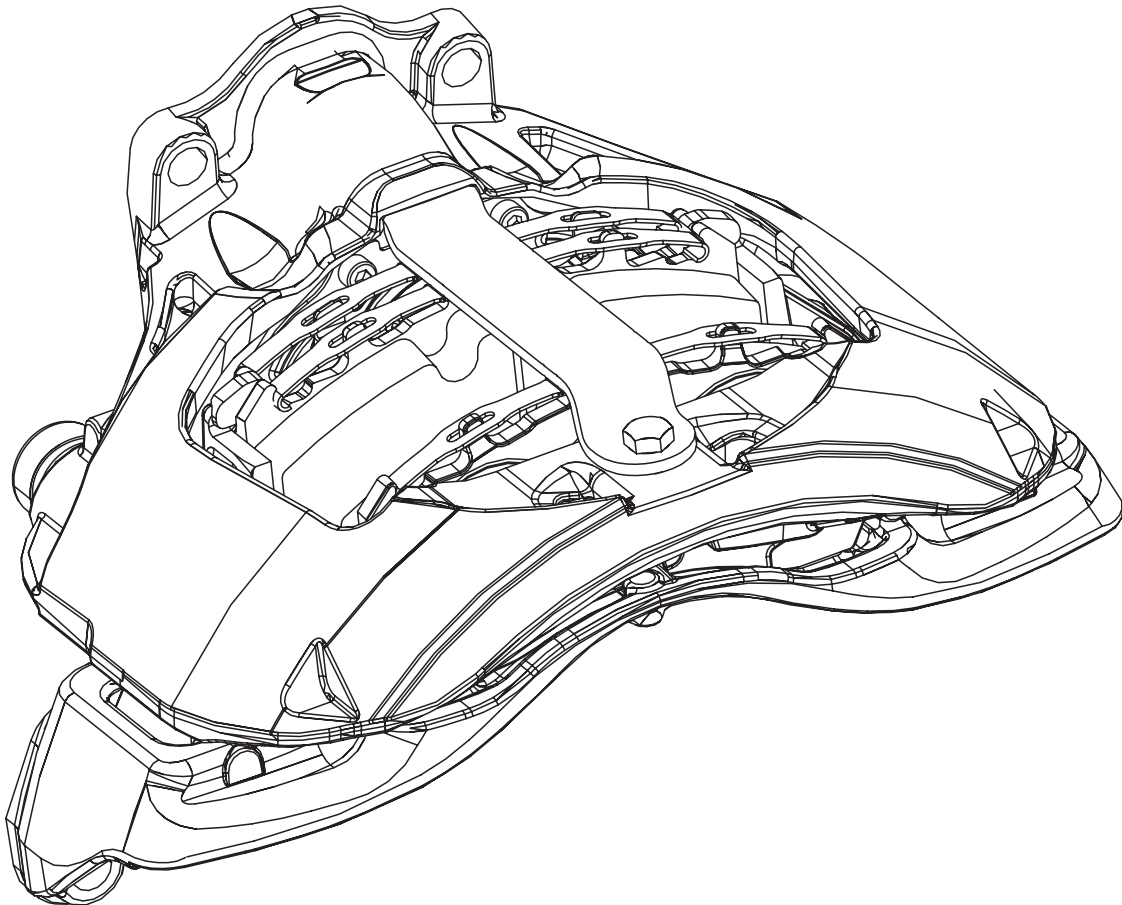


EX+™ Series

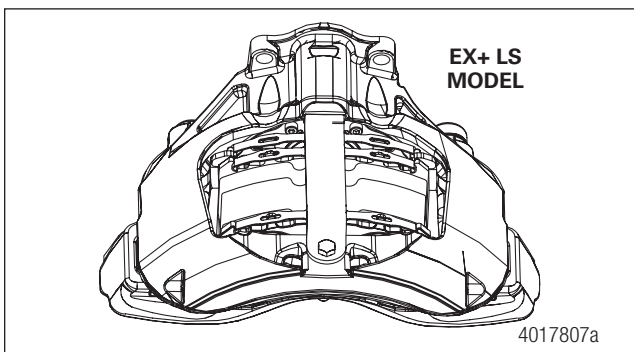
MERITOR EX+™ LS AIR DISC BRAKE CALIPER MAINTENANCE MANUAL



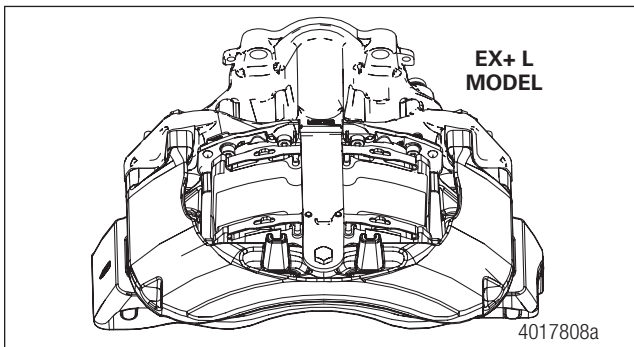
Service Notes

About this Manual

This manual provides installation and maintenance procedures for the EX+™ LS air disc brake. The brake model can be identified using the part number on the mylar tag on top of the brake caliper, or on the back inboard face, below the air chamber mounting face. The EX+ LS air disc brake can also be distinguished from other EX+ models by its single piston and monoblock caliper design. The EX+ LS part number can be recognized by the presence of the “S” instead of the “L” or “H” of other production designs. (Example: EX225S201XX000). For all other EX+ models (i.e. EX225H###AA### or EX225L###AA###), please refer to Maintenance Manual MM-0467, EX+™ Air Disc Brake.



EX+LS Air Disc Brake with Single-Piston Caliper Design



For EX+ L and H model air disc brakes (twin piston), refer to Maintenance Manual MM-0467.

How to Obtain Additional Maintenance, Service and Product Information

Visit [Literature on Demand at Cummins.com](https://www.cummins.com/literature-on-demand) to access and order additional information.

Contact the Meritor OnTrac™ Customer Service Center at 866-668-7221 (US and Canada) between 7:30 AM and 10:00 PM ET Monday through Friday, and between 9:00 AM and 6:00 PM ET on Saturday; 001-800-889-1834 (Mexico); or visit our website: www.cummins.com/components/drivetrain-systems/warranty

How to Obtain Parts, Tools and Supplies Specified in this Manual

Contact Meritor's Commercial Vehicle Aftermarket at 888-725-9355.

For assistance with parts, you may also contact the Meritor Parts Center in Florence, KY at CustCareCntr.Florence@Meritor.com or 859-525-3500.

Table of Contents

Section 1: About this Manual	2	Section 8: Diagnostics	20
How to Obtain Additional Maintenance, Service and Product Information	2	Section 9: Component Replacement	22
How to Obtain Parts, Tools and Supplies Specified in this Manual.....	2	Brake Repair/Replacement Procedures	22
Section 2: Safety Information	4	Remove the Caliper Assembly	22
Hazard Alert Messages	4	Remove the Caliper Housing Assembly	23
Safety Precautions	4	Remove the Slide Pin Boots	23
Section 3: Exploded View	7	Remove the Slide Pin Bushings	23
EX+ LS Air Disc Brake	7	Install the Slide Pin Bushings	24
Section 4: Description and Operation	8	Install the Slide Pins and Boots.....	26
Description	8	Install the Caliper Housing Assembly.....	26
Operation.....	8	Install the Carrier Assembly.....	27
Automatic Adjustment.....	8	Section 10: Rotor	28
Operation without Adjustment	8	Inspection	28
Operation with Adjustment	9	Removal and Installation	30
Manual Adjustment and De-adjustment During a Pad Change	9	Section 11: Air Chamber	32
Section 5: Pre-Trip Driver Inspection	10	Air Chambers on EX+LS Calipers	32
Pre-Trip Driver Inspection.....	10	Air Chamber Removal and Inspection	32
Section 6: Wheel-On Inspections	11	Air Chamber Installation.....	33
Before You Begin Inspection	11	Section 12: Specifications	35
Wheels-On Inspections	11	Torque Wrench Setting Using Extension Adapter MST225 5001 (ADB225 Wrench).....	36
Section 7: Wheels-Off Inspections and Brake Pad Replacement	13	Section 13: Special Tools	37
Wheels-Off Inspections.....	13	MST1000, Bushing Service Tool	37
Brake De-Adjustment Procedure	13	MST225 5001, ADB225 Wrench (Extension Adapter)	37
Brake Pad Removal and Inspection.....	14		
Brake Pad Installation	17		

1 Safety Information

Safety Information

Hazard Alert Messages

Read and observe all hazard alert messages in this publication.

DANGER

Indicates imminent danger. Failure to follow this instruction will result in death or serious injury.

WARNING

Indicates a possibly impending danger. Failure to follow this instruction can result in death or serious injury.

CAUTION

Indicates a hazardous situation or unsafe practice which, if not avoided, could result in injury or damage to components.

Safety Precautions

Observe the following safety precautions when working on the vehicle.

DANGER

- Before starting any work on the vehicle, carefully read and understand all instructions and hazard alert messages provided in this publication. Failure to follow procedures and alerts as directed can result in death or serious personal injury and damage to components.
- Service may be performed **ONLY** by trained professionals who are qualified to service vehicles. Attempting service or repairs without the proper training, tools and equipment can cause serious injury or death, damage to the vehicle and an unsafe condition for the operator.
- Only perform work on a flat, level surface in a well-lighted, ventilated area. Failure to do so can result in death or serious personal injury and damage to components.
- Follow all safety instructions and service guidelines established at the service facility where work is being performed. Failure to do so can result in death or serious personal injury and damage to components.
- Use only the recommended tools for service. Follow all safety guidelines and instructions provided by the tool manufacturer. Failure to do so can result in death or serious personal injury and damage to components.

DANGER

- Engage the parking brake to prevent the vehicle from moving before beginning maintenance or service procedures that require working under the vehicle. Failure to do so can result in death or serious personal injury and damage to components.
- Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. NEVER work under a vehicle supported only by jacks. Jacks can slip and fall over. Failure to use safety stands can result in death or serious personal injury and damage to components.
- **ASBESTOS AND NON-ASBESTOS FIBERS** - 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. Use caution when handling both asbestos and non-asbestos materials. Refer to Section 1 for asbestos and non-asbestos safety information and recommended work practices.

WARNING

- Always wear proper eye protection and other appropriate personal protective equipment when performing procedures.
- Never wear loose clothing and jewelry when working on a vehicle. Always tie long hair back. Loose clothing, hair and jewelry can catch on parts, resulting in serious injury.
- Turn the engine Off and remove the ignition key before working on a vehicle. Contact with moving parts can result in serious injury.
- After operating a vehicle, allow the vehicle to cool down before performing service. Coming into contact with hot parts and fluids can cause burns and serious injury.
- Drain the air completely from the air system before working on any connected air lines or components. Never disconnect or connect an air line containing pressurized air. The air line can whip around or project debris, resulting in personal injury.
- Follow the manufacturer's instructions for proper handling and disposal of lubricating oil. Improper handling can cause irritation to skin. Improper disposal is unlawful and can cause harm to the environment.
- Use only Meritor® brand replacement parts, components and kits. Use of unauthorized parts can result in damage or injury, and void the Meritor warranty.
- Always ensure all components and systems are in correct operating condition before returning the vehicle to service. Failure to do so can result in an unsafe condition for the operator and damage to components.

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 Meritor.

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 any 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.

1 Safety Information

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 Meritor.

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

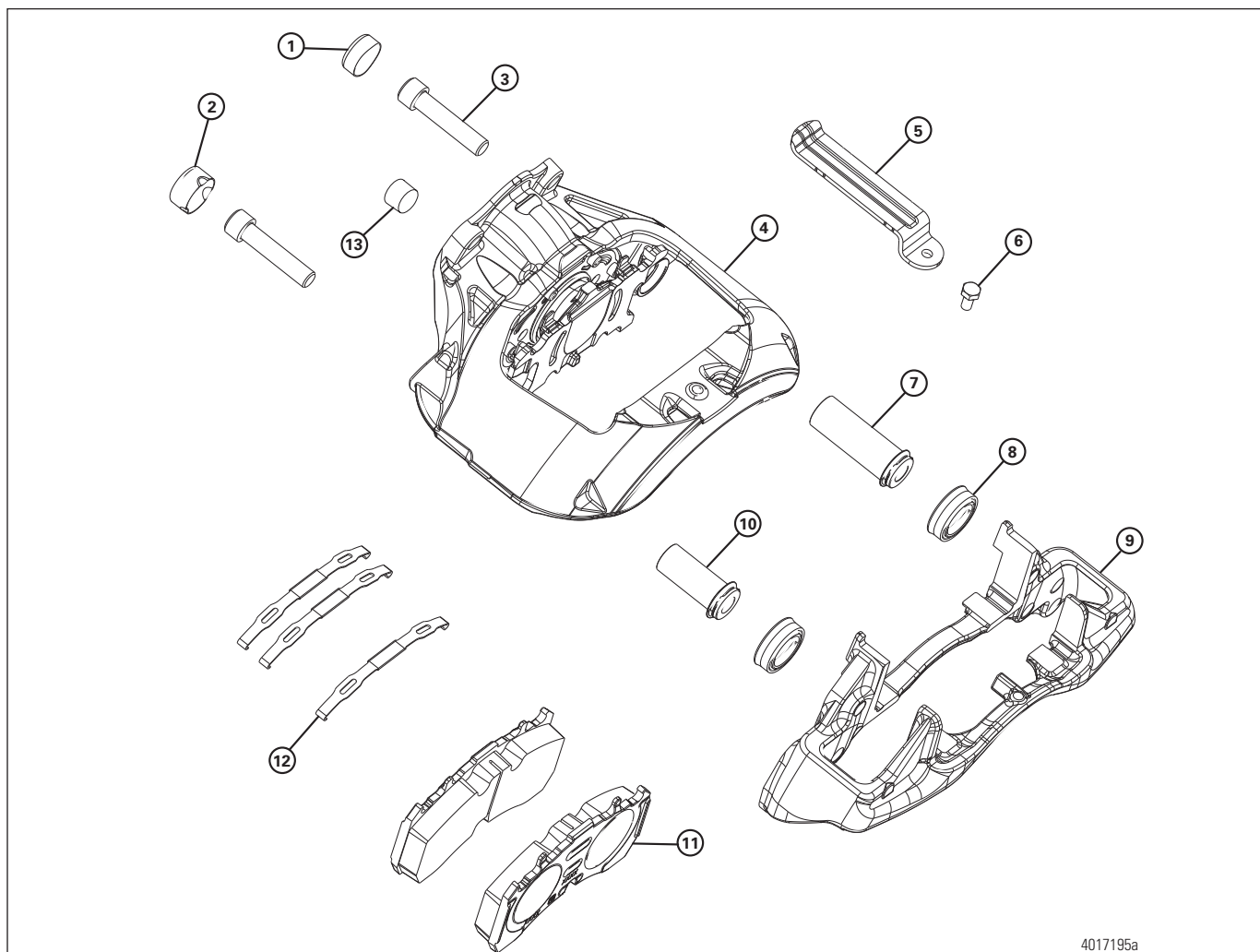
- 1. Separate Work Areas.** Whenever feasible, service brakes in a separate area away from other operations to reduce risks to unprotected persons.
- 2. Respiratory Protection.** OSHA has set a maximum allowable level of exposure for silica of 0.1 mg/m³ as an 8-hour time-weighted average. Some manufacturers 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.

