

Bendix® ADB 22X™, ADB 225™, SN6™, SN7™, SK7™ Air Disc Brakes

DESCRIPTION

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

Bendix Air Disc Brakes convert air pressure into braking force. (See Figure 2.) When the vehicle brakes are applied, air enters the service brake chamber through the supply port, applying pressure within the diaphragm. The pressure expands the diaphragm, applying force to, and moving the pressure plate and pushrod forward. The pushrod acts against a cup in the internal lever which pivots on an eccentric bearing moving the bridge. Moving against a return spring, the bridge transfers the motion to two threaded tubes and tappets, which move the inner brake pad. 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. 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. The clamping action of the brake pads on the rotor applies braking force to the wheel.

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 in. (0.6 and 1.1 mm).



FIGURE 1 - BENDIX® ADB 22X™ AIR DISC BRAKE

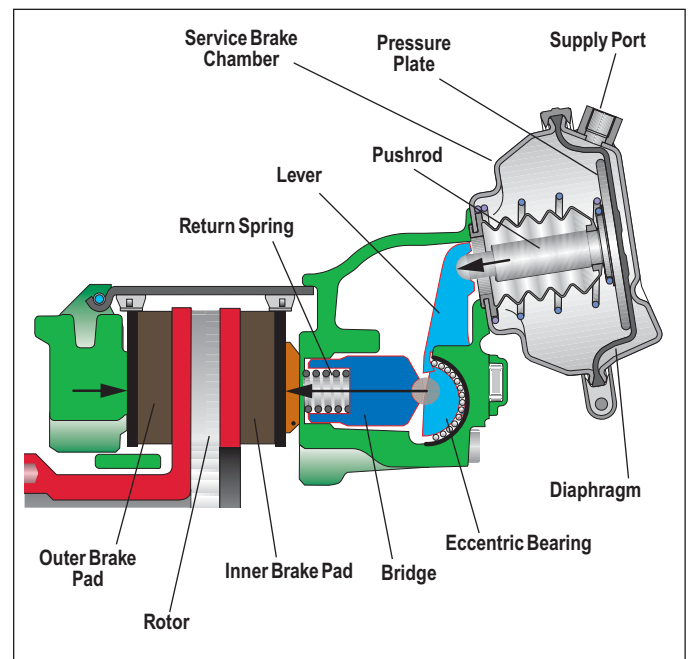


FIGURE 2 - CROSS-SECTION VIEW SHOWING BRAKE OPERATION

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/procedures.
2. Stop the engine and remove 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 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, tubing, hose, fittings, etc. 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 Automatic 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: Not all wheels and valve stems are compatible with Bendix Air Disc Brakes. Use only wheels and valve stems approved by the vehicle manufacturer to avoid the risk of valve stem shear and other compatibility issues.

BRAKE DUST 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-containing brake linings or disc pads, the long-term effects of certain non-asbestos fibers have not been determined. Current OSHA Regulations cover exposure levels to some, but not all, components of non-asbestos linings and pads. The following precautions should be used when handling these materials:

- Avoid creating dust. Compressed air or dry brushing must never be used to clean brake assemblies or the work area.
- Brake workers must take steps to minimize their exposure to airborne brake lining particles. Procedures to reduce exposure include: working in a well-ventilated area, segregating areas where brake work is performed, using local filtered ventilation systems or enclosed cells with filtered vacuums for all brake work. 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, shower after working, and 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 Bendix[®] air disc brake pads, as required by OSHA, are available from Bendix Spicer Foundation Brake LLC.

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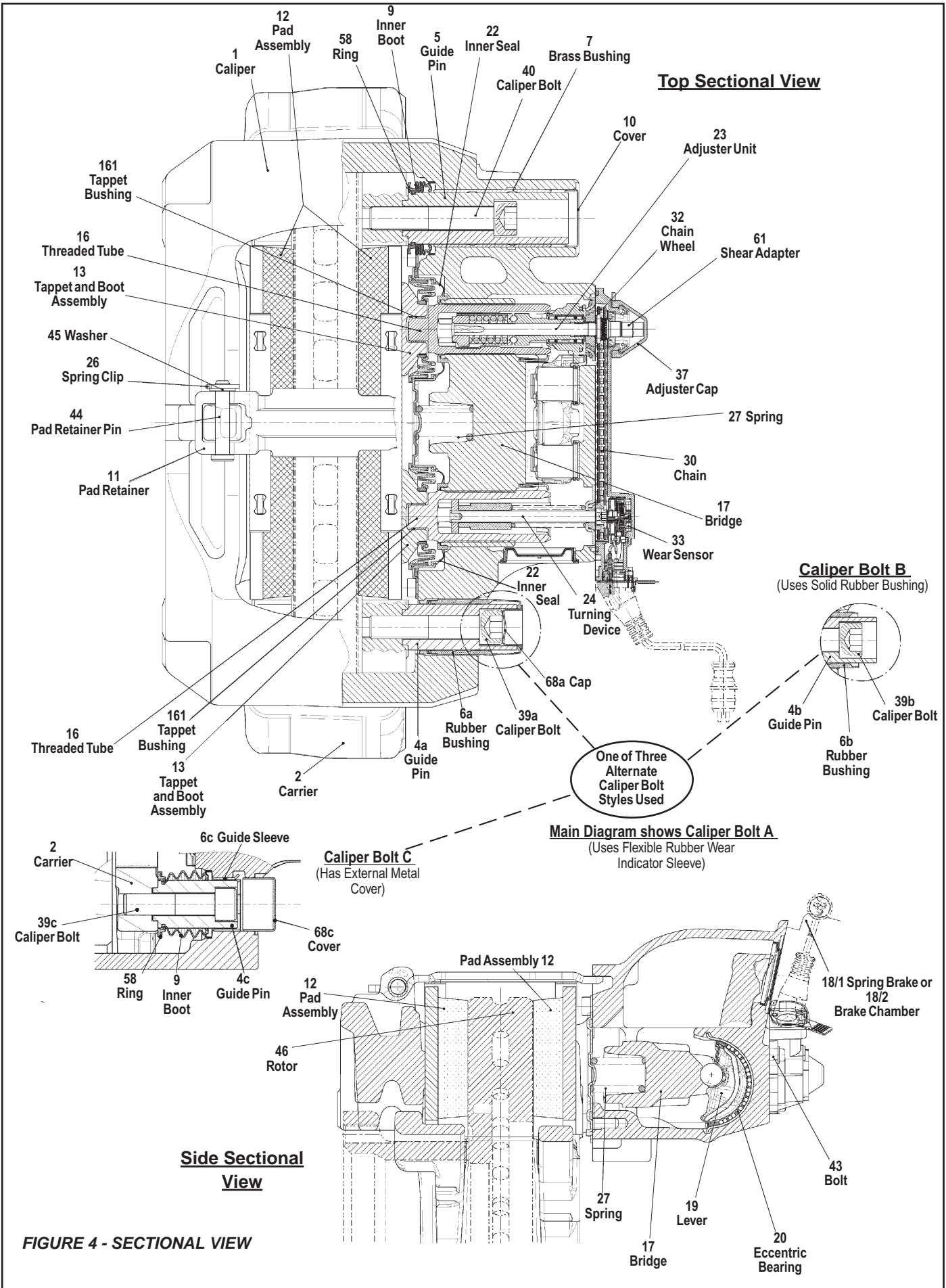


