Peterbilt

A PACCAR COMPANY

Professional Service Technician WORKBOOK

Issue 2, 2011 • Volume 34

Air Disc Brakes

Bendix®

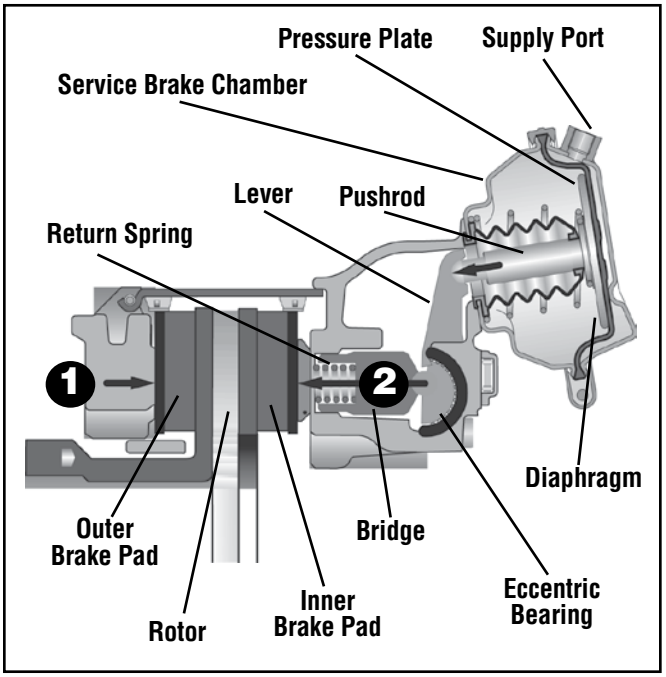
Bendix® air disc brakes use a floating caliper design to provide foundation braking on all axles of heavy commercial vehicles, buses and trailers. Bendix air disc brakes provide safety and performance, as well as ease of service. Available in models with or without a combination spring brake unit, these brakes may also include optional wear sensors and/or wear diagnostic equipment.

Operation

Brake Application

Bendix air disc brakes convert air pressure into braking force in the following sequence:

1. When the vehicle brakes are applied, air enters the service brake chamber through the supply port, applying pressure within the diaphragm.
2. The pressure expands the diaphragm, applying force to, and moving the pressure plate and pushrod forward.
3. The pushrod acts against a cup in the internal lever which pivots on an eccentric bearing moving the bridge.
4. Moving against a return spring, the bridge transfers the motion to two threaded tubes and tappets, which move the inner brake pad.
5. The inner brake pad (from its normal position of having a running clearance between it and the rotor) moves into contact with the brake rotor.
6. Further movement of the bridge forces the caliper, sliding on two stationary guide pins, away from the rotor, which pulls the outer brake pad into the rotor.
7. The clamping action of the brake pads on the rotor applies braking force to the wheel.



Bendix® ADB22X™ Air Disc Brake Operation

Brake Release and Adjustment

When the vehicle brakes are released, the air pressure in the service brake chamber is exhausted and the return springs in the chamber and the bridge return the air disc brake to a neutral, non-braked position. To maintain the running clearance gap between the rotor and the brake pads over time, the non-braked position is mechanically adjusted by a mechanism in the caliper. The adjustment mechanism operates automatically whenever the brakes are activated to compensate for rotor and brake pad wear and to keep the running clearance constant. During pad or rotor maintenance, the technician manually sets the system's initial non-braked position. The total running clearance (sum of clearances on both sides of the rotor) should be between 0.024- to 0.043-inch (0.6 and 1.1 mm).

Peterbilt Dealer Training Director: Mike Arzamendi Peterbilt Editor: Mike Tenbush

Produced by Burgio, Cooney & Associates, Independence, MO • Phone: 816-353-3672, Fax: 816-353-4206, e-mail: dave.sachs@bcakc.com

Published by Peterbilt Motors Company.

Safe Maintenance Practices

WARNING! PLEASE READ AND FOLLOW THESE INSTRUCTIONS TO AVOID PERSONAL INJURY OR DEATH:

When working on or around a vehicle, the following general precautions should be observed at all times:

1. Park the vehicle on a level surface, apply the parking brakes, and always block the wheels. Always wear safety glasses. Where specifically directed, the parking brakes may have to be released, and/or spring brakes caged, and this will require that the vehicle be prevented from moving by other means for the duration of these tests and procedures.
2. Stop the engine and remove the ignition key when working under or around the vehicle. When working in the engine compartment, the engine should be shut off and the ignition key should be removed. Where circumstances require that the engine be in operation, EXTREME CAUTION should be used to prevent personal injury resulting from contact with moving, rotating, leaking, heated or electrically charged components.
3. Do not attempt to install, remove, disassemble or assemble a component until you have read and thoroughly understand the recommended procedures. Use only the proper tools and observe all precautions pertaining to use of those tools.
4. If the work is being performed on the vehicle's air brake system, or any auxiliary pressurized air systems, make certain to drain the air pressure from all reservoirs before beginning ANY work on the vehicle. If the vehicle is equipped with an AD-IS® air dryer system or a dryer reservoir module, be sure to drain the purge reservoir.
5. Following the vehicle manufacturer's recommended procedures, deactivate the electrical system in a manner that safely removes all electrical power from the vehicle.
6. Never exceed the manufacturer's recommended pressures.
7. Never connect or disconnect a hose or line containing pressure; it may whip. Never remove a component or plug unless you are certain all system pressure has been depleted.
8. Use only genuine Bendix® replacement parts, components and kits. Replacement hardware such as tubing, hose, and fittings must be of equivalent size, type and strength as original equipment, and be designed specifically for such applications and systems.
9. Components with stripped threads or damaged parts should be replaced rather than repaired. Do not attempt repairs requiring machining or welding unless specifically stated and approved by the vehicle and component manufacturer.
10. Prior to returning the vehicle to service, make certain all components and systems are restored to their proper operating condition.
11. For vehicles with Antilock Traction Control (ATC), the ATC function must be disabled (ATC indicator lamp should be ON) prior to performing any vehicle maintenance where one or more wheels on a drive axle are lifted off the ground and moving.

WARNING: AVOID CREATING DUST WHEN WORKING WITH BRAKE PADS DUE TO POSSIBLE CANCER AND LUNG DISEASE HAZARD.

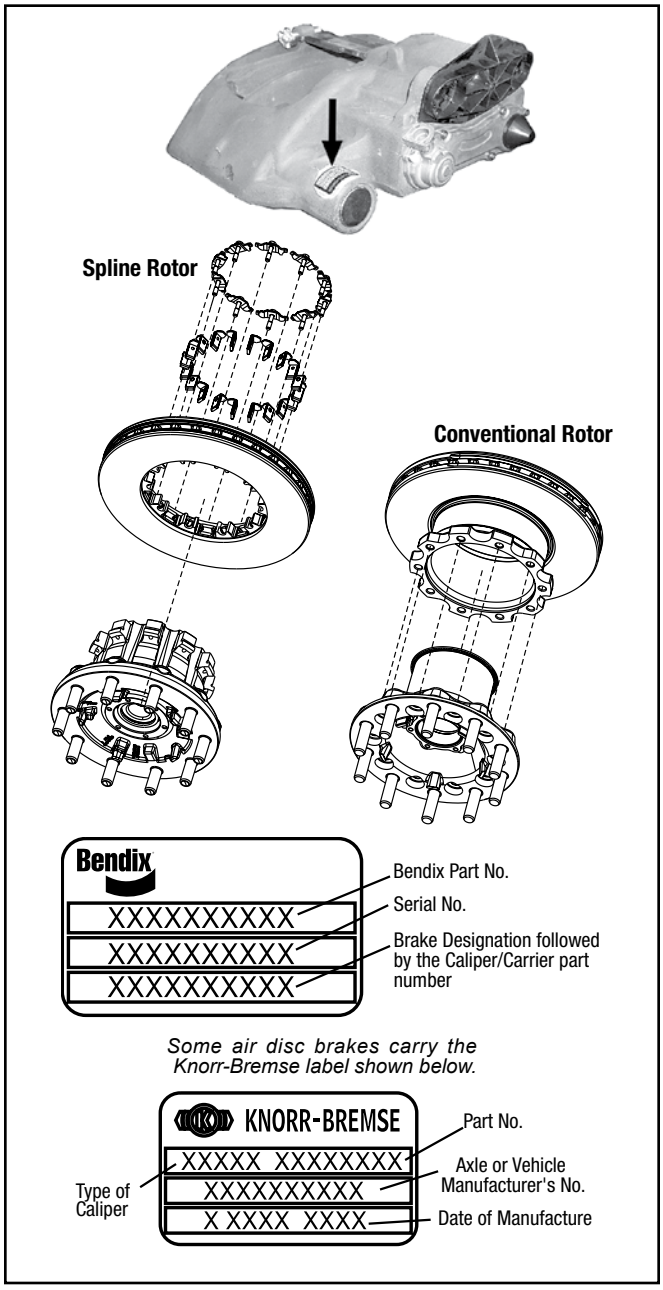
While Bendix Spicer Foundation Brake LLC does not offer asbestos brake linings, the long-term effects of some non-asbestos fibers have not been determined. Current Occupational Safety and Health Administration (OSHA) regulations cover exposure levels to some components of non-asbestos linings, but not all. The following precautions must be used when handling these materials.

- Avoid creating dust. Compressed air or dry brushing must never be used for cleaning brake assemblies or the work area.
- Bendix recommends that workers doing brake work must take steps to minimize exposure to airborne brake lining particles. Proper procedures to reduce exposure include working in a well-ventilated area, segregating areas where brake work is done, using local filtered ventilation systems or using enclosed cells with filtered vacuums. Respirators approved by the Mine Safety and Health Administration (MSHA) or National Institute for Occupational Safety and Health (NIOSH) should be worn at all times during brake servicing.
- Workers must wash before eating or drinking, should not use tobacco products in any form, should shower after working and should not wear work clothes home. Work clothes should be vacuumed using a high efficiency particulate filter (HEPA) vacuum and laundered separately without shaking.
- OSHA regulations regarding testing, disposal of waste and methods of reducing exposure for asbestos are set forth in 29 Code of Federal Regulations §1910.001. These regulations provide valuable information which can be utilized to reduce exposure to airborne particles.
- Material Safety Data Sheets on this product, as required by OSHA, are available from Bendix. Call 1-800-247-2725 and speak to the Tech Team or e-mail techteam@bendix.com.

Air Disc Brake and Rotor Identification

To determine which version of the Bendix air disc brake is installed, locate the identification label near the guide pin housing (below).

Certain maintenance inspection procedures depend on the type of rotor installed.

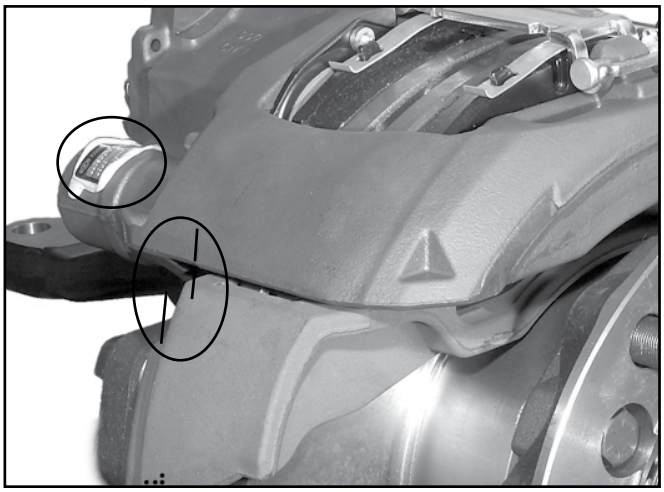


Caliper and Rotor Identification and Part No. Label Location

Mechanical Brake Pad and Rotor Wear Indicators

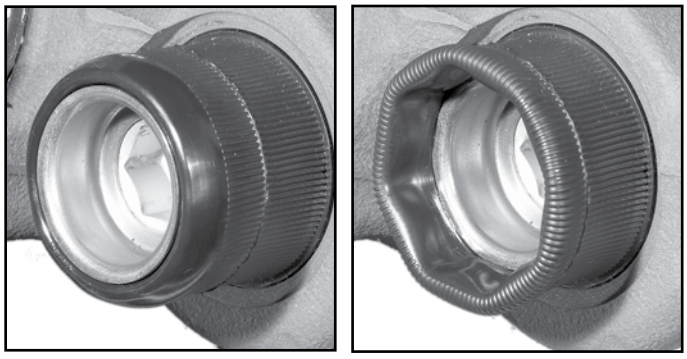
A preliminary visual check of the condition of the brake pad and rotor wear can be made without removing the wheels. See below for the inspection of each of four guide pin styles.