Exploded View

EX+ LS Air Disc Brake



4017195a

Item	Description	Qty.
1	End Cap, Long Pin Side	1
2	End Cap, Short Pin Side	1
3	Capscrew, M18x1.5x82-10.9	2
4	Brake Housing Assembly	1
5	Pad Retainer	1
6	Pad Retainer Bolt (Metric)	1
7	Slide Pin Assembly, Long	1
8	Slide Pin Boot	2
9	Brake Carrier Assembly	1
10	Slide Pin Assembly, Short	1
11	Brake Pad Assembly	2
12	Pad Spring	3
13	Adjuster Plug	1

3 Description and Operation

Description and Operation

Description

The EX+LS air-actuated disc brake has a direct-mounted air chamber. Figure 3.1. The brake can be installed on steer, drive and trailer axles and can be used for vehicle parking when it is equipped with a service/spring brake chamber. The EX+LS brake is designed as a handed brake and should always be installed with the long pin in the "leading" position. The brake utilizes an automatic adjuster to ensure the brake pads have proper clearance at all times. It is essential that the correct service procedures be observed to ensure that the brake gives satisfactory service throughout its working life.

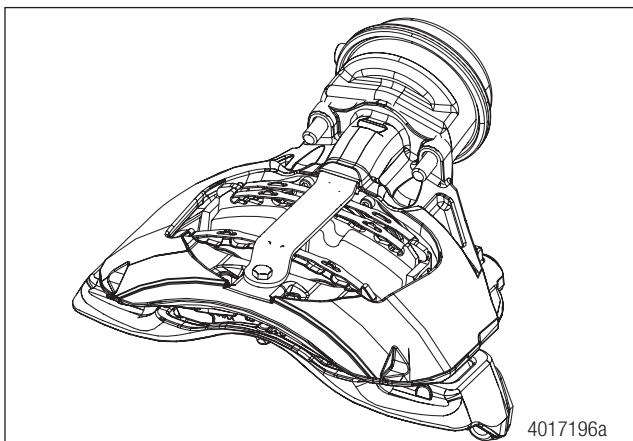


Figure 3.1 EX+ LS Model Air Disc Brake

Operation

The air chamber is directly attached to the brake housing and provides sealing between the caliper and air chamber assembly. The force applied by the chamber actuating directly engages the operating shaft assembly, which amplifies the force through an eccentric cam into the piston assembly. The piston then pushes the inner pad into the rotor, slides on the pins and pulls the outer pad into the rotor, clamping the rotor and providing torque to slow the vehicle. The housing assembly slides on two sealed pins which are bolted to the brake carrier. Note if the piston is in the fully de-adjusted position, the brake will not slide because tabs on the piston rest against stops on the carrier. The carrier is mounted to the vehicle, either directly to the knuckle or a weldment on the axle, or through a bolt-on torque plate. As the pads wear, adjustment takes place automatically and independent of load. 'Load independent' means adjustment takes place under very small clamping forces only, therefore preventing over adjustment and minimizing air consumption.

The caliper has two different slide pins, one long, one short. The short slide pin side of the caliper has an oval bushing to accommodate deflection during braking. On the long slide pin side of the caliper, the bushings are round and provide a more positive location for the housing. The slide pins are sealed externally by the slide pin boots and the slide pin caps.

The brakes release as input force on the operating shaft is reduced, which in turn reduces clamping force and brake torque. As the input force is eliminated, the return springs move the clamping mechanism and operating shaft into their starting position, which leaves the pads with a defined running clearance to 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.

Operation without Adjustment

From the rest position, the air chamber push rod moves FORWARD, rotating the operating shaft (1). When the piston moves FORWARD through the built-in running clearance, the ball-ended drive pin (2) starts to contact the driving side of the fork on the end of the adjuster. Further movement of the air chamber push rod rotates the operating shaft, causing the adjuster to rotate because the built-in clearance has been taken up. The outer drive sleeve (4) is fixed to the adjuster insert (EU variants also have an adjuster stem) and is rotated by the inner drive (3) sleeve through frictional forces developed by the unidirectional spring (5). If the rotation is through less than the correct running clearance, the friction in the threads of the tappet and piston increases due to the clamping force on the pads. The piston (7) cannot rotate in the adjuster housing, and due to the high torque to turn the tappet, the clutch pack (8) slips, preventing adjustment of the mechanism below the correct running clearance. Figure 3.2 and Figure 3.3.

3 Description and Operation

Manual Adjustment and De-adjustment 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. The adjuster plug must be removed to gain access to the adjustment mechanism. The plug can be removed with a standard 3/8" ratchet or extension end. A 3/8" extension of at least 6" length should be used to access the adjuster mechanism (6). (EU variants have an adjuster stem.) The automatic adjuster maintains a nominal pad-to-rotor clearance of 0.030-inch (0.75 mm). Refer to Brake De-Adjustment Procedure on page 13 for adjustment and de-adjustment procedures.

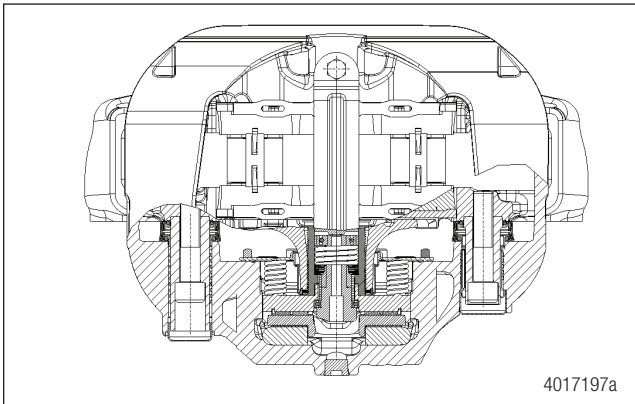


Figure 3.2 Top Down View

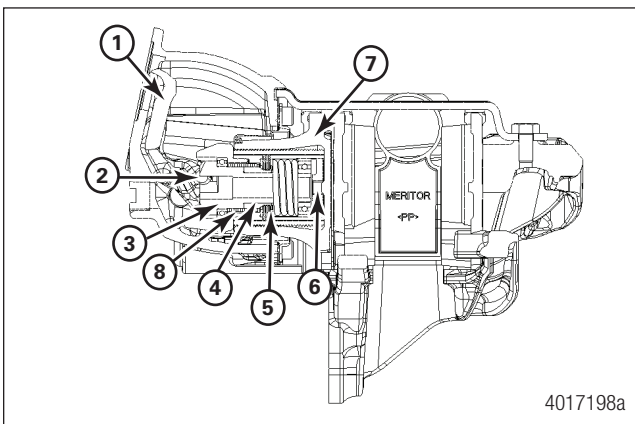


Figure 3.3 Side View

Operation with Adjustment

When the running clearance is greater than the built-in tolerance as the 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 piston moves 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. Further operating shaft movement causes rotation of the adjuster through the ball-ended drive pin. Driving through the unidirectional spring and then through the clutch pack, the inner sleeve rotates, driving the outer sleeve. Due to the excessive running clearance, the clutch pack rotates the piston and since the tappet is grounded by the carrier and cannot rotate it is extended. The torque to turn the tappet 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 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 outer sleeve, leaving the tappet and intermediate gear in the adjusted state. The system is in starting position.

4 Pre-Trip Driver Inspection

Pre-Trip Driver Inspection

Hazard Alert Messages

Read and observe all hazard alert messages in this publication.

⚠ DANGER

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. NEVER work under a vehicle supported only by jacks. Jacks can slip and fall over. Failure to use a jack stand can result in serious personal injury and damage to components.

⚠ DANGER

ASBESTOS AND NON-ASBESTOS FIBERS - 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. Use caution when handling both asbestos and non-asbestos materials. Refer to Section 1 for asbestos and non-asbestos safety information and recommended work practices.

⚠ WARNING

To prevent eye injury, always wear eye protection when performing vehicle maintenance or service.

Pre-Trip Driver Inspection

The pre-trip driver inspection procedure should be completed in addition to any other industry standard driver inspections.

⚠ DANGER

Correct any issues found during the pre-trip driver inspection before driving the vehicle. Failure to do so can result in serious personal injury and damage to components.

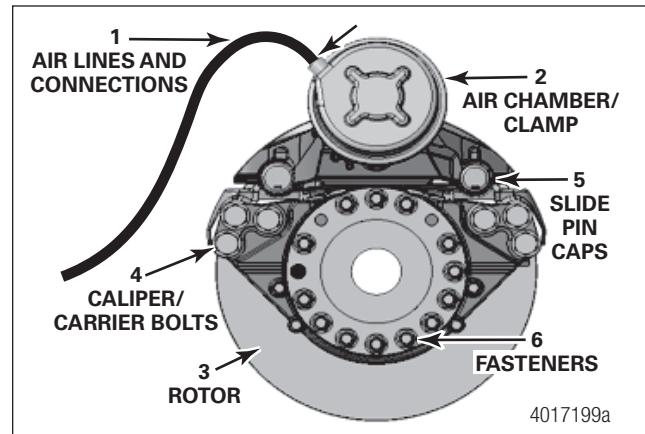


Figure 4.1 Pre-Trip Inspection Points

- 1. Air Line Connections:** Inspect and ensure that all air lines are connected properly and that there are no cuts, cracks, or holes in air lines. Check that connections are tight and not corroded or leaking.
- 2. Air Chamber and Clamp:** Inspect and ensure that the air chamber is fastened tightly to the caliper and that the clamp (if fitted) is secured.
- 3. Rotor:** Inspect and check (where allowable and visible without removing shields) that there are no large cracks, heat checks, or deep grooves. Refer to Rotor on page 28 for rotor inspection instructions. Note: Excessive corrosion on braking surfaces may indicate a non-operational brake.
- 4. Carrier Bolts:** Inspect all six carrier bolts to ensure that the bolts are present and fastened tightly. Check all bolts for signs of loosening or movement.
- 5. End Caps and Slide Pins:** Visually inspect that end caps are present, in place and that they are not punctured, severely dented, excessively protruding from the caliper, or show signs of movement.
- 6. Torque Plate Fasteners:** Check that all fasteners (if fasteners are present) are tight, show no signs of movement or rotation, and that any bolts present are not missing any nuts.

Wheel-On Inspections

Hazard Alert Messages

Read and observe all hazard alert messages in this publication.

⚠ DANGER

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. NEVER work under a vehicle supported only by jacks. Jacks can slip and fall over. Failure to use a jack stand can result in serious personal injury and damage to components.

⚠ DANGER

ASBESTOS AND NON-ASBESTOS FIBERS - 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. Use caution when handling both asbestos and non-asbestos materials. Refer to Section 1 for asbestos and non-asbestos safety information and recommended work practices.

⚠ WARNING

To prevent eye injury, always wear eye protection when performing vehicle maintenance or service.

Before You Begin Inspection

Before performing inspections, put on safe eye protection. Park the vehicle on a level surface and block the wheels to prevent the vehicle from moving.

Wheels-On Inspections

Wheels-on inspections must be completed in addition to any other industry standard driver inspections and Pre-Trip Driver Inspection.

⚠ DANGER

Correct any issues found during the pre-trip driver inspection before driving the vehicle. Failure to do so can result in serious personal injury and damage to components.

1. Torque Plate-to-Flange Mounting Bolts Inspection

- Torque plate-to-flange fasteners may not be present with integrated knuckle or integrated torque plate axles.
- Check that all bolts are present and have a nut attached.
- Ensure that the bolts/nuts do NOT rotate by hand.

2. Adjuster Plug Inspection

- Check that the adjuster plug is present. If missing, replace the plug immediately. Figure 5.1.

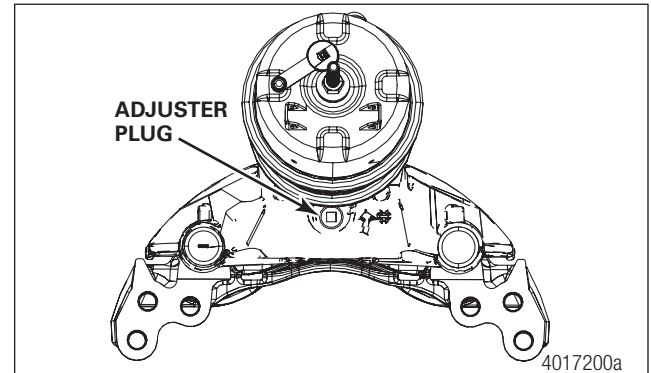


Figure 5.1 Adjuster Plug Installed

3. Rotor Inspection

Check for rotor condition, minimum thickness and runout, if possible. Refer to Rotor on page 28 for complete inspection steps.

Rotor Shield Removal and Installation

If the rotor is equipped with a rotor shield, use the following steps to remove it to allow better access to the rotor for inspection.

1. Remove the shield retaining bolts and remove the shield from the torque plate, axle, or knuckle. Figure 5.2 and Figure 5.3.

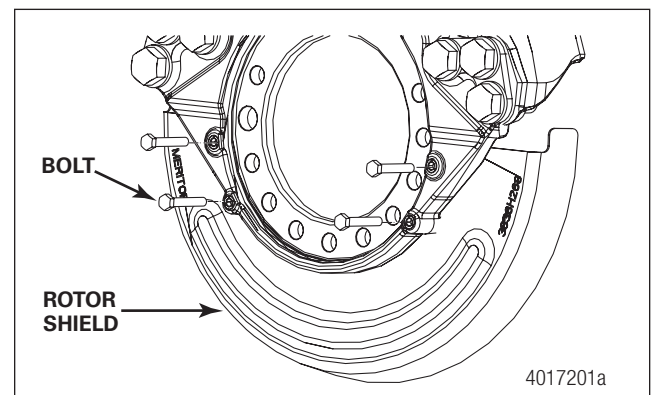


Figure 5.2 Rotor Shield Retaining Bolts

5 Wheels-On Inspections

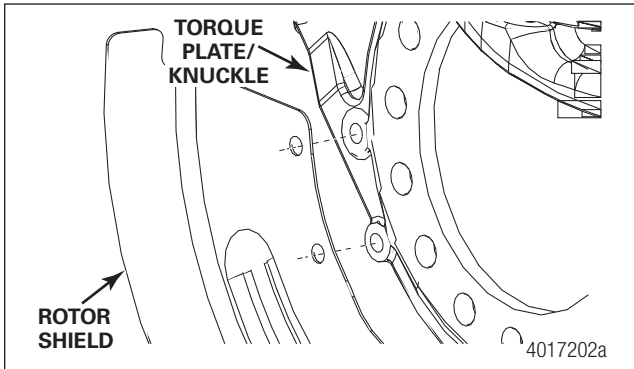


Figure 5.3 Rotor Shield

- Once the inspection is complete, reinstall the rotor shield on the torque plate and align the bolt holes. Figure 5.3.
- Insert the rotor shield retaining bolts and start them by hand. Figure 5.3. If the bolts are not damaged, reuse the original bolts. If the bolts are damaged, use new M8x1.25 class 8 bolts of an appropriate length. Figure 5.2.
- Tighten the retaining bolts to 18-22 lb-ft (24-30 Nm).

4. Pad Wear Indicator Inspection

The EX+LS has a cast-in notch on the bridge and corresponding bump on the carrier. As the outer pad wears, the bump and notch come closer together. When the outer pad wears to the point that the bump and notch are aligned, the wheels should be removed and the pads should be visually inspected. Refer to Section 6. Figure 5.4, Figure 5.5, Figure 5.6 and Figure 5.7.