FIGURE 4 - SECTIONAL VIEW

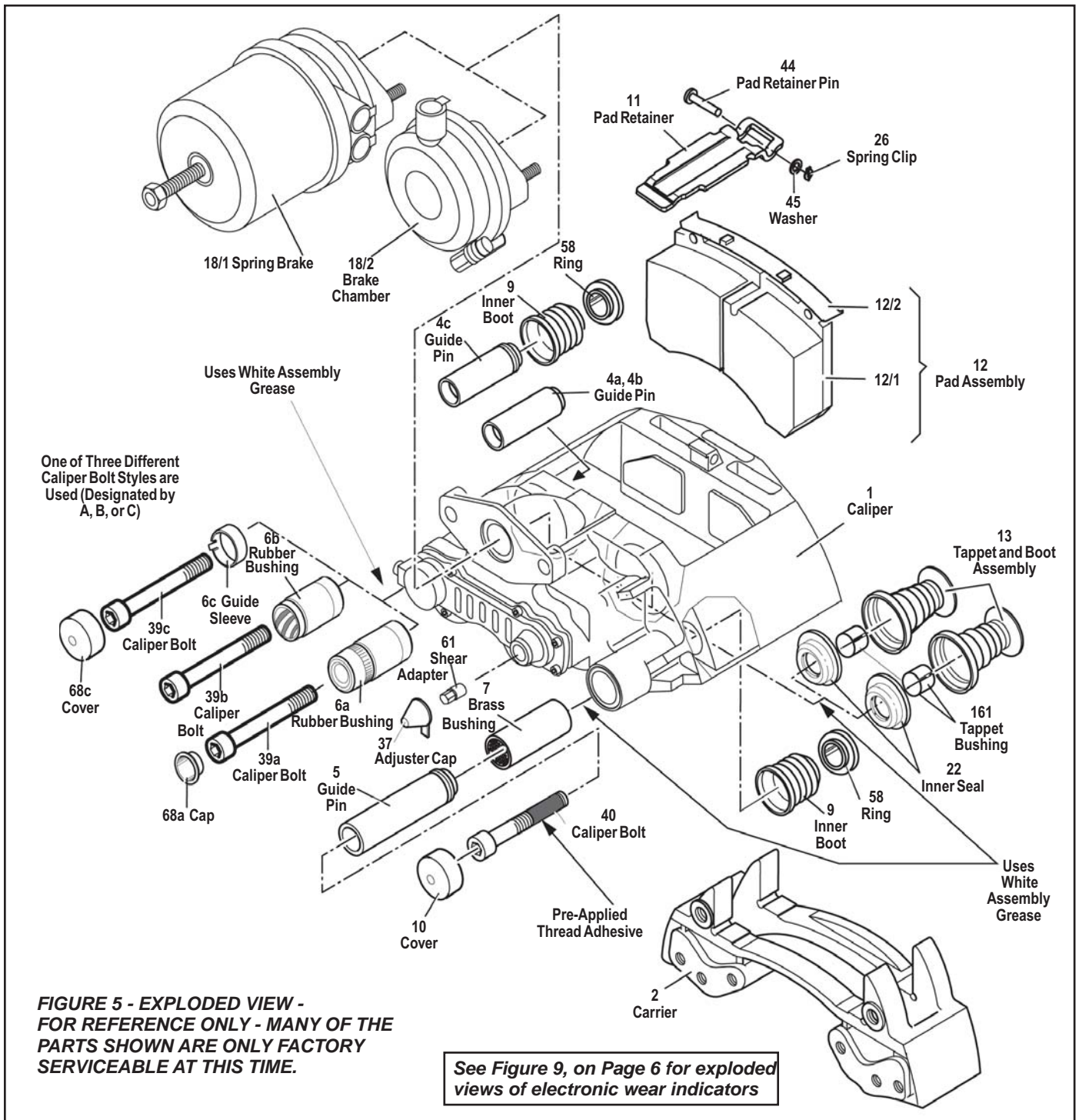


FIGURE 5 - EXPLODED VIEW - FOR REFERENCE ONLY - MANY OF THE PARTS SHOWN ARE ONLY FACTORY SERVICEABLE AT THIS TIME.

See Figure 9, on Page 6 for exploded views of electronic wear indicators

KEY

Adjuster Cap..... 37	Chain 30	Pad Retainer Pin 44
Adjuster Unit..... 23	Chain Wheel..... 32	Ring 58
Bolt 43	Cover 10	Rubber Bushings 6a, 6b, 6c
Brake Chamber 18/2	Eccentric Bearing 20	Shear Adapter..... 61
Brass Bushing 7	Guide Pins 4a, 4b, 4c, 5	Spring 27
Bridge 17	Guide Sleeve 6c	Spring Brake..... 18/1
Caliper 1	Inner Boot..... 9	Spring Clip 26
Caliper Bolt..... 39a, 39b, 39c, 40	Inner Seal..... 22	Tappet and Boot Assembly..... 13
Carrier..... 2	Lever..... 19	Tappet Bushing..... 161
	Pad..... 12/1	Threaded Tube..... 16
	Pad Holder Spring 12/2	Turning Device..... 24
	Pad Assembly..... 12	Washer 45
	Pad Retainer..... 11	Wear Sensor..... 33

Caliper Bolt A
Caliper Bolt..... 39a
Cap..... 68a
Guide Pin 4a
Rubber Bushing 6a

Caliper Bolt B
Caliper Bolt..... 39b
Guide Pin 4b
Rubber Bushing 6b

Caliper Bolt C
Caliper Bolt..... 39c
Guide Pin 4c
Cover 68c

AIR DISC BRAKE IDENTIFICATION

To determine which version of the Bendix air disc brake is installed, locate the identification label near the guide pin housing. See below for examples of the different styles of label you may find.