NOTE: These inspections provide an indication of when to schedule a full wheel-removed inspection of the brake pads and rotor. The thicknesses of both the pad and rotor will affect the wear indicator position at which maintenance is actually needed. These inspections do not constitute “out-of-service” criteria.



Style A: Rolling Boot Style Wear Indicator

Inspect the position of the guide pin flexible rubber bushing. When the guide pin has moved in so that the ribbed section of the flexible rubber bushing reaches the point where it folds back in, it is time to schedule a full wheel-removed inspection of the pads and rotor.

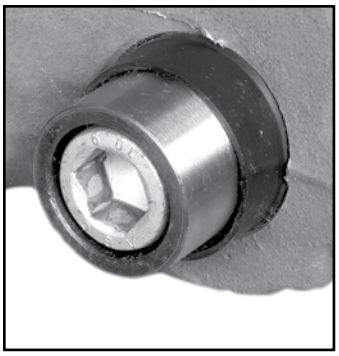


The guide pin moves in and folds back the ribbed section of the flexible rubber bushing.

Style B: Solid Rubber Bushing Style Wear Indicator

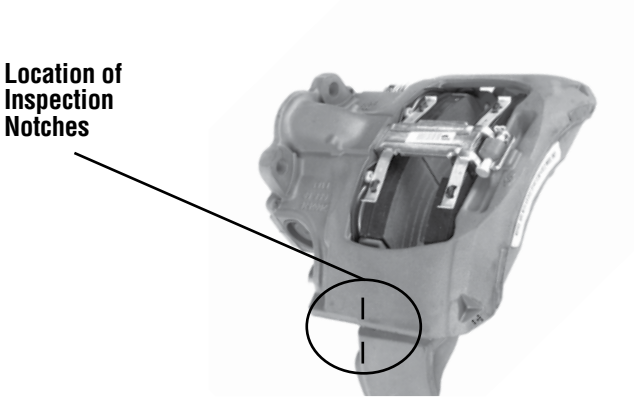
Inspect the position of the guide pin compared to the solid rubber bushing. When the guide pin is aligned with the bushing, it is time to schedule a full wheel-removed inspection of the pads and rotor.

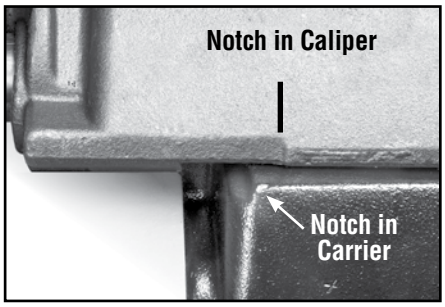
Note: This is only an indication that the pads and rotor are ready for inspection, and does not necessarily mean that maintenance is required.



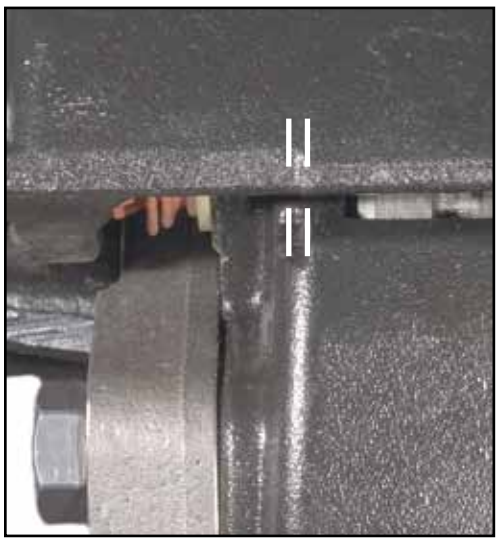
Style C: Where Both the Carrier and Caliper Have an Indicator Notch

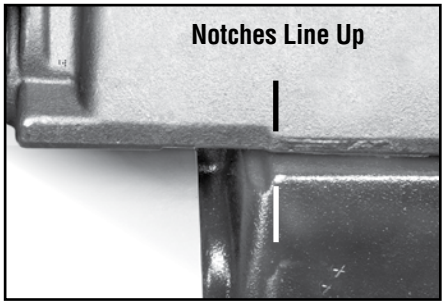
Compare the relative position of two notches cast into the carrier and the caliper. When the two notches align, it is time to schedule a full wheel-removed inspection of the pads and rotor.





When the guide pin is enclosed by a cover, check the alignment of inspection notches cast into the carrier.

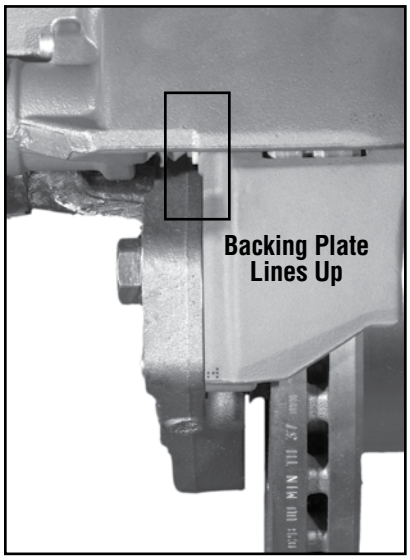




Time to schedule inspection of pads and rotor.

Style D: Where Only the Caliper has an Indicator Notch

When the notch in the carrier aligns with the front edge of the torque plate, it is time to schedule a full wheel-removed inspection of the pads and rotor.

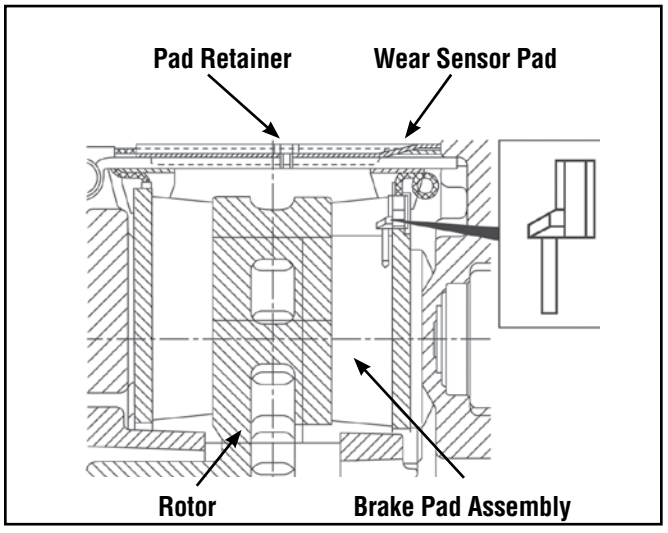


Electronic Brake Pad Wear Indicators

The electronic monitoring system uses sensors installed in a pre-formed slot in the brake pad to allow the status of the pad wear to be monitored. When the pad wears away through use, the point is reached when the indicator itself comes into contact with the rotor.

For in-pad normally-closed indicators, when the indicator is worn through, the circuit is broken and the vehicle operator is alerted.

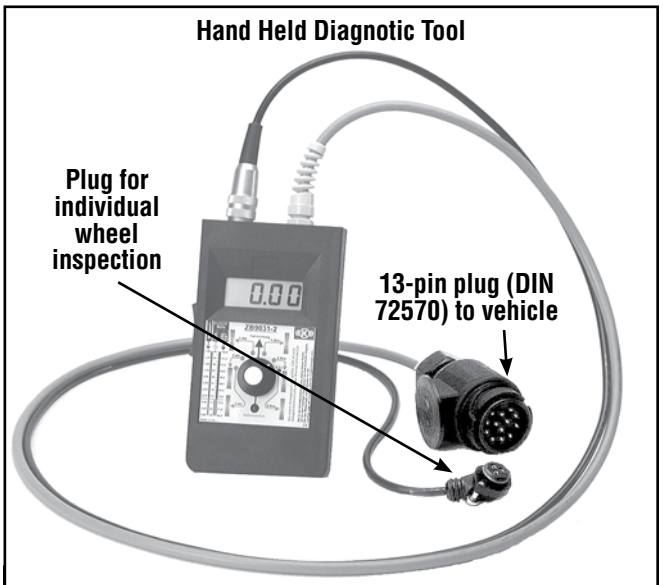
For in-pad normally-open indicators, when the indicator is worn through, the circuit is completed by the rotor touching the contacts and the vehicle operator is alerted.

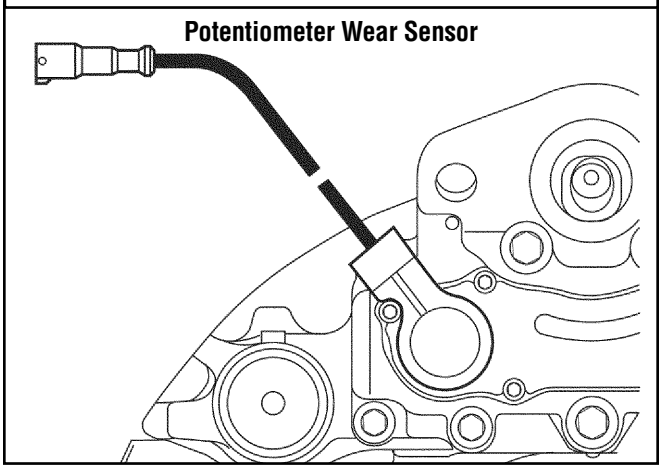


Example of normally open or closed wear sensor

On some vehicles, the electronic system is fully integrated into the vehicle monitoring system and uses a buzzer or indicator lamp to alert the driver.

Alternate vehicle arrangements permit a hand-held diagnostic tool to be used to test individual wheel connectors, or where installed, attach to a DIN socket in the dash, and allow up to six brakes to be checked from that location. The system provides feedback on the pad wear and can also conduct a test of the wear indicator potentiometer.





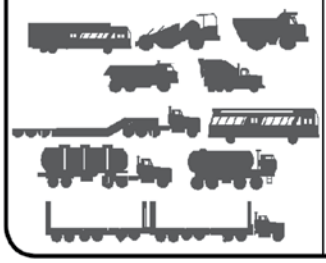
Even when using wear indicators, always follow the standard preventive maintenance schedule outlined on the following page.

Refer to the vehicle manual and/or the diagnostic tool manual for specific device operating instructions.

Preventive Maintenance

Regular inspection and maintenance of air disc brake components is an important part of vehicle maintenance. The maintenance practices outlined here are recommended in addition to all standard industry practices such as daily pre-trip inspections. Also, see the vehicle's manual for recommendations.

Use the table below for a guide to maintenance interval planning. However, depending on the vehicle use, more frequent checks of the components may be necessary. Keep track of the results of maintenance inspections to help determine the ideal maintenance interval for the vehicle.