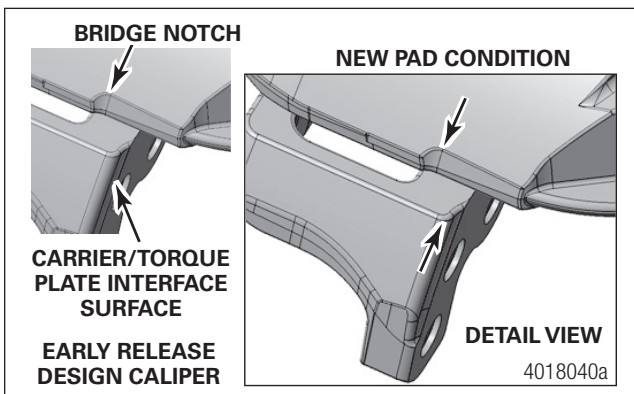


Figure 5.4 New Pad Condition on Early Release Design Caliper

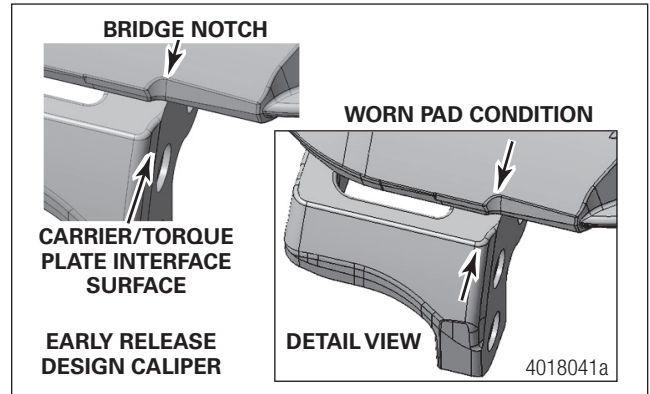


Figure 5.5 Worn Pad Condition on Early Release Design Caliper

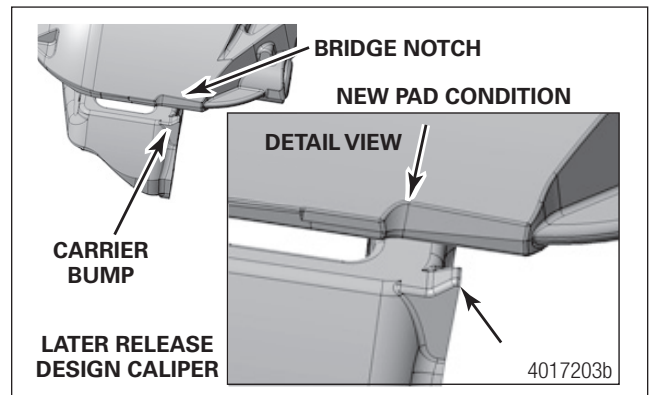


Figure 5.6 New Pad Condition on Later Release Design Caliper

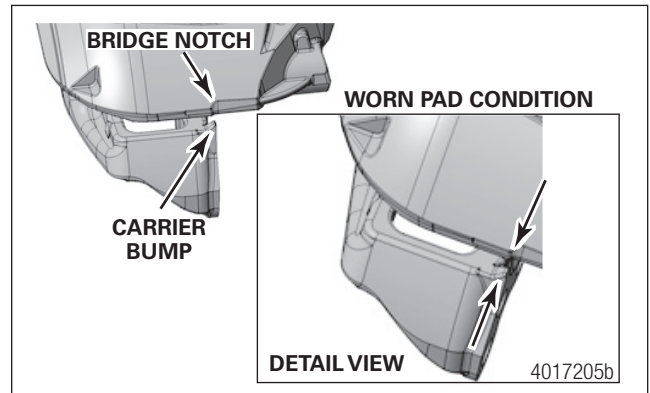


Figure 5.7 Worn Pad Condition on Later Release Design Caliper

NOTE: Newer models have been designed with a cast finger on the carrier. The finger has been added to make it easier to determine that the bump on the housing aligns with the machined mounting face of the carrier.

6 Wheels-Off Inspections and Brake Pad Replacement

Wheels-Off Inspections and Brake Pad Replacement

Hazard Alert Messages

Read and observe all hazard alert messages in this publication.

⚠ DANGER

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. NEVER work under a vehicle supported only by jacks. Jacks can slip and fall over. Failure to use a jack stand can result in serious personal injury and damage to components.

⚠ DANGER

ASBESTOS AND NON-ASBESTOS FIBERS - 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. Use caution when handling both asbestos and non-asbestos materials. Refer to Section 1 for asbestos and non-asbestos safety information and recommended work practices.

⚠ WARNING

To prevent eye injury, always wear eye protection when performing vehicle maintenance or service.

Wheels-Off Inspections

Wheels-off inspections must be completed in addition to any other industry standard driver inspections, Pre-Trip Driver Inspection and Wheels-On Inspections.

⚠ DANGER

Correct any issues found during the pre-trip driver inspection before driving the vehicle. Failure to do so can result in serious personal injury and damage to components.

Wheels-Off Inspection 1: De-adjust and Inspect the Brake Pads and Hold Down Springs

- Inspect the pad springs. Ensure that three springs are present and inspect for cracking or breakage.
- Remove and inspect the brake pads. Using the following procedures.
- Reuse or replace as required.

Brake De-Adjustment Procedure

1. Wear safe eye protection. Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Ensure that the service and parking brakes are released prior to de-adjustment.
2. Remove any loose dirt or debris from the plug area. Using a 3/8" drive ratchet, remove the adjuster plug. If needed, a 3/8" drive extension can be used to clear the air chamber. Figure 6.1.

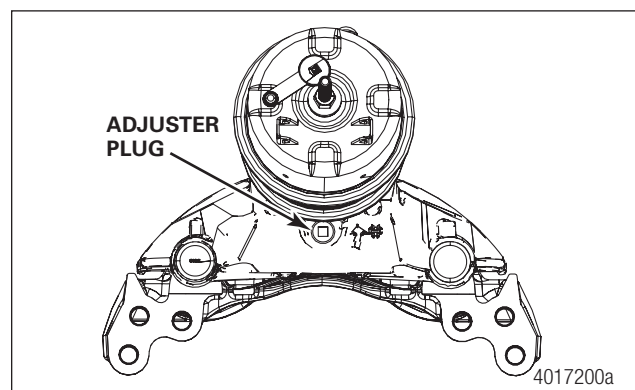


Figure 6.1 Adjuster Plug

⚠ CAUTION

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

NOTE: It is not necessary to remove the air chamber to access the adjuster. Extensions can be used to reach past the air chamber.

NOTE: This brake features an internal 3/8" square drive feature for adjustment and de-adjustment. It can be accessed by using a minimum 6" long, 3/8" square drive, socket extension.

3. Use a six-inch (6") standard 3/8" extension on a hand-held ratchet wrench to de-adjust the brake. Rotate the adjuster stem **IN THE OPPOSITE DIRECTION OF THE ARROW CAST INTO BACK OF HOUSING** until you feel the adjuster stem stop. De-adjustment requires more force than adjustment. Do not exceed 30 lb-ft (40 Nm) in either direction. Figure 6.2, Figure 6.3 and Figure 6.4.

NOTE: The direction of the arrow cast into the caliper housing may be to the right or left depending on the brake.

- **If the manual adjuster does not rotate in either direction:** Replace the caliper assembly and chamber assembly.

6 Wheels-Off Inspections and Brake Pad Replacement

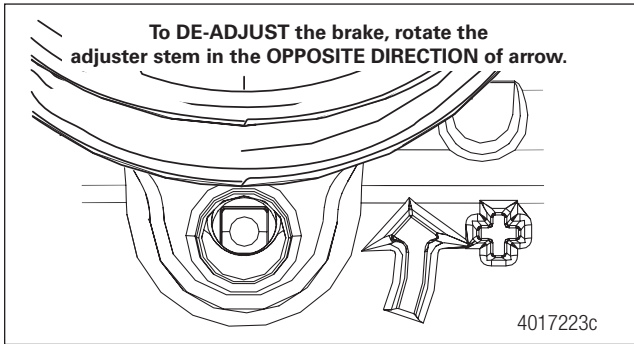


Figure 6.2 Adjustment Arrow Cast into the Caliper Housing (RH)

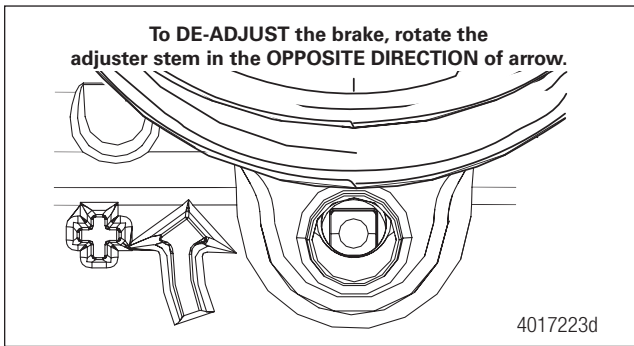


Figure 6.3 Adjustment Arrow Cast into the Caliper Housing (LH)

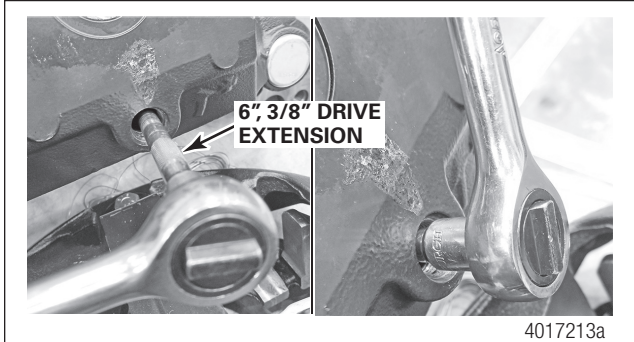


Figure 6.4 Rotate Adjuster Stem using Wrench with 6" 3/8-Drive Extension

⚠ CAUTION

When re-adjusting the brakes (rotating the adjustment mechanism **IN THE DIRECTION OF ARROW CAST INTO BACK OF HOUSING**), do NOT extend the piston beyond 3.75" (95 mm), from the stamped tappet plate to the outer face of the piston, or the piston can come completely out of the housing assembly. Figure 6.3. The brake housing assemblies do not have a travel stop feature to prevent the piston from over traveling. The risk of the piston rotating out of the housing assembly may be increased further if the caliper assembly is removed from the vehicle, or if the caliper assembly is left on the vehicle, but the rotor is in a worn condition. If the piston becomes disengaged from the threads, take care not to unseat the boot. Re-engage the threads and rotate the adjuster in the de-adjust direction to reseat the piston.

Brake Pad Removal and Inspection

1. If the brake is equipped with a PWWI, remove the PWWI clip from the pad retainer before removing the pad retainer from the caliper. Figure 6.5.

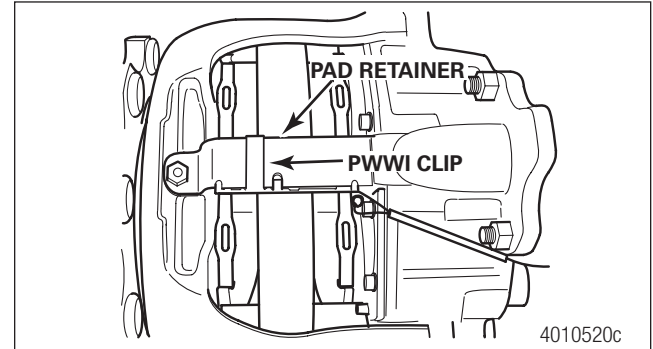


Figure 6.5 PWWI Clip

2. Use a 17 mm wrench to remove the pad retainer bolt. Remove the pad retainer. Figure 6.6.

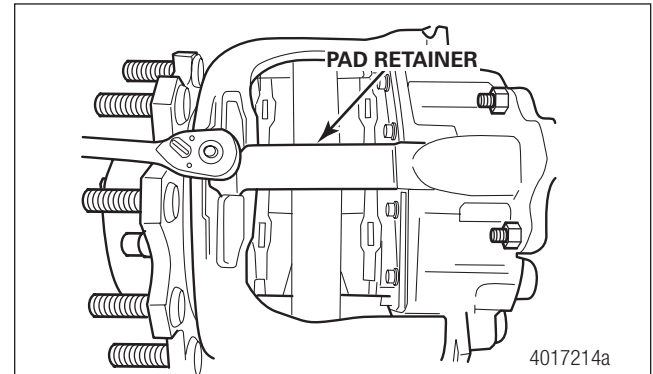


Figure 6.6 Pad Retainer

3. Visually inspect the pad retainer. Remove the pad shield, if fitted.
 - **If the pad retainer is bent or damaged:** Replace the pad retainer.

Do not remove the plastic block sensors from their locations in the pads unless the PWWI assembly is being replaced. Figure 6.7.

6 Wheels-Off Inspections and Brake Pad Replacement

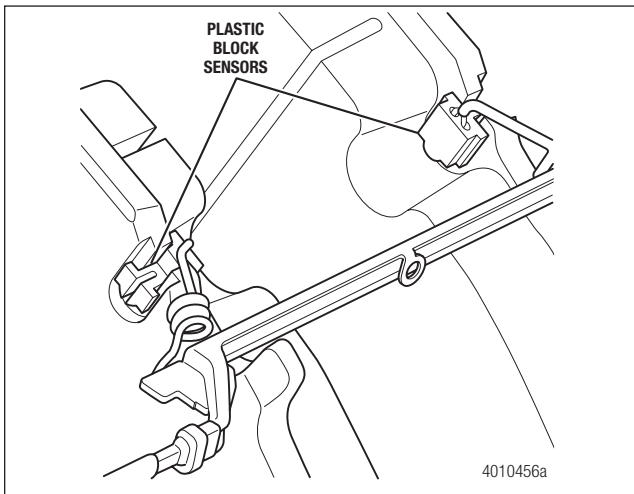


Figure 6.7 Do not remove the PWVI sensor blocks.

- Remove the pad springs. Figure 6.8.

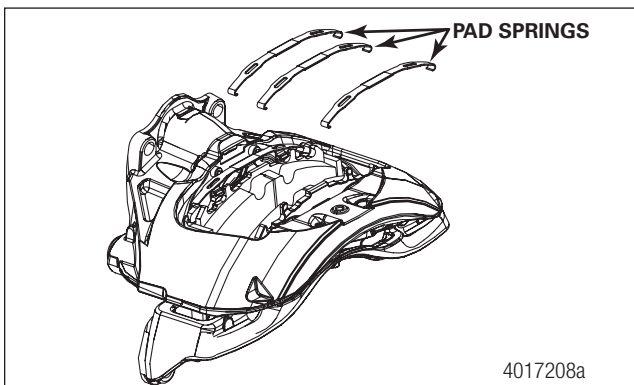


Figure 6.8 Pad Springs

- Remove the outboard brake pad from the caliper assembly and mark the brake pad "outboard". Figure 6.9.

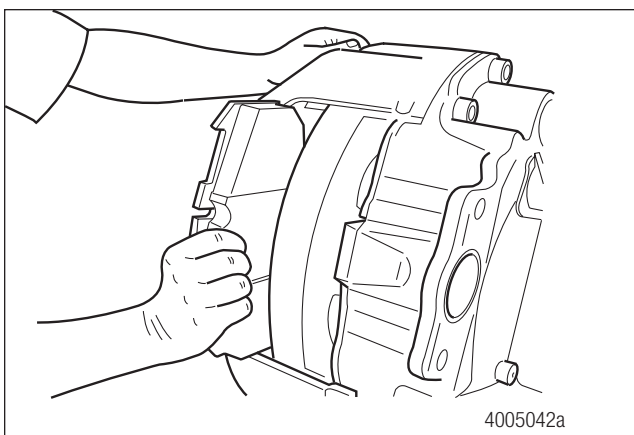


Figure 6.9 Remove the outboard brake pad.