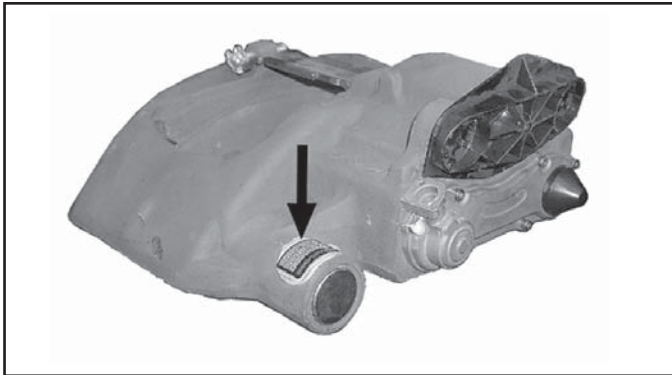


FIGURE 6 - PART NUMBER LABEL LOCATION

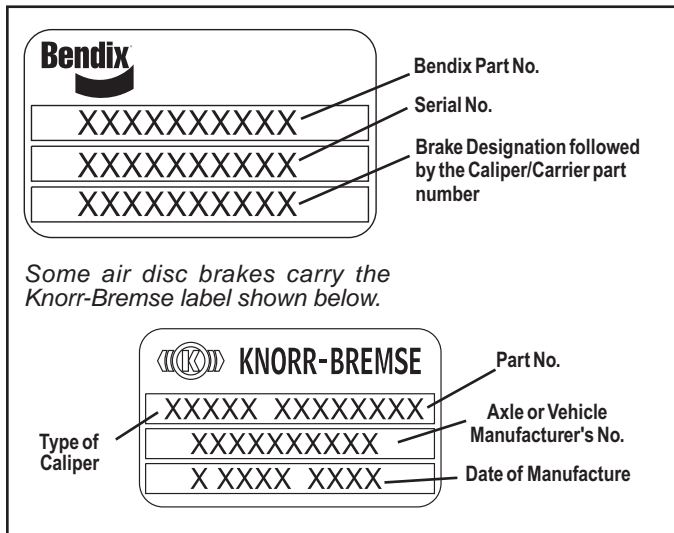


FIGURE 7 - PART NUMBER LABEL FIELDS

ROTOR IDENTIFICATION

Certain maintenance inspection procedures depend on the type of rotor installed (See Page 13). See below for examples of the different styles of rotor in use.