Vehicle Used for:	Basic Inspection Program Pad & Rotor Wear, Running Clearance *(Inspection with the wheel mounted)*	At Least Once Annually and at Every Pad Replacement *(Inspection with wheel removed)*
Over the Road e.g. Line haul, RV, Open Highway Coach. 	• For vehicles with electronic wear indicators, use the dash indicator(s) and/or the hand-held diagnostic tool to regularly monitor the pad wear. • In all cases, **visually inspect the wear indicator every four months** (or keep track of the results of maintenance inspections to schedule checks 4 to 5 times during the pad lifetime). **At the same time, conduct the Running Clearance Inspection** (see below). • **A visual check is recommended** of the mechanical wear indicator every time the tire pressures are checked. Be alert for any visible rotor cracks, etc.	**Inspect:** • The rotor for cracks, etc. • The running clearance and adjuster function • The caliper travel • The tappet and boot assemblies • All covers, caps, hoses, and brake exterior for damage, etc.
Higher Duty Use e.g. Pick-Up & Delivery, Off-Highway, Construction, Loggers, Concrete Mixer, Dump Truck, City Transit Bus, Refuse, Urban Region Coach, School Bus. 	• For vehicles with electronic wear indicators, use the dash indicator(s) and/or the hand-held diagnostic tool to regularly monitor the pad wear. • In all cases, **visually inspect the wear indicator every three months** (or keep track of the results of maintenance inspections to schedule checks 4 to 5 times during the pad lifetime). **At the same time, conduct the Running Clearance Inspection** (see below). • A visual check is recommended of the mechanical wear indicator every time the tire pressures are checked. Be alert for any visible rotor cracks, etc.	

NOTE: These inspections provide an indication of when to schedule a full wheel-removed inspection of the brake pads and rotor. The thicknesses of both the pad and rotor will affect the wear indicator position at which maintenance is actually needed. These inspections do not constitute out-of-service criteria.

Air Disc Brake Running Clearance Inspection

Follow all industry safety guidelines, including those in this workbook. On level ground, with the wheels chocked and the parking brake temporarily released, check for movement of the brake caliper. This small movement, less than 0.80" (2 mm) in the inboard/outboard direction, indicates that the brake is moving properly on its guide pins. If the caliper does not move or appears to move more than cited above, a full wheel-removed inspection will be necessary.

Inspections

Follow all standard safety procedures including, but not limited to, those on page 3 of this workbook.

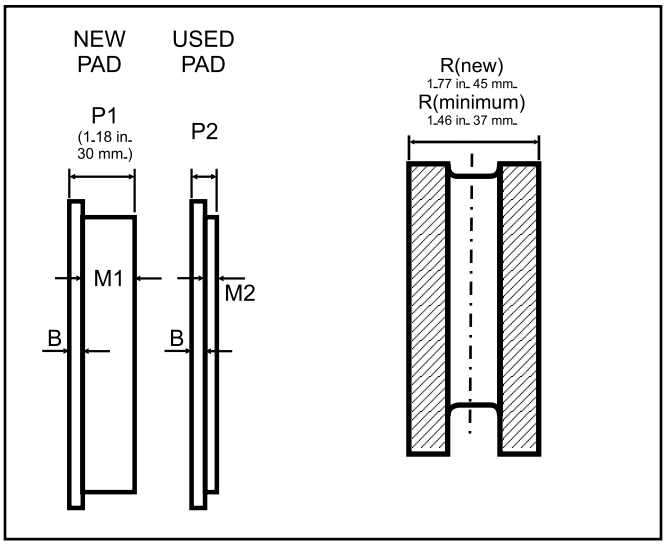
Brake Pads and Rotors

Bendix® air disc brakes are precision-engineered braking mechanisms. The friction-couple braking characteristics have been carefully optimized, and the rotor design and materials have been matched with special formulation brake pads for optimal performance.

CAUTION: When replacing brake pads, Bendix strongly recommends using only replacement pads and replacement rotors approved by the OEM. Use of non-approved rotors or non-approved replacement disc pads can cause excess wear to brake components, and can increase the risks of such problems as rotor cracking. Note that two thicknesses of backing plate are generally available, so to maintain the vehicle within specifications, only use brake pads with the type of backing plate and lining material originally supplied by the vehicle manufacturer. See the manual supplied with the vehicle for further information.

Inspect Brake Pads

Regular inspection of the brake pads (even for vehicles that use a wear indicator) is an important part of vehicle maintenance. If the thickness of the friction material (M2) is less than 0.079-inch (2 mm) the pads must be replaced.



Pad and Rotor Dimensions

Bendix® ADB22X™, ADB 225™, SN6™, SN7™ (and some SK7™) air disc brakes use 0.35-inch (9 mm) backing plates, so P2 (the combined pad and backing plate thickness) must be a minimum of 0.43-inch (11 mm).

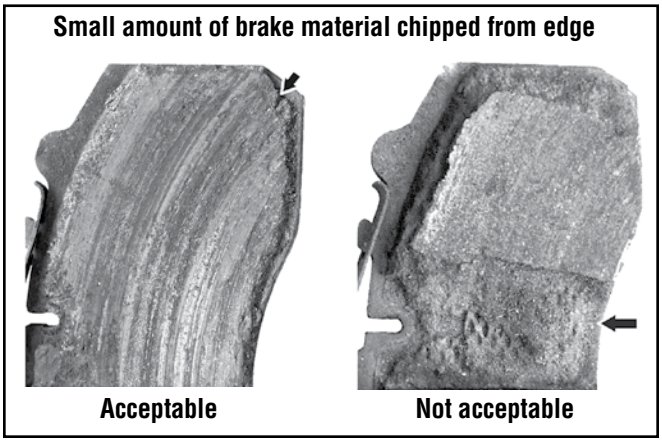
Note that for some Bendix® SK7™ air disc brakes, a 0.28-inch (7 mm) backing plate is used, so P2 (the combined pad and backing plate thickness) must be a minimum of 0.35-inch (9 mm).

If the pad thickness is within the acceptable range, inspect the pad surface. Minor damage at the edges is permitted, but replace the pads if major damage on the surface of the pad is found.

When replacing brake pads, Bendix strongly recommends that all the brake pads on an axle be replaced at one time. See page 14 for the pad replacement procedure. In addition, see the vehicle manual recommendations.

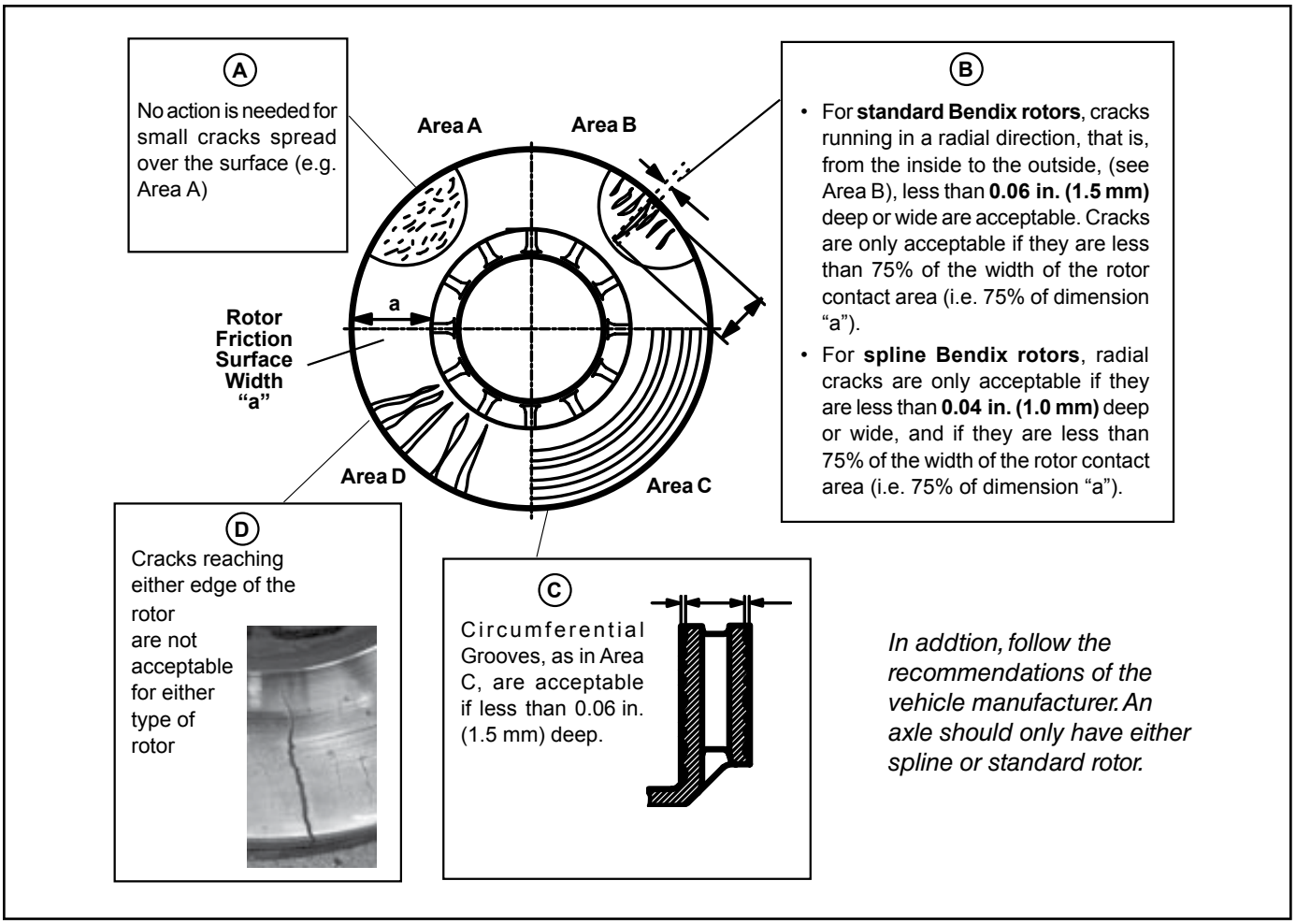
Inspect Rotors

Identify the rotor as being a conventional or a splined assembly (page 4). Examine the rotor and measure the thickness at the thinnest point. Avoid measuring near the edge of the rotor as minor burrs may be present. Replace Bendix rotors when the minimum thickness of 1.46-inch (37 mm) is reached or as instructed by the



Pad Inspection

vehicle manufacturer. When replacing rotors, please refer to the instructions of the vehicle manufacturer. It is recommended to install Bendix brake rotors, available from the local Bendix Spicer Foundation Brake parts outlet, and it is also recommended that the pads should be replaced at the same time.



Rotor Inspection

If a non-Bendix® rotor is used, refer to the vehicle manual and rotor manufacturer's recommendations.

CAUTION: The use of non-approved brake rotors may reduce levels of safety and invalidate the warranty.

Rotor Surface Inspection

Inspect the rotor at each change of pads for grooves and cracks. The action to take depends on the type of rotor, and also the size, depth and direction of the imperfections.

Rotor Turning (Grinding)

Bendix rotors are normally service-free. Turning of Bendix spline rotors is not permitted. Conventional rotors may be turned when changing pads, but is not normally necessary. In the case of severe grooving of the entire friction surface, however, turning could be useful, and may increase the load-bearing surface of the pads. To meet Bendix recommendations, the minimum rotor thickness after turning must be greater than 1.53-inch (39 mm).