- Remove the inboard brake pad from the caliper assembly and mark the brake pad "inboard".

- Use a vacuum brush or damp cloth to remove the dirt and dust from the carrier brake pad contact surfaces.
- Inspect the carrier for signs of damage or wear. Pay particular attention to the pad abutments. Check for grooves on the pad abutments in excess of 0.02 inch (0.5 mm). Look for any carrier wear or damage that would cause the pad backing plate to catch and/or become cocked. Figure 6.10.
 - If any of the above conditions are found:** Replace the caliper.

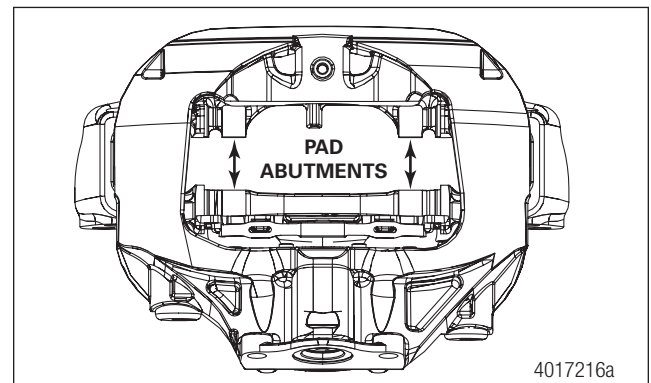


Figure 6.10 Pad Abutments

⚠ DANGER

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 may occur. Personal injury can result.

- 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 the brake pad assemblies as directed above. Figure 6.11 and Figure 6.12.

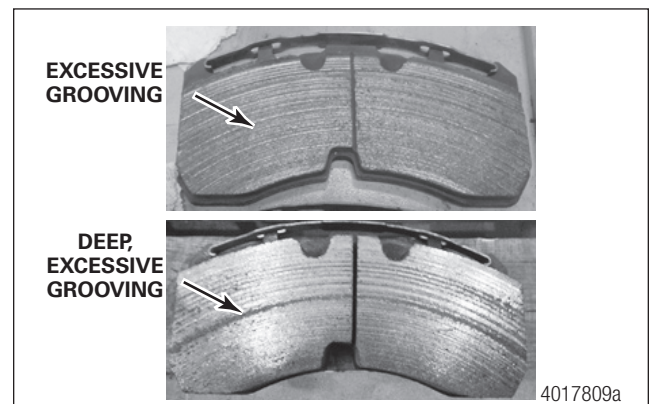


Figure 6.11

6 Wheels-Off Inspections and Brake Pad Replacement

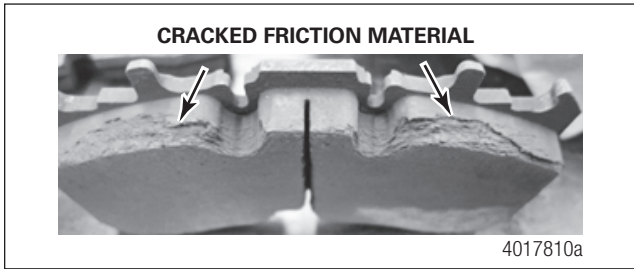


Figure 6.12

10. Measure the friction material thickness on the brake pad. Replace brake pad assemblies before the lining thickness reaches 0.12-inch (3 mm). Figure 6.13.

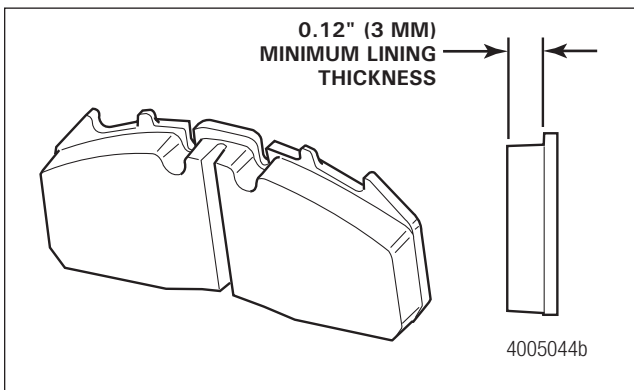


Figure 6.13 Measure the lining thickness.

11. Inspect the three pad springs. Replace bent, cracked or broken pad springs.

⚠ WARNING

When sliding the caliper forward, use care to avoid trapping fingers.

⚠ CAUTION

When sliding the caliper inboard and outboard, use care to avoid pinching the slide pin boot between the carrier and caliper housing.

12. Verify that the caliper slides freely, by hand, on the slide pins. To slide the caliper, the piston will first need to be extended from the housing approximately 3/4" so it does not get caught on stops on the piston and pad carrier. Take care not to trap your fingers while you check the sliding action of the brake.
 - **If the caliper does not slide:** Replace the caliper or slide pins and bushings.

13. With the pads removed, visually inspect the caliper slide pin boots. All slide pin boots should be free from damage and correctly seated.

The bead at each end of the guide pin boot should be seated in the groove, and the boots should contract around the pin when the housing slides in the inboard direction. Figure 6.14.

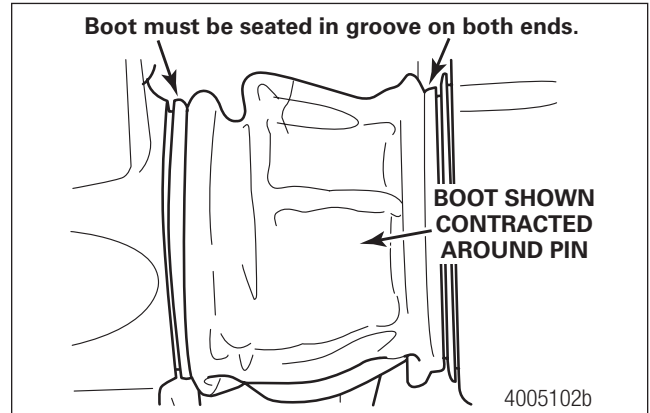


Figure 6.14 Slide Pin Boot Properly Seated

- **If any of the slide pin boots are damaged or unseated:** Replace the boots.

Wheels-Off Inspection 2: Check Slide Pin Bushing Wear

Radial Test

Check the slide pin bushing wear if you find tapered wear on the pads or other pad wear issues. This check should be performed with the brake assembly installed on the vehicle. Minimal force is required to perform this test.

1. Loosen the pad strap and reposition it 180 degrees from the installed position. Retighten the pad strap bolt to 20 lb-ft (27 Nm) so that the strap does not move. Figure 6.15.

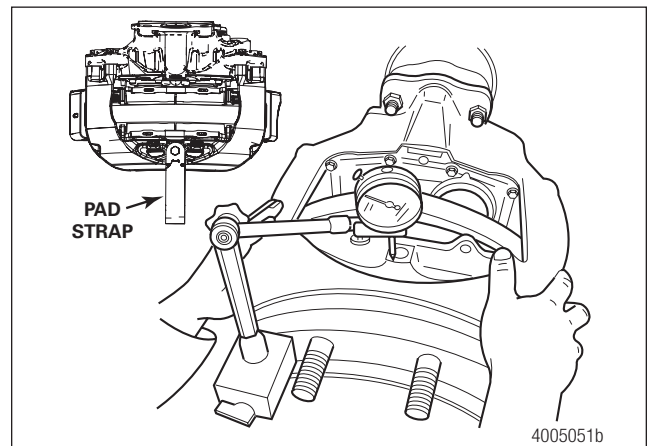


Figure 6.15 Dial Indicator Position on Caliper

6 Wheels-Off Inspections and Brake Pad Replacement

- Position the brake at the new pad condition. Pull the caliper outboard in the direction of the arrow as far as possible and let it settle into resting position. Figure 6.16.

⚠ WARNING

When sliding the caliper forward, use care to avoid trapping fingers.

⚠ CAUTION

When sliding the caliper inboard and outboard, use care to avoid pinching the slide pin boot between the carrier and caliper housing.

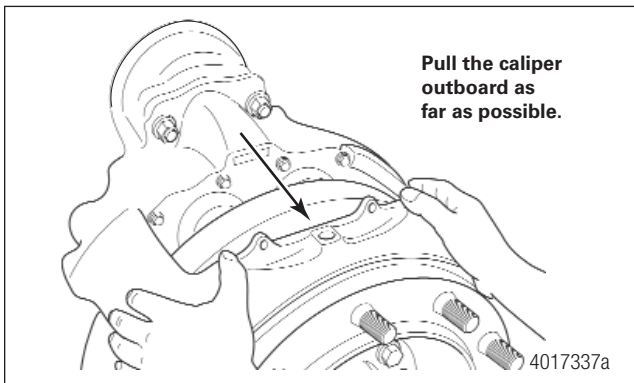


Figure 6.16

- Attach a dial indicator onto the vehicle hub and set it against the caliper. Figure 6.15.
- Position the dial indicator on the pad strap bolt and push downwards on the pad strap with ~10 lbs. of force; set the dial indicator to ZERO.
- Lift up on the pad strap with ~10 lbs. force and record total movement of the dial indicator.

Alternative Method: Without using the pad strap, position the caliper in the new pad condition per Step 3. Position the dial indicator per Step 4. Press down on the edges of the bridge with ~10 lbs. force and set the indicator to '0'. Lift up at the edges of the bridge using your hands with ~10 lbs. force (do NOT use a pry bar to lift) and record total movement of the dial indicator.

Maximum acceptable reading is 0.100-inch (2.5 mm).

- If the reading is more than 0.100-inch (2.5 mm):** Replace the caliper assembly or the bushings and slide pins.

Wheels-Off Inspection 3: Inspect the Piston Boot

- Inspect to see if boot properly seated. Check for rips, tears or holes. Figure 6.17.

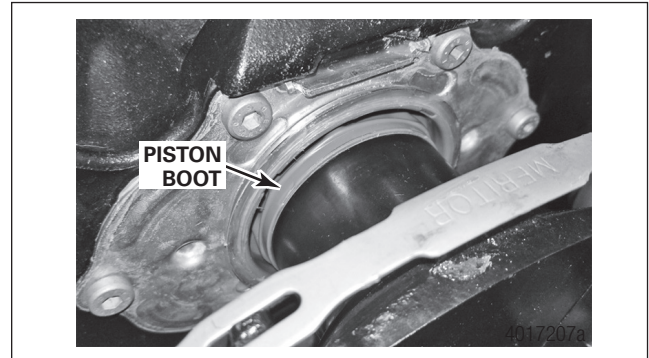


Figure 6.17 Piston Boot

Brake Pad Installation

⚠ CAUTION

Install the pads with the friction material facing the rotor. If pads are not installed facing the correct way, damage to components can result. Pad backing plates are "keyed" to alert the user to incorrect installation orientation of the pads in the brake assembly (i.e., the friction material against the rotor). If the pads do not drop easily into position, ensure that the friction material is facing the rotor and reattempt to install the pad.

⚠ CAUTION

When sliding the caliper inboard and outboard, use care to avoid pinching the slide pin boot between the carrier and caliper housing.

- Slide the caliper OUTWARD. Install the outboard pad and spring into the outboard side of the caliper. Figure 6.18.

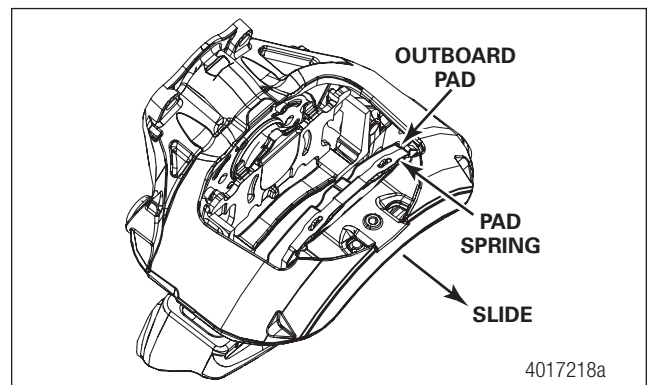


Figure 6.18 Slide the caliper out.

6 Wheels-Off Inspections and Brake Pad Replacement

- Slide the caliper INWARD. Install the inboard pad and two springs into the inboard side of the caliper, install the pad spring onto the piston tappet. Figure 6.19.

NOTE: EX+LS calipers require three pad springs, not just two.

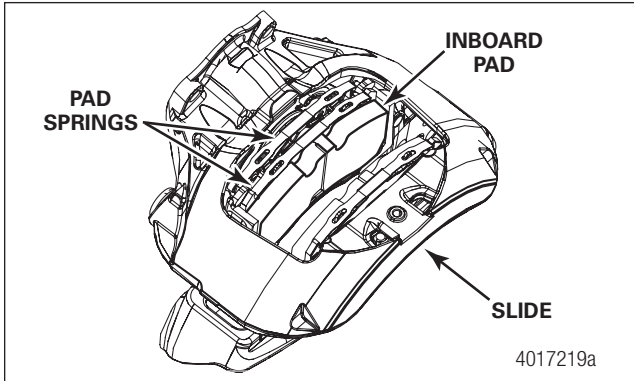


Figure 6.19 Slide the caliper in.

NOTE: Some variants may have additional features such as pad shield, electronic PWWI, or +PR™ (positive pad retraction springs). These assemblies will require the features to be installed prior to the shield.

- If necessary, install the PWWI as follows.

PWWI Installation

- If a new PWWI is to be installed, position the pad wear cable correctly and carefully clip the pad wear warning cable retainer to the pad retaining plate. Figure 6.20.

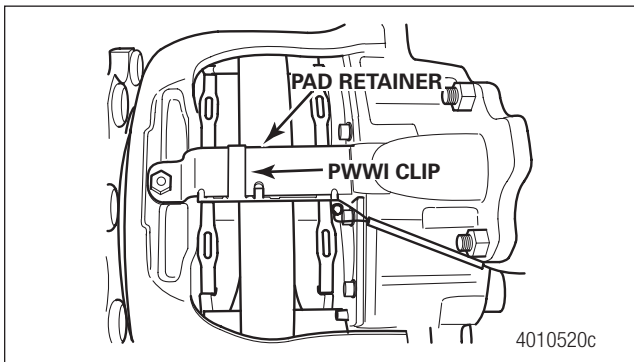


Figure 6.20 PWWI Assembly Installed

- Carefully hold the pad retainer with the PWWI in position to allow for installation of the plastic sensor blocks. Install the plastic blocks of the PWWI into the pads. Do not use excessive force, but ensure they are pushed to the bottom of the slot. Figure 6.21.