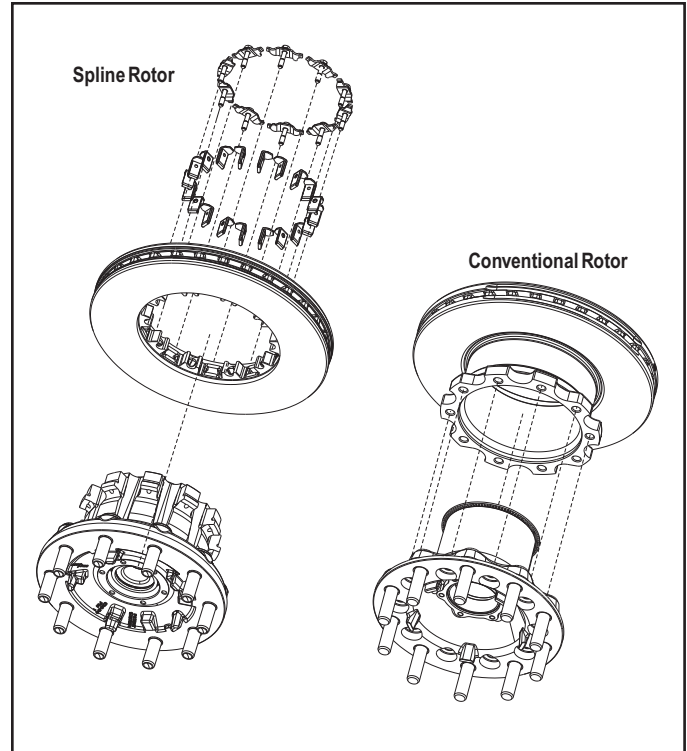


FIGURE 8 - ROTOR IDENTIFICATION

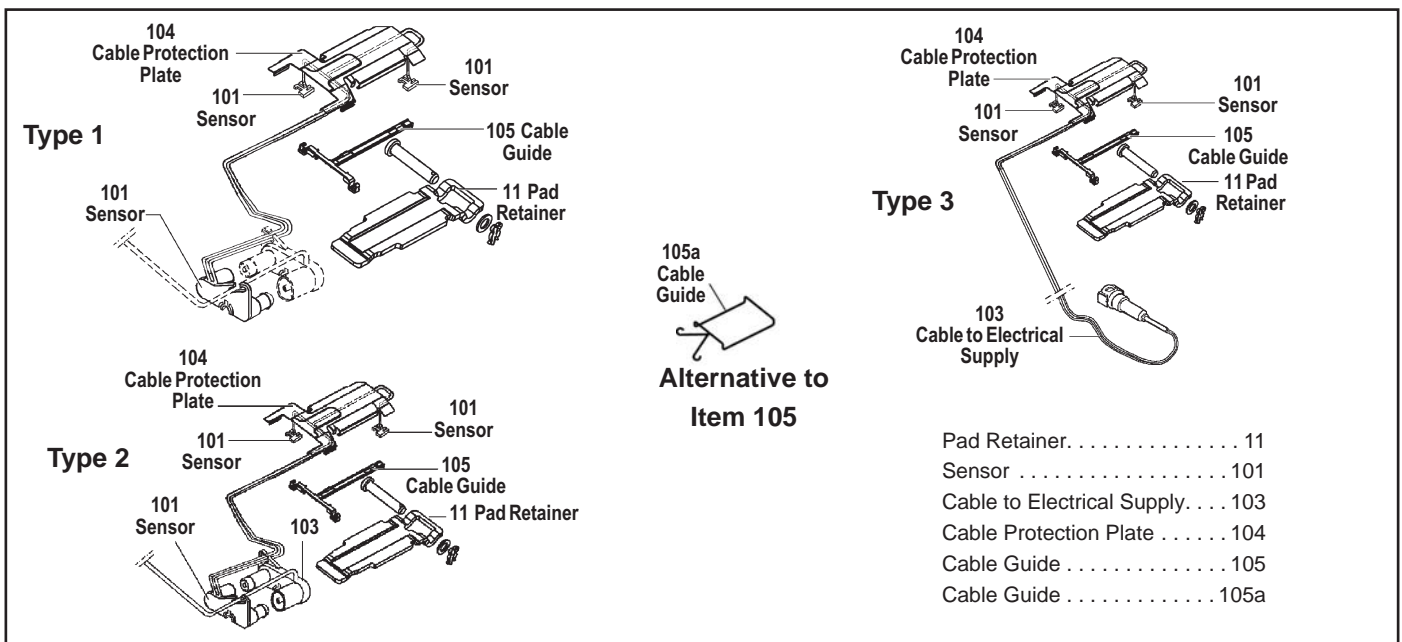



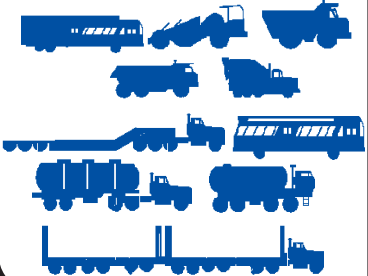
FIGURE 9 - ELECTRONIC WEAR INDICATOR COMPONENTS

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 (including e.g. daily pre-trip inspections, etc.) 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 your maintenance inspections to assist you determine the ideal maintenance interval for the vehicle.

Vehicle Used for:	Basic Inspection Program	
	Pad & Rotor Wear, Running Clearance <i>(Inspection with the wheel mounted)</i>	At Least Once Annually and at Every Pad Replacement <i>(Inspection with wheel removed)</i>
<p>Over the Road</p> <p>e.g. Line haul, RV, Open Highway Coach.</p> 	<ul style="list-style-type: none"> 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 (see Pages 8-9) 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 of the mechanical wear indicator every time the tire pressures are checked is recommended. Be alert for any rotor cracks, etc. visible (See Page 13 for criteria.) 	<p>Inspect:</p> <ul style="list-style-type: none"> The rotor for cracks, etc. (see Page 13 for criteria) The running clearance and adjuster function (see Page 15) The caliper travel (see Pages 16-17) The tappet and boot assemblies (see Page 14) All covers, caps, hoses, and brake exterior for damage etc.
<p>Higher Duty Use</p> <p>e.g. Pick-Up & Delivery, Off-Highway, Construction, Loggers, Concrete Mixer, Dump Truck, City Transit Bus, Refuse, Urban Region Coach, School Bus.</p> 	<ul style="list-style-type: none"> 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 (see Pages 8-9) 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 of the mechanical wear indicator every time the tire pressures are checked is recommended. Be alert for any rotor cracks, etc. visible (See Page 13 for criteria.) 	

Air Disc Brake Running Clearance Inspection.

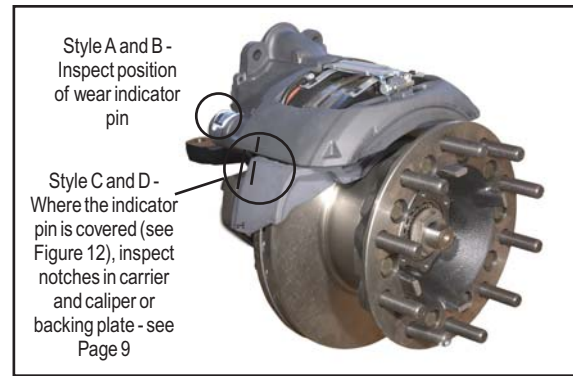
Follow all industry safety guidelines, including those listed on Page 2. On level ground, with the wheels chocked and the parking brake temporarily released, check for movement of the brake caliper. This small movement, less than 0.80" (2 mm) - approximately the thickness of a nickel - in the inboard/outboard direction indicates that the brake is moving properly on its guide pins. If the caliper has no movement or appears to move greater than the distances above, a full wheel-removed inspection will be necessary. See Page 16.

MECHANICAL BRAKE PAD AND ROTOR WEAR INDICATORS

A preliminary visual check of the condition of the brake pad/rotor wear can be made without removing the wheels. See below for the inspection to make for each of the three guide pin styles in use for Bendix air disc brakes.

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. See Figure 10. 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. Note: This is only an indication that the pads and rotor are ready for inspection, and does not necessarily mean that maintenance is required.

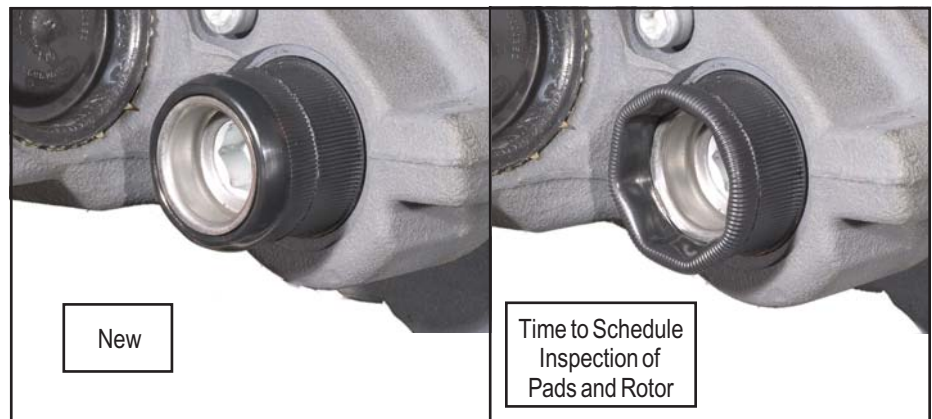


FIGURE 10 - ROLLING BOOT-STYLE WEAR INDICATOR INSPECTION

Style B: Solid Rubber Bushing Style Wear Indicator

Inspect the position of the guide pin compared to the solid rubber bushing. See Figure 11. 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.

