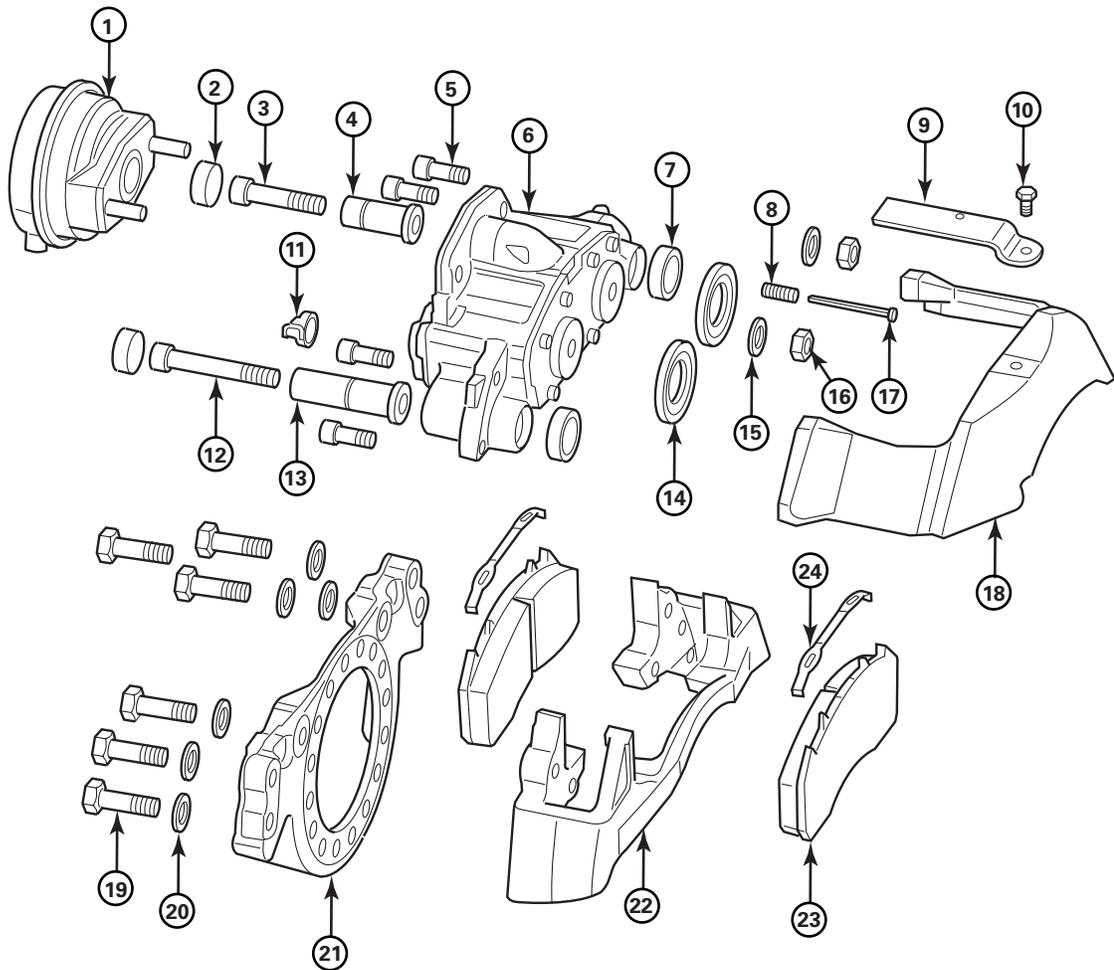
5. **Worker Clean-Up.** After servicing brakes, wash your hands before you eat, drink or smoke. Shower after work. Do not wear work clothes home. Use a vacuum equipped with a HEPA filter to vacuum work clothes after they are worn. Launder them separately. Do not shake or use compressed air to remove dust from work clothes.

6. **Waste Disposal.** Dispose of discarded linings, used rags, cloths and HEPA filters with care, such as in sealed plastic bags. Consult applicable EPA, state and local regulations on waste disposal.

### Regulatory Guidance

References to OSHA, NIOSH, MSHA, and EPA, which are regulatory agencies in the United States, are made to provide further guidance to employers and workers employed within the United States. Employers and workers employed outside of the United States should consult the regulations that apply to them for further guidance.

## DiscPlus™ EX225 Air Disc Brake

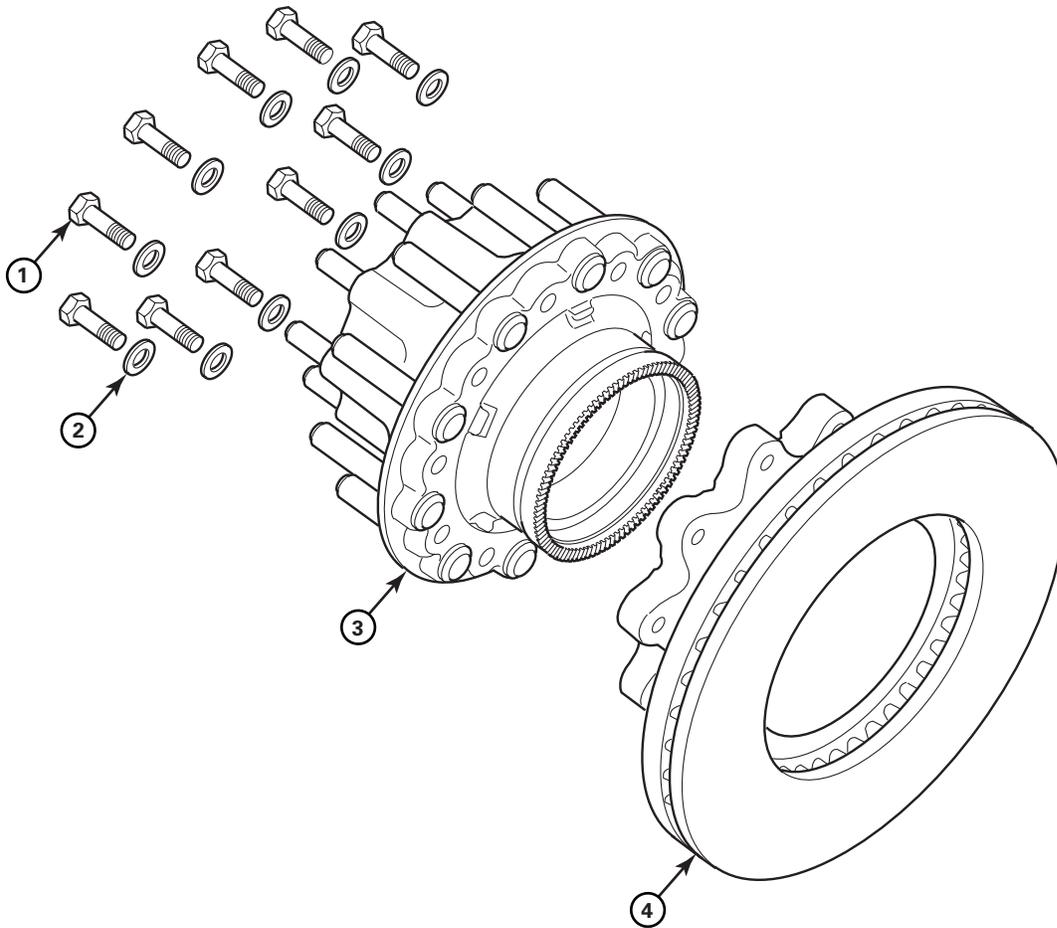


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Item	Description	Item	Description
1	Air Chamber	13	Long Slide Pin
2	Slide Pin Cap (2)	14	Piston Boot (2)
3	Short Slide Pin Bolt	15	Air Chamber Washer (2)
4	Short Slide Pin	16	Air Chamber Nut (2)
5	Bridge Bolt (4)	17	Visual Wear Indicator
6	Caliper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

# 1 Exploded Views

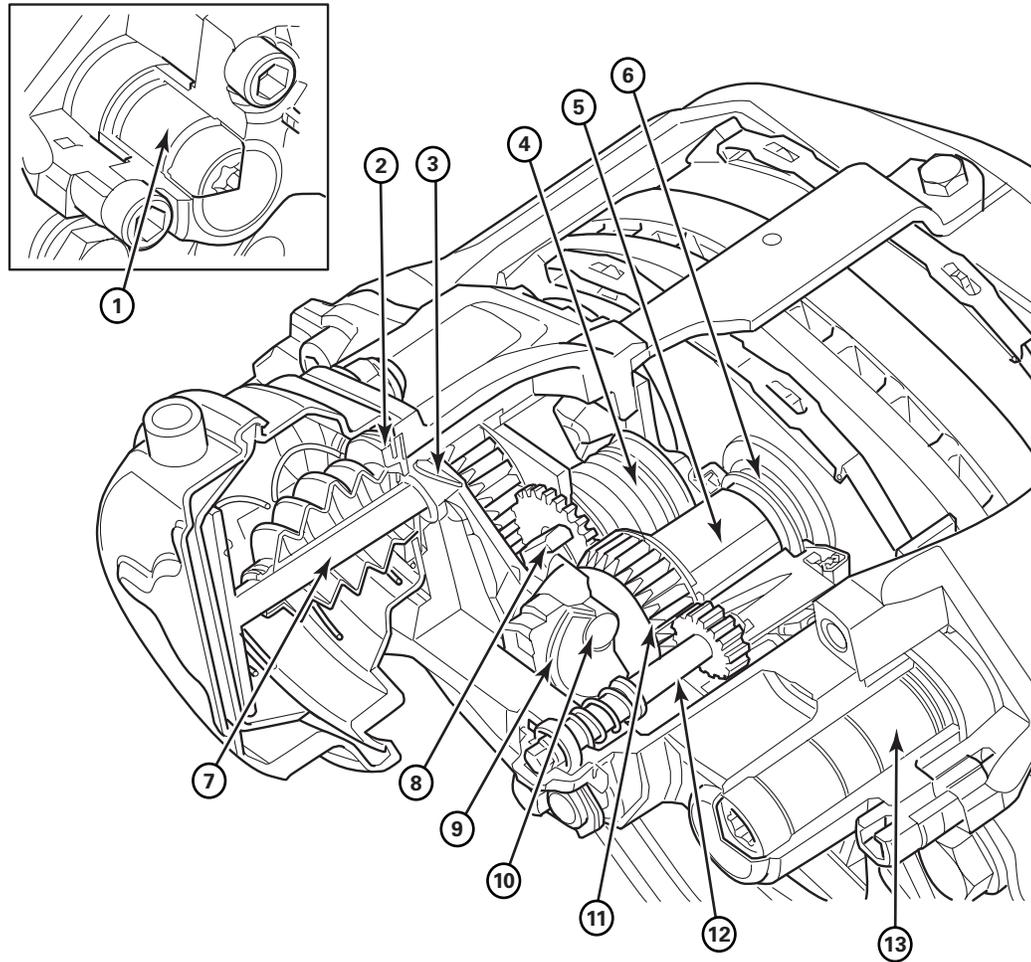
## Hub and Rotor Assembly



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<u>Item</u>	<u>Description</u>
1	Hub-to-Rotor Bolt
2	Washer
3	Hub Assembly
4	Rotor

## Caliper Sectional View



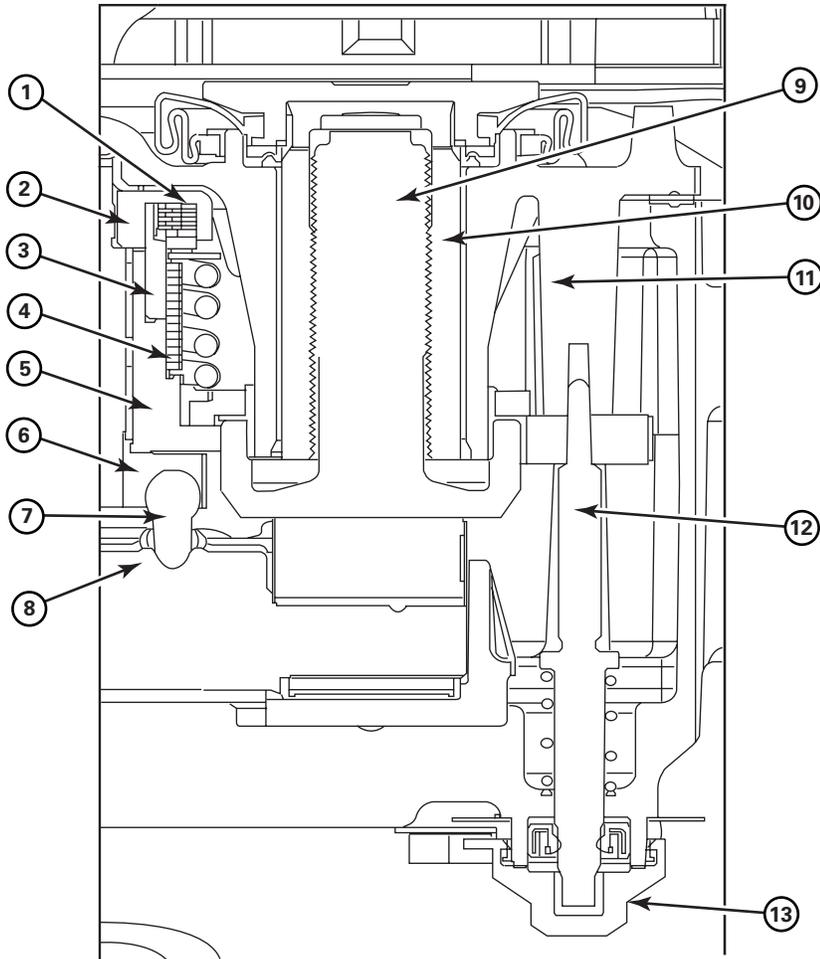
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Item	Description
1	Short Slide Pin Oval Bushing
2	Housing Seal
3	Operating Shaft
4	Return Spring
5	Piston
6	Piston Head
7	Chamber Piston
8	Adjuster Shaft
9	Half Bearing

Item	Description
10	Roller
11	Tappet
12	Adjuster Stem
13	Long Slide Pin Bushing

# 1 Exploded Views

## Adjuster Sectional View



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Item	Description
1	Clutch Pack
2	Outer Drive Sleeve
3	Inner Drive Sleeve
4	Unidirectional Friction Spring
5	Intermediate Gear
6	Adjuster Shaft
7	Drive Pin
8	Operating Shaft
9	Tappet

Item	Description
10	Piston
11	Adjuster Housing
12	Adjuster Stem
13	Adjuster Cover

## Description

The EX225 air-actuated disc brake has a direct-mounted air chamber. Figure 2.1. The brake can be installed onto any axle and can be used for vehicle parking when it is equipped with a service spring brake chamber. The basic operation of the brake is simple, but it is important that the features of the load insensitive automatic adjuster are clearly understood. It is essential that the correct service procedures be observed to ensure that the brake gives satisfactory service throughout its working life.

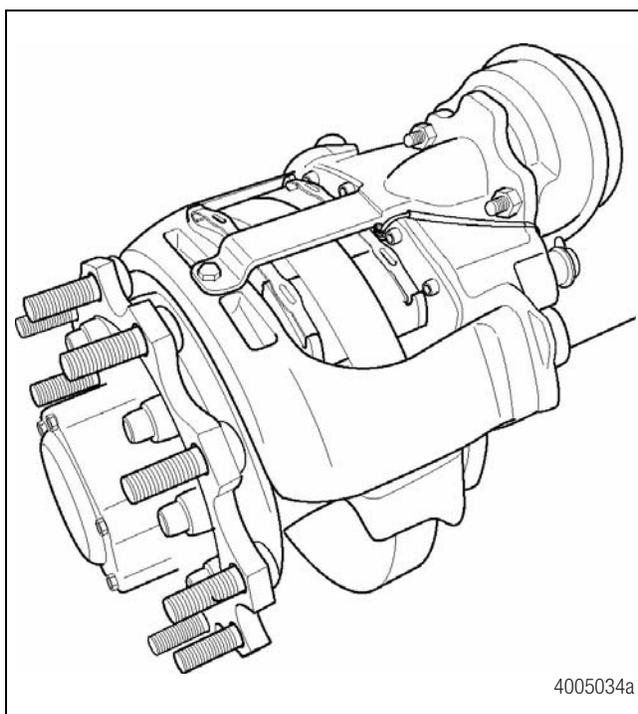


Figure 2.1

## Operation

The air chamber is attached to the caliper housing and operates directly onto the internal operating shaft assembly. Seals in the housing and chamber assemblies provide sealing between the air chamber and housing. The carrier is mounted to the vehicle. It straddles the rotor and supports the brake pads. The housing assembly slides on two fully sealed slide pins which are bolted to the brake carrier. As the pads wear, adjustment takes place automatically and independently of load. Load independent means adjustment takes place under very small clamping forces only, therefore preventing over adjustment and minimizing air consumption.