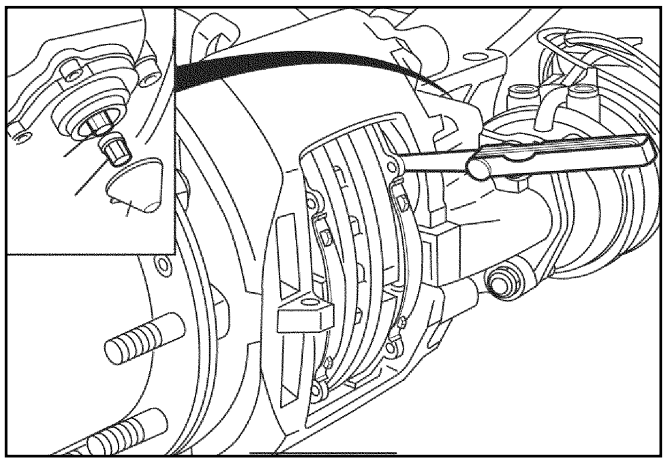
CAUTION: Always maintain air disc brake pads and rotors within specifications. Excessive pad or rotor wear will degrade optimum performance. When replacing rotors, be sure to adhere to the vehicle manufacturer's recommended bolt tightening torques.

Caliper Inspection

CAUTION: Follow all standard safety procedures including, but not limited to, those on page 3 of this workbook. See the vehicle manufacturer's recommendations. When working on foundation brakes, be sure that the vehicle is on level ground, that the vehicle is parked by other means than the foundation brakes, and that the wheels are chocked.

Caliper Movement Test

1. Remove the wheel.
2. With the spring brakes caged, push the caliper assembly inboard on its guide pins.
3. Using a suitable tool, press the inboard pad away from the tappets.



Measuring the Running Clearance

4. Check the gap between the tappet and the inboard pad backplate. It should be between 0.024- and 0.043-inch (0.6 and 1.1 mm). If the movement is within the range, there is no need to inspect further.

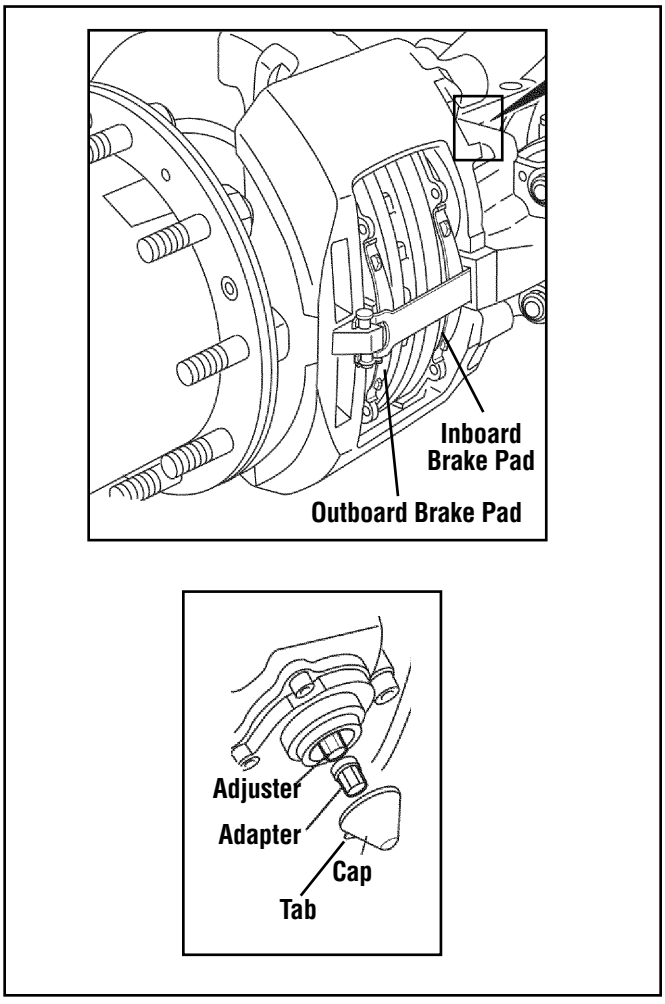
CAUTION: If the clearance is too wide, there is a danger of brake failure. If the clearance is too small, there is a danger of overheating. That may lead to consequential damage.

If there is no movement, go to page 11 for the "Guide Pin Bearing Inspection." If there is movement, but the running clearance is too small or too large, the adjuster may not be functioning correctly and should be checked. See "Inspect Adjuster Mechanism" as follows.

Inspect Adjuster Mechanism

CAUTION: Follow all standard safety procedures including, but not limited to, those on page 3 of this workbook. See the vehicle manufacturer's recommendations. When working on foundation brakes, be sure that the vehicle is on level ground, that the vehicle is parked by other means than the foundation brakes, and that the wheels are chocked.

Aside from the normal maintenance schedule, this adjuster check is also carried out when the Caliper Movement Test finds that the running clearance is too small or too large.



Adjuster Mechanism Components

The adjuster should then be checked:

1. Release or cage the spring brake.
2. Remove the adjuster cap using the tab, taking care not to move the shear adapter. Note: One of two styles of adjuster cover (stamped metal or plastic) may be used.

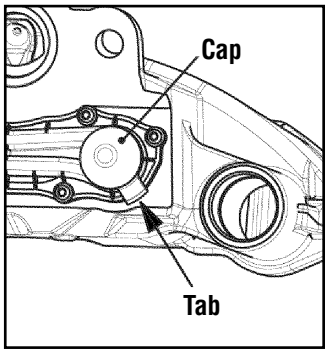
CAUTIONS:

- Although the adjuster and shear adapter are shown separated, only turn the adjuster with the shear adapter installed on the adjuster. Never turn the adjuster without the shear adapter installed. The shear adapter is a safety feature and is designed to prevent an excess of torque being applied to the adjuster. The shear adapter will fail (by breaking loose) if too much torque is applied. If the shear adapter fails, you may attempt a second time with a new (unused) shear adapter. A second failure of the shear adapter confirms that the adjustment mechanism is seized and the caliper must be replaced.
- Do not use an open-ended wrench as this may damage the adapter.

3. Using a box-end wrench or socket, turn the shear adapter counter-clockwise and listen for the sound of 2 or 3 clicks as the mechanism increases the running clearance.
4. Position a box-end wrench or socket so that it can turn freely on the shear adapter without coming into contact with parts of the vehicle.

NOTE: In step 5 below, as the number of applications increases, the turning movement will decrease (as the brake reaches its normal calibration point).

5. Make five to ten moderate applications of the brakes [at about 30 psi (2 Bar)]. For a normally functioning Bendix® air disc brake, the box-end wrench or socket should turn clockwise in small increments.
6. The automatic adjuster has failed and the caliper/carrier assembly must be replaced if the box-end wrench or socket:
   a. Does not turn.
   b. Turns only with the first application.
   c. Turns forward and backward with every application.
7. Bendix recommends installing a new adjuster cap (lightly greased using white lithium-based grease) when returning the air brake to service.
8. Ensure that the tab is in the position shown.



Guide Pins

CAUTION: Follow all standard safety procedures including, but not limited to, those on page 3 of this workbook. See the vehicle manufacturer's recommendations. When working on foundation brakes, be sure that the vehicle is on level ground, that the vehicle is parked by other means than the foundation brakes, and that the wheels are chocked.

NOTE: If the steps below lead the technician to a step where the wheel needs to be removed, inspect first to see that there is no contact between the caliper and axle, vehicle, chassis sections or carrier that may be impeding the caliper movement. When removing wheels, refer to the vehicle manufacturer's recommendations.

This guide pin inspection should be carried out if the result of the Caliper Movement Test (page 10) is that the technician cannot move the caliper.

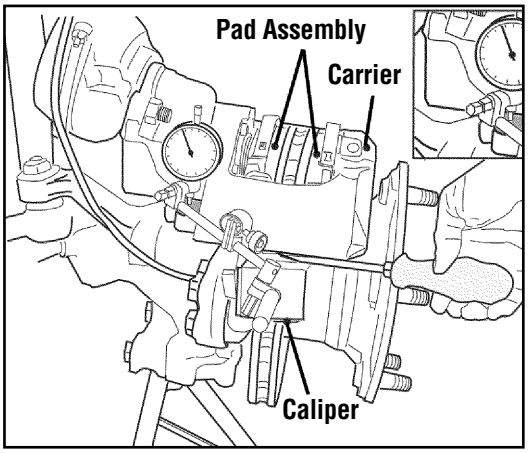
GUIDE PIN BEARING INSPECTION

1. Check caliper movement along the guide pins:
   a. Remove the pads (page 14).

NOTE: One of three different styles of guide pin (A, B or C) may be present (page 12). The bearings for styles A and B use a rubber bushing, and style C uses a guide sleeve.

   b. Clean dirt and road grime from the guide pin or cover.
   c. Using hand pressure only (no tools), the caliper should slide freely along the whole length of the guide pin arrangement. With the pads removed, this movement should be at least 0.8-inch (20 mm). If the movement is less than this amount, replace the caliper/carrier assembly.
2. To measure the clearance from the rubber bushing guide pin A or B (page 12) or guide sleeve (C) to the guide pin:
   a. Remove the wheel.
   b. Remove the pad retainer, but leave the pads in position.

c. Attach a magnetic dial-gauge holder to the carrier on the short bearing side of the caliper.



Attaching Magnetic Dial-Gauge to Carrier

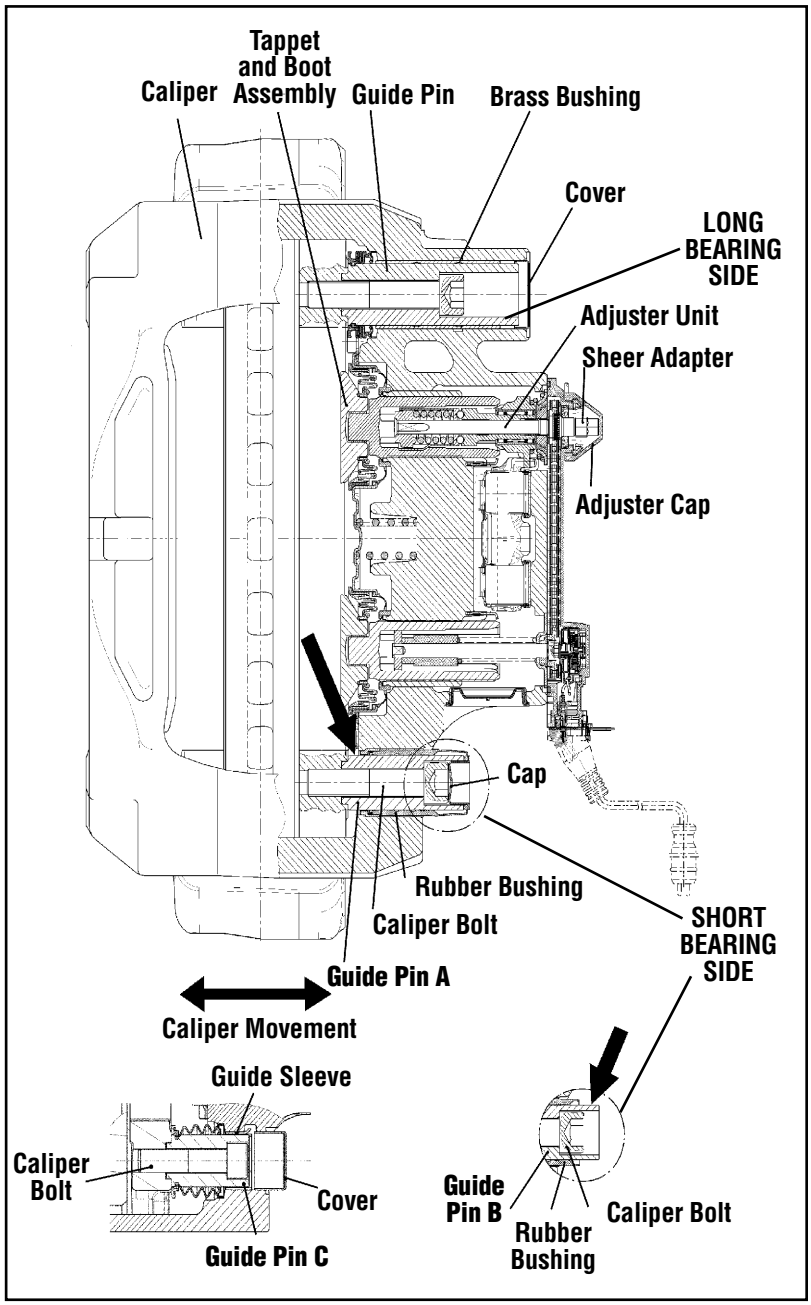
d. Use the measuring point on the caliper, press the caliper in the direction of the carrier and set the dial-gauge to zero.

e. Place a suitable tool like a screwdriver between the carrier and the caliper, forcing them in opposite directions, and read the maximum value on the dial-gauge.

f. The caliper/carrier assembly must be replaced if the value is greater than the following:

   1) A and B guide pins – 0.079-inch (2.0 mm)

   2) C guide pins – 0.039-inch (1.0 mm)



Guide Pin Styles

GUIDE PIN SEAL INSPECTION

1. Inspect the following components:

   a. The long bearing side guide pin is sealed with the cover and with the inner boot. Note: It may be necessary to remove the pads to inspect the inner boots if pad wear is minimal.