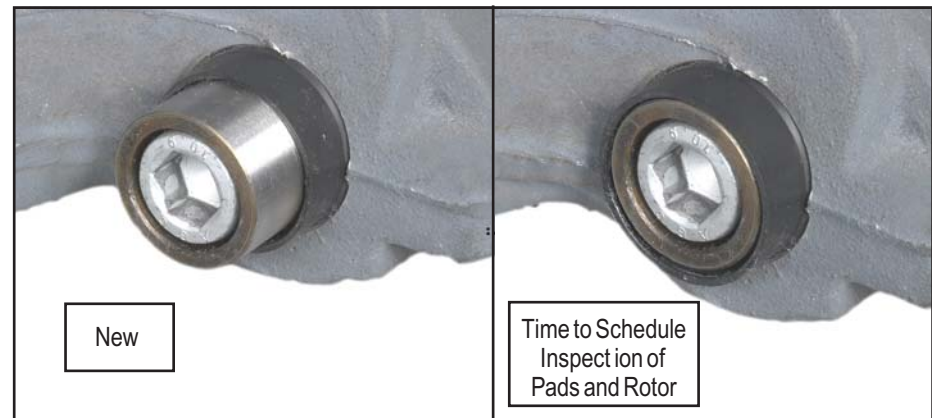


FIGURE 11 - SOLID RUBBER BUSHING-STYLE WEAR INDICATOR INSPECTION



Where the Guide Pin is enclosed by a cover - see next page for inspection criteria.

FIGURE 12 - PIN COVER

MECHANICAL BRAKE PAD AND ROTOR WEAR INDICATORS (continued)

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

Compare the relative position of two notches cast into the Carrier and Caliper. See Figure 13. When the two notches align, 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.

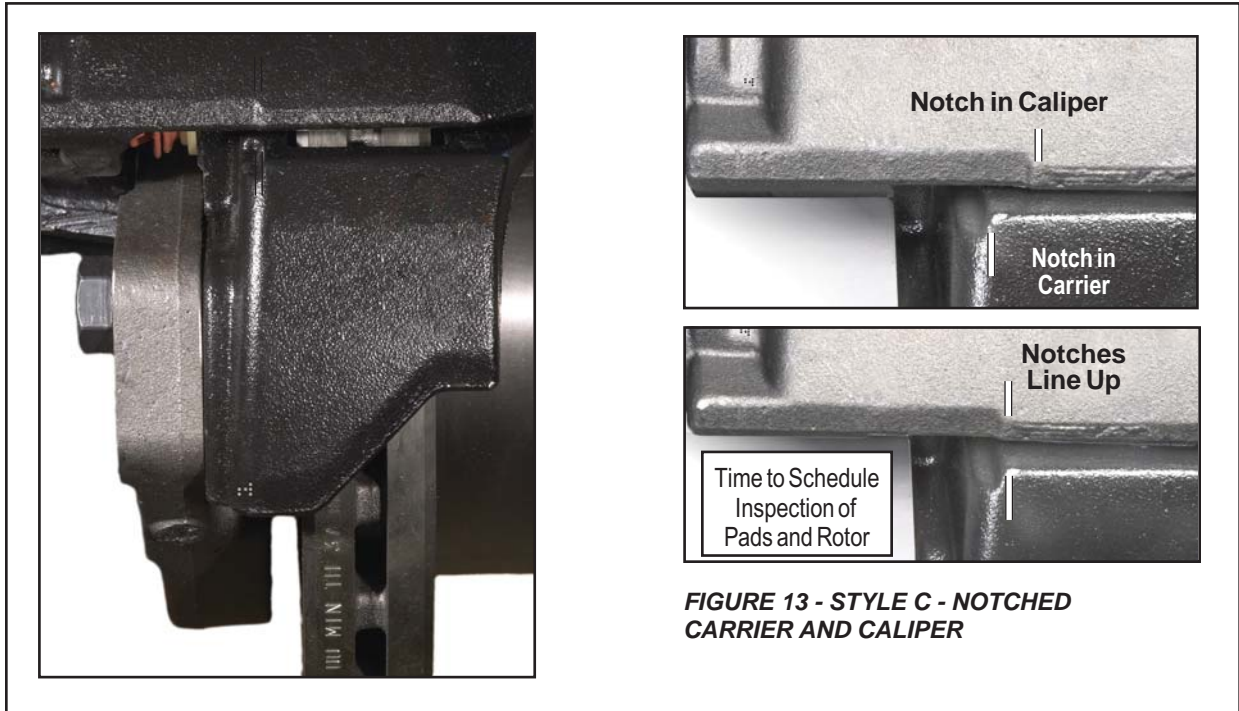
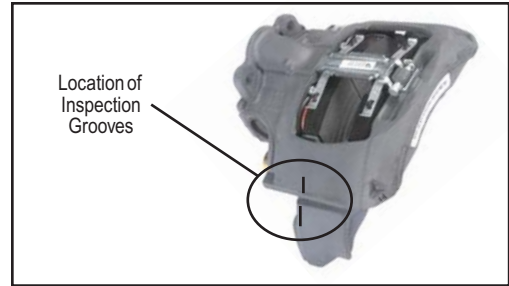
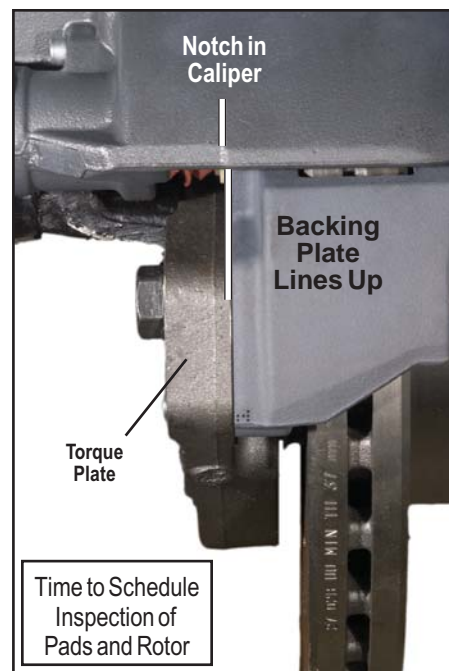