Two slide pins are attached to the brake carrier by slide pin bolts. The brake carrier is connected to the axle through the use of the torque plate. The caliper housing assembly is mounted so that it floats on the slide pins. A bridge is attached to the caliper housing assembly to provide the reaction force on the outboard pad.

The caliper housing and bridge slide on bushings that are pressed into the caliper housing assembly. On the short slide pin side, the bushing is oval to accommodate brake deflection during braking. On the long slide pin side, the bushings are round and provide a more positive location for the housing. The slide pins are sealed externally by slide pin boots and slide pin caps.

The force introduced from the air chamber is amplified by the geometry of the operating shaft. This clamping force is transferred to the inboard pad through the half-bearings, rollers, tappets, pistons and piston heads. Once the inboard pad has been applied, the force of reaction acting through the floating caliper housing assembly and bridge pulls the outboard pad onto the brake rotor. The forces created by the friction of the brake pads on the brake rotor are transferred at the ends of the pads onto the carrier, which is rigidly mounted to the axle.

The brakes are released by reducing the input force on the operating shaft, thus reducing the clamp force of the brake. The return spring then returns the clamping mechanism and the operating shaft back to their starting position, leaving the pads with a defined running clearance to the rotor. The small runout of the brake rotor and hub-bearing clearances will then generate a small clearance for the outboard pad through only a few revolutions of the rotor.

## Automatic Adjustment

The automatic adjuster adjusts the brake pad clearance to compensate for pad wear. Every time the brake is applied, the system senses whether adjustment is required or whether the running clearance of the brake pads to the brake rotor is still within the built-in tolerance and does not need to be adjusted. The built-in tolerance is determined in the design by the clearance between the ball-ended drive pin that is rigidly fixed to the operating shaft and the fork on the end of the adjuster shaft.

## 2 Introduction

### Operation Without Adjustment

From the rest position, the air chamber push rod moves FORWARD, rotating the operating shaft. When the pistons move FORWARD through the built-in running clearance, the ball-ended drive pin starts to contact the driving side of the fork on the end of the adjuster shaft. Further movement of the air chamber push rod rotates the operating shaft, causing the adjuster shaft to rotate because the built-in clearance has been taken up. The outer drive sleeve is fixed to the adjuster shaft and rotates the inner drive sleeve through the clutch pack. The inner drive sleeve is linked to the intermediate gear by a unidirectional friction spring and this tries to rotate the tappets. However, the friction in the threads of the tappets and pistons increases due to the clamping force on the pads. This prevents the pistons and tappets from rotating relative to one another. The pistons cannot rotate in the adjuster housing, and due to the high torque to turn the tappets, the clutch pack slips, preventing adjustment of the mechanism below the correct running clearance.

### Operation with Adjustment

When the running clearance is greater than the built-in tolerance as a result of pad or rotor wear, adjustment is required. From the rest position, the push rod of the air chamber moves FORWARD, rotating the operating shaft. As the pistons move FORWARD beyond the built-in running clearance, the ball-ended drive pin starts to contact the driving side of the fork on the end of the adjuster shaft. Further operating shaft movement causes rotation of the adjuster shaft through the ball-ended drive pin.

Driving through the clutch plates and the unidirectional friction spring, the intermediate gear rotates. Due to the excessive running clearance, the tappets now rotate in the pistons. The pistons cannot rotate and are wound out from their housing. When the pads contact the rotor, the clamping force increases the thread friction in the tappets and pistons. The torque to turn the tappets increases and the clutch pack driving the intermediate gear starts to slip, preventing further adjustment. The adjustment is not wound back during the return of the actuation mechanism. As the operating shaft returns to the brake's off position, the ball-ended drive pin travels back through the clearance in the fork on the end of the adjuster shaft. Once this clearance is taken up, the adjuster shaft rotates in the reverse direction, rotating the inner drive sleeve through the clutch pack. However, in this direction, the unidirectional friction spring cannot drive the intermediate gear, leaving the tappets and intermediate gear in the adjusted state. The system is in its starting position.

### Manual Adjustment and Deadadjustment During a Pad Change

Manual adjustment of the brake must only be made at a pad change. No manual intervention is required between pad changes.

A manual adjuster stem runs in constant mesh with the gear form on the outside of the tappets. The end of this stem comes out from the brake housing through a seal and is protected by an adjuster cover.

The automatic adjuster maintains a nominal pad-to-rotor clearance of 0.030-inch (0.75 mm).

Refer to Section 4 for adjustment and deadadjustment procedures.

## Intervals

Periodically inspect the brakes. Check the caliper, torque plate, pads and rotor for signs of wear and damage. Use the schedule below that gives the most frequent inspections. For additional roadside inspection information, call ArvinMeritor's Customer Service Center at 800-535-5560.

- Fleet chassis lubrication schedule
- Chassis manufacturer lubrication schedule
- At least four times during lining life
- At tire replacement

## Procedures

### WARNING

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury and damage to components can result.

1. Wear safe eye protection. Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving.
2. With the wheels on, check the following conditions.

## Inspection Procedure

### Caliper Adjustment

1. Attach a dial indicator to the torque plate or axle frame. The dial indicator reading should be taken from the slide pin cap. Figure 3.1.

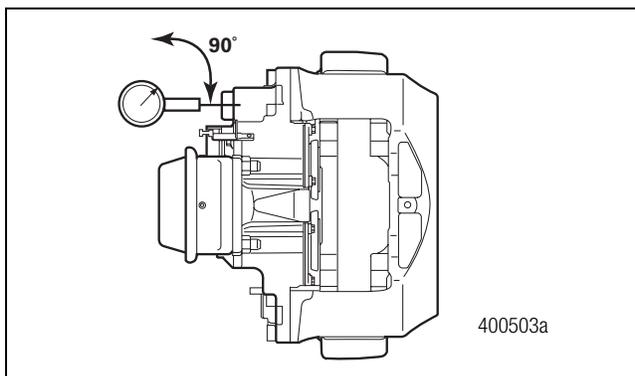


Figure 3.1

2. Check the brake adjustment by sliding the caliper back and forth, by hand, along the slide pins.

- **If the caliper slides more than 0.08-inch (2 mm):**  
The brake is out-of-adjustment and requires further inspection or replacement.

### Lining Wear

The visual wear indicator shows approximately how much of the lining material is remaining. Figure 3.2.

- **If the indicator protrudes less than 0.16-inch (4 mm) from the casting:** The pads require further inspection or replacement. Refer to Section 4.

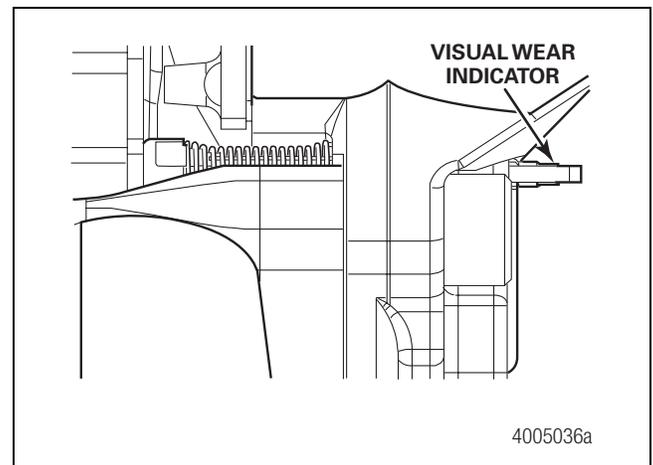


Figure 3.2

### Rotor

Visually inspect the rotor for signs of cracks, deep grooves, blue marks and heat checking. Refer to Section 6.

### Air Chamber

Inspect the air chamber to verify that the caliper mounting bolts and air lines are securely fastened and are not damaged.

## 4 Caliper Assembly and Brake Pad

### Hazard Alert Messages

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

#### **⚠ WARNING**

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury and damage to components can result.

Before you service a spring chamber, carefully follow the manufacturer's instructions to compress and lock the spring to completely release the brake. Verify that no air pressure remains in the service chamber before you proceed. Sudden release of compressed air can cause serious personal injury and damage to components.

#### **⚠ ASBESTOS AND NON-ASBESTOS FIBERS WARNING**

Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. You must use caution when you handle both asbestos and non-asbestos materials.

### Inspection

#### Caliper

1. Wear safe eye protection. Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving.
2. Apply air pressure to release the parking brake.
3. Remove all air from the air system. If the brake has spring chambers, carefully cage and lock the spring. Refer to Section 7.
4. Use a jack to raise the vehicle so that the wheels to be serviced are off the ground. Support the vehicle with safety stands.
5. Remove the wheel and tire assembly.

#### **⚠ WARNING**

Remove dry brake dust with a vacuum brush or wipe the areas with a damp cloth. Never use an air line to blow dust from the brake and rotor area. Never try to accelerate drying time by using an air line. Serious personal injury and damage to components can result.

6. Use a vacuum brush or damp cloth to remove any dirt from the brake assembly.
7. Visually check the caliper housing, bridge and carrier for damage.
  - If there is any damage: Replace the component or caliper assembly.

### Brake Deadadjustment Procedure

1. Remove the adjuster cover. Figure 4.1.

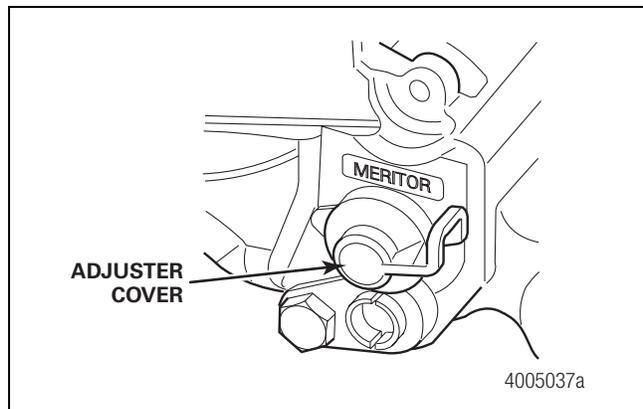


Figure 4.1

#### **⚠ CAUTION**

Always use a suitable wrench to carefully deadadjust and adjust the brake. Do not use air or power tools. Damage to components can result.

2. Use a 10 mm wrench to deadadjust the brake. Rotate the adjuster stem COUNTERCLOCKWISE until you feel the adjuster stem stop. Deadadjustment requires more force than adjustment. Do not exceed 30 lb-ft (40 N•m) in either direction. Figure 4.2 and Figure 4.3. **ⓘ**
  - If the manual adjuster does not rotate in either direction: Replace the caliper assembly and chamber assembly.

## 4 Caliper Assembly and Brake Pad

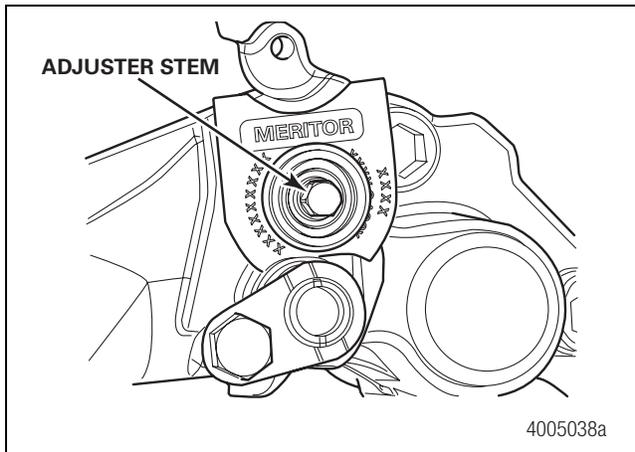


Figure 4.2

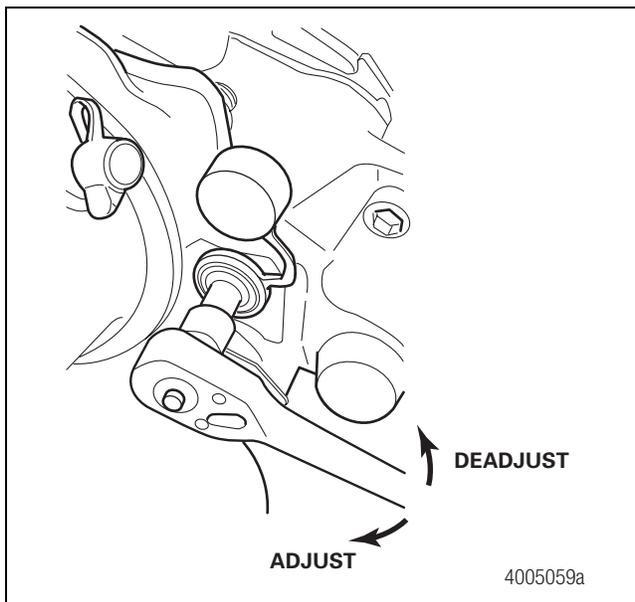


Figure 4.3

### Brake Adjustment Inspection

#### ⚠ CAUTION

Before you check for correct brake adjustment, verify that the wrench will not be obstructed by the air chamber, hoses or other brake or axle components. Damage to the brake can result.

1. To check for correct brake adjustment, deadadjust the brake. Use a 10 mm wrench to rotate the adjuster stem one-quarter turn COUNTERCLOCKWISE.

2. With the 10 mm wrench on the adjuster stem, actuate the brake one time. Figure 4.4.

- If the wrench rotates **CLOCKWISE** when you actuate the brake: The adjuster mechanism is working correctly.
- If the wrench does not rotate **CLOCKWISE** when you actuate the brake: The adjuster mechanism is not working correctly. Replace the caliper assembly.

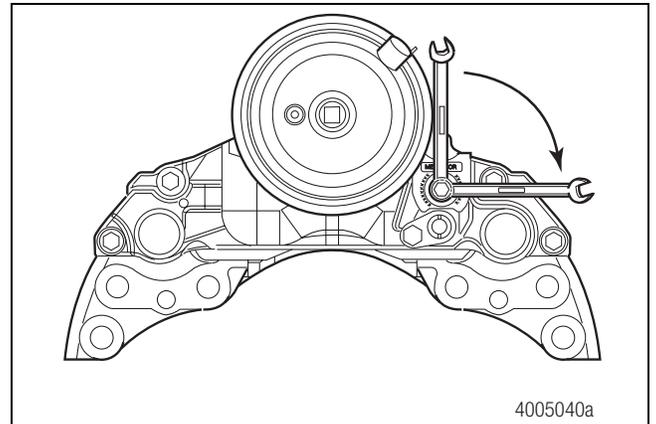


Figure 4.4

### Brake Pad Removal and Inspection

1. Use a 17 mm wrench to remove the pad retainer bolt. Remove the pad retainer. Figure 4.5.

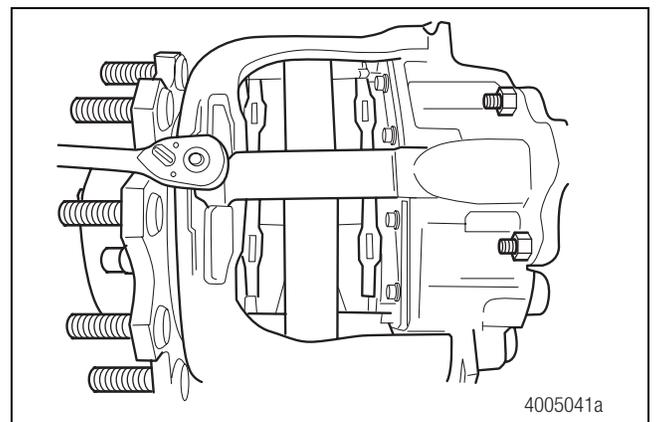


Figure 4.5

2. Visually inspect the pad retainer.
  - If the pad retainer is bent or damaged: Replace the pad retainer.
3. Remove the pad springs.