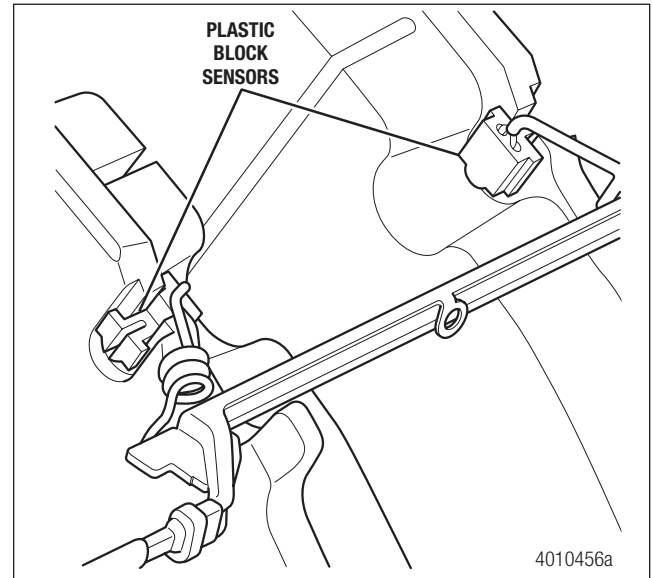


Figure 6.21 PWWI Plastic Sensor Blocks Installation

- Ensure the PWWI wiring is routed over the pad backplate, away from the rotor.
- Where used, place the shield on the caliper before installing the pad retainer. Inspect the shield for damage and replace if necessary. Position the pad shield so that the pad retainer bolt hole is centered in the crush section of the shield and with the bent tabs against the tappet plate and the ends of the shield resting on the caliper. Figure 6.22.

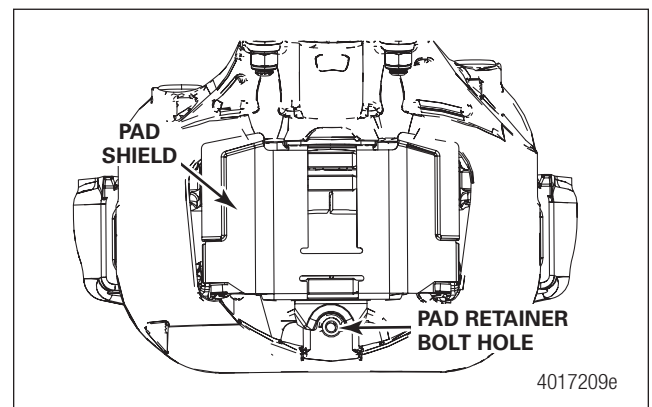


Figure 6.22 Pad Shield and Pad Retainer

- Install the pad retainer on the brake. Prior to installation, inspect pad retainer for damage and replace if necessary. Figure 6.23.

6 Wheels-Off Inspections and Brake Pad Replacement

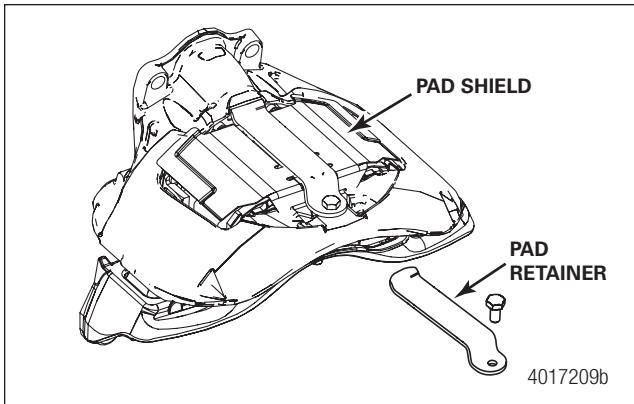


Figure 6.23 Pad Shield and Pad Retainer

6. Install the pad retainer bolt and tighten to 25-30 lb-ft (34-40 Nm).

Set the Initial Brake Pad-to-Rotor Running Clearance

⚠ WARNING

You must adjust the initial brake pad-to-rotor clearance or an inefficient, dragging brake can occur. Personal injury and damage to components can occur as a result of brake drag.

1. Remove the adjuster plug. Figure 6.24.

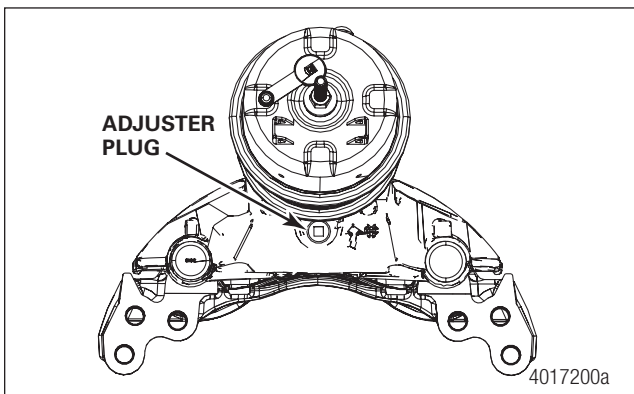


Figure 6.24 Adjuster Plug

2. Use a six-inch (6") standard 3/8" drive extension on a hand-held wrench to rotate the manual adjuster stem IN DIRECTION OF ARROW CAST INTO BACK OF HOUSING so that the brake pad-to-rotor clearance is ZERO. Figure 6.25, Figure 6.26 and Figure 6.27.

NOTE: The direction of the arrow cast into the caliper housing may be in the clockwise or counter-clockwise direction depending on the brake.

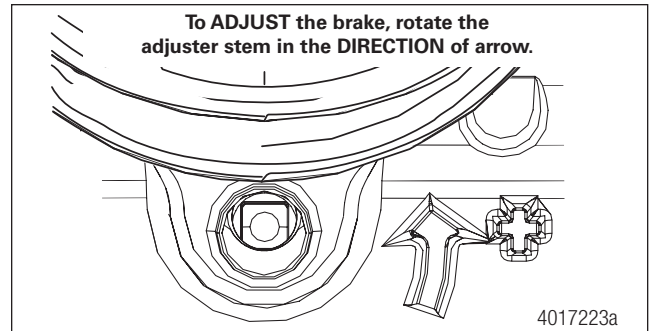


Figure 6.25 Adjustment Arrow Cast into the Caliper Housing (RH)

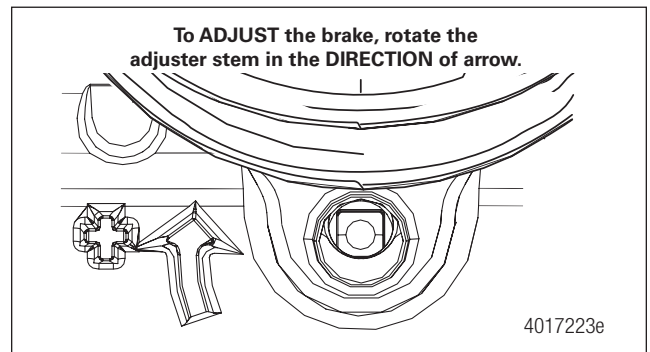


Figure 6.26 Adjustment Arrow Cast into the Caliper Housing (LH).

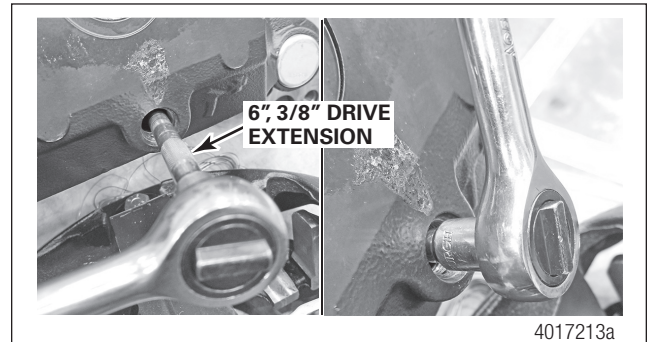


Figure 6.27 Use wrench with 6", 3/8-drive extension to rotate adjuster stem.

3. De-adjust the manual adjuster stem one half turn OPPOSITE THE DIRECTION OF ARROW CAST INTO BACK OF HOUSING to set the initial running clearance.
4. Reinstall the adjuster plug and tighten to 25-27 lb-ft (34-37 Nm).

Wheels-Off Inspection 4: Inspect the Rotor

- Refer to Rotor on page 28.

7 Diagnostics

Diagnostics

Refer to the following table to troubleshoot and correct brake issues. When checking the condition of the brakes, always follow safe work practices and refer to the safety information provided in Safety Information on page 4.

Table A: EX+ LS Diagnostics

Condition	Possible Cause	Check the following	Correction/Action
Dragging brake	Air line too short	Correct air line length.	Replace the air line. Refer to the vehicle manufacturer's instructions.
	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		
	Incorrect initial adjustment	Correct pad-to-rotor clearance.	Readjust to set the correct rotor-to-pad clearance.
	Incorrect pad-to-rotor clearance		
	Brake not releasing		Damaged slide pin boots, caliper should move back and forth by hand with linings removed.
Water entry or seized operation shaft, internal.			Replace the caliper assembly and air chamber.
Short brake pad lining life	Vehicle overload	Refer to the weight limitations on the vehicle identification plate.	Observe the vehicle manufacturer's load recommendations.
	Abrasive environment	Contamination on the brake pad and rotor surface.	Install pad or rotor shields where available.
	Damaged rotor surface	Cracks or heavy heat checking.	Refer to Rotor on page 28.
	Companion brakes do not work correctly	Inspect the companion vehicle brakes and air system.	Adjust or repair as needed.
	Dragging brake	Refer to Dragging brake.	Refer to Dragging brake.
	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.
Smoking brakes	Contamination on the linings or rotor.	Grease, oil, undercoating, paint, etc., on the linings or rotor.	Inspect the hub seal. Replace as required. Clean the rotor and caliper assembly. Replace the pads.
	High brake temperature	Refer to Dragging brake and Short brake pad lining life.	Refer to Dragging brake and Short brake pad lining life. Can be a temporary situation with new or low mileage pads.

7 Diagnostics

Condition	Possible Cause	Check the following	Correction/Action
Poor stopping power, Long stopping distances, Poor driver feel, High brake pressures, Vehicle pulls to one side	Vehicle overload	Refer to the weight limitations on the vehicle identification plate.	Observe the vehicle manufacturer's load recommendations.
	Vehicle air system malfunction	Correct air pressure at the chamber inlet.	Have the air system evaluated by a qualified brake system specialist.
	Contamination on the linings or rotor	Grease, oil, undercoating, paint, etc., on the linings or rotor.	Inspect the hub seal. Replace as required. Clean the rotor and caliper assembly. Replace the pads.
	Incorrect pads installed	Refer to the vehicle manufacturer for the correct pads.	Replace the pads.
	Companion brakes not working correctly	Inspect the companion vehicle brakes and air system.	Adjust or repair as required.
	Brakes out-of-adjustment	Excessive pad-to-rotor clearance.	Readjust to set the correct pad-to-rotor clearance.
Brake noise	Rotor cracks or excessive runout	Excessive cracking, heat checking or runout.	Refer to Rotor on page 28.
	Brake component attachments are not installed to specification	Check for loose connections and fasteners.	Tighten the connections and fasteners to the specified torque.
	Worn brake pads	Lining thickness.	Replace the pads, if necessary.
	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.
	Incorrect pad installation	Friction material facing the rotor surface.	Correct the pad installation. Replace the pads and rotor, if necessary.
	Bent or loose pad retainer	Bent pad retainer or loose pad retainer bolt.	Replace or tighten the pad retainer.
	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.

8 Component Replacement

Component Replacement

Hazard Alert Messages

Read and observe all hazard alert messages in this publication.

⚠ DANGER

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. NEVER work under a vehicle supported only by jacks. Jacks can slip and fall over. Failure to use a jack stand can result in serious personal injury and damage to components.

⚠ DANGER

ASBESTOS AND NON-ASBESTOS FIBERS - 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. Use caution when handling both asbestos and non-asbestos materials. Refer to Section 1 for asbestos and non-asbestos safety information and recommended work practices.

⚠ WARNING

To prevent eye injury, always wear eye protection when performing vehicle maintenance or service.

Brake Repair/Replacement Procedures

This section provides all of the procedures required to completely disassemble the caliper. If you do not need to disassemble the caliper completely, you may repair and reassemble the caliper using the appropriate steps in this section.

Remove the Caliper Assembly

1. Wear safe eye protection. Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving.

⚠ WARNING

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

2. If the caliper has a spring chamber, carefully cage and lock the spring. Follow the chamber manufacturer's instructions to completely release the brake. Use the correct wrench to remove the air chamber nuts and washers.
3. Remove the air chamber assembly from the brake caliper and inspect the air chamber. Refer to Section 10 for procedures. Figure 8.1.

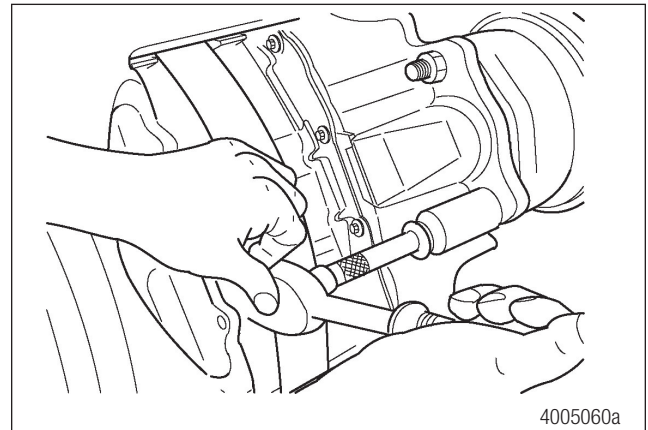


Figure 8.1 Air Chamber Removal

4. Inspect the chamber mounting face and sealing surface on the caliper. If the sealing surface is corroded, replace the caliper. Figure 8.2.

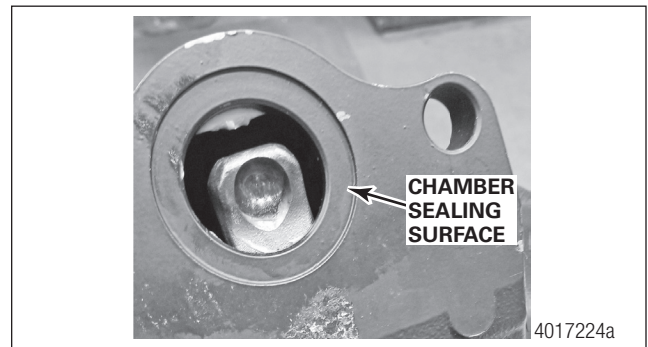


Figure 8.2 Check sealing surface.

5. Cover the exposed air chamber mounting aperture with tape to prevent debris from entering the caliper housing assembly. Figure 8.3.

8 Component Replacement

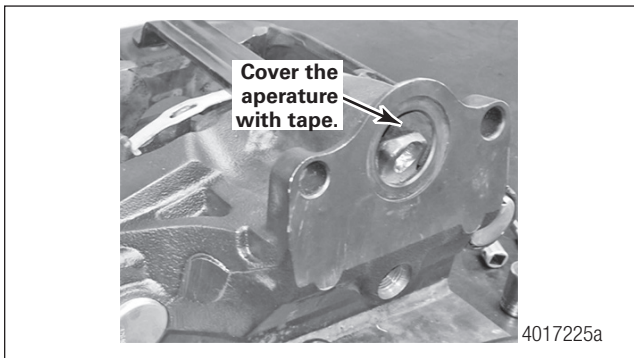


Figure 8.3 Air Chamber Mounting Aperture

6. Deadadjust the caliper and remove the brake pads. Refer to Wheels-Off Inspections and Brake Pad Replacement on page 13.
7. If the caliper is being removed from the vehicle, support the caliper to prevent it from falling when the attachment bolts are removed.
8. Using a 30 mm socket, loosen and remove the six caliper mounting bolts.
9. Remove the brake assembly from the vehicle.

Remove the Caliper Housing Assembly

⚠ DANGER

The caliper housing assembly is not serviceable. Do not attempt to tighten or loosen the six piston housing bolts. Tightening or loosening the bolts can cause the caliper to malfunction, resulting in serious personal injury and damage to components.