FIGURE 13 - STYLE C - NOTCHED CARRIER AND CALIPER

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

FIGURE 14 - CARRIER WEAR INDICATOR NOTCH AND BACKING PLATE ALIGNMENT



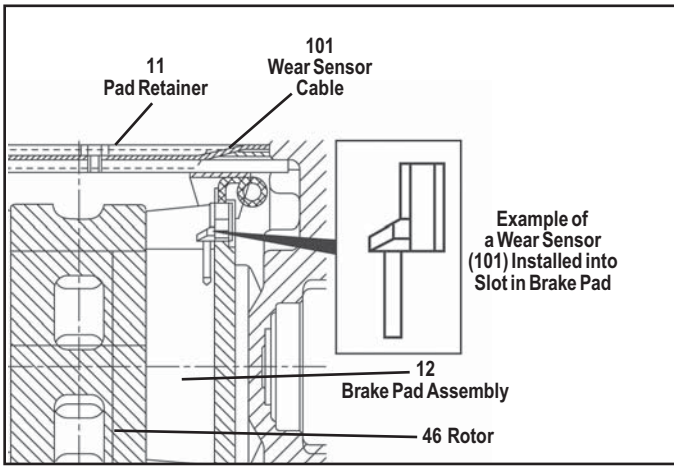


FIGURE 15 - EXAMPLE OF NORMALLY OPEN OR CLOSED WEAR SENSOR

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 point is reached when the indicator itself is worn through, the circuit flowing through it is broken and the vehicle operator is alerted.

For **in-pad Normally-Open Indicators**, when the point is reached when the indicator itself is worn through, the circuit is completed by the rotor touching the contacts and the vehicle operator is again alerted.

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 page 7.