## 4 Caliper Assembly and Brake Pad

4. Remove the outboard brake pad from the caliper assembly and mark the brake pad "outboard". Figure 4.6.

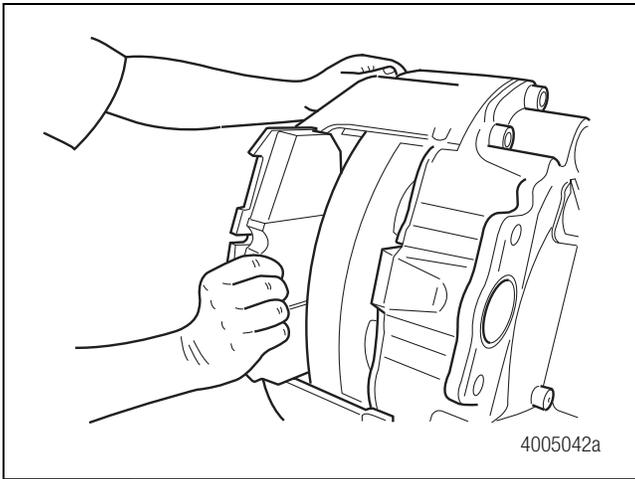


Figure 4.6

5. Remove the inboard brake pad from the caliper assembly and mark the brake pad "inboard".
6. Use a vacuum brush or damp cloth to remove the dirt and dust from the carrier brake pad contact surfaces.
7. Inspect the carrier for signs of damage or wear. Pay particular attention to the pad abutments. Figure 4.7.
  - **If there is excessive wear or damage to the abutments:** It may be necessary to replace the caliper assembly.

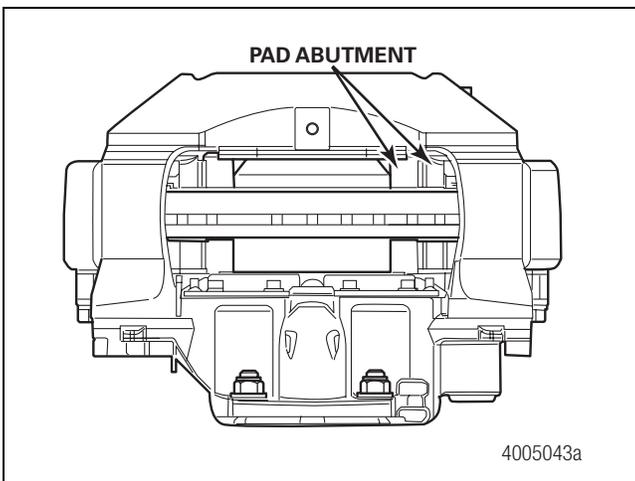


Figure 4.7

### ⚠ CAUTION

Replace the pads on both brakes of a single axle or all four brakes of a tandem axle at the same time. If you do not replace all the pads at the same time, poor brake performance will occur.

8. Inspect the brake pads for excessive grooving or cracked friction material. Check if the friction material is loose or detached from the backing plate. If necessary, replace all the brake pad assemblies.
9. Measure the friction material thickness from the center of the brake pad. Replace brake pad assemblies before the lining thickness reaches 0.12-inch (3 mm). Figure 4.8.

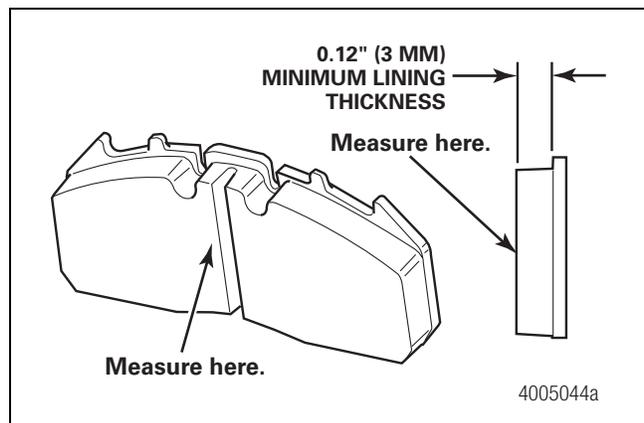


Figure 4.8

10. Inspect the pad springs. Replace bent, cracked or broken pad springs.
11. Verify that the caliper slides freely, by hand, on the slide pins. Take care not to trap your fingers while you check the sliding action of the brake.
  - **If the caliper does not slide:** Check the slide pin boots for damage and verify that they are seated correctly.
12. With the pads removed, visually inspect the caliper slide pin boots and piston boots. All slide pin and piston boots should be free from damage and should be correctly seated. Figure 4.9, Figure 4.10 and Figure 4.11.
  - **If any of the piston boots or the slide pin boots are damaged or unseated:** Replace the boots.

## 4 Caliper Assembly and Brake Pad

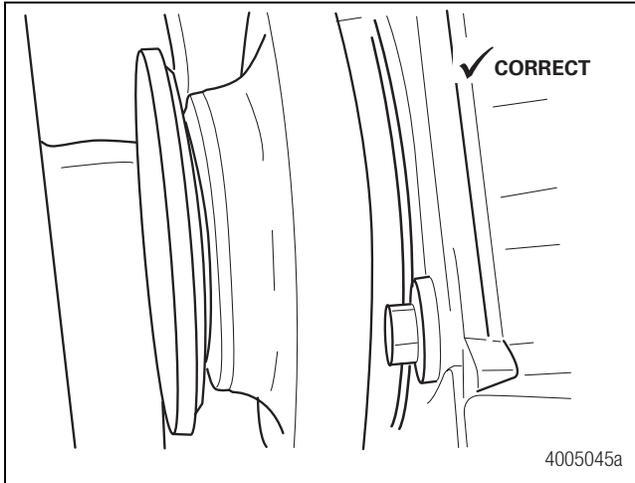


Figure 4.9

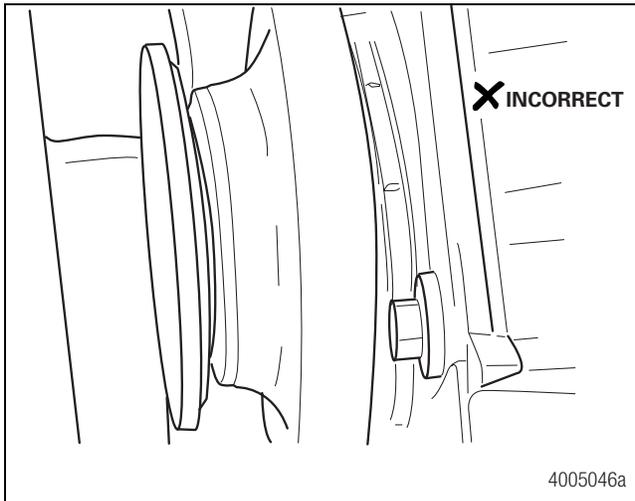


Figure 4.10

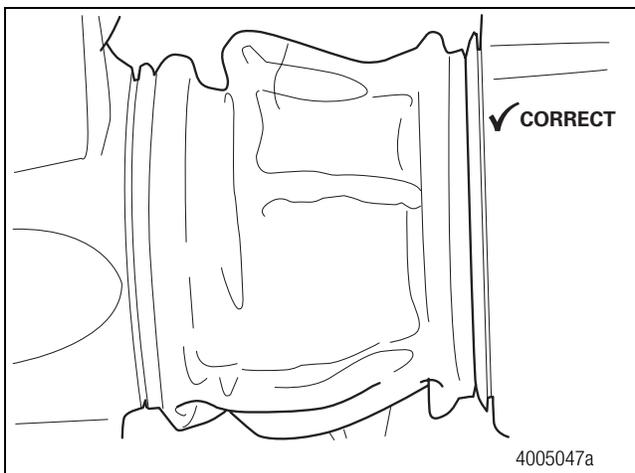


Figure 4.11

### Check Slide Pin Bushing Wear

Perform the following procedures with the brake assembly installed on the vehicle.

#### Tangential Test

1. With the pads removed, pull the caliper housing assembly OUTWARD toward the wheel flange. Attach a dial indicator so that it is in line with the centerline of the short slide pin. Attach the indicator to the hub. Figure 4.12.

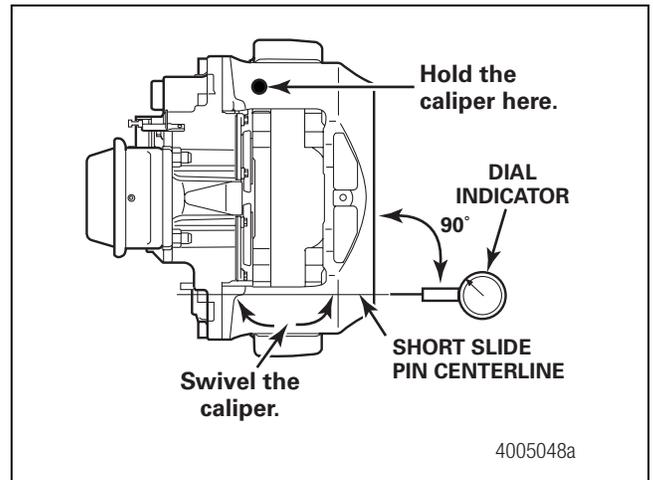


Figure 4.12

2. Hold the caliper so that it cannot move. Swivel the caliper until it stops in one direction. Set the gauge to ZERO. Figure 4.12 and Figure 4.13.

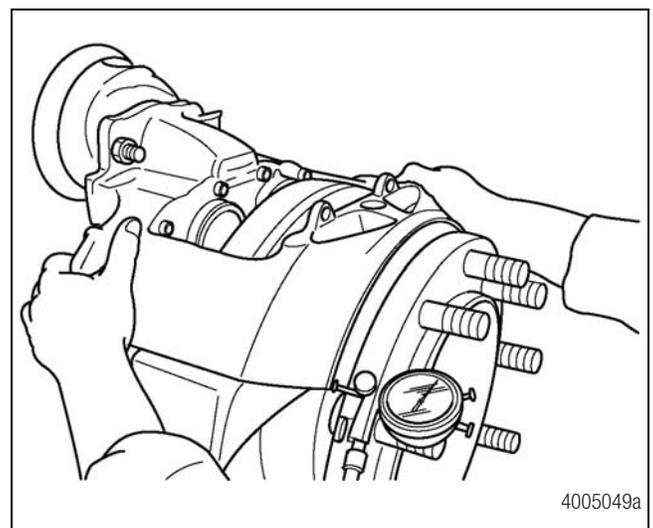


Figure 4.13

## 4 Caliper Assembly and Brake Pad

3. Move the housing in the opposite direction until it stops. Figure 4.13. The maximum acceptable reading is 0.118-inch (3 mm).
  - **If the reading is more than 0.118-inch (3 mm):** Replace the caliper assembly.

### Radial Test

1. Attach a dial indicator onto the vehicle hub and set it against the caliper. Figure 4.14.

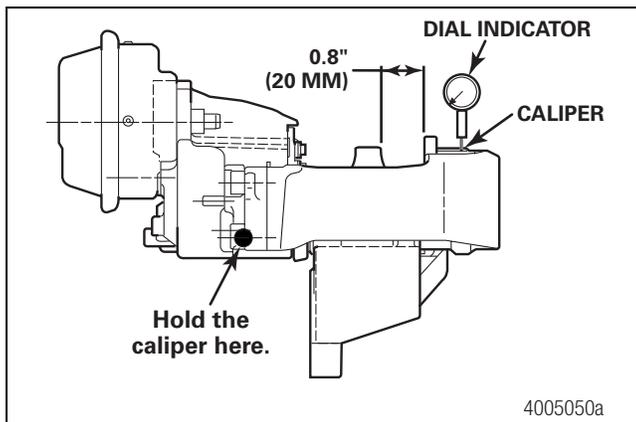


Figure 4.14

2. Position the brake in the half-worn pad position. This is set when a gap of approximately 0.8-inch (20 mm) exists between the rotor and bridge. Hold the caliper at the outboard pad edge and by the air chamber.
3. Push the brake down by hand as far as possible and set the gauge to ZERO. Figure 4.14 and Figure 4.15.

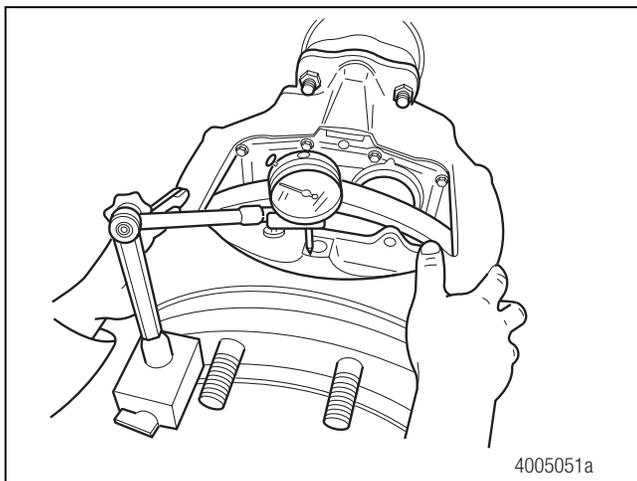


Figure 4.15

4. Pull the caliper up as far as possible without allowing the caliper to slide. The maximum acceptable reading is 0.078-inch (2 mm).
  - **If the reading is more than 0.078-inch (2 mm):** Replace the caliper assembly.

### Brake Pad Installation

#### ⚠ CAUTION

Install the pads with the friction material facing the rotor. Damage to components can result.

1. If necessary, deadadjust the brakes and remove the brake pads. Refer to the procedures in this section.
2. Slide the caliper OUTWARD. Install the outboard pad and spring into the outboard side of the caliper. Figure 4.16.

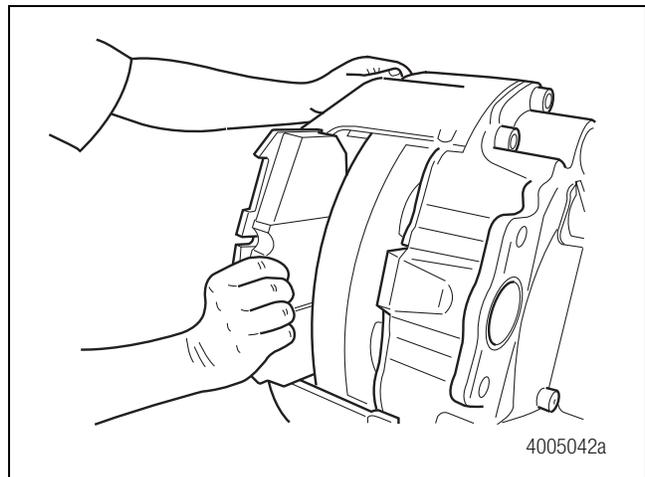


Figure 4.16

3. Slide the caliper INWARD. Install the inboard pad and spring into the inboard side of the caliper. Figure 4.16.
4. Install the pad retainer and pad retainer bolt. Tighten the bolt to 25-30 lb-ft (34-40 N•m). Figure 4.17. 

  - **If you are replacing the pad retainer:** Do not use the original pad retainer bolt. Use the pad retainer bolt supplied with the kit.