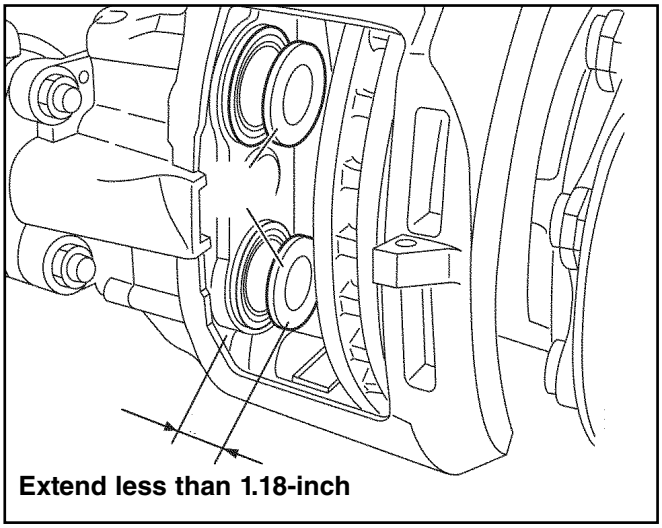
   b. The guide pin (A, B or C depending on the style) is also sealed with an inner boot and a cover (style C), or a flexible rubber wear indicator in the case of style A guide pins.

2. If damage is found, replace the caliper/carrier assembly. No kits are available at this time for guide pin seals.

TAPPET AND BOOT ASSEMBLY INSPECTION

CAUTION: In the following procedure, NEVER EXTEND THE TAPPET MORE THAN 1.18 in. (30 mm). Over-extending the tappet will result in the tappet losing engagement with the threads of the synchronizing mechanism. Since the mechanism can only be set at the manufacturing plant, the CALIPER/CARRIER ASSEMBLY MUST BE REPLACED if this happens.

1. Remove the wheel.
2. To inspect the tappet and boot assembly, it may be necessary to remove the pads and advance the shear adapter clockwise until the boots are clearly visible.



Tappet Extension Limit

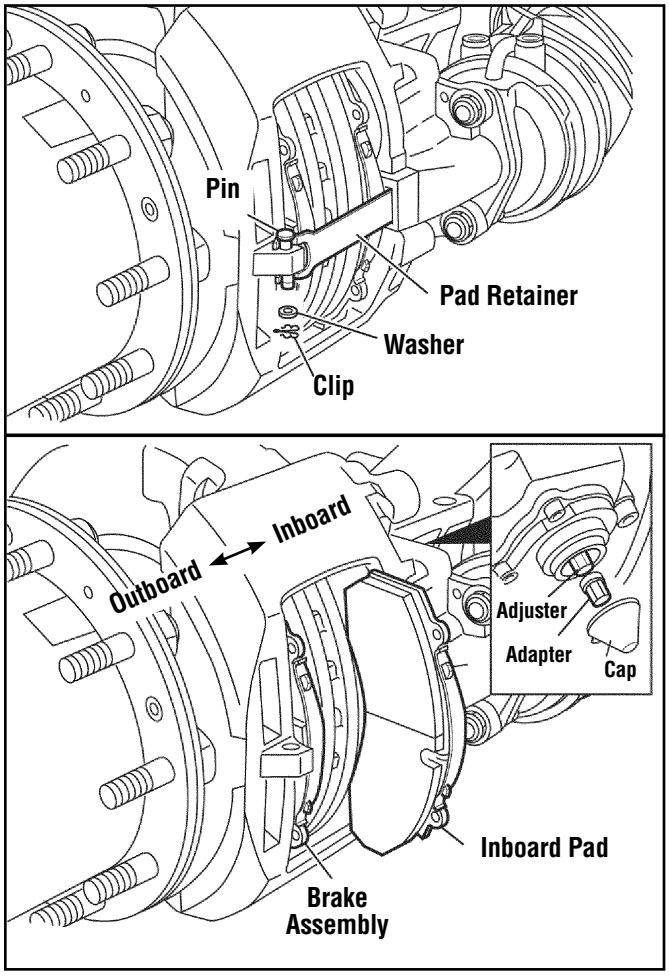
3. Inspect the tappet and boot assemblies for evidence of damage or corrosion. The penetration of dirt and moisture into the brake can lead to corrosion and impair the function of the air disc brake.
4. Replace assemblies as necessary (page 17).
5. Re-install the wheel according to the vehicle manufacturer's recommendations
6. Ensure that there is sufficient clearance between the tire inflation valve stem, the caliper and the wheel rim to avoid damage. Note: Not all wheels or valve stems are compatible with Bendix® air disc brakes. Use only wheels and valve stems approved by the vehicle manufacturer.

Maintenance Procedures

Pad Replacement

CAUTION: Follow all standard safety procedures including, but not limited to, those on page 3 of this workbook. See the vehicle manufacturer's recommendations. When working on foundation brakes, be sure that the vehicle is on level ground, that the vehicle is parked by other means than the foundation brakes, and that the wheels are chocked. When installing pads, where appropriate use heavy duty gloves and always keep fingers away from potential pinch hazard areas.

As noted earlier, Bendix® Air Disc Brakes are precision-engineered braking mechanisms. The "friction couple" braking characteristics have been carefully optimized and the rotor design and materials have been matched with special formulation brake pads for optimal performance.



Brake Pad Removal and Discarded Components

Pad Removal

Bendix strongly recommends that pads are replaced as an axle set. Use only pads which are permitted by the vehicle manufacturer, axle manufacturer and/or disc brake manufacturer. Failure to comply with this may invalidate the vehicle manufacturer's warranty.

1. Release or cage spring brakes.
2. Remove the wheel according to the vehicle manufacturer's recommendations.

Note: Before continuing with step 3 below for removing the brake pads, it is strongly recommended that the adjuster mechanism be checked for correct operation (page 10).

3. Remove and discard the clip and washer.
4. Depress the pad retainer and remove and discard the pad retainer pin.
5. As necessary, remove and discard any in-pad wear sensor components.
6. Pull off the adjuster cap using the tab, taking care to keep the shear adapter in position on the adjuster.

CAUTIONS:

- Never turn the adjuster without the shear adapter installed. The shear adapter is a safety feature and is designed to prevent an excess of torque being applied to the adjuster. The shear adapter will fail (by breaking loose) if too much torque is applied. If the shear adapter fails, you may attempt a second time with a new (unused) shear adapter. A second failure of the shear adapter confirms that the adjustment mechanism is seized and the caliper/carrier assembly must be replaced.
- In step 7 below, do not use an open-ended wrench as this may damage the adapter.

7. Using a box-end wrench or socket, fully wind back the tappet and boot assemblies by rotating the shear adapter counter-clockwise.
8. To remove the outboard brake pad, slide the caliper fully to the outboard position.
9. To remove the inboard pad, move the caliper fully to the inboard position.
10. Inspect the rotor (pages 8-9).

Brake Pad Installation

CAUTIONS:

- When replacing brake pads, take care to always use the correct replacement pads. For example, note that two thicknesses of backing plate are generally available. To maintain the vehicle within specifications, only use brake pads with the type of backing plate and lining material originally supplied by the vehicle manufacturer. See the manual supplied with the vehicle for further information.

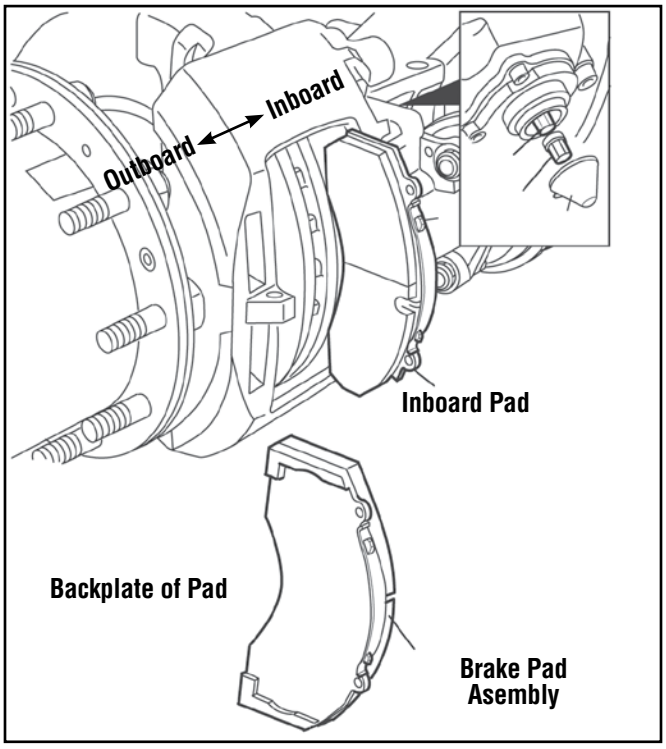
NOTE: Bendix® strongly recommends that when replacing brake pads, pads are replaced as an axle set. Use only pads which are permitted by the vehicle manufacturer, axle manufacturer and/or disc brake manufacturer. Failure to comply with this may invalidate the vehicle manufacturer's warranty.

- Bendix recommends that after every air brake service, the technician checks the brake performance and the system behavior on a dynamometer, if available.

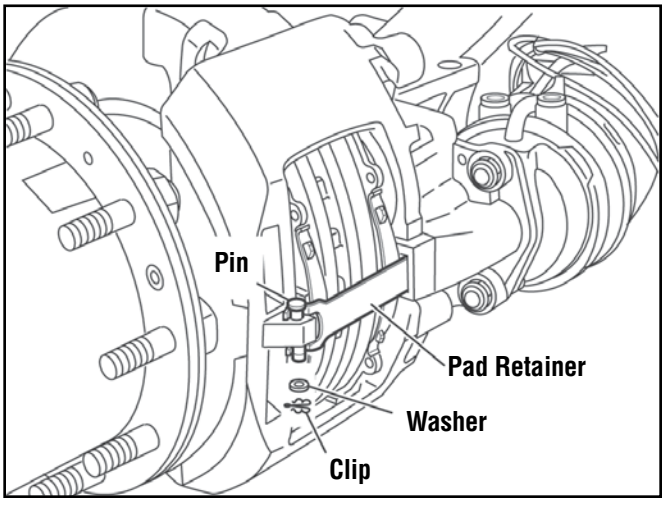
NOTES:

- Use only pads with the same backing plate thickness as originally specified for the vehicle's brakes.
- The Bendix air disc brakes covered by this workbook use more than one pad retainer design. Be sure to install the correct part number for the vehicle.