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

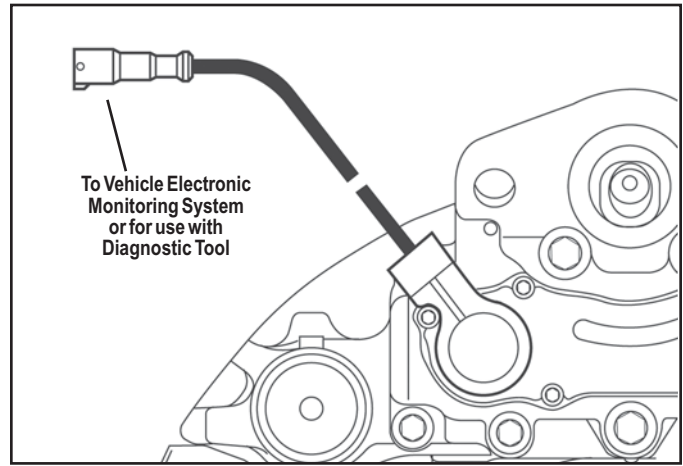


FIGURE 16 - EXAMPLE OF POTENTIOMETER WEAR SENSOR

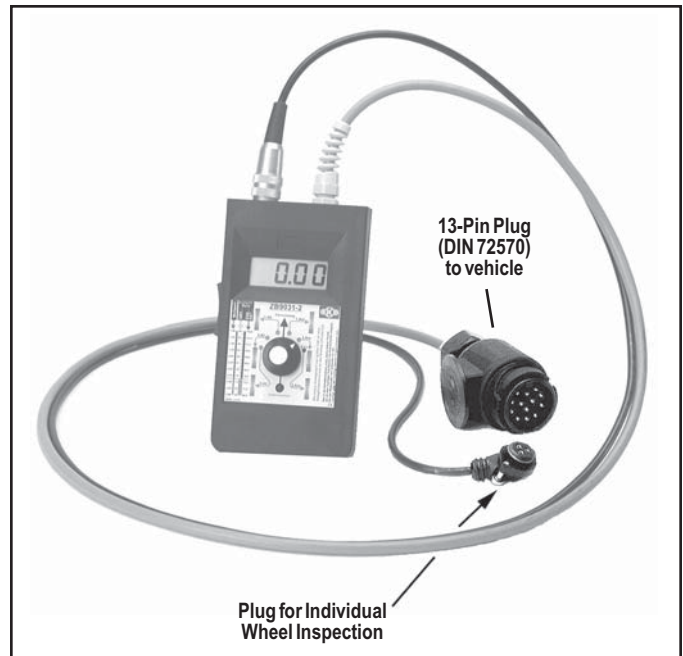


FIGURE 17 - HAND HELD DIAGNOSTIC TOOL

GENERAL TROUBLESHOOTING PROCEDURE FLOWCHART

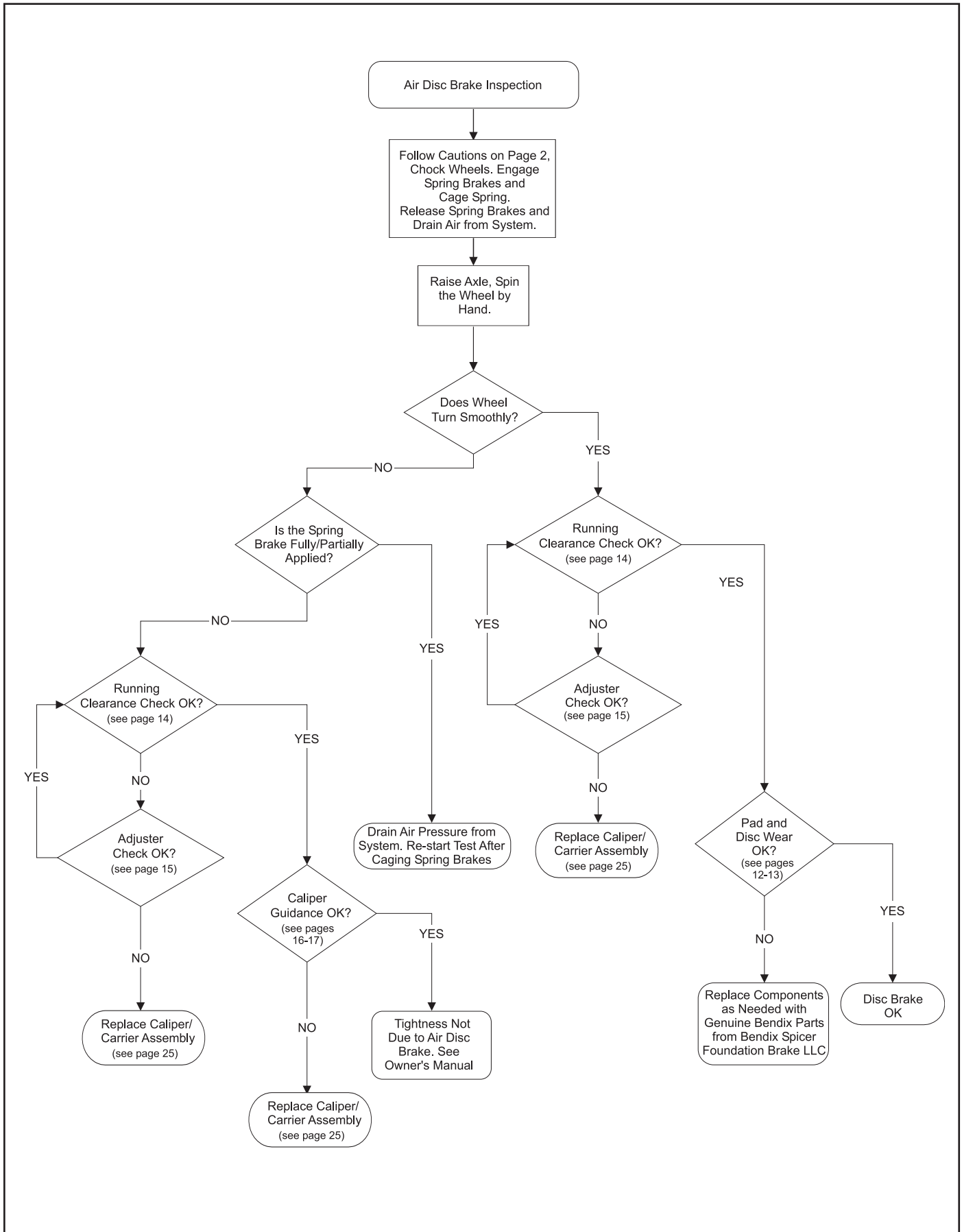


FIGURE 18 - TROUBLESHOOTING BENDIX AIR DISC BRAKES

INSPECTIONS

Follow all standard safety procedures including, but not limited to, those on page 2 of this service manual.

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 rotor cracking, etc. Note that two thicknesses of backing plate are generally available, so to maintain the vehicle within spec's 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.

See Figure 16. If the thickness of the friction material (M2) is less than 0.079 in. (2 mm) the pads must be replaced.

Bendix® ADB 22X™, ADB 225™, SN6™, SN7™ (and some SK7™) air disc brakes use 0.35 in. (9 mm) backing plates, so P2 (the combined pad and backing plate thickness) must be a minimum of 0.43 in. (11 mm).

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

If the pad thickness is within the acceptable range, inspect the pad surface. Minor damage at the edges is permitted (see Figure 20), but replace the pads if major damage on the surface of the pad is found (see Figure 21).

When replacing brake pads, Bendix strongly recommends that all the brake pads on an axle be replaced at one time. See pages 18-19 for the pad replacement procedure. Also see the vehicle manual recommendations.

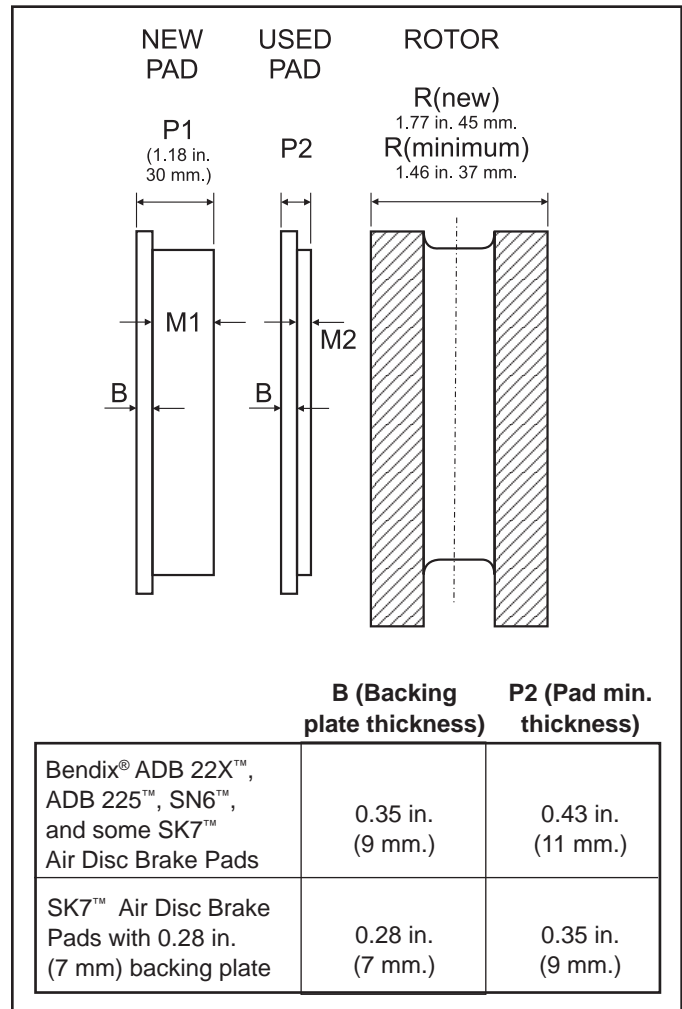


FIGURE 19 - PAD AND ROTOR DIMENSIONS

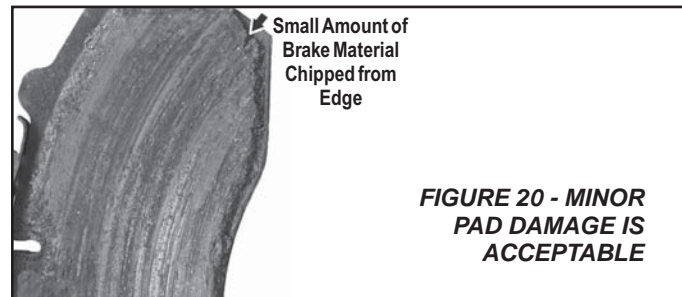


FIGURE 20 - MINOR PAD DAMAGE IS ACCEPTABLE

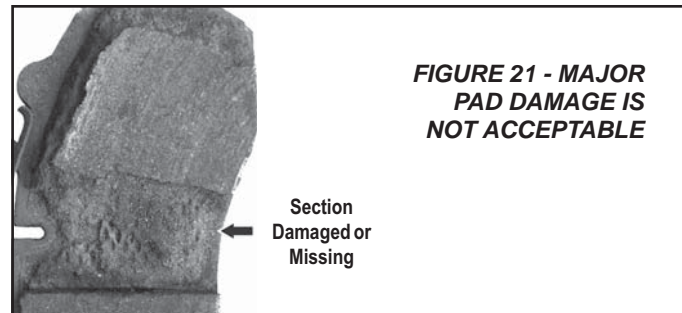


FIGURE 21 - MAJOR PAD DAMAGE IS NOT ACCEPTABLE

INSPECT ROTORS

Identify if the rotor is a conventional or a splined assembly (see Page 6).