## 4 Caliper Assembly and Brake Pad

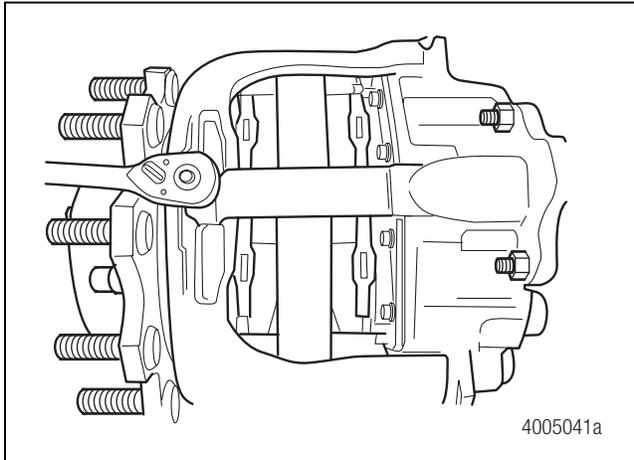


Figure 4.17

### ⚠ CAUTION

You must adjust the initial brake pad-to-rotor clearance or an inefficient, dragging brake can occur. Damage to components can result.

5. Set the initial brake pad-to-rotor running clearance. Refer to the procedure in this section.

### Set the Initial Brake Pad-to-Rotor Running Clearance

### ⚠ CAUTION

Always set the initial brake pad-to-rotor running clearance with the air chamber installed. Damage to components can result.

1. Remove the adjuster cover. Figure 4.18.

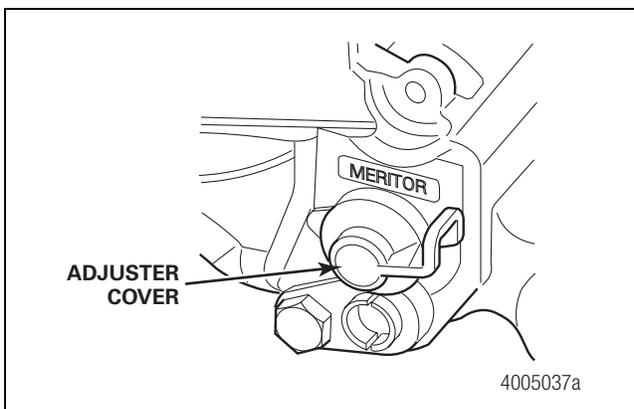


Figure 4.18

2. Use a 10 mm wrench to rotate the manual adjuster stem **CLOCKWISE** so that the brake pad-to-rotor clearance is **ZERO**. Figure 4.19.

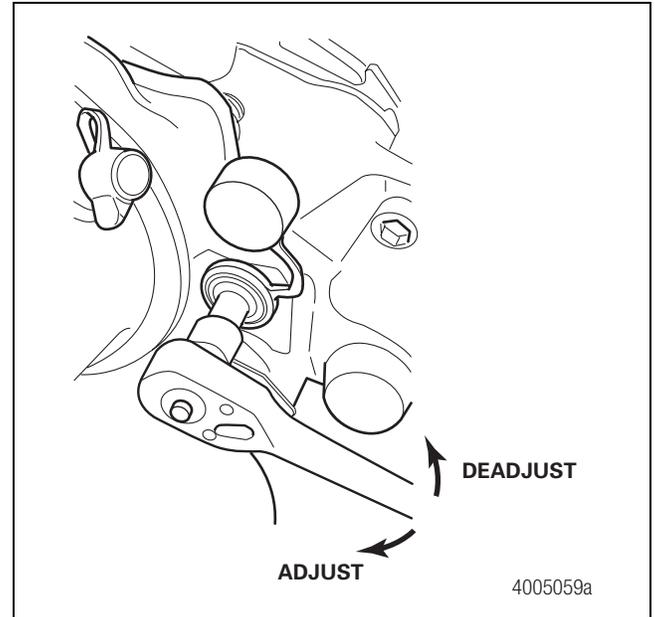


Figure 4.19

3. Deadadjust the manual adjuster stem one half turn **COUNTERCLOCKWISE** to set the initial running clearance. Reinstall the adjuster cover. Figure 4.19.

## 5 Caliper Components Replacement

### Hazard Alert Messages

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

#### **⚠ WARNING**

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury and damage to components can result.

#### **⚠ ASBESTOS AND NON-ASBESTOS FIBERS WARNING**

Some brake linings contain asbestos fibers, a cancer and lung disease hazard. Some brake linings contain non-asbestos fibers, whose long-term effects to health are unknown. You must use caution when you handle both asbestos and non-asbestos materials.

### Introduction

This section contains all the procedures required to completely disassemble the caliper. The disassembly procedures are presented in a specific sequence. If you are not completely disassembling the caliper, you will not be performing all the procedures in this section.

### Remove the Caliper Assembly

#### **⚠ WARNING**

Before you service a spring chamber, carefully follow the manufacturer's instructions to compress and lock the spring to completely release the brake. Verify that no air pressure remains in the service chamber before you proceed. Sudden release of compressed air can cause serious personal injury and damage to components.

1. Cage the spring chambers. Carefully remove the air hoses from the air chamber. Use the correct wrench to remove the air chamber nuts and washers. Figure 5.1. Remove the air chamber assembly from the brake caliper and inspect the air chamber.
  - **For Meritor chambers:** Refer to Section 7.
  - **For non-Meritor chambers:** Refer to the manufacturer's instructions.

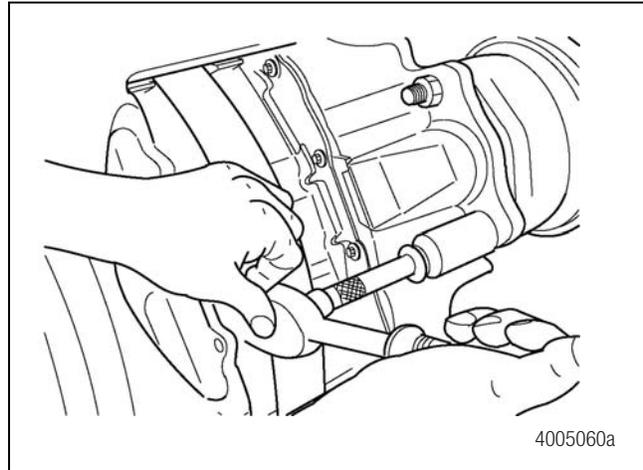


Figure 5.1

2. Cover the exposed air chamber mounting aperture with tape to prevent debris from entering the caliper housing assembly. Figure 5.2.

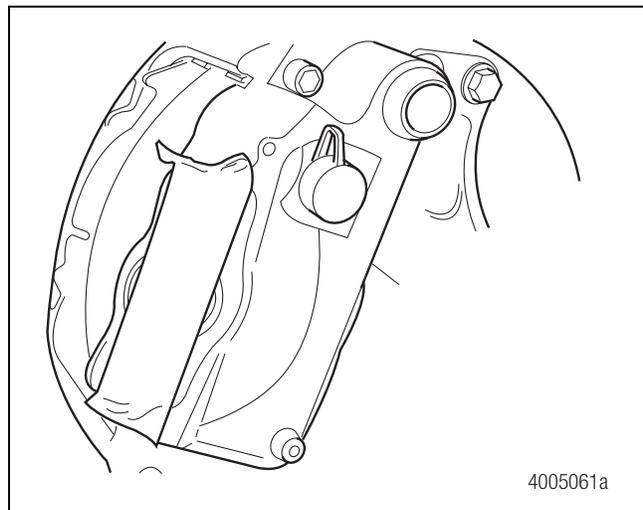


Figure 5.2

3. Deadadjust the caliper and remove the brake pads. Refer to Section 4.
4. Use a 30 mm socket wrench to remove the carrier bolts and washers. Figure 5.3. Carefully remove the caliper assembly from the axle.

## 5 Caliper Components Replacement

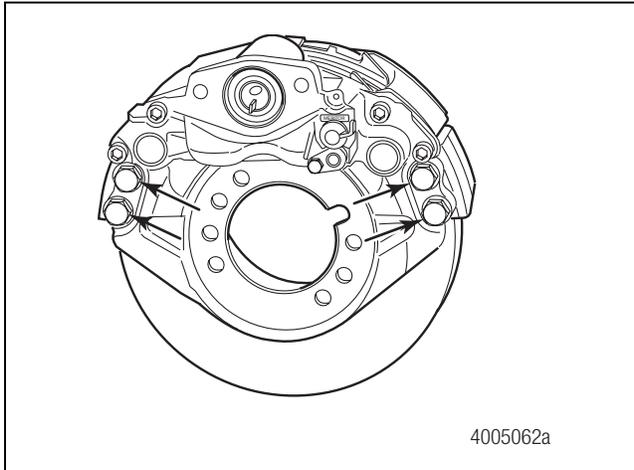


Figure 5.3

### Install the Caliper Assembly

1. Place the caliper assembly over the rotor.
2. Align the caliper carrier bolt holes. Assemble the caliper to the torque plate using the carrier bolts and washers. Tighten the carrier bolts to 350-450 lb-ft (474-610 N•m). 
3. Check the caliper assembly to verify that it slides by hand.
4. Before you install the air chamber onto the caliper assembly, ensure the perforated transit plug is removed from the caliper chamber seal by pulling the tab. Figure 5.4 and Figure 5.5.

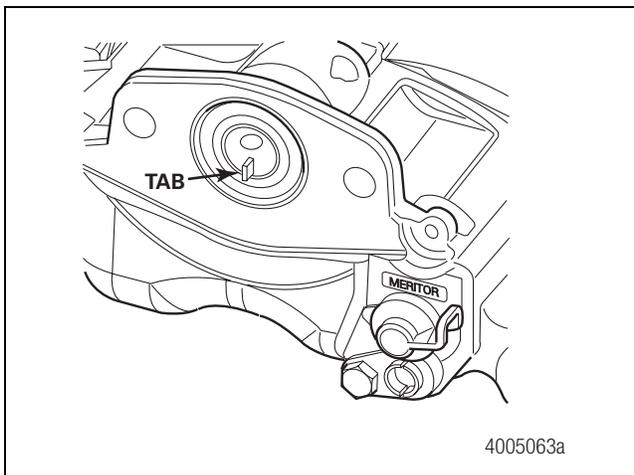


Figure 5.4

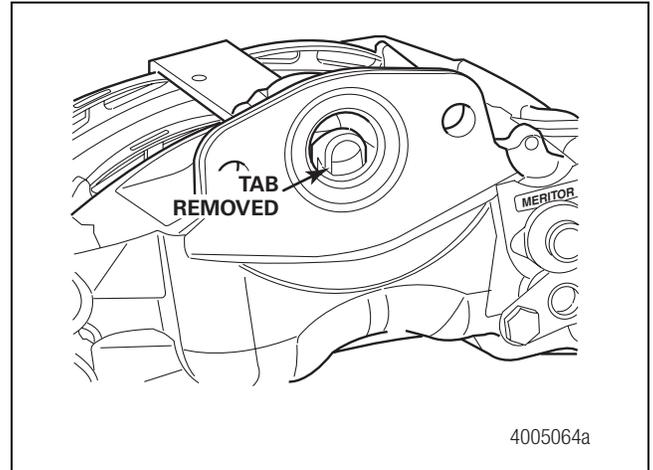


Figure 5.5

5. Install the air chamber onto the caliper assembly.
  - **For Meritor chambers:** Refer to Section 7.
  - **For non-Meritor chambers:** Refer to the manufacturer's instructions.
6. Install the pads and set the initial brake pad-to-rotor clearance. Refer to Section 4.

### Replace the Adjuster Cover

1. Remove the adjuster cover from the caliper assembly. Figure 5.6.

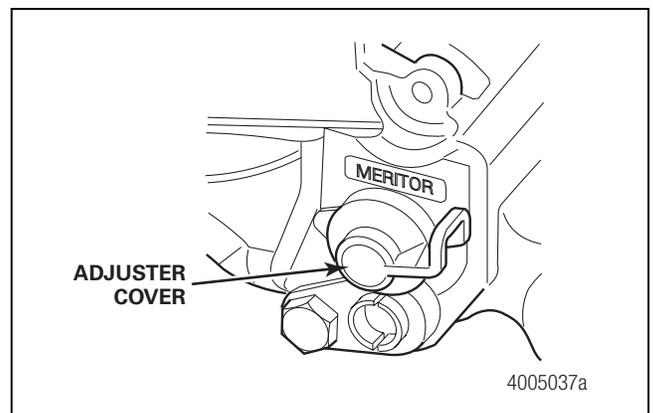


Figure 5.6

2. Install the new adjuster cover. Verify that it is correctly located on the adjuster cover retaining ring.

## 5 Caliper Components Replacement

### Replace the Piston Boots

1. Cage the spring chambers.
  - **For Meritor chambers:** Refer to Section 7.
  - **For non-Meritor chambers:** Refer to the manufacturer's instructions.
2. Deadadjust the caliper and remove the brake pads. Refer to Section 4.
3. Use a 10 mm wrench to rotate the manual adjuster stem **CLOCKWISE** until the piston assemblies are extended approximately two-inches (50 mm). Figure 5.7 and Figure 5.8.

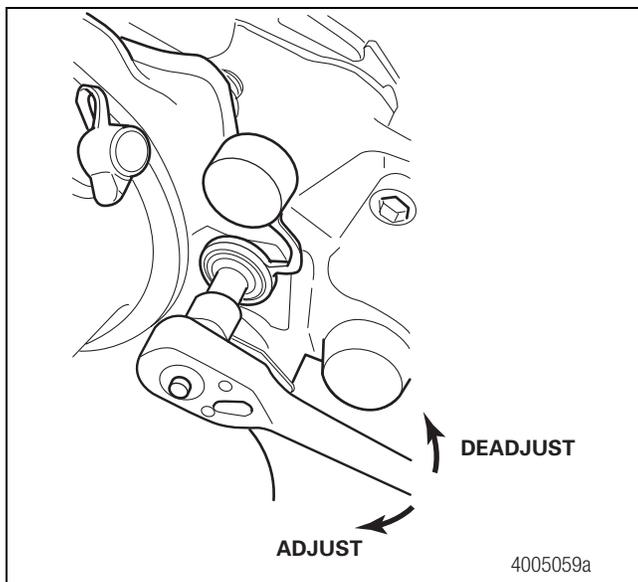


Figure 5.7

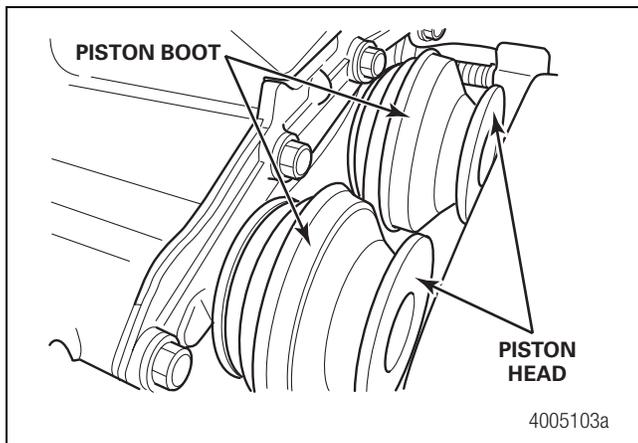


Figure 5.8

4. Remove the piston boots. Do not remove the piston heads from the piston assembly.
5. Use a suitable brake cleaner to clean the piston heads and housing.
6. Check the condition of the piston shafts.
  - **If excessive corrosion or wear is present:** Replace the caliper.
7. Use the grease supplied in the kit to lightly lubricate the piston shafts. Only use the grease supplied with the replacement components and kits.

### **⚠ CAUTION**

**When you install the new piston boots, do not use grease to aid assembly. Your hands must be clean and free from grease. Using grease may result in damage to the piston boots.**

8. Carefully install a new piston boot over a piston head. The larger seal diameter with the tab goes over the piston head first. Do not install the piston boot bead into the housing assembly retaining groove at this time. Figure 5.9.