1. Remove the wheel.
2. Check that the tappet and boot assemblies have been fully retracted.
3. Clean the brake as needed according to the vehicle manufacturer's recommendations.
4. To install the outboard brake pad:
   a. Slide the caliper fully to the outboard position.
   b. Insert the pad with the brake lining material facing the rotor.
5. To install the inboard pad:
   a. Slide the caliper fully to the inboard position.
   b. Insert the brake pad with the lining material facing the rotor.
6. If appropriate, install new in-pad wear indicator kit as shown in the next procedure.



Pad Installation

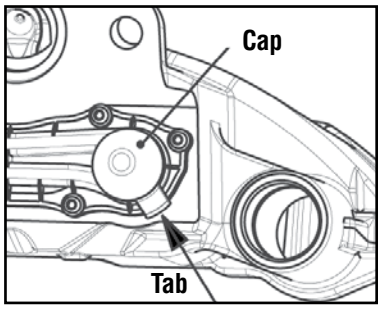


Brake Pad Installation

7. Using a box-end wrench or socket, turn the shear adapter clockwise until the pads come into contact with the rotor.
8. Turn back the shear adapter counter-clockwise two clicks to set the initial running clearance.

9. Install the pad retainer supplied with the kit into the groove of the caliper.
10. Depress the retainer to insert the pad retainer pin.
11. Install the supplied washer and spring clip to the pad retainer pin. It is recommended that the pad retainer pin be installed pointing downwards.
12. Apply and release the brake.
13. Assure that the hub turns easily by hand.

NOTE: In step 13 above, the tab of the adjuster cap should be positioned as shown here for ease of access.



Tab Position

14. Lightly lubricate and install a new adjuster cap, using white lithium-based grease.

NOTE: For step 15 below, not all wheels or valve stems are compatible with Bendix® air disc brakes. Use only wheels and valve stems approved by the vehicle manufacturer.

15. Re-install the wheel according to the vehicle manufacturer's recommendations.

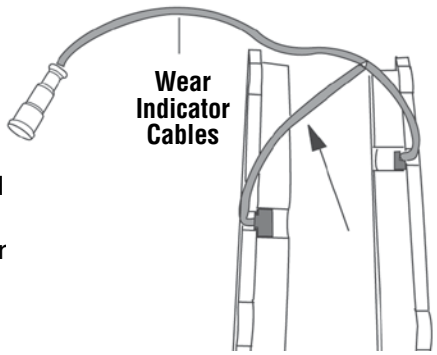
Electronic Wear Indicator Replacement

Normally-Closed or Normally-Open Type. See page 6.

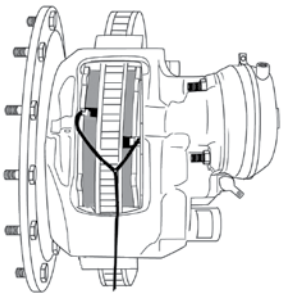
New wear indicators are normally installed whenever brake pads are replaced. Please see Brake Pad Installation on page 15 for cautions and procedures. The wear indicator is installed after the new brake pads are installed into the brake, but before the retainer hardware.

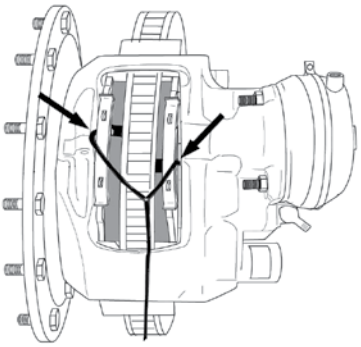
1. Remove and retain the pad holder springs.

Installation: The longer branch of the wear indicator cable (see arrow) must be installed in the outboard pad. Insert the wear indicator cables into the pre-cut slot in the pads. The wear indicators snap into place.



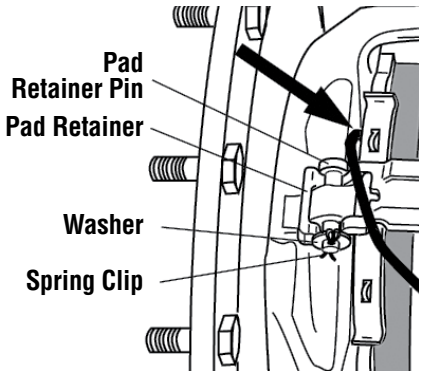
2. Insert wear indicator sensors into the pads.

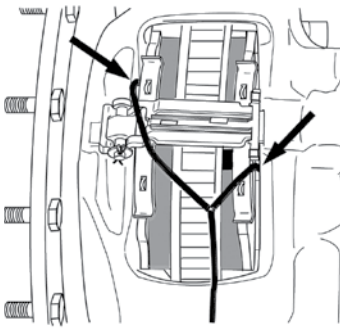




3. Install the pad holder springs onto the pads with the wear indicator cable.

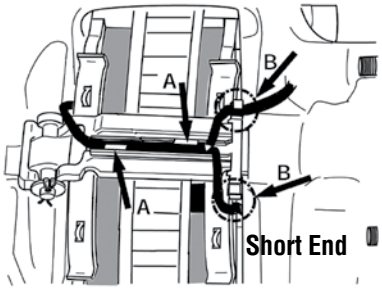
4. Install the pad retainer, pad retainer pin, washer and spring clip with the wear indicator cable.



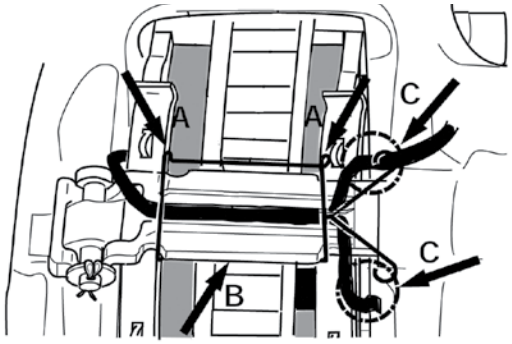


5. Install the cable guide onto the pad retainer. The cable guide snaps into place when pressing lightly onto the pad retainer.

6. Press the wear indicator cable into the locating tabs of the cable guide (see arrows A). The short cable end of the wear indicator cable must not be secured by locating tabs of the cable guide. According to vehicle type, install the cable that leads to the electrical supply of the vehicle, in one of the two locating tabs (see arrows B).



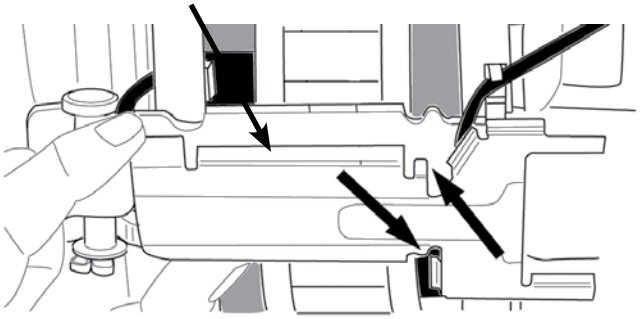
7. Install the indicator cable in the middle of the pad retainer. Insert the cable guide at one side of the pad retainer (see arrow B). Slightly press in on the other side of the pad retainer (see arrows A). The cable guide snaps into place.



According to vehicle type, install the cable that leads to the electric supply of the vehicle, in one of the wire loop (see arrows C). The short end of the wear indicator cable must not be secured by a wire loop of the cable guide (see arrows C).

8. Carefully install the cable protection plate with attention to the correct position of the cable protection plate's catch (see arrows).

The cable protection plate will snap into place.



Tappet and Boot Assemblies Replacement

CAUTION: Follow all standard safety procedures including, but not limited to, those on page 3 of this workbook. See the vehicle manufacturer's recommendations. When working on foundation brakes, be sure that the vehicle is on level ground, that the vehicle is parked by other means than the foundation brakes, and that the wheels are chocked. When installing pads, where appropriate use heavy duty gloves and always keep fingers away from potential pinch hazard areas. Cage spring brakes before beginning procedure.

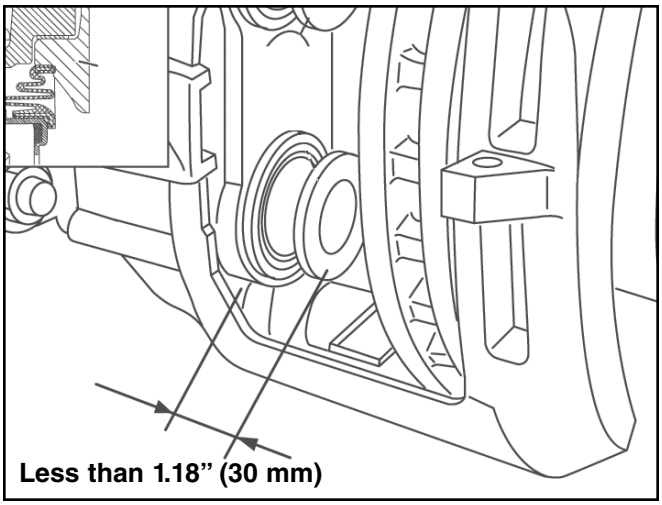
Note: In some cases, the technician may find it easier to remove the caliper from the vehicle before making the replacement.

Removal of Tappet and Boot Assemblies

1. Follow the procedure for removing brake pads on page 14.

CAUTION: Never turn the adjuster without the shear adapter installed. The shear adapter is a safety feature and is designed to prevent an excess of torque being applied to the adjuster. The shear adapter will fail (by breaking loose) if too much torque is applied.

CAUTION: Never extend the tappet more than 1.18-inch (30 mm). Over-extending the tappet will result in the tappet losing engagement with the threads of the synchronizing mechanism. Since the mechanism can only be set at the manufacturing plant, **the caliper/carrier assembly must be replaced** if this happens.



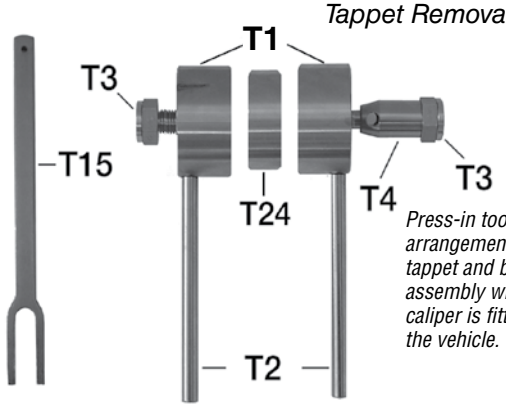
Tappet and Boot Assemblies

2. Removal of the tappet and boot assembly requires the use of the wedge fork (A). Extend the tappets less than 1.18-inch (30 mm) by turning the shear adapter clockwise until there is sufficient access to the boots to remove the tappet boot from the caliper bore.

CAUTION: In step 3 below, take care not to damage the inner sealing face. Gouges or grooves prevent a good seal and necessitate caliper replacement.

3. Using a screwdriver, move the boot location ring to allow a wedge fork to be inserted (B).
4. Remove the tappet and boot assemblies from the threaded tubes by using the wedge fork.
5. Remove the old tappet bushings (C).
6. Inspect the inner sealing face (D). If damage is found to the inner seal, the caliper/carrier assembly must be replaced.

Tappet Removal Tool



Press-in tool arrangement for tappet and boot assembly when caliper is fitted on the vehicle.