1. Using a 17 mm wrench, remove the pad retainer bolt and the pad retainer. Remove the pads.
2. Using a punch, put a hole in each of the end caps near the edge of the cap. Use the opened hole to pry the end cap out of the caliper.
3. Loosen the guide pin bolts. Be careful during this step; the housing assembly is held up by these two pins and will drop when they are both removed.
4. Carefully remove the housing assembly and slide pins from the carrier. Figure 8.4.

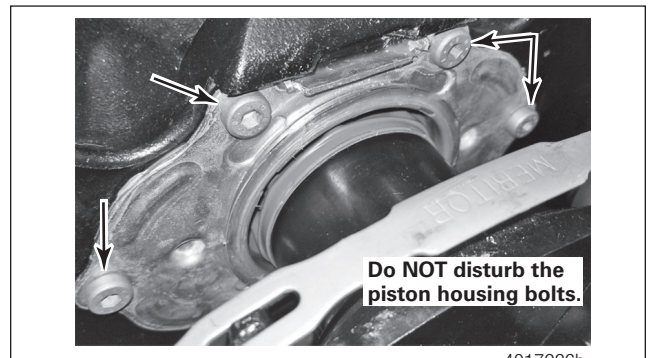


Figure 8.4 Caliper Piston

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.
 - **If there is damage or excessive wear to the slide pins:** Replace the slide pins before proceeding. Refer to the procedure in this section.

Remove the Slide Pin Bushings

EX+ LS brakes incorporate a long and short slide pin arrangement.

The long slide pin uses two round, steel-backed plastic bushings. Figure 8.5.

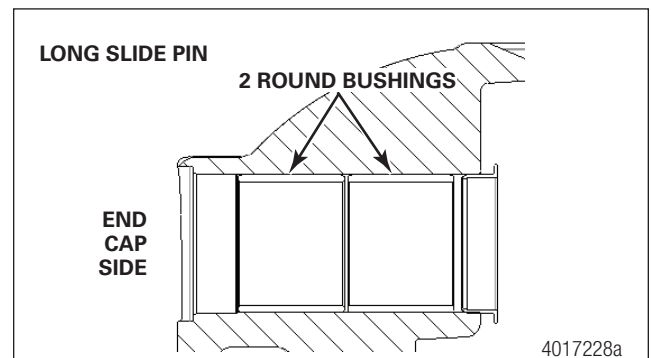


Figure 8.5 Long Slide Pin Bushings

The short slide pin uses a single plastic oval bushing. Figure 8.6.

8 Component Replacement

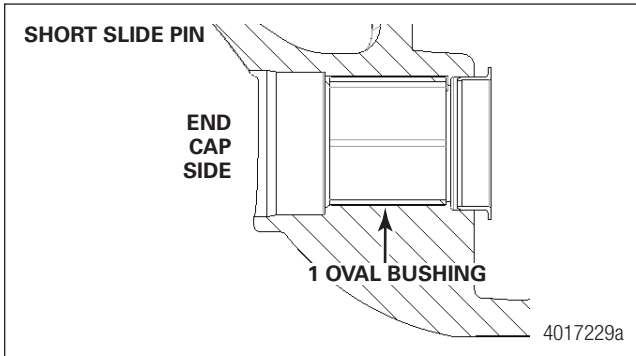


Figure 8.6 Short Slide Pin Bushing

Remove the Round Slide Pin Bushings

NOTE: When you remove the round, steel-backed plastic slide pin bushings, the dust boot retainers which are pressed into the housing slide pin bores will be removed at the same time.

DANGER

Observe all hazard alerts provided by the press manufacturer to avoid damage to components and serious personal injury.

Use a suitable driver and mallet or press to drive the bushing and dust boot retainer out of the housing

Remove the Oval Slide Pin Bushing

NOTE: Due to the presence of a lip shown in Figure 8.7, the oval bushings must be removed in the opposite direction of the round plastic bushings.

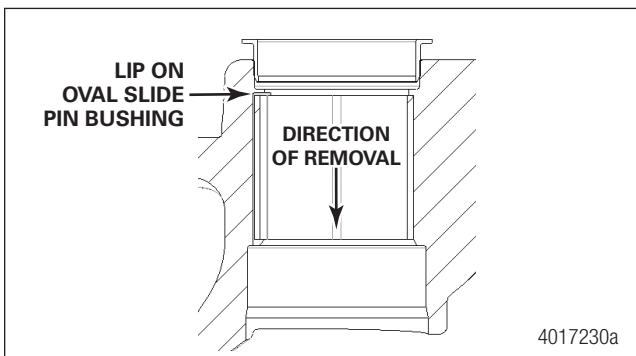


Figure 8.7 Oval Slide Pin Bushing Lip

1. Remove the slide pin boot retainer from the bushing bore. Figure 8.8.

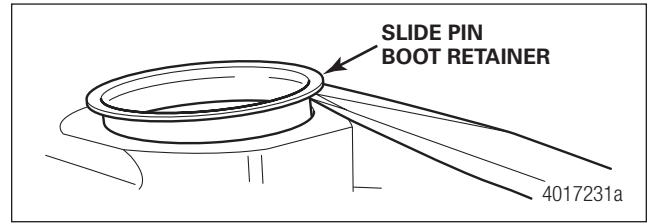


Figure 8.8 Slide Pin Retainer

2. Remove the oval slide pin bushing by hand. No special tool is required for removal or installation.

Install the Slide Pin Bushings

Clean and Inspect the Slide Pin Bushing Bores

1. Before you install the bushings, clean the slide pin bushing bores with a suitable brake cleaner.
2. Inspect the slide pin bushing bores for excessive wear, corrosion or damage.
 - **If you find excessive wear, corrosion or damage:**
Replace the caliper assembly.

Install the Round Plastic Slide Pin Bushings

1. Place one of the new bushings onto a suitable driver from Meritor tool MST 1000.
2. Insert the bushing into the housing bore from the slide pin boot retainer side of the bore. Figure 8.9.

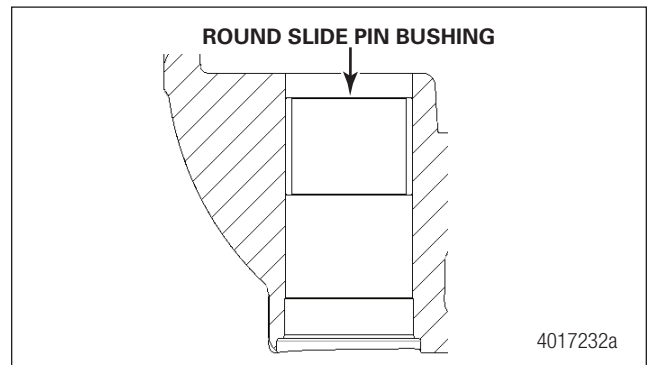


Figure 8.9 Round Slide Pin Bushing

8 Component Replacement

⚠ WARNING

Do not apply excessive force when you pull the bushing into the housing or damage to the bushing can occur. Improper brake operation and personal injury can result.

Using the applicable parts from Meritor tool MST 1000, pull the bushing into the slide pin bore to a depth of 0.15 inch (3.9 mm) measured from the end face of the housing (on the boot retainer side of the bore). Figure 8.10.

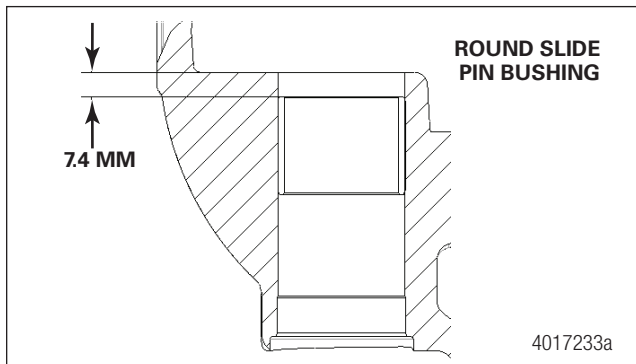


Figure 8.10 Round Slide Pin Bushing Depth from End Face of Housing

3. Repeat Steps 1-3 to install the second bushing, but insert the bushing from the end cap side of the bore. To confirm the correct position for the second bushing, measure the distance from the same end face of the housing (on the boot retainer side of the bore) to the bottom of the second bushing. The measurement should be 0.29-inch (7.4 mm). Figure 8.11.

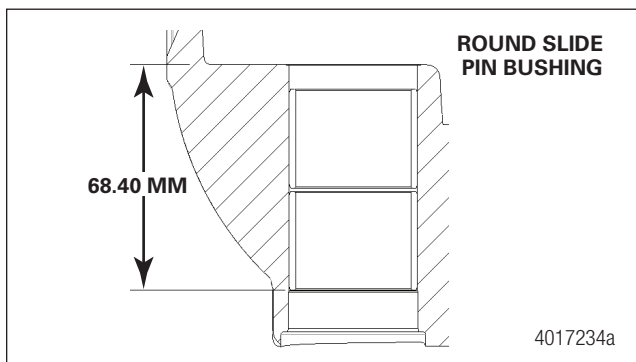


Figure 8.11 Round Slide Pin Bushing Depth

Install the Boot Retainers for Round Slide Pins

1. Place the retainer onto a suitable driver from Meritor tool MST 1000. Figure 8.12.

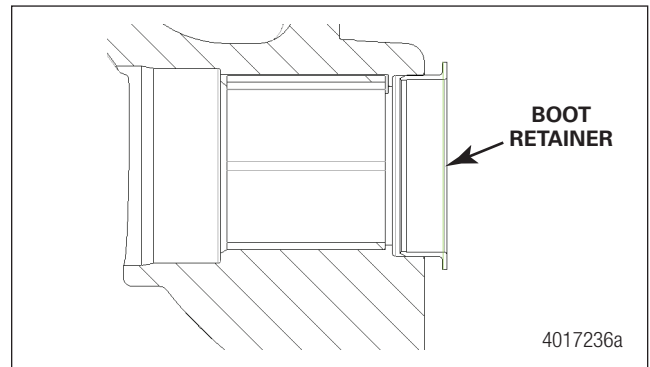


Figure 8.12 Slide Pin Bushing Retainer

2. Place the retainer onto the housing.
3. Use the applicable parts of Meritor tool MST 1000 to draw the retainer into the slide pin bore until the flat face of the retainer is 0.15-inch (3.9 mm) from the end of the slide pin bore. Figure 8.13.

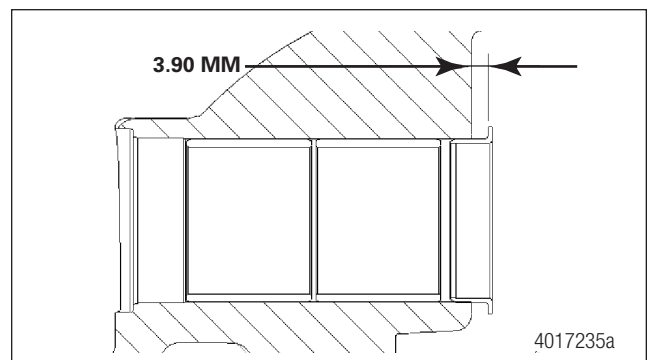


Figure 8.13 Slide Pin Bushing Depth Measurement

Install the Oval Slide Bushings

NOTE: The bushing must be assembled from the actuator side of the housing.

1. Align the new oval plastic bushing notch with the corresponding notch in the housing. Figure 8.14.

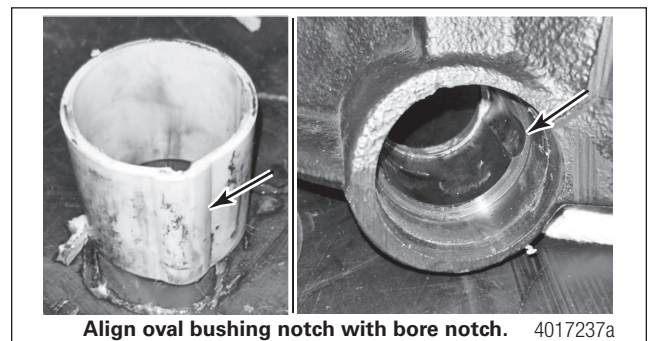


Figure 8.14 Oval Bushing Installation

2. Press the bushing by hand into the bore, until it stops.

8 Component Replacement

Install the Boot Retainers for Oval Slide Pins

1. Place the retainer onto a suitable driver from Meritor tool MST 1000.

⚠ WARNING

Do not apply excessive force when you pull the retainer into the bore or damage to the bushing or retainer can occur. Improper brake operation and personal injury can result.

2. Place the retainer onto the housing. Do not apply excessive force when you pull the retainer into the bore or damage to the bushing or retainer can result.
3. Use the applicable parts of Meritor tool MST 1000 to draw the retainer into the slide pin bore until the flat face of the retainer is 0.15-inch (3.9 mm) from the end of the slide pin bore. Figure 8.15.

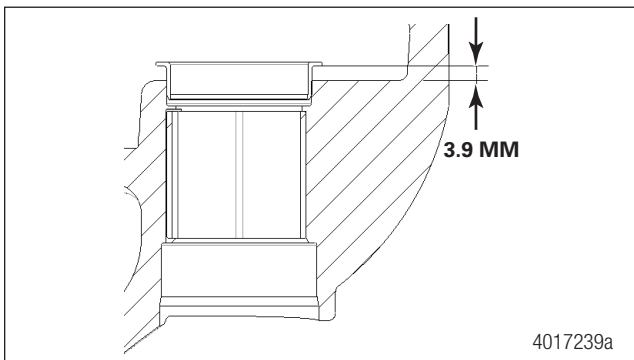


Figure 8.15 Slide Pin Bushing Depth Measurement

Install the Slide Pins and Boots

1. Apply grease to the slide pins and slide bores in the housing assembly.
2. 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.
3. Slide the new boot onto the lip on the slide pin and verify that the bead seats in the groove.
4. Carefully slide the slide pins into the corresponding bore and slide the boot over the retaining ring installed in the housing. Be careful not to tear the boot as you draw it over the ring and seat the bead into the groove.
5. Verify that each boot is properly seated by pulling the slide pin out of the bore.

Install the Caliper Housing Assembly

1. Place the housing assembly with guide pins onto the carrier.
2. Make sure that the piston tappet top tabs are located on the top of the vertical carrier abutments and that the bottom of the tappet rests on the horizontal carrier abutments.
3. Align the guide pin holes with the threaded holes on the carrier and install the slide pin bolts.
4. Hand tighten the bolts, then torque to 55-63 lb-ft + 90° ±2° (75-85 Nm + 90° ±2°).
5. Install the slide pin caps. Figure 8.16 and Figure 8.17.