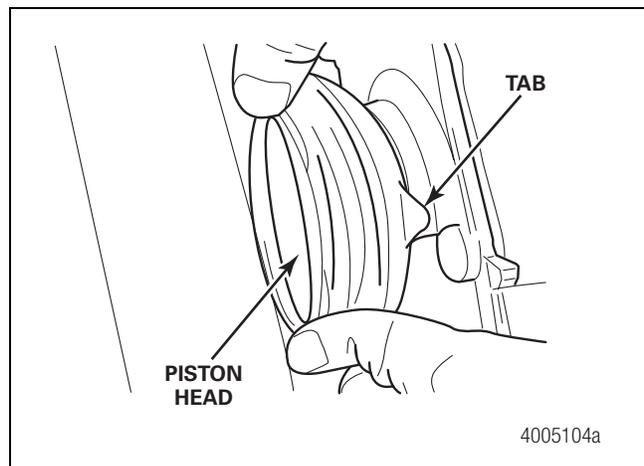


Figure 5.9

9. Carefully install the piston boot into the piston head groove. Verify that the boot is correctly seated in the piston head groove. Figure 5.10.

## 5 Caliper Components Replacement

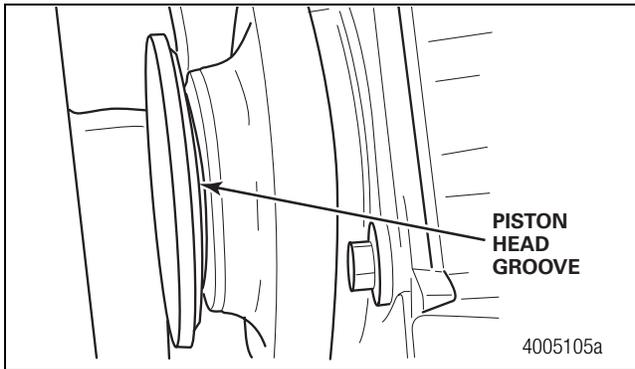


Figure 5.10

10. Use two fingers to stretch the piston boot and pull it over the housing assembly retainer groove. Figure 5.11.

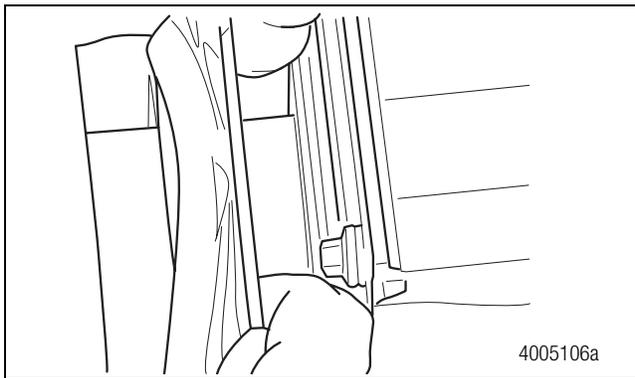


Figure 5.11

11. Rotate the piston boot and verify that the piston boot beads are correctly seated in the retainer groove. Figure 5.12. The piston boot beads must be correctly seated. Figure 5.13 and Figure 5.14.

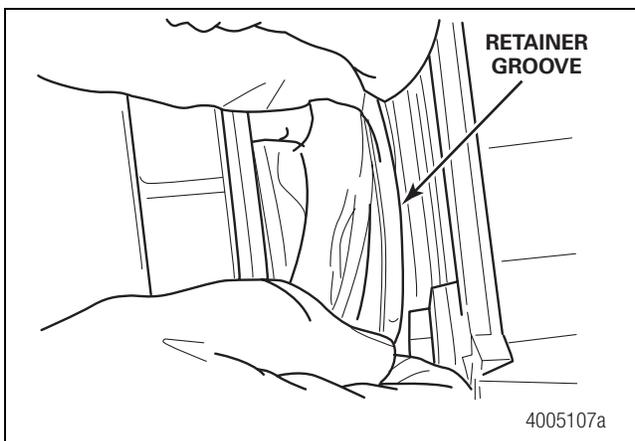


Figure 5.12

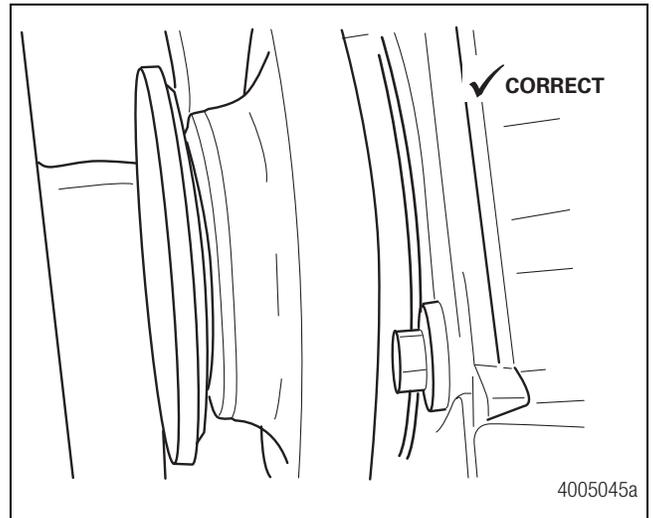


Figure 5.13

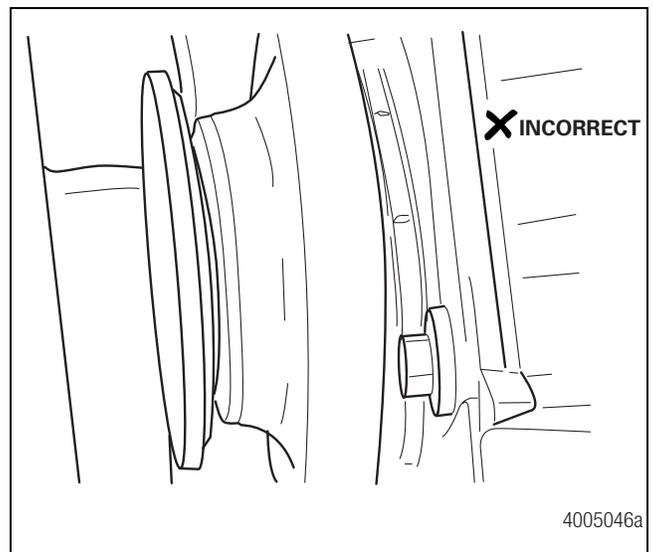


Figure 5.14

12. Repeat the procedure to install the second piston boot.

## 5 Caliper Components Replacement

- Use a 10 mm wrench to rotate the manual adjuster stem COUNTERCLOCKWISE and deadadjust the piston assemblies. With the brake fully deadadjusted, it may be necessary to lift the piston boot tab and release air that may be inflating the boot. Figure 5.15.

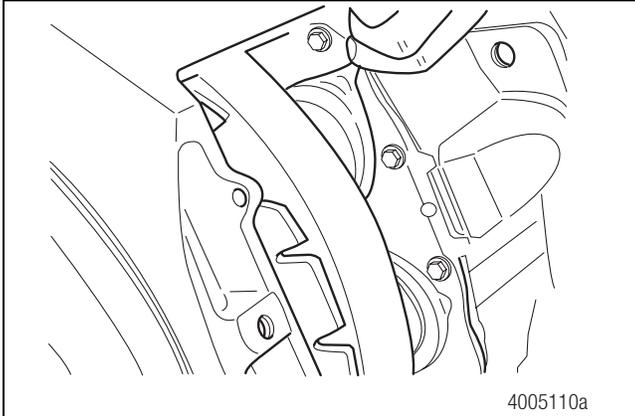


Figure 5.15

- Install the pads and set the initial brake pad-to-rotor running clearance. Refer to Section 4.
  - If other caliper components must be replaced:** Replace the components before you install the pads and set the initial brake pad-to-rotor running clearance. Refer to the procedures in this section.

### Remove the Caliper Bridge

This procedure is required to replace the following caliper components:

- Housing assembly
- Slide pin boots
- Slide pins

- Remove the caliper assembly from the axle. Refer to the procedure in this section.
  - If there is adequate room in the wheel well to service the caliper assembly:** You don't have to remove the caliper assembly from the axle.
- Use the correct size socket to remove the four bridge bolts. Figure 5.16. Discard the bridge bolts after they have been removed. They are no longer usable.

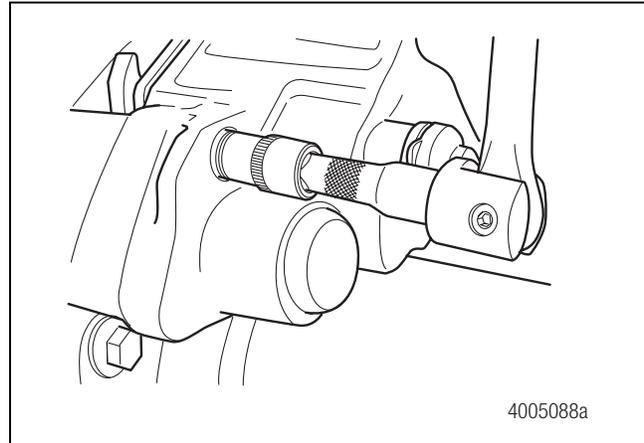


Figure 5.16

- Carefully remove the bridge. Figure 5.17.
  - If you are replacing the caliper housing assembly, slide pin boots or slide pins:** Proceed to the caliper housing assembly removal procedure in this section. Otherwise, proceed to the caliper bridge installation procedure in this section.

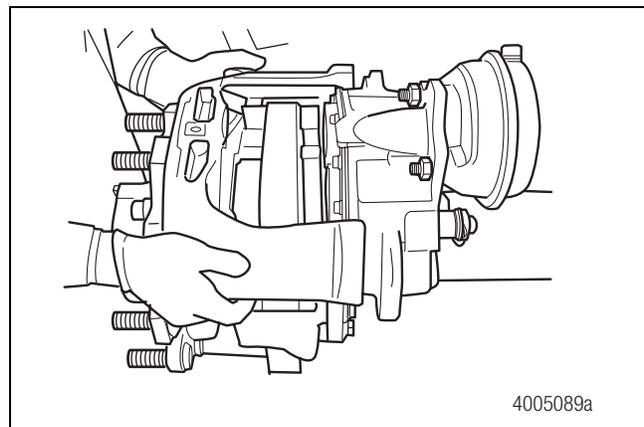


Figure 5.17

### Remove the Caliper Housing Assembly

Carefully remove the housing assembly from the slide pins. Figure 5.18.

- If you are replacing the slide pin boots or slide pins:** Proceed to the slide pin boots removal procedure in this section. Otherwise, proceed to the caliper housing assembly installation procedure in this section.

## 5 Caliper Components Replacement

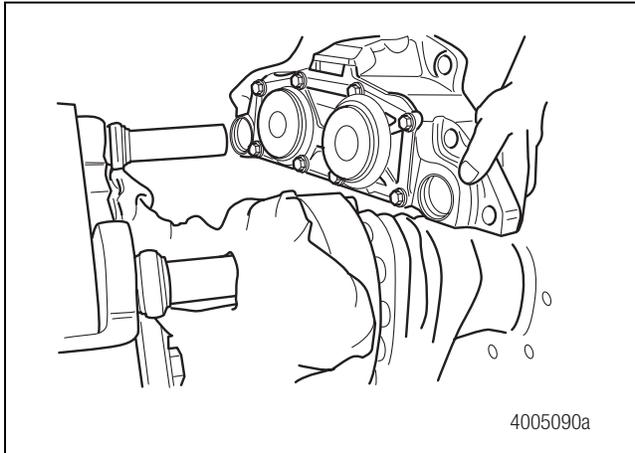


Figure 5.18

### Remove the Slide Pin Boots

1. Remove the slide pin boots from the slide pins or the housing assembly retainers. Discard the slide pin boots.
2. Clean and inspect the carrier for damage and wear. Pay particular attention to the pad abutment areas and slide pins. Figure 5.19.
  - **If there is damage or excessive wear to the slide pins:** Replace the slide pins before proceeding. Refer to the procedure in this section.
  - **If there is excessive wear or damage to the carrier:** Replace the caliper assembly. Refer to the procedure in this section. Otherwise, proceed to the slide pin boots installation procedure in this section.

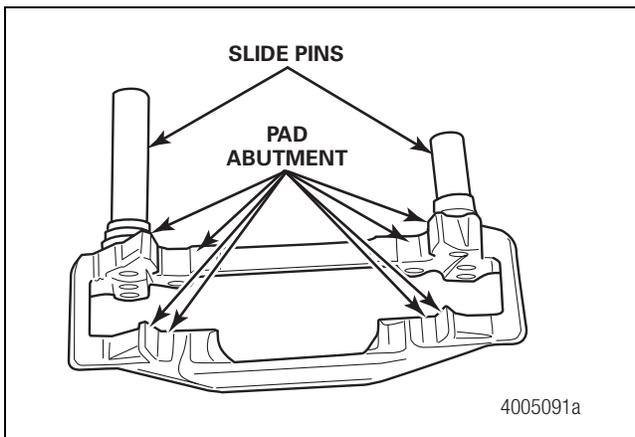


Figure 5.19

### Replace the Slide Pins

1. Before you remove the slide pins, note the locations of the long and short slide pins. Remove the slide pin bolts retaining the slide pins to the carrier. Figure 5.20. If necessary, carefully release the slide pins from their location on the carrier using a rubber or soft metal hammer.

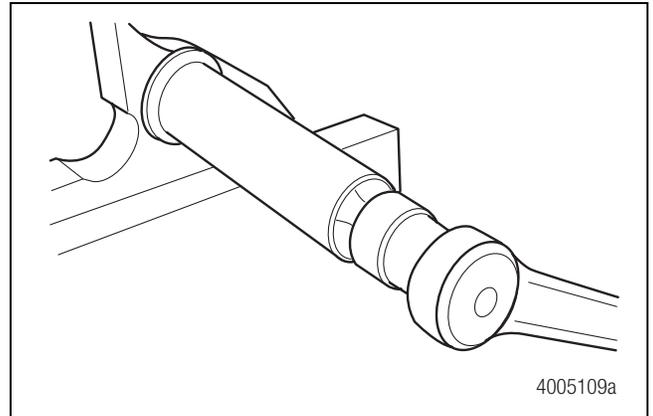


Figure 5.20

2. Clean the slide pin contact areas and the threaded holes in the carrier. Check for wear.
  - **If the carrier requires replacement:** Remove it from the axle and replace it with a new caliper. Refer to the procedure in this section.
3. To ensure correct function of the caliper, the long and short slide pins must be correctly located and installed onto the carrier. The long slide pin and short slide pin need no alignment. Locate the new slide pin positions on the carrier and secure with the corresponding slide pin bolts. Tighten the bolts to 310-332 lb-ft (420-450 N•m). 

### Install the Slide Pin Boots

1. Use the grease provided in the kit to lightly lubricate the slide pins and the inside of the new slide pin boots. You must use the grease supplied with the replacement components and kits. Do not use any other type of grease.
2. Slide the new slide pin boots over the slide pins. Verify that the slide pin boot bead is in the slide pin retainer groove. Figure 5.21 and Figure 5.22.