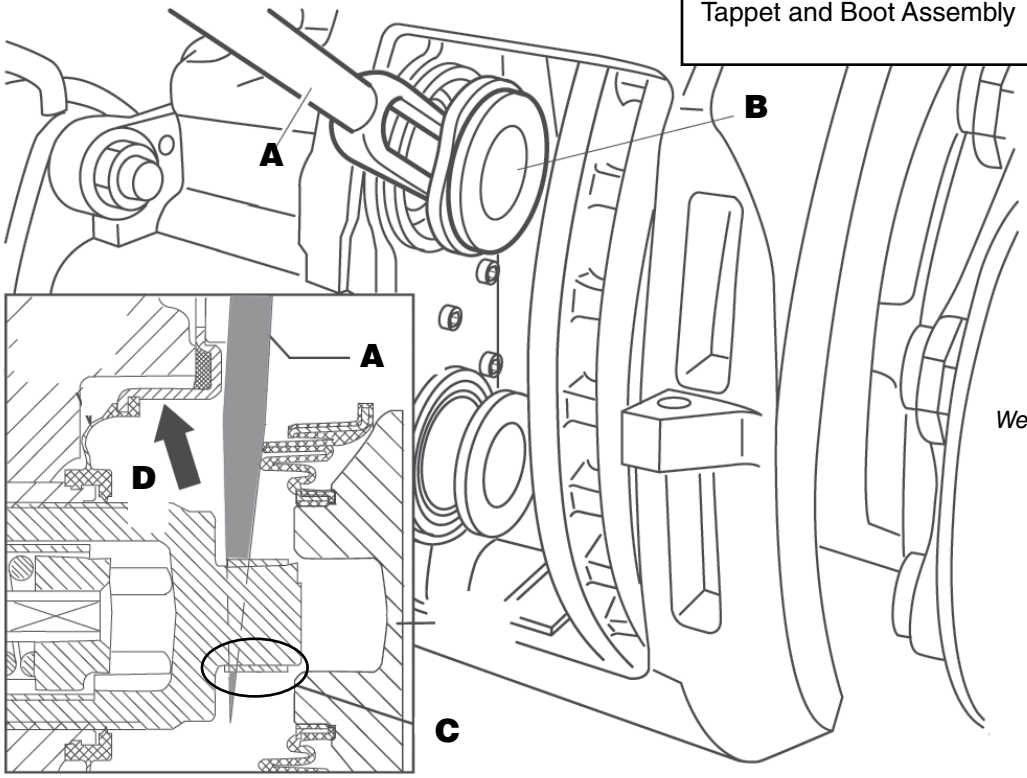
Press-in tool arrangement for tappet and boot assembly when caliper is removed from the vehicle.

Ring T24 for SK7™ and 225™ and 22X™ air disc brakes. Installation device for tappet and boot assembly when caliper is removed from axle.

Press-in Tool (Z004190) for
Tappet and Boot Assembly T1, T2, T3, T4

Wedge Fork (II32202) for
removal of Tappet and Boot Assembly. T15

Ring (K004082) for
Tappet and Boot Assembly T24



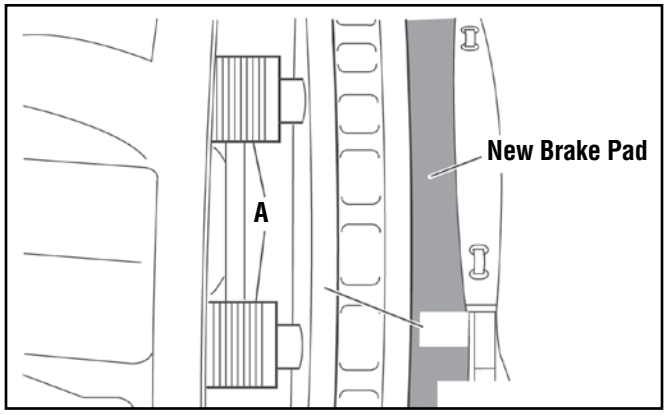
Wedge Fork Use

Inspect the Threaded Tubes

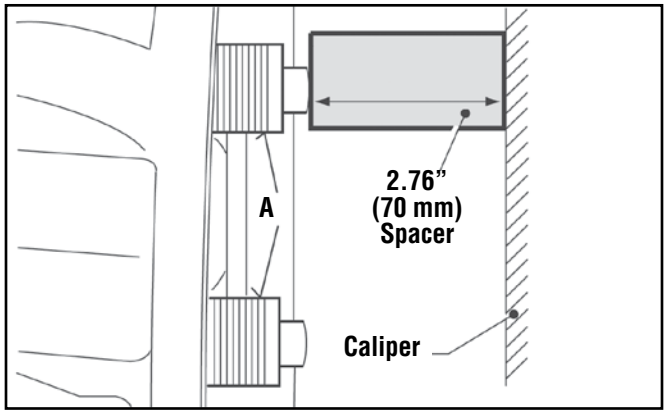
CAUTION: Never turn the adjuster without the shear adapter installed. The shear adapter is a safety feature and is designed to prevent an excess of torque being applied to the adjuster. The shear adapter will fail (by breaking loose) if too much torque is applied.

CAUTION: NEVER EXTEND THE TAPPET MORE THAN 1.18-inch (30 mm). Over-extending the tappet will result in the tappet losing engagement with the threads of the synchronizing mechanism. Since the mechanism can only be set at the manufacturing plant THE CALIPER/CARRIER ASSEMBLY MUST BE REPLACED if this happens.

For the inspection of the threads, the tubes must be extended, but by less than 1.18-inch (30 mm), by turning the shear adapter clockwise (A). If working with the caliper on the vehicle, the technician may place a new brake pad into the outboard gap to help avoid the loss of thread engagement of the threaded tubes. If the work is being carried out at a workbench, the technician may insert a 2.76-inch (70 mm) spacer into the caliper to help avoid the loss of thread engagement.



Use of a New Brake Pad as a Spacer

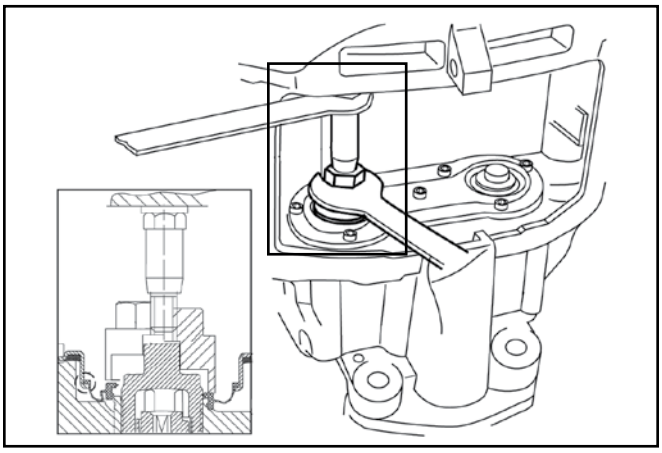


Use of a Spacer (off vehicle use)

1. Check the threads for rust, corrosion, or damage etc. If there is evidence of damage to the threads, rust or corrosion, the caliper/carrier assembly must be replaced.
2. If the threads are in good condition, fully wind back the threaded tubes by turning the shear adapter counter-clockwise.

Installing the Tappet and Boot Assemblies

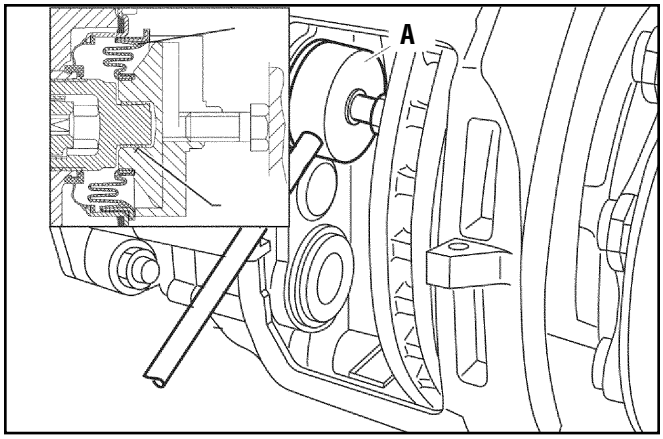
1. Grease threads with white grease (Part No. II14525 or II32868).
2. Screw back the threaded tubes, by turning the shear adapter counter-clockwise (see Cautions earlier in these instructions).
3. The sealing seat in the caliper for tappet and boot assemblies must be clean and free of grease.



Inner Seal Installation

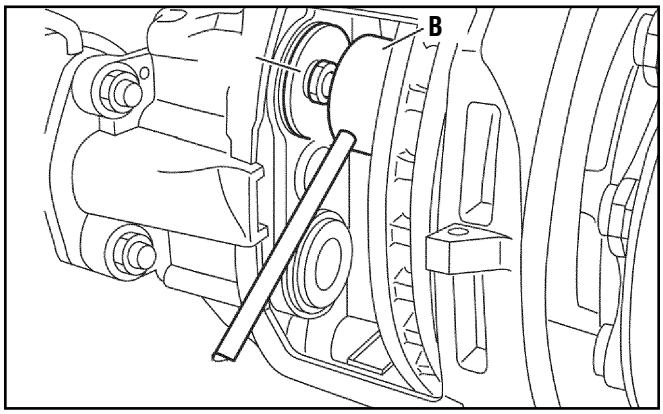
4. Fit a new tappet bushing onto the center post of each threaded tube.

5. Technicians working with the caliper installed on vehicle:
   a. Install the boots using the press-in tool (A) with the short press-in extension (T3) for positioning and pressing into place.
   b. Position a tappet assembly onto each tappet bushing. Using press-in tool (A) in a reversed orientation with the press-in extension (T3) towards the threaded tube, install each tappet onto its tappet bushing.
6. Technicians working with the caliper not installed on vehicle:
   a. Install the boots using the press-in tool (B) with the long press-in extension (T3 + T4) for positioning and pressing into place.



On Vehicle Boot Installation

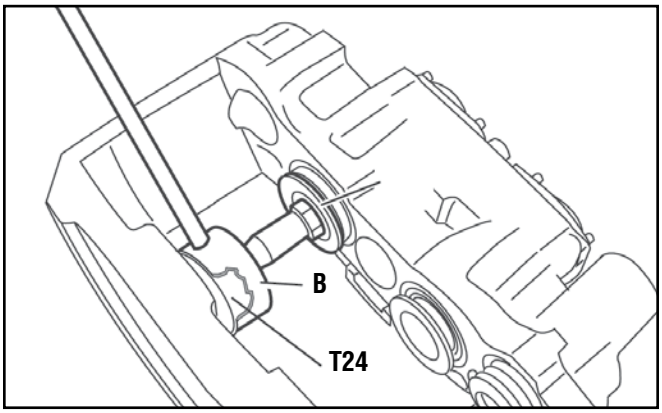
   b. Position a tappet onto each tappet bushing. Using press-in tool (B) in a reversed orientation with the press-in extension (T3 + T4) towards the threaded tube, install each tappet onto its tappet bushing.



On Vehicle Tappet Installation

7. After assembly, check that the tappet is free to turn in both directions.

NOTE: When installing the tappet for Bendix® ADB 22X™, ADB 225™, and SK7™ disc brakes, use the supplemental ring (T24), inserted into the tool (T2) to assist the installation, since the caliper's back plate is too thin using only Tool (B) to achieve the correct position.