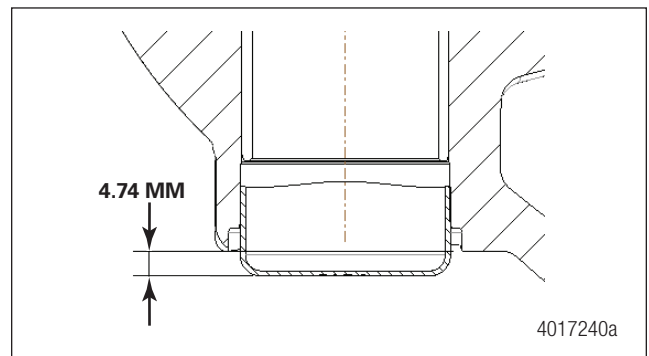


Figure 8.16 Slide Pin Measurement

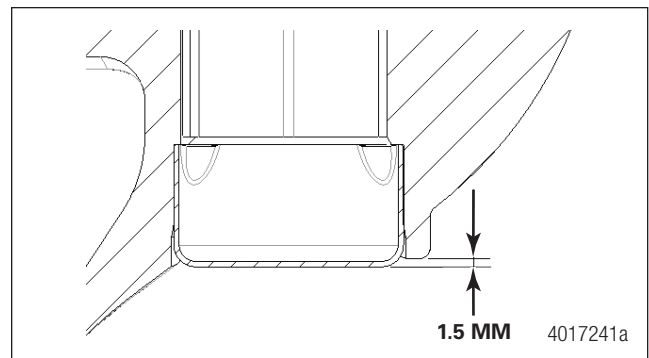


Figure 8.17 Slide Pin Measurement

⚠ WARNING

Use a brass or synthetic mallet for assembly and disassembly procedures. NEVER hit steel parts with a steel hammer. Pieces of a part can break off. Serious personal injury and damage to components can result.

Remove the Carrier Assembly

1. Remove the pad strap and pads (and PWWI and shield, if necessary).
2. Remove the slide pin end caps.

8 Component Replacement

3. Loosen and remove the M16 Torx-head slide pin bolts.
4. Lift the caliper from the carrier.
5. Remove the six caliper mounting bolts and remove the carrier from the vehicle.

Install the Carrier Assembly

 CAUTION
--

When placing the caliper and carrier assembly onto the vehicle, take care not to pinch the slide pin boots between the caliper housing and the torque plate. Pinching the boots can cause damage, which may lead to premature wear or failure of the slide pins.
--

1. Install the new carrier onto the vehicle and torque the caliper mounting bolts to 350-450 lb-ft (474-610 Nm).
2. Place the caliper onto the carrier and align the slide pins with the holes in the carrier.
3. Install the slide pin bolts and torque to 55-63 lb-ft + 90° ±2° (75-85 Nm + 90° ±2°).
4. Reinstall the slide pin caps.
5. Install the caliper and carrier assembly onto the vehicle and torque the carrier mounting bolts to 350-450 lb-ft (474-610 Nm).

9 Rotor

Rotor

Hazard Alert Messages

Read and observe all hazard alert messages in this publication.

⚠ DANGER

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. NEVER work under a vehicle supported only by jacks. Jacks can slip and fall over. Failure to use a jack stand can result in serious personal injury and damage to components.

⚠ DANGER

ASBESTOS AND NON-ASBESTOS FIBERS - 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. Use caution when handling both asbestos and non-asbestos materials. Refer to Section 1 for asbestos and non-asbestos safety information and recommended work practices.

⚠ WARNING

To prevent eye injury, always wear eye protection when performing vehicle maintenance or service.

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 Specifications on page 35.

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 9.1.

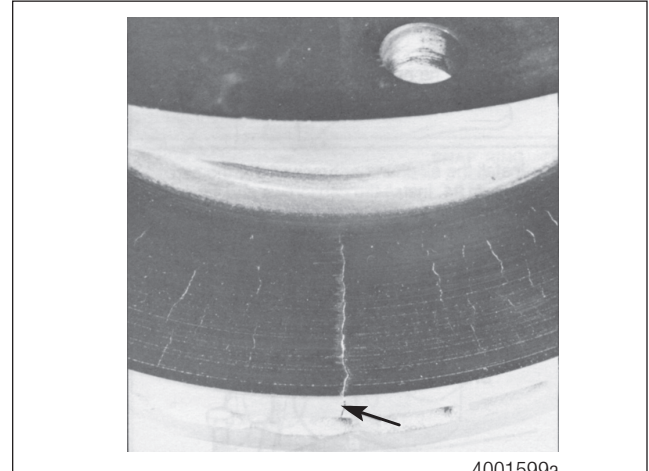


Figure 9.1 Cracks

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 9.2.

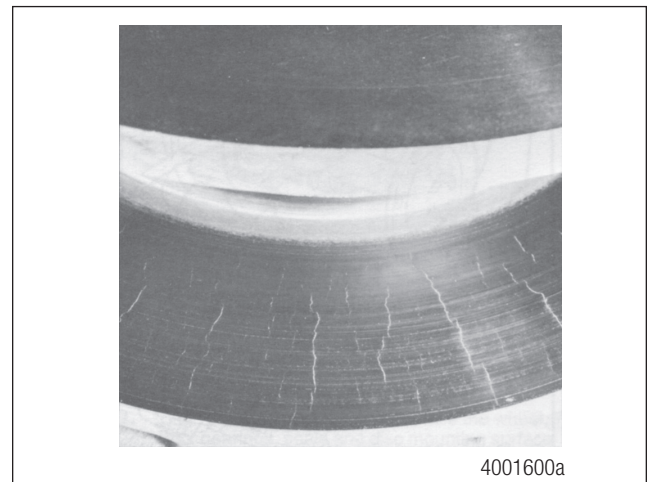


Figure 9.2 Heat Checking

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 9.3.

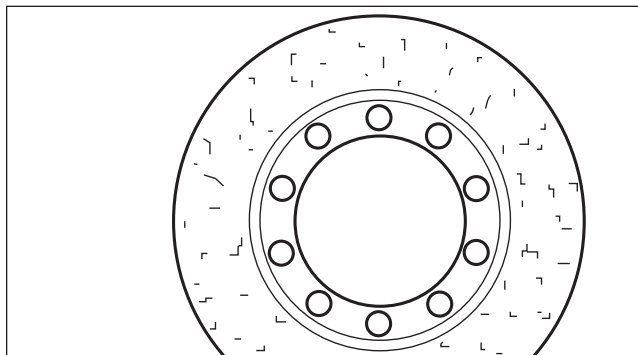


Figure 9.3 Light Heat Checking

Heavy Heat Checking

Heavy heat checks are 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 9.4.

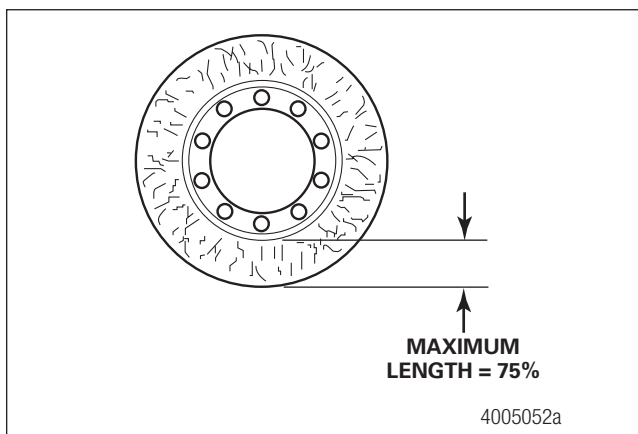


Figure 9.4 Heavy Heat Checking

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), resurface or replace the rotor. 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. Figure 9.5.

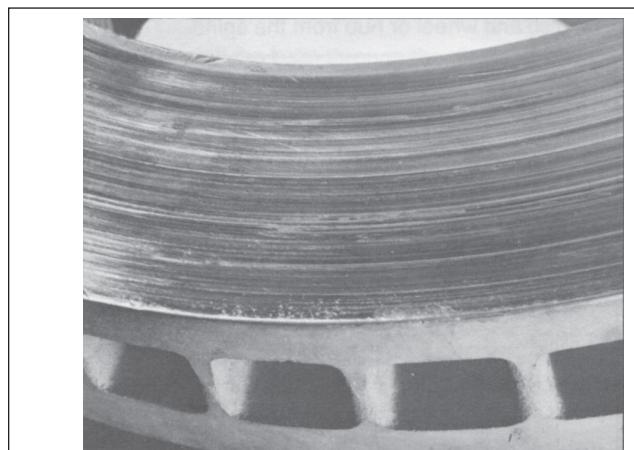


Figure 9.5 Deep Grooves and Scores

Blue Marks or Bands

Blue marks or bands indicate that the rotor was very hot. Determine the cause and correct the conditions. Figure 9.6

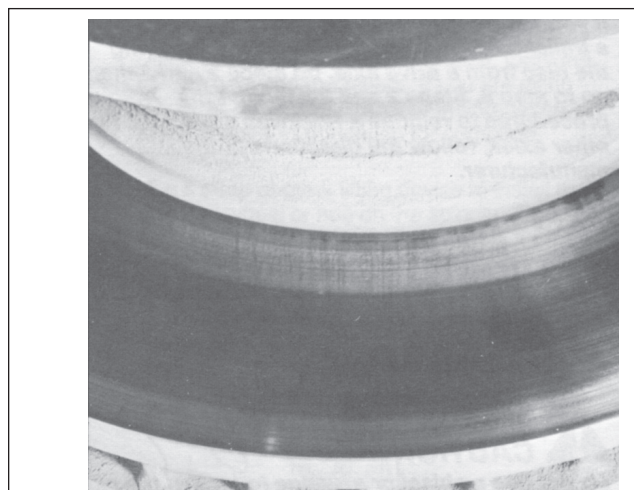


Figure 9.6 Blue Marks, Bands

Measure the Rotor Thickness

CAUTION

Replace the rotor if it reaches the minimum allowable rotor thickness found on the rotor casting. Damage to components can result.

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 the minimum discard thickness found on the rotor casting. Figure 9.7.

9 Rotor

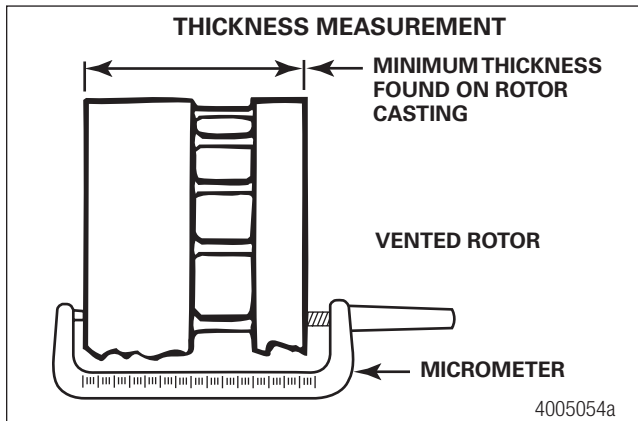


Figure 9.7 Measure the Rotor Thickness

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

Remove the Rotor

1. Remove the caliper. Refer to Remove the Caliper Assembly on page 22.
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 Specifications on page 35. 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.

Install the 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.

WARNING

Take care when using 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. If Loctite adhesive material gets into the eyes, follow the manufacturer's emergency procedures and get checked by a physician as soon as possible.

1. Apply Loctite® 620 threadlocker to the new hub-to-rotor bolts.
2. 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.
3. Tighten the hub-to-rotor bolts in a crisscross pattern to the correct torque. Refer to Specifications on page 35. Figure 9.8 or Figure 9.9.

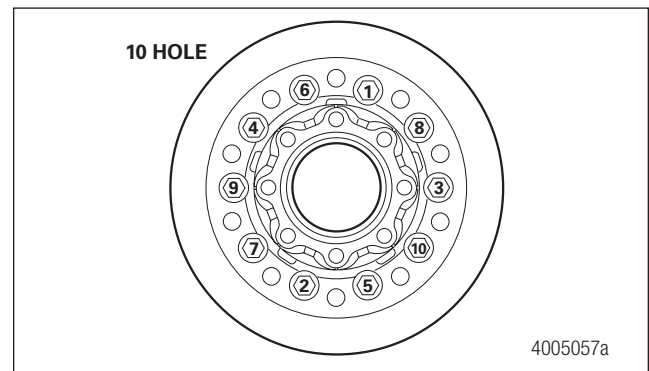


Figure 9.8 10-hole Rotor Torque Sequence

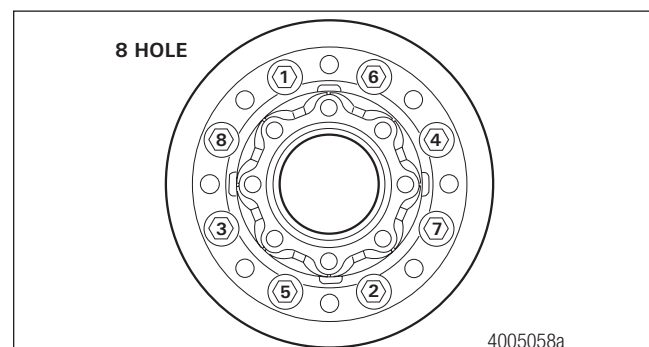


Figure 9.9 8-hole Rotor Torque Sequence

4. Ensure that all bolt heads do not protrude past the wheel-to-hub mounting surface.
5. 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.
6. Install the caliper assembly and brake pads. Adjust the brake pad-to-rotor clearance. Refer to Brake Pad Installation on page 17.

10 Air Chamber

Air Chamber

Hazard Alert Messages

Read and observe all hazard alert messages in this publication.

⚠ DANGER

Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving. Support the vehicle with safety stands. NEVER work under a vehicle supported only by jacks. Jacks can slip and fall over. Failure to use a jack stand can result in serious personal injury and damage to components.

⚠ DANGER

ASBESTOS AND NON-ASBESTOS FIBERS - 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. Use caution when handling both asbestos and non-asbestos materials. Refer to Section 1 for asbestos and non-asbestos safety information and recommended work practices.

⚠ WARNING

To prevent eye injury, always wear eye protection when performing vehicle maintenance or service.

Air Chambers on EX+LS Calipers

The EX+LS air disc brake uses a 0.59-inch (15 mm) chamber piston standout length. Figure 10.1. The air chamber part number is located on a nameplate.

⚠ 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.

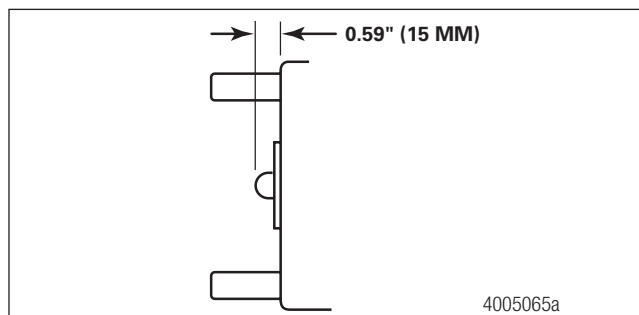


Figure 10.1 Chamber Piston Standout Length

Air Chamber Removal and Inspection

1. Wear safe eye protection. Park the vehicle on a level surface. Block the wheels to prevent the vehicle from moving.

⚠ WARNING

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

2. If the brake chamber has a spring brake, carefully cage and lock the spring to completely release the brake prior to removal. Refer to the chamber manufacturer's instructions for complete procedures.
3. Remove the brake chamber. Refer to the chamber manufacturer's instructions for complete procedures.
4. With the air chamber removed, visually inspect the chamber mounting studs. Figure 10.2.

- **If there are signs of uneven wear, broken, loose or missing studs:** Replace the chamber.