## 5 Caliper Components Replacement

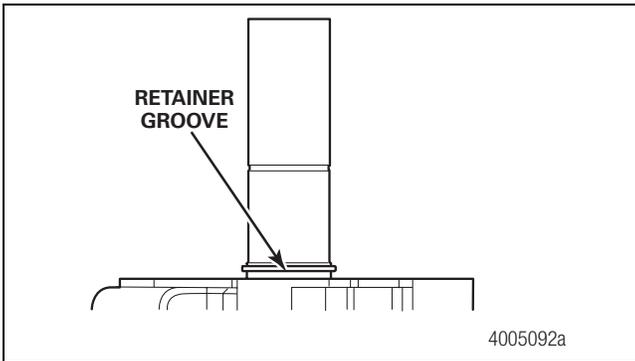


Figure 5.21

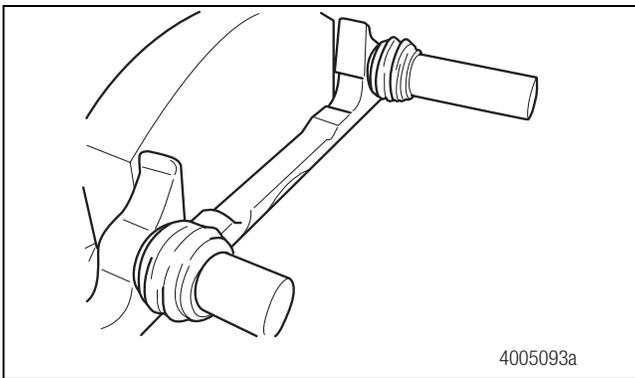


Figure 5.22

3. Proceed to the caliper housing assembly installation procedure in this section.

### Install the Caliper Housing Assembly

1. Apply grease to the slide pins and slide bores in the housing assembly. Figure 5.23 and Figure 5.24.

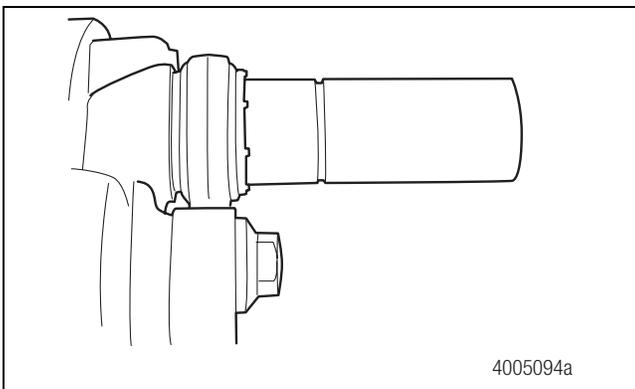


Figure 5.23

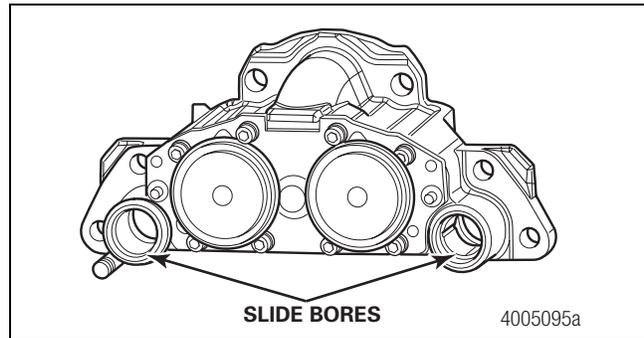


Figure 5.24

2. Carefully slide the housing assembly onto the slide pins. Be careful not to damage the slide pin boots when you install the housing assembly onto the slide pins. Figure 5.25.

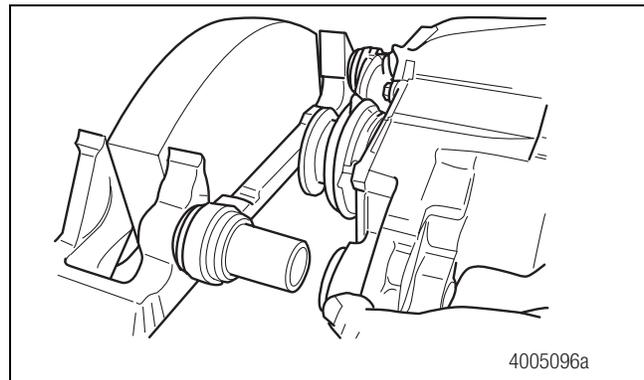


Figure 5.25

3. Install the slide pin boot beads into the housing retainer grooves. Figure 5.26 and Figure 5.27.

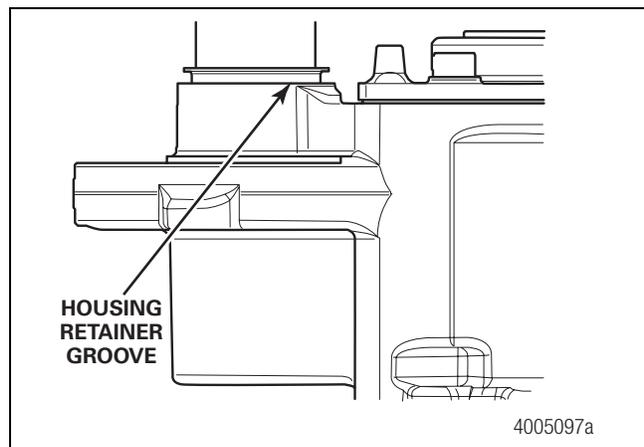


Figure 5.26

## 5 Caliper Components Replacement

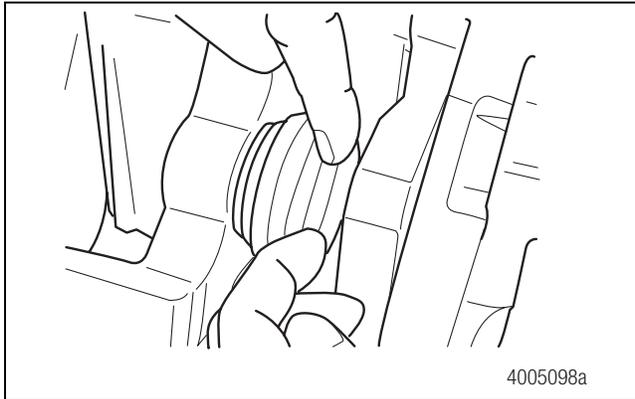


Figure 5.27

4. Verify that the slide pin boots are correctly located on both the carrier and housing retainers. Figure 5.28.

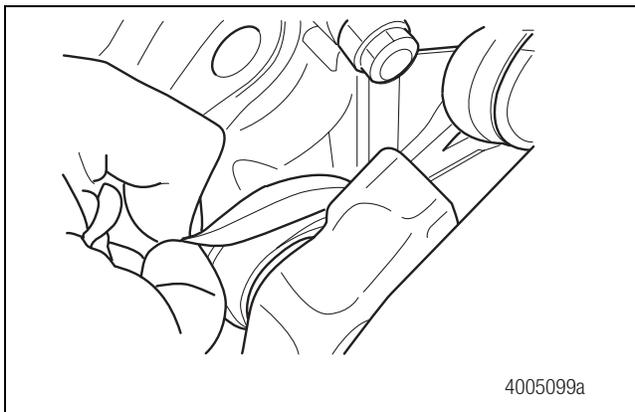


Figure 5.28

### **WARNING**

Use a brass or synthetic mallet for assembly and disassembly procedures. Do not hit steel parts with a steel hammer. Pieces of a part can break off. Serious personal injury and damage to components can result.

5. If you are installing a new housing, use a copper-faced mallet to carefully tap one of the new end caps into the caliper housing assembly until it retains itself. Use the correct size tool to tap the end cap into the bore 0.069-0.088-inch (1.75-2.25 mm) for the short slide pin side, Figure 5.29, and 0.228-0.251-inch (5.8-6.4 mm) for the long slide pin side, Figure 5.30. The caps must be installed to the correct depth.

- **If the cap is pressed into the bore below the minimum dimension:** The full movement of the housing assembly will be restricted.

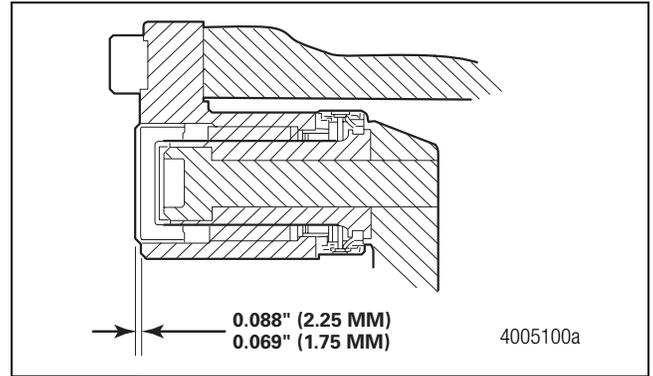


Figure 5.29

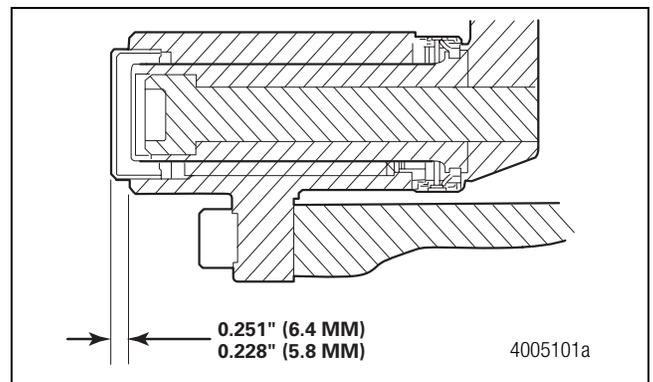


Figure 5.30

6. Check the housing assembly to verify that it slides by hand on the slide pins. Take care not to trap your fingers while you check the sliding action of the housing assembly. Slide the housing assembly back and forth several times to check for smooth movement on the slide pins. The boots are correctly installed if they collapse from the pressure changes within the slide pin mechanism. Figure 5.31.

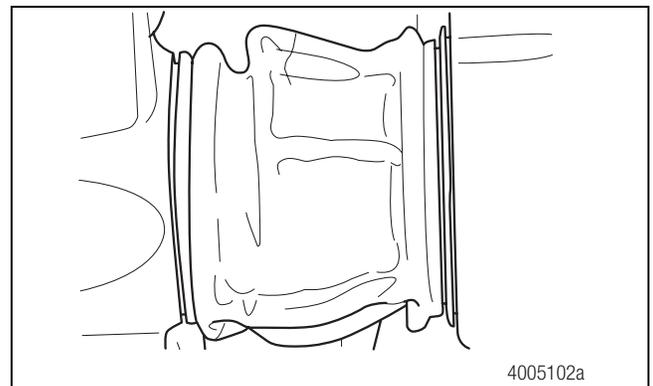


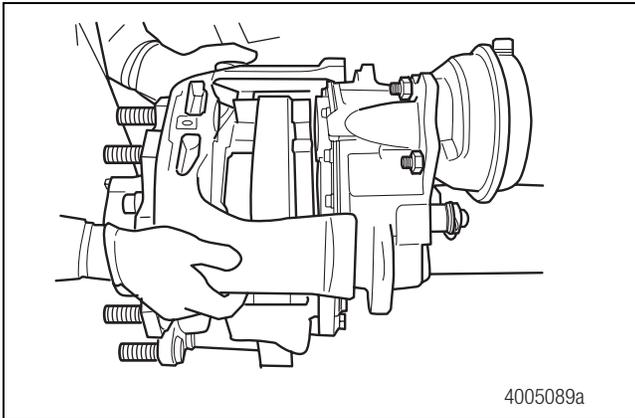
Figure 5.31

## 5 Caliper Components Replacement

7. Proceed to the caliper bridge installation procedure in this section.

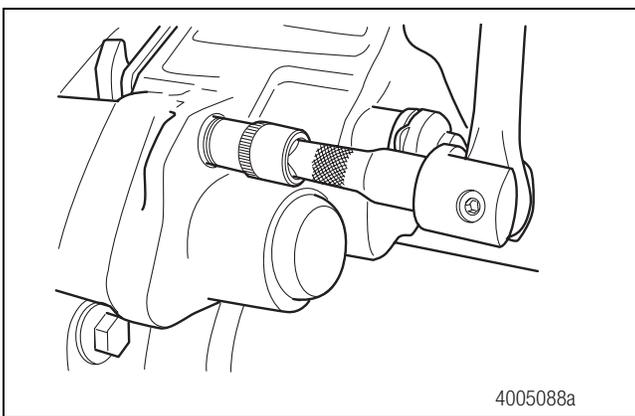
### Install the Caliper Bridge

1. Position the bridge against the caliper housing assembly. Figure 5.32.



**Figure 5.32**

2. Support the bridge in position and install the four new bridge bolts. For the EX225L caliper, tighten the M14 bolts to 174-202 lb-ft (235-275 N•m). For the EX225H2 and EX225H3 calipers, tighten the M16 bolts to 221-253 lb-ft (300-350 N•m). Figure 5.33. If necessary, install the caliper assembly onto the axle. Refer to the procedure in this section.



**Figure 5.33**

## Hazard Alert Messages

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

### **⚠ WARNING**

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. Do not work under a vehicle supported only by jacks. Jacks can slip and fall over. Serious personal injury and damage to components can result.

## Inspection

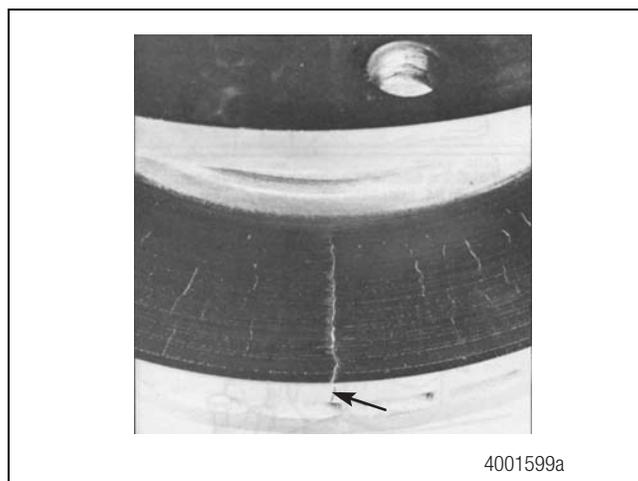
1. Wear safe eye protection. Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving.
2. Use a jack to raise the vehicle so that the wheels to be serviced are off the ground. Support the vehicle with safety stands.
3. With the pads removed, rotate the wheel and inspect the hub and rotor assembly for damage.
4. Inspect both sides of the rotor for cracks and heat checks. Replace the hub, rotor or entire assembly, if necessary.
5. Check the hub and rotor assembly for damaged, loose or missing fasteners. For the correct torque, refer to Section 8.

## Cracks

### **⚠ WARNING**

Always replace a cracked rotor to avoid serious personal injury and damage to components.

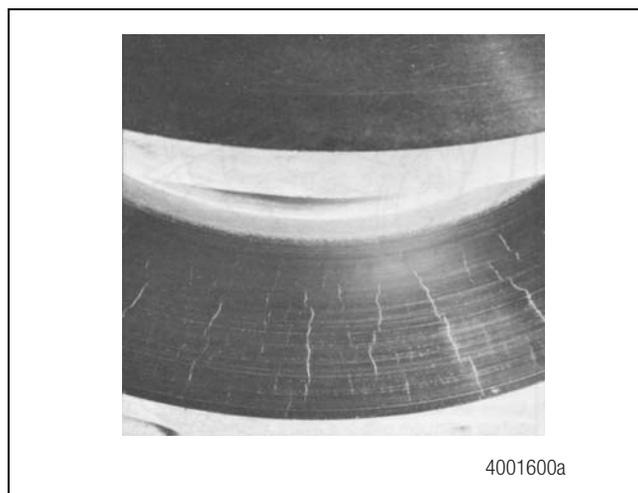
When the crack extends through a section of the rotor, replace the rotor. Figure 6.1.



**Figure 6.1**

## Heat Checking

Heat checks are short, thin, sometimes numerous, radial interruptions of the rotor braking surfaces. They are the result of disc brake operation. They are caused by the heating and cooling that occurs as the brakes are applied time after time. Heat checks will frequently wear away and reform, or they may become braking surface cracks, depending on such factors as the lining and rotor wear rate, brake balance, and how hard the brakes are used. There are two kinds of heat checking: light and heavy. Figure 6.2.



**Figure 6.2**

## 6 Rotor

### Light Heat Checking

Cracks on the surface of the rotor that result from light heat checking are small and fine and do not require rotor replacement. Figure 6.2 and Figure 6.3.

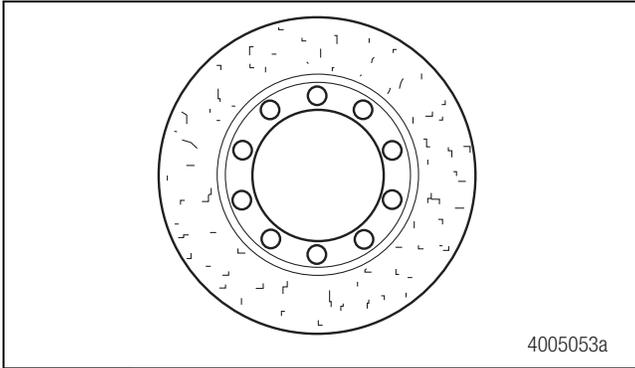


Figure 6.3

### Heavy Heat Checking

Heavy heat checking is surface cracks that have width and depth. Replace the rotor if the heat checks have a width greater than 0.02-inch (0.5 mm), depth greater than 0.04-inch (1 mm) and extend across the surface more than 75% in the radial direction. Figure 6.4.