Off Vehicle – Use of Extra Tool for Some Styles

Caliper/Carrier Assembly Replacement

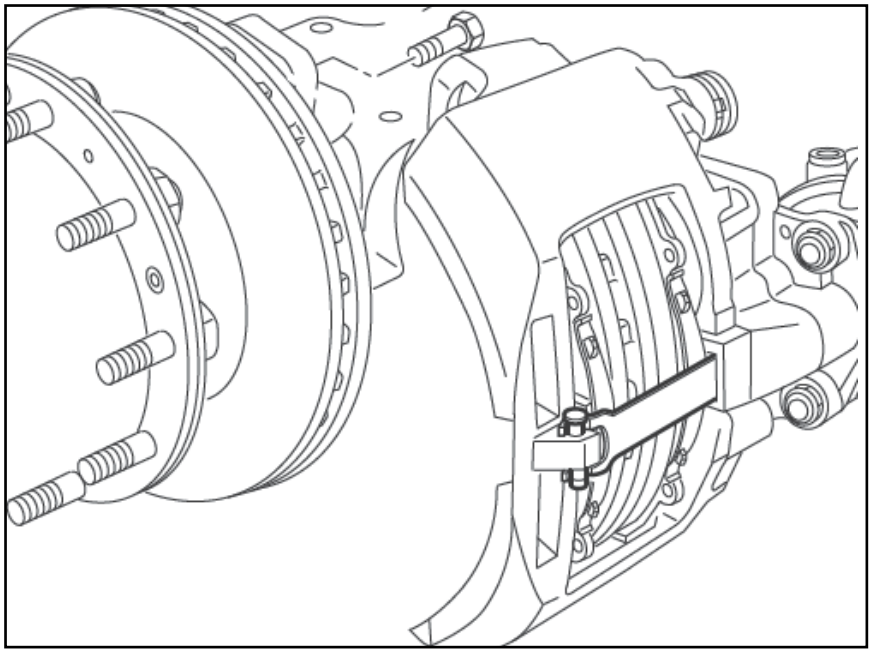
CAUTIONS:

- Follow all standard safety procedures including, but not limited to, those on page 3 of this workbook. See the vehicle manufacturer's recommendations. When working on foundation brakes, be sure that the vehicle is on level ground, that the vehicle is parked by other means than the foundation brakes and that the wheels are chocked.
- Do not attempt to use the pad retainer to attach any lifting device to the brake. The pad retainer is not suitable for this purpose, and damage to the brake and/or unsafe conditions may result.
- When installing pads, where appropriate use heavy duty gloves and always keep fingers away from potential pinch hazard areas.

NOTES:

- The correct choice of caliper/carrier must be ensured by using the air disc brake part number on the identification label when ordering replacement parts (page 4).
- Replacement caliper/carrier assemblies may be delivered with a plastic cap, adhesive tape, or a breakthrough diaphragm in the area of the actuator attachment. Remove the cap or tape only after installing the replacement caliper on the vehicle. If the replacement caliper has the breakthrough diaphragm, it should be left in place.
- If the replacement caliper/carrier assembly is equipped with a potentiometer for wear indication, then the connection must be made using the appropriate mating plug – refer to the vehicle manufacturer's recommendations.

1. Securely support the caliper/carrier assembly.
2. Remove and discard the six bolts attaching the carrier to the axle.
3. Clean and inspect the axle contact area. See the axle or vehicle manual for instructions if damage is found.
4. With the replacement carrier/caliper assembly held in position, install with new bolts. (Replacement bolts are not supplied by Bendix®. Use only those of a grade and type specified by the vehicle manufacturer. Consult the vehicle manual for required torques.)



Caliper/Carrier Assembly Replacement

Brake Actuator and Spring Brake Replacement

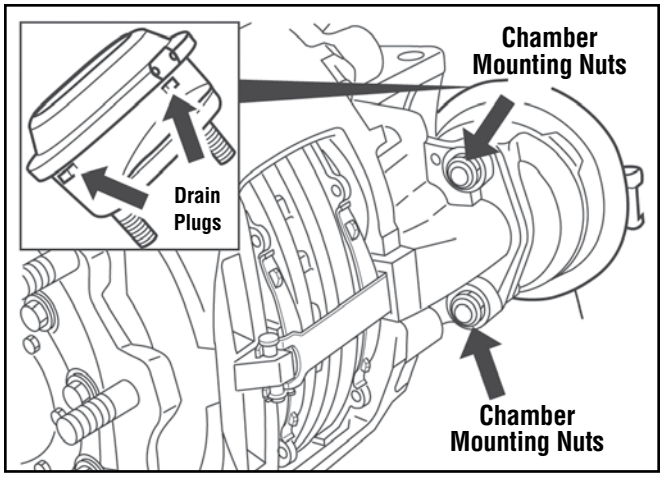
CAUTIONS:

- Replace actuator and spring brakes only with the same as originally installed on the vehicle. Replacement with alternate equipment (without written authorization from Bendix® and the vehicle manufacturer) could compromise brake performance.
- Follow all standard safety procedures including, but not limited to, those on page 3 of this workbook. See the vehicle manufacturer's recommendations. When working on foundation brakes, be sure that the vehicle is on level ground, that the vehicle is parked by other means than the foundation brakes and that the wheels are chocked.

Brake Chamber Removal

With all air pressure drained from the air brake system, disconnect the air hose from the brake chamber.

Remove and discard brake chamber mounting nuts.

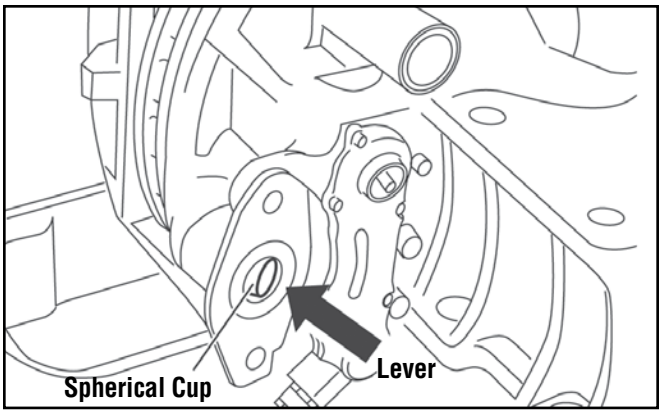


Actuator Installation

Brake Chamber Installation

NOTE: New brake chambers (18/2) have drain plugs installed. After installation, remove whichever plug is at the lowest position. Be sure that all other drain holes remain plugged. The drain hole must be aligned downwards (or within ±30°) when installed on the vehicle.

1. Before installing the new brake chamber, the actuator flange must be cleaned and inspected. Consult the vehicle manual.
2. The spherical cup in the lever must be greased with white grease (Part No. II14525 or II32868).



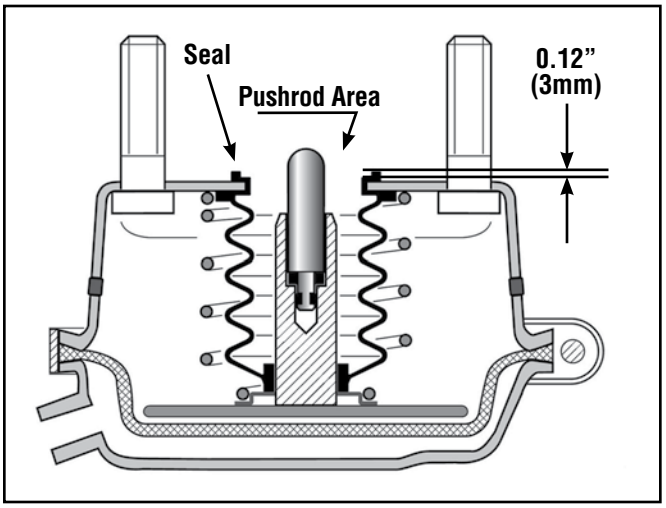
Actuator Flange

CAUTION: Do not use grease containing molybdenum disulfate.

3. The seal, as well as the pushrod area, must be clean and dry.

CAUTION: Do not use brake chambers with seals with a thickness less than 0.12 in. (3 mm). Use only actuators which are recommended by the vehicle manufacturer.

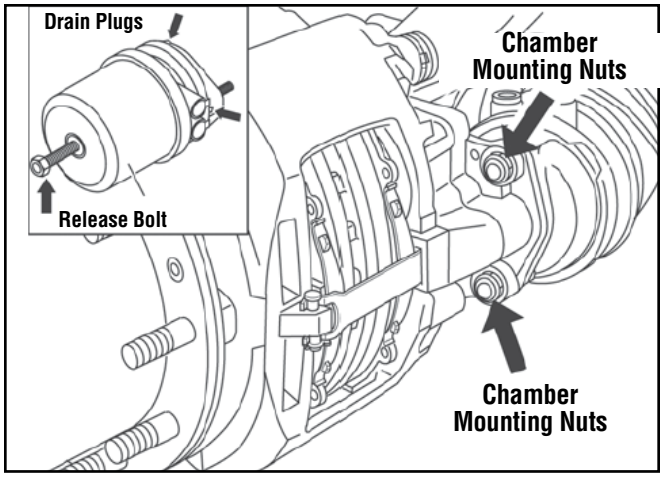
4. Install the brake chamber using new self-locking nuts (EN ISO 10513).
5. Tighten alternately both the nuts step by step up to a final torque of 133 ± 7 ft. lbs (180 ± 10 Nm).



Cap Installation

6. Re-connect the air hose and be sure that the hose is not twisted or in contact with moving vehicle components. The air hose routing must allow for full caliper travel.
7. Test for leakage.
8. Check the brake operation and effectiveness before returning vehicle to service.

Spring Brake Removal



Spring Brake Installation

CAUTION: Follow all standard safety procedures. Be familiar with the spring brake manufacturer's recommended safety practices.

1. With all air pressure drained from the air brake system, disconnect the air hose from the brake chamber.
2. Back out the release bolt using a maximum torque of 26 ft. lbs. (35 Nm) to release spring force on the pushrod. Refer to the spring brake and vehicle manufacturer's recommendations – in some cases it may be permissible to cage the spring brake while the spring brake is engaged.
3. While supporting the spring brake in position, remove and discard brake chamber mounting nuts.
4. Remove the spring brake.

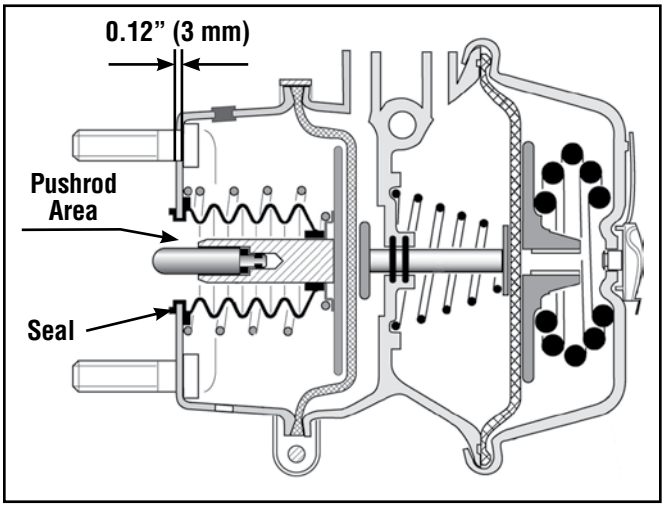
Spring Brake Chamber Installation

NOTE: New spring brake chambers (18/1) have drain plugs installed (see page 22 Actuator Flange). After installation, remove whichever plug is at the lowest position. Be sure that all other drain holes remain plugged. The drain hole must be aligned downwards (or within ±30°) when installed on the vehicle.

1. Before installing the new brake chamber, the actuator flange must be cleaned, and inspected. Consult the vehicle manual.
2. The spherical cup in the lever must be greased with white grease (Part No. II14525 or II32868).

CAUTION: Do not use grease containing molybdenum disulfate.

3. The seal, as well as the pushrod area, must be clean and dry.



Cap Installation

CAUTION: Do not use brake chambers with seals with a thickness less than 0.12 in. (3 mm). Use only actuators which are recommended by the vehicle manufacturer.

4. Install the brake chamber using new self-locking nuts (EN ISO 10513).
5. Tighten alternately both the nuts step by step up to a final torque of 133 ± 7 ft. lbs (180 ± 10 Nm).
6. Re-connect the air hose and be sure that the hose is not twisted or in contact with moving vehicle components. The air hose routing must allow for full caliper travel.
7. Test for leakage.
8. Check the brake operation and effectiveness before returning vehicle to service.

Troubleshooting Flowchart