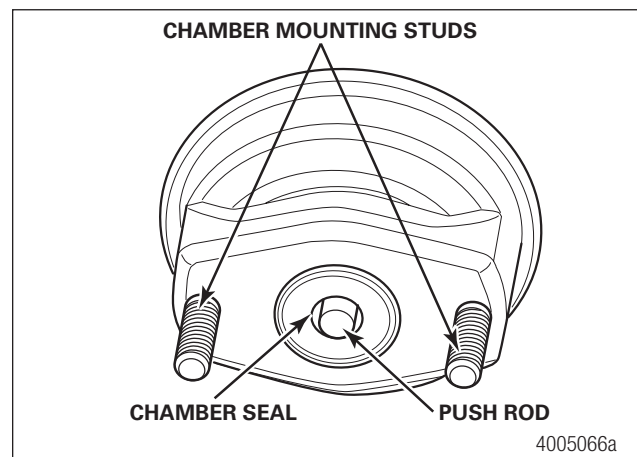


Figure 10.2 Air Chamber Inspection Points

5. Visually inspect the chamber push rod and chamber seal on the chamber.
- **If there is damage:** Replace the chamber.

- Inspect the inner boot on the brake chamber for damage and proper seal. If the inner boot of the brake chamber is damaged, water can enter the caliper housing assembly, resulting in damage to the component. Figure 10.3.

- If the inner boot is damaged or not sealed properly:**
Replace the brake chamber per the chamber manufacturer's recommendations.

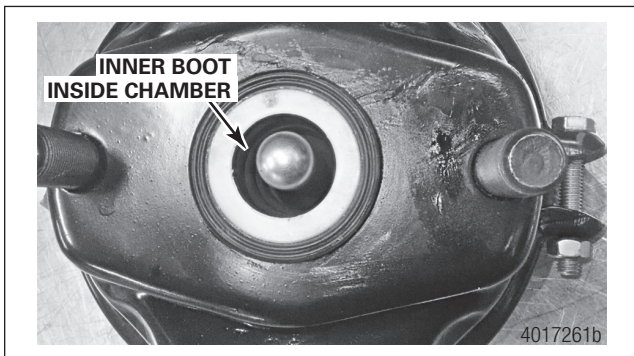


Figure 10.3 Air Chamber Inner Boot

- Visually inspect the chamber-mounting aperture on the caliper housing assembly for signs of water entry and corrosion.

- If signs of water entry and corrosion are present:**
Replace both the brake chamber and caliper assembly.

- If the chamber is removed and not replaced, cover the exposed air chamber mounting aperture with tape to prevent debris from entering the caliper housing assembly. Figure 10.4.

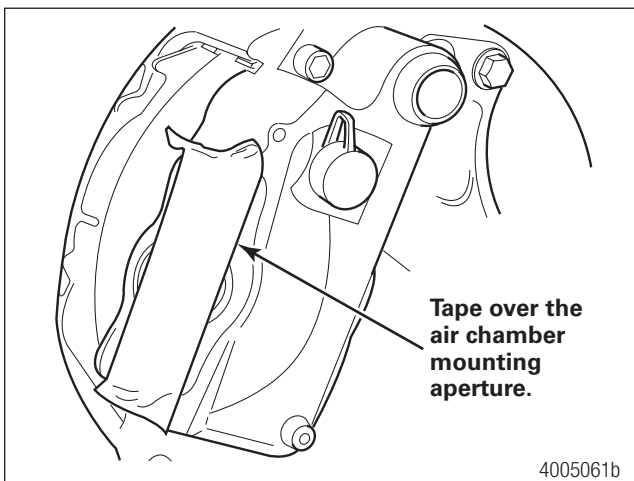


Figure 10.4 Cover the air chamber opening.

Air Chamber Installation

When installing service brake chambers, if there is no spring brake chamber to cage, proceed to the installation procedure. If the caliper has a spring chamber, carefully cage and lock the spring. Follow the chamber manufacturer's instructions completely to release the brake. Typically, new spring brake chambers are shipped caged.

⚠ WARNING

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

- Verify that the chamber seal is well seated, free of debris and shows no signs of damage. Check the mounting face for corrosion or debris. Do not install a brake chamber that shows signs of debris or excess flash on the seal.
- Verify that the caliper seal surface and the mounting surface are free of oil, grease and debris and show no signs of damage.
- If you are installing the brake chamber on an existing caliper, install a new caliper-to-air brake chamber seal on the caliper.
- 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.
- Position the chamber onto the caliper. Determine which of the two possible brake chamber orientations places the ports in the most accessible position.
- As you position the chamber onto the caliper, visually check that the chamber push rod is nesting in the pocket of the operating shaft.

⚠ WARNING

Do not work directly behind a spring brake chamber during installation. If the air chamber fails, the release of the spring under great tension can cause personal injury.

- 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.

10 Air Chamber

8. 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 Nm). Then, use a torque wrench to tighten each nut to 133-155 lb-ft (180-210 Nm).
9. If breather plugs are supplied, locate the bottommost breather plug and remove it from the chamber. Figure 10.5 and Figure 10.6.

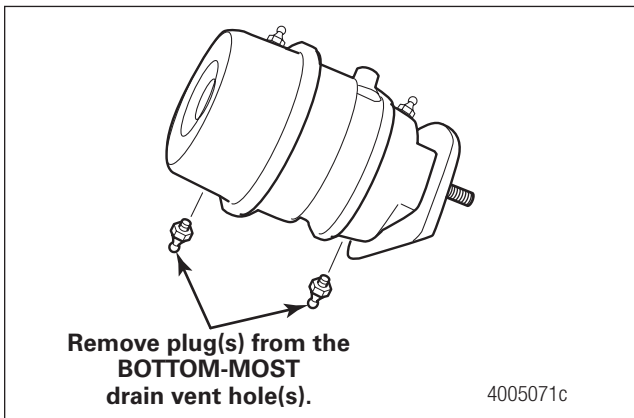


Figure 10.5 Service/Spring Chamber Breather Plugs

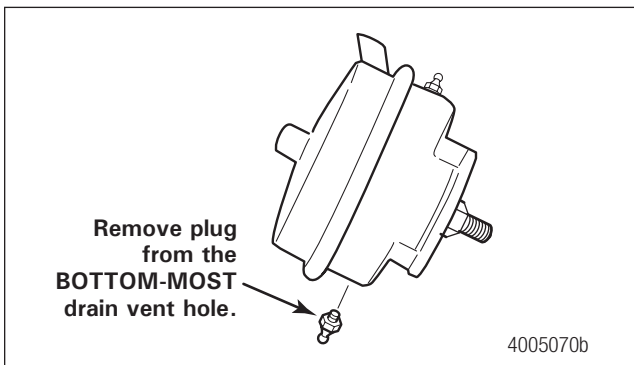


Figure 10.6 Service Chamber Breather Plug

10. Install the air hoses to the chamber ports. Refer to the manufacturer's instructions.
11. If the caliper has a spring chamber, carefully uncage and unlock the spring. Follow the chamber manufacturer's instructions.

Specifications

Table B: EX+ LS Torque Specifications

Fastener	Fastener Size	Socket Size	Torque Specification
Caliper/carrier bolt	M20x2.5	30 mm	350-400 lb-ft (474-542 Nm)
FF/FG torque plate bolt	3/4-16	1-1/8"	370-420 lb-ft (501-570 Nm)
R-series torque plate bolt	5/8-18	15/16"	180-230 lb-ft (244-312 Nm)
Long guide pin bolt	M18 Torx	T80	55-63 lb-ft + 90° +/-2° (75-85 Nm + 90° +/-2°)
Short guide pin bolt	M18 Torx	T80	55-63 lb-ft + 90° +/-2° (75-85 Nm + 90° +/-2°)
Pad retainer bolt	M10	17 mm	24-30 lb-ft (33-40 Nm)
Adjuster plug	3/4-14 NPT	3/8" driver	25-27 lb-ft (34-37 Nm)
Rotor-to-hub bolt (Meritor rotors only)	5/8-18	15/16"	180-230 lb-ft (244-312 Nm)
Air chamber nut	M16	24 mm	Initial: 59-75 lb-ft (80-100 Nm)
			Final: 133-155 lb-ft (180-210 Nm)

Table C: EX+ LS Minimum Thickness

Specification	Minimum Allowable Thickness
Pad thickness	0.12" (3.0 mm) remaining lining thickness
Rotor thickness	Minimum discard thickness located on side of rotor braking surface

11 Specifications

Torque Wrench Setting Using Extension Adapter MST225 5001 (ADB225 Wrench)

Extension adapter MST225 5001 (ADB225 Wrench) is a service tool designed to provide easier access to the axial type ADB carrier-to-torque plate bolts. When using this extension adapter, the torque wrench setting must be altered to obtain accurate tightening of the carrier-to-torque plate bolts. Refer to MST225 5001, ADB225 Wrench (Extension Adapter) on page 37 for an illustration of the tool and Table D for the altered torque wrench setting.

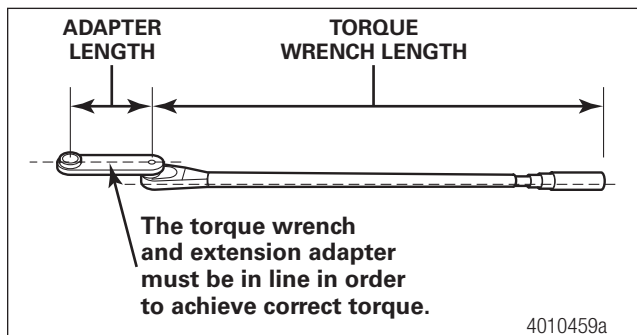


Figure 11.1 Adapter installed in-line with torque wrench requires adjustment of torque. Refer to the table below.

NOTE: If the extension adapter is installed at a 90-degree angle to the direction of torque application, no adjustment in torque needs to be made. Figure 11.2.

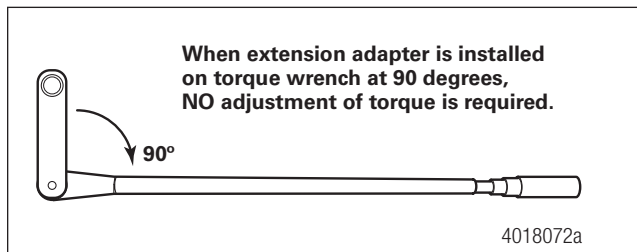


Figure 11.2 Adapter installed at 90 degrees requires no torque adjustment.

The following torque specifications are for 7-inch extension adapters only. If you are using a different size extension adapter, the torque specifications will be affected.

Table D: Carrier-to-Torque Plate Torque Using 7-Inch Extension Adapter

Description	Lb Ft	Nm
Carrier Bolt Standard Torque Wrench Setting	450	610
2-Foot Torque Wrench Setting with 7-inch Extension Adapter	348	472
3-Foot Torque Wrench Setting with 7-inch Extension Adapter	377	511
4-Foot Torque Wrench Setting with 7-inch Extension Adapter	392	531
5-Foot Torque Wrench Setting with 7-inch Extension Adapter	402	545

Special Tools

To obtain tools in this section, call Meritor's Commercial Vehicle Aftermarket at 888-725-9355.

MST1000, Bushing Service Tool

NOTE: This kit is for bushing installation. Bushings can be removed using the drivers in the kit and a dead blow hammer. Figure 12.1.

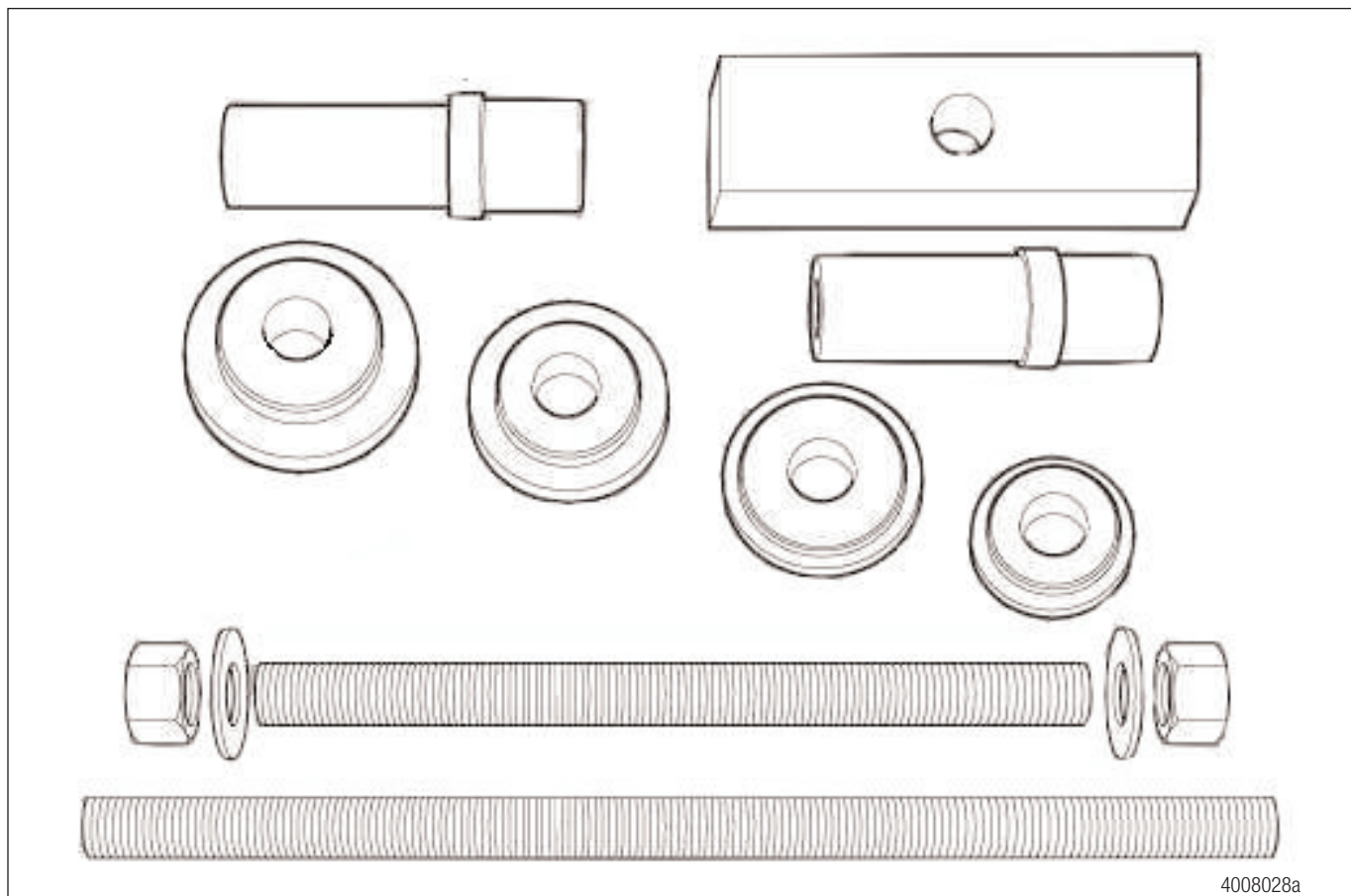


Figure 12.1 MST1000

MST225 5001, ADB225 Wrench (Extension Adapter)

Refer to Specifications on page 35 for altered torque settings when using this tool. Figure 12.2.

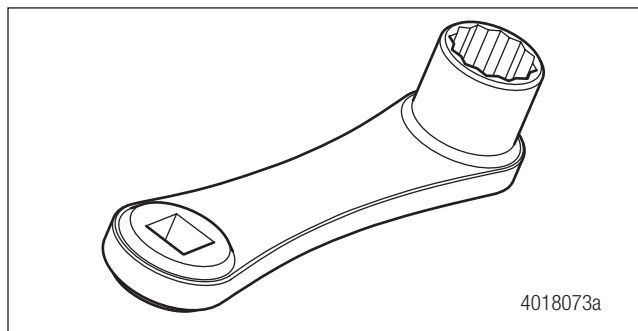


Figure 12.2 Extension Adapter



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