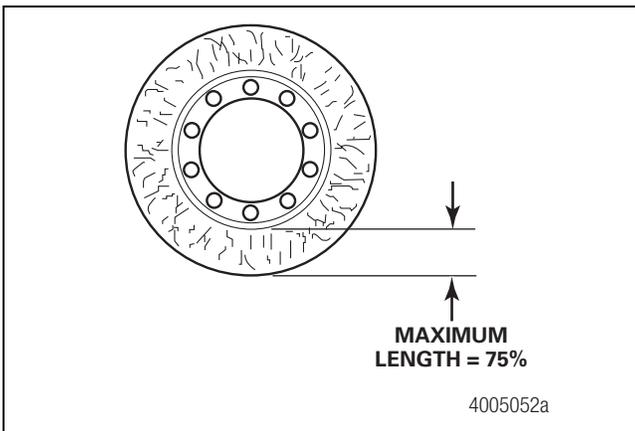


Figure 6.4

### Deep Grooves or Scores

Inspect both sides of the rotor. If you find grooves or scores of a depth less than 0.02-inch (0.5 mm), continue to use the rotor. If the grooves are greater than 0.02-inch (0.5 mm), you may choose to resurface the rotor. If the rotor thickness measured across any groove is less than 1.46-inches (37 mm), discard and replace the rotor. Figure 6.5.

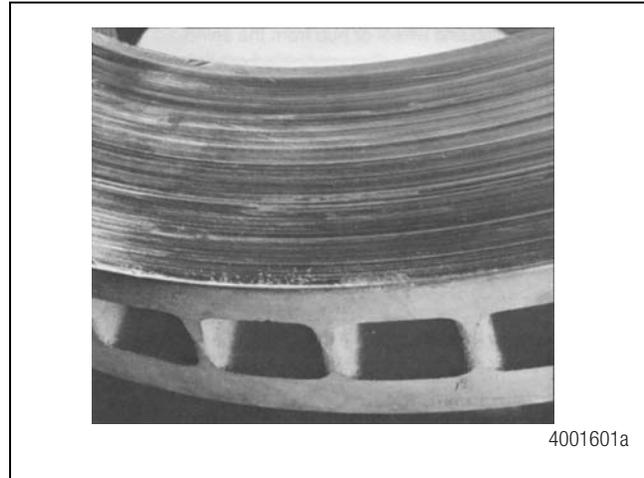


Figure 6.5

### Blue Marks or Bands

Blue marks or bands indicate that the rotor was very hot. Determine the cause and correct the conditions. Figure 6.6.

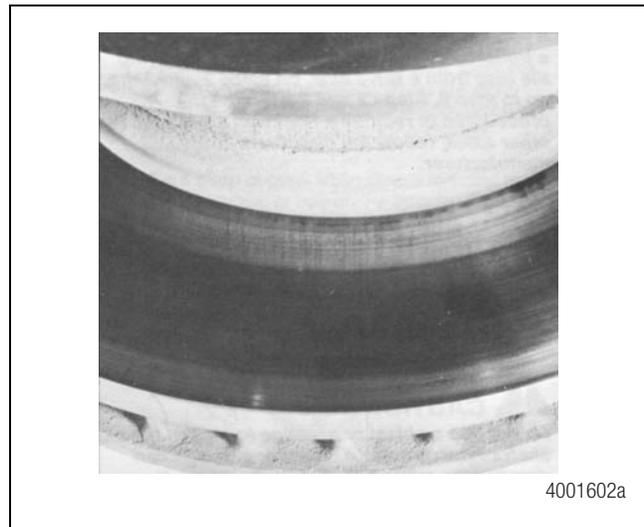


Figure 6.6

## Measure the Rotor Thickness

### ⚠ CAUTION

Replace the rotor if it reaches the minimum allowable rotor thickness of 1.46-inches (37 mm). Damage to components can result.

1. Use a micrometer to measure the rotor thickness. If you are replacing the brake pads, the rotor should be replaced if the rotor thickness is less than 1.54-inches (39 mm). Figure 6.7.

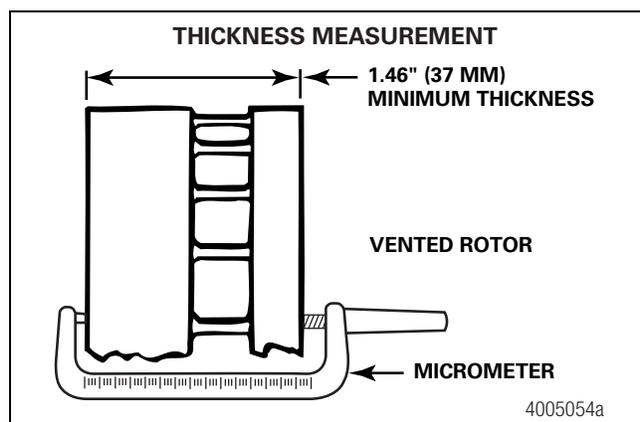


Figure 6.7

2. Check for uneven rotor wear. Using the pad retainer as a gauge, place it between the rotor surface and carrier pad abutment. Check both the inboard and outboard sides of the rotor. Figure 6.8 and Figure 6.9.

- **If the pad retainer fits into the gap on either side:**  
Replace the rotor.

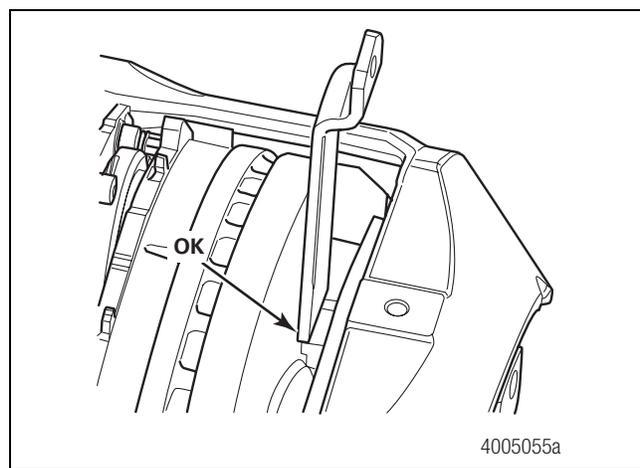


Figure 6.8

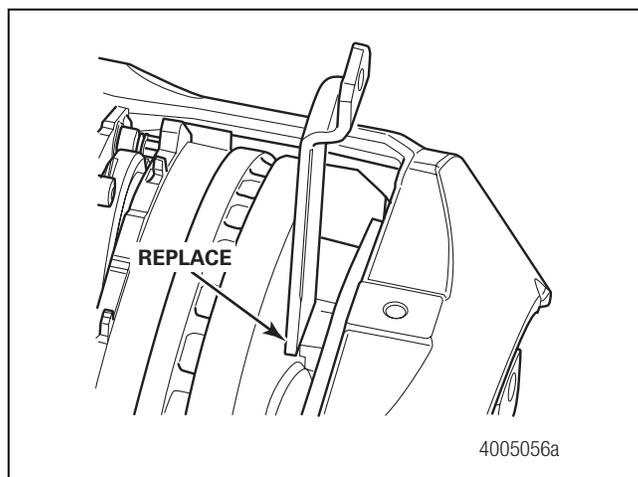


Figure 6.9

## Measure the Rotor Runout

1. Attach a dial indicator to the caliper or axle frame.
2. Check the lateral runout of the rotor braking surface. The runout measurement should be taken from the center of the rotor braking surface. The end play of the hub bearings should not be included in this measurement. The runout should not exceed 0.02-inch (0.5 mm) through one full revolution of the rotor.
  - **If the runout is greater than 0.02-inch (0.5 mm):** Check the wheel bearings for correct adjustment. Refer to the manufacturer's instructions.

## Removal and Installation

### Replace the Rotor

1. Remove the caliper. Refer to Section 5.
2. Remove the hub and rotor assembly. Refer to the axle manufacturer's service manual.
3. Use the correct size socket wrench to remove the hub-to-rotor bolts and washers. Refer to Section 8. Remove the rotor from the hub.
4. Verify that the hub and rotor mating surfaces are clean and free of debris or burrs. Verify that the hub rotor pilots are correctly engaged to the rotor.

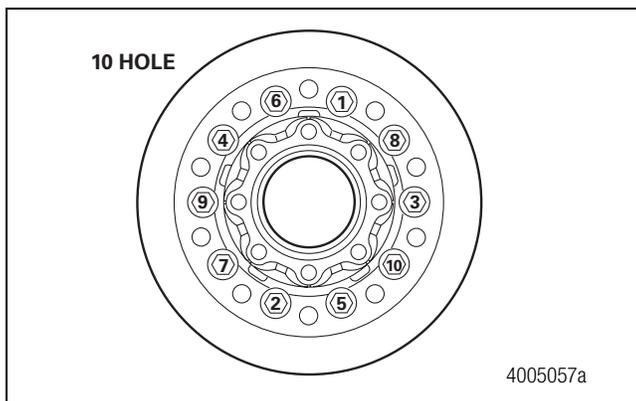
## 6 Rotor

### **⚠ WARNING**

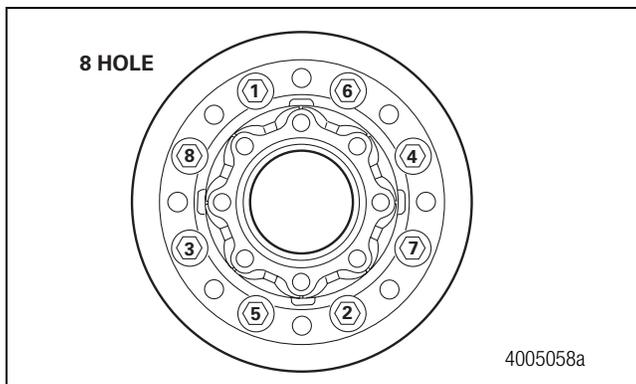
Use the correct fasteners and washers. Incorrect fasteners and washers may result in an insufficient clamping load or damage to the caliper or wheel. Serious personal injury and damage to components can result.

Take care when you use Loctite® adhesive to avoid serious personal injury. Read the manufacturer's instructions before using this product. Follow the instructions carefully to prevent irritation to the eyes and skin.

5. Apply Loctite® 620 retaining compound to the new hub-to-rotor bolts.
6. Use the new hub-to-rotor bolts and washers to attach the new rotor to the hub. Be careful not to damage or move the hub-mounted tone rings during new rotor installation.
7. Tighten the hub-to-rotor bolts in a crisscross pattern to the correct torque. Refer to Section 8. Figure 6.10 or Figure 6.11.
8. Ensure that all bolt heads do not protrude past the wheel-to-hub mounting surface.
9. Install the hub and rotor assembly to the axle. Refer to the axle manufacturer's service manual. Ensure that the rotor braking surfaces are free of oil, grease and other contaminants.
10. Install the caliper assembly and brake pads. Adjust the brake pad-to-rotor clearance. Refer to Section 5.



**Figure 6.10**



**Figure 6.11**

## Hazard Alert Messages

Read and observe all Warning and Caution hazard alert messages in this publication. They provide information that can help prevent serious personal injury, damage to components, or both.

### **⚠ WARNING**

To prevent serious eye injury, always wear safe eye protection when you perform vehicle maintenance or service.

## Introduction

The information in this section applies to Meritor air chambers only.

- **If the brake is equipped with Meritor air chambers:** Refer to the procedures in this section.
- **If the brake is equipped with non-Meritor air chambers:** Refer to the air chamber manufacturer's instructions.

### **⚠ WARNING**

Always install an air chamber with the correct chamber piston length. If an incorrect air chamber is installed, the difference in chamber piston length will result in partial brake application. Serious personal injury and damage to components can result.

The DiscPlus™ EX225 air disc brake uses a 0.59-inch (15 mm) chamber piston standout length. Figure 7.1. The air chamber part number is located on a nameplate.

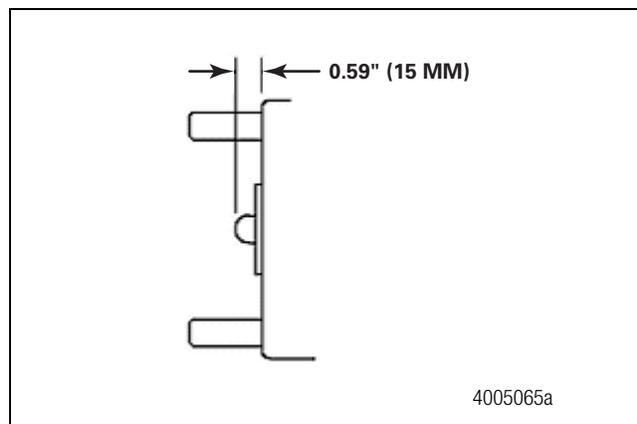


Figure 7.1

## Inspection

1. With the air chamber removed, visually inspect the chamber mounting studs. Figure 7.2.
  - **If there are signs of uneven wear, broken, loose or missing studs:** Replace the chamber.

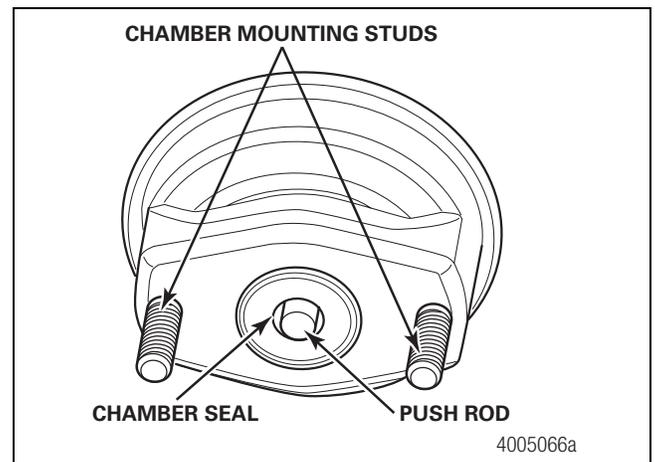


Figure 7.2

2. Visually inspect the chamber push rod and chamber seal. Figure 7.2.
  - **If there is damage:** Replace the chamber.
3. Visually inspect the chamber piston, chamber seal and chamber-mounting aperture on the caliper housing assembly. Figure 7.2 and Figure 7.3.
  - **If signs of water entry and corrosion are present:** Replace the chamber and caliper assembly.

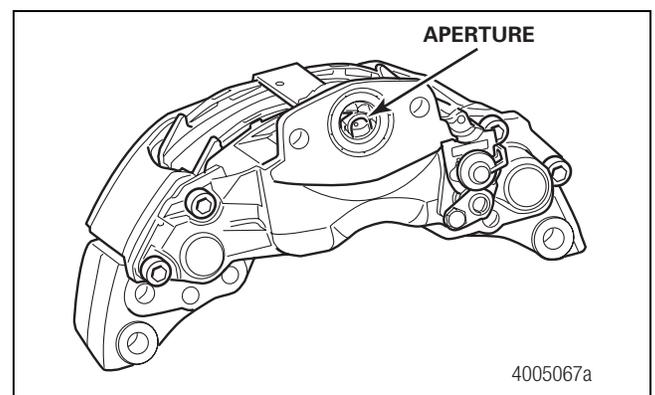


Figure 7.3

## 7 Air Chamber

### Cage the Spring Brake Chamber

When removing or installing service brake chambers, if there is no spring brake chamber to cage, proceed to the removal or installation procedure. Typically, new spring brake chambers are shipped caged.

- **If the spring brake chamber you are removing or installing is already caged:** Proceed to the removal or installation procedure.
- **If the spring brake chamber is not caged:** Use one of the following procedures to cage the spring brake chamber. The preferred method of caging is to use compressed air. An alternate manual method can be used if compressed air is not available.

#### **⚠ WARNING**

Before you service a spring chamber, carefully follow the manufacturer's instructions to compress and lock the spring to completely release the brake. Verify that no air pressure remains in the service chamber before you proceed. Sudden release of compressed air can cause serious personal injury and damage to components.

#### Compressed Air Method

1. Wear safe eye protection.
2. Remove the dust plug from the release tool access hole in the center of the spring housing. Remove the release tool bolt, washer and nut from the holder. Figure 7.4.

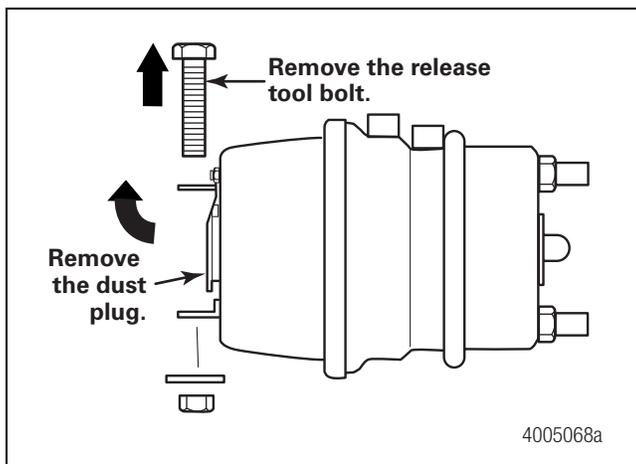


Figure 7.4

3. Apply vehicle or shop air pressure, 120 psi (8.3 bar) maximum, 90 psi (6.2 bar) minimum, to the emergency side of the brake. Cycle the brake three times. Maintain this air pressure.
4. Insert the release tool bolt through the access hole, all the way into the pressure plate inside the spring housing. Do not attempt to mechanically release or cage the spring on any spring brake chamber if it shows signs of structural damage, significant corrosion or any other damage. Figure 7.5.

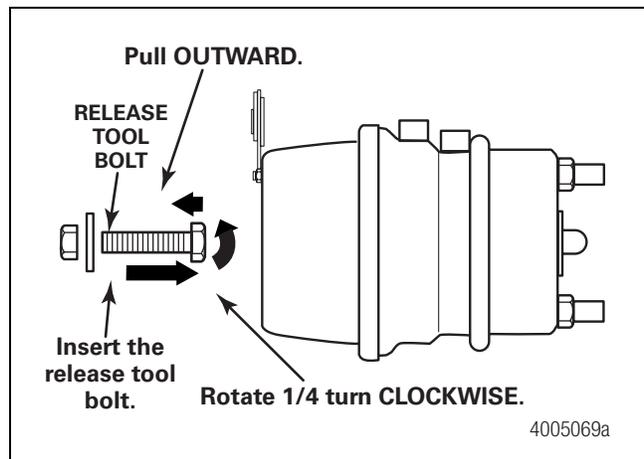


Figure 7.5

5. You must engage the release tool bolt on the pressure plate by turning the bolt one-quarter turn CLOCKWISE and pulling OUTWARD. If the release tool bolt is correctly engaged on the pressure plate, it will not turn more than one-quarter turn CLOCKWISE and will not pull OUTWARD more than 0.75-inch (19 mm). Figure 7.5.

#### **⚠ WARNING**

Overtightening the nut can cause pressure plate, washer and spring housing damage. The main spring could release suddenly and cause the release tool, washer and nut to become airborne. Serious personal injury and property damage can result.

6. Install the release tool washer and tighten the nut finger-tight. Do not overtighten the nut.
7. The spring brake chamber is now caged. Release the air pressure and proceed to the installation procedure in this section.

### Manual Method

This manual method should be used only if the spring brake chamber is not already caged and if a compressed air source is not available. The preferred method of caging is to use compressed air. This method applies only if the spring brake chamber is not pressurized.

1. Wear safe eye protection.
2. Remove the dust plug from the release tool access hole in the center of the spring housing. Remove the release tool bolt, washer and nut from the holder. Figure 7.4.
3. Use a flashlight to look through the access hole and check that the top of the pressure plate is located about 2.5-3-inches (63-76 mm) deep.
4. Insert the release tool bolt through the access hole, all the way into the pressure plate inside the spring housing. Do not attempt to mechanically release or cage the spring on any spring brake chamber if it shows signs of structural damage, significant corrosion or any other damage. Figure 7.5.
5. You must engage the release tool bolt on the pressure plate by turning the bolt one-quarter turn **CLOCKWISE** and pulling **OUTWARD**. If the release bolt is correctly engaged on the pressure plate, it will not turn more than one-quarter turn **CLOCKWISE** and will not pull **OUTWARD** more than 0.75-inch (19 mm). Figure 7.5.
6. Install the release tool washer and tighten the nut finger-tight. Do not overtighten the nut.
7. Use a hand wrench to cage the main spring by tightening the release tool nut. Do not use an impact wrench to tighten the release tool nut. Overtightening the release tool nut can cause pressure plate damage.
8. The service push rod should be retracting while you tighten the release tool nut. When the service push rod stops moving, the release tool bolt torque reaches 35 lb-ft (47 N•m) or the release tool extends beyond the nut more than 3.25-inches (83 mm), stop tightening the release tool nut. 
9. The spring brake chamber is now caged. Proceed to the installation procedure in this section.

### Installation

#### Spring or Service Brake Chamber

1. Verify that the chamber seal is well seated, free of debris and shows no signs of damage. Do not install a brake chamber that shows signs of debris or excess flash on the seal.
2. Verify that the caliper seal surface and the mounting surface are free of oil, grease and debris and show no signs of damage.
3. Before you install the air chamber onto the caliper assembly, ensure the perforated transit plug is removed from the caliper chamber seal by pulling the tab. Figure 7.6 and Figure 7.7.

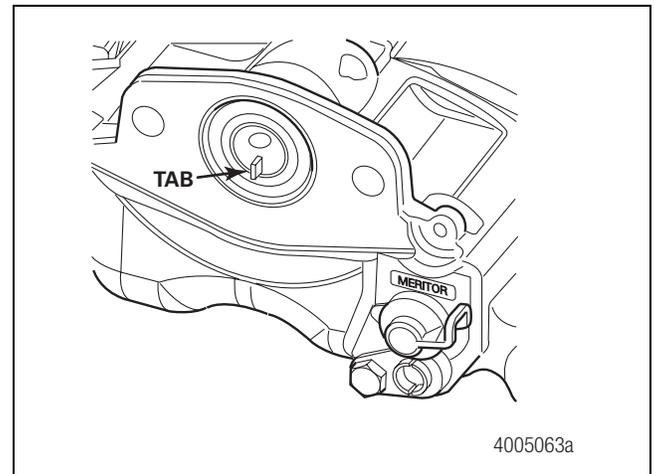


Figure 7.6

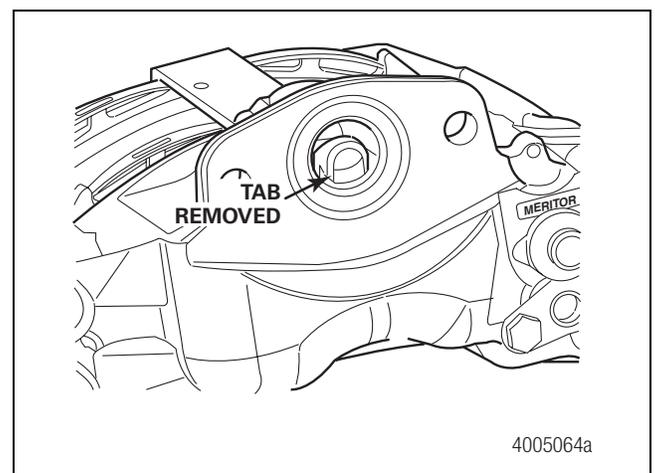


Figure 7.7

## 7 Air Chamber

4. Position the chamber onto the caliper. Determine which of the two possible brake chamber orientations places the ports in the most accessible position.
5. As you position the chamber onto the caliper, visually check that the chamber push rod is nesting in the pocket of the operating shaft.
6. Firmly hold the chamber onto the caliper by hand. Place the two washers and nuts onto the mounting studs. Do not work from behind the spring brakes, always work from the side and front. Spring brake chambers are under more than 2,000 pounds (8900 N) of spring force.
7. Use a 24 mm wrench to tighten the nuts in an alternating sequence.
  - A. Tighten the nuts until the mating surfaces meet. Use minimal torque on the two nuts.
  - B. Use a torque wrench to tighten each nut to 59-75 lb-ft (80-100 N•m). Then, use a torque wrench to tighten each nut to 133-155 lb-ft (180-210 N•m). 
8. If breather plugs are supplied, locate the bottommost breather plug and remove it from the chamber. Figure 7.8 and Figure 7.9.

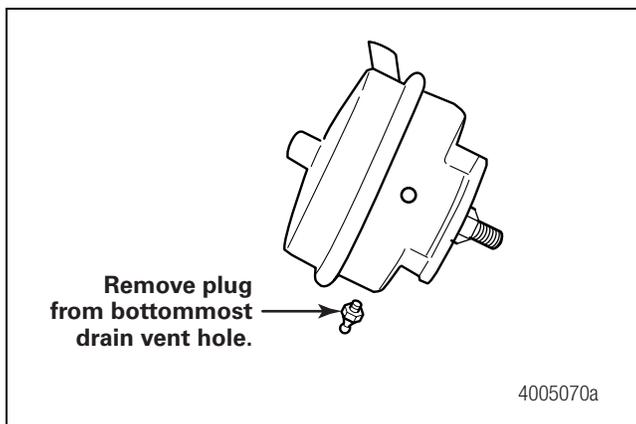


Figure 7.8

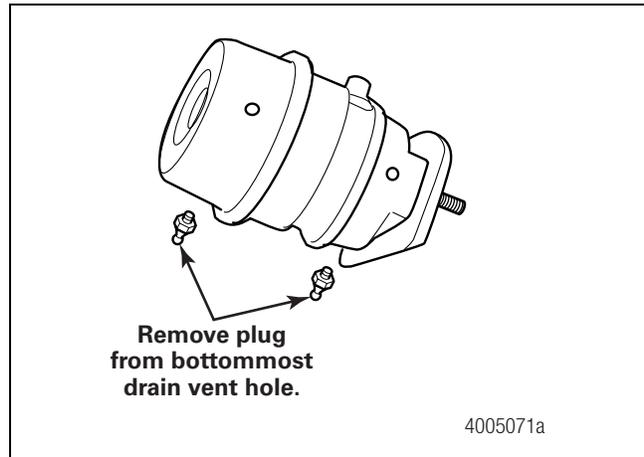


Figure 7.9

9. Install the air hoses to the chamber ports. Use Teflon<sup>®</sup> tape on NPT fittings to secure a leak-free connection. Metric fittings usually incorporate a ring seal. Tighten the fittings to 25-33 lb-ft (34-45 N•m). 
10. Pressurize the air lines and use a soap solution to check that there are no leaks.
11. Uncage the main spring by pressurizing the emergency side of the spring chamber and removing the nut, washer and release tool bolt.
12. Install the release tool bolt, washer and nut in the holder. Use a torque wrench to tighten it to 5-11 lb-ft (7-15 N•m). 
13. Insert the dust plug into the release tool access hole in the center of the spring housing.

## Torque Specifications

Description	Fastener Size	Wrench Size	lb-ft	N•m
Pad Retainer Bolt	M10	17 mm	25-30	34-40
Carrier Bolt	M20	30 mm	350-450	474-610
Bridge Bolt	M14	E18	174-202	235-275
Bridge Bolt	M16	14 mm	221-253	300-350
Slide Pin Bolts	T80	T80	310-332	420-450
Hub-to-Rotor Bolt	5/8-inch	15/16-inch	155-195	210-264
Hub-to-Rotor Bolt	M16	24 mm	165-190	224-257
Air Chamber Nut, Initial	M16	24 mm	59-75	80-100
Air Chamber Nut, Final	M16	24 mm	133-155	180-210
Chamber Release Tool	1/2-inch	3/4-inch	5-11	7-15
Air Hose-to-Chamber	As specified by manufacturer	As specified by manufacturer	25-33	34-45

## 9 Diagnostics

### Troubleshooting

#### Air Disc Brake

Conditions	Possible Causes	Check For	Corrections
<b>Brake drag</b>	Incorrect initial adjustment	Correct pad-to-rotor clearance	Readjust to set the correct rotor-to-pad clearance.
	Incorrect pad-to-rotor clearance		
	Spring or service brake not releasing	Correct operation of air system or air chamber	Refer to the vehicle manufacturer's instructions. Repair or replace parts as required.
	Vehicle air system malfunction		
	Brake not releasing	Damaged slide pin boots, caliper should move back and forth by hand with linings removed	Replace the caliper assembly.
		Water entry or seized operation shaft, internal	Replace the caliper assembly and air chamber.
	Air line too short	Correct air line length	Replace the air line. Refer to the vehicle manufacturer's instructions.
<b>Short brake pad lining life</b>	Refer to Brake drag.	Refer to Brake drag.	Refer to Brake drag.
	Caliper seized or sticking on slide pins	Damaged slide pin boots, caliper should move back and forth by hand with linings removed	Replace the caliper assembly.
	Damaged rotor surface	Cracks or heavy heat checking	Refer to Section 6.
	Vehicle overload	Refer to the weight limitations on the vehicle identification plate.	Observe the vehicle manufacturer's load recommendations.
	Companion brakes do not work correctly	Inspect the companion vehicle brakes and air system.	Adjust or repair as required.
<b>Smoking brakes</b>	High brake temperature	Refer to Brake drag and Short brake pad lining life.	Refer to Brake drag and Short brake pad lining life. Can be a temporary situation with new or low mileage pads.
	Contamination on the linings or rotor	Grease, oil, undercoating, paint, etc., on the linings or rotor	<ul style="list-style-type: none"> <li>Inspect the hub seal. Replace as required.</li> <li>Clean the rotor and caliper assembly.</li> <li>Replace the pads.</li> </ul>

Conditions	Possible Causes	Check For	Corrections
<b>Poor stopping power</b>	Vehicle air system malfunction	Correct air pressure at the chamber inlet	Have the air system evaluated by a qualified brake system specialist.
<ul style="list-style-type: none"> <li>• <b>Long stopping distances</b></li> <li>• <b>Poor driver feel</b></li> <li>• <b>High brake pressures</b></li> <li>• <b>Vehicle pulls to one side</b></li> </ul>	Contamination on the linings or rotor	Grease, oil, undercoating, paint, etc., on the linings or rotor	<ul style="list-style-type: none"> <li>• Inspect the hub seal. Replace as required.</li> <li>• Clean the rotor and caliper assembly.</li> <li>• Replace the pads.</li> </ul>
	Brakes out-of-adjustment	Excessive pad-to-rotor clearance	Readjust to set the correct pad-to-rotor clearance.
	Vehicle overload	Refer to the weight limitations on the vehicle identification plate.	Observe the vehicle manufacturer's load recommendations.
	Companion brakes not working correctly	Inspect the companion vehicle brakes and air system.	Adjust or repair as required.
	Incorrect pads installed	Refer to the vehicle manufacturer for the correct pads.	Replace the pads.
<b>Brake noise</b>	Incorrect pad installation	Friction material facing the rotor surface	Correct the pad installation. Replace the pads and rotor, if necessary.
	Brake pads not free to move in the caliper	Corrosion or debris on the pads or carrier abutments	Clean or replace the pads, if necessary. Clean the pad abutments on the carrier.
	Worn brake pads	Lining thickness	Replace the pads, if necessary.
	Brake component attachments are not installed to specification	Check for loose connections and fasteners.	Tighten the connections and fasteners to the specified torque.
	Rotor cracks or excessive runout	Excessive cracking, heat checking or runout	Refer to Section 6.
	Pad spring damaged or not installed	Correct pad spring installation	Install the pad springs.
	Incorrect pads installed	Refer to the vehicle manufacturer for the correct pads.	Replace the pads.
	Bent or loose pad retainer	Bent pad retainer or loose pad retainer bolt	Replace or tighten the pad retainer.

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