Examine the rotor and measure the thickness at 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 in. (37 mm) is reached or as instructed by vehicle manufacturer. When replacing Rotors, please refer to the instructions of the Vehicle Manufacturer. It is recommended to install Bendix Brake Rotors, available from your local Bendix Spicer Foundation Brake parts outlet, and it is also recommended that the pads should be replaced at the same time.

Non-Bendix rotors. 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 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, see Figure 22.

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 in. (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.

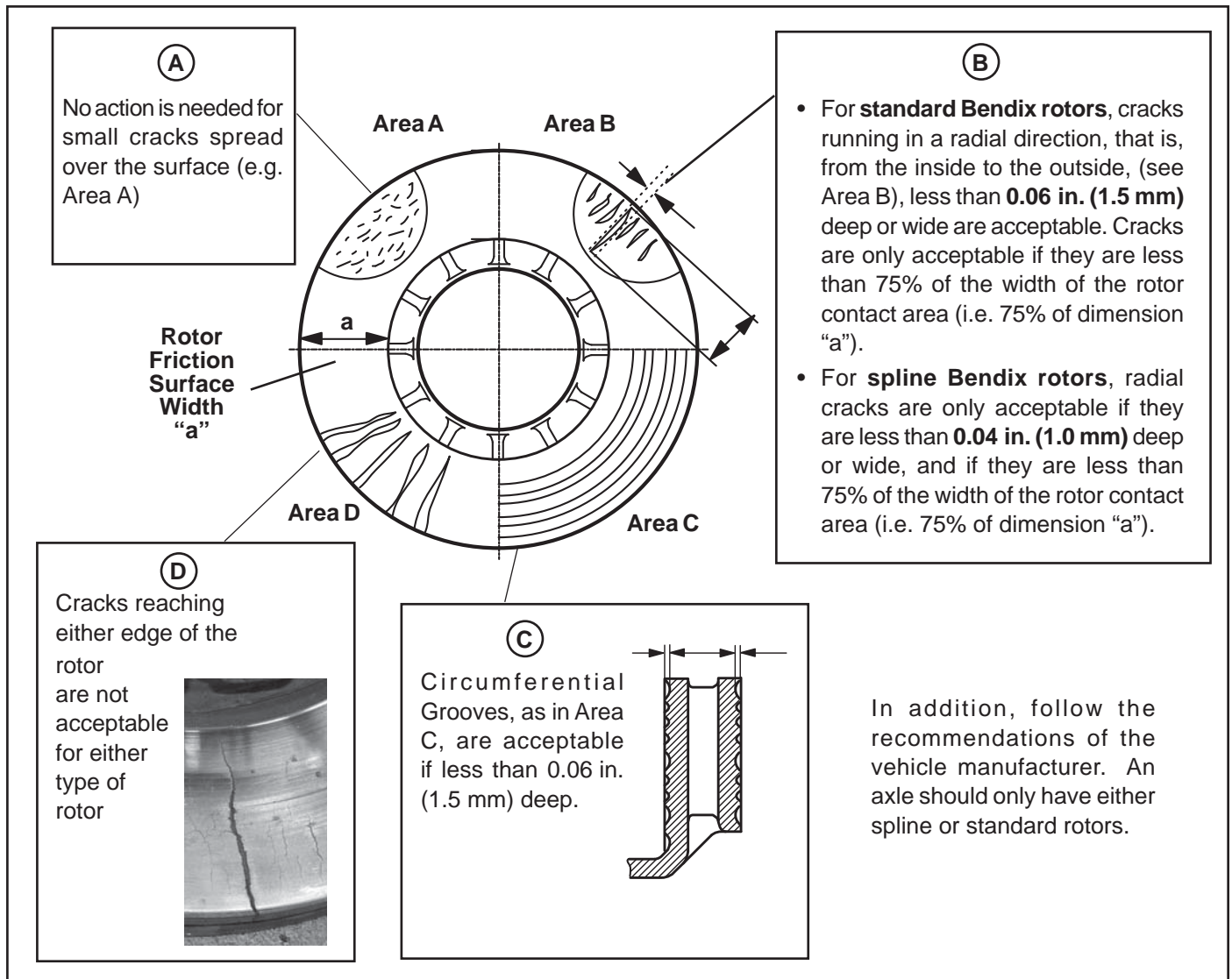


FIGURE 22 - EXAMPLES OF ACCEPTABLE AND NON-ACCEPTABLE ROTOR CRACKS AND GROOVES

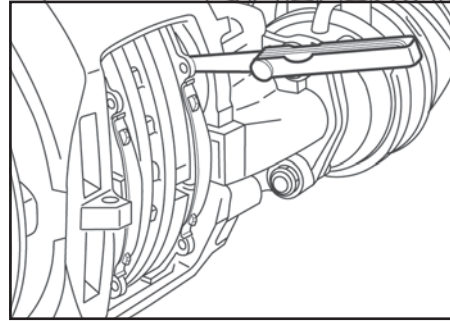
2. CALIPER RUNNING CLEARANCE

CAUTION: Follow all standard safety procedures including, but not limited to, those on page 2 of this service manual. 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

Remove the wheel. With the spring brakes caged, push the caliper assembly inboard on its guide pins. Using a suitable tool, press the inboard pad (12) away from the tappets and check the gap between the tappet and the inboard pad backplate - it should be between 0.024 in. (0.6 mm) & 0.043 in. (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.



**FIGURE 23 -
MEASURING
THE RUNNING
CLEARANCE**

If there is no movement at all, go to pages 16-17 for the "Guide Pin Inspection Procedure."

If instead, 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" on Page 15.

CONTACTING BENDIX

www.foundationbrakes.com

Bendix on-line information is available 24/7. In the on-line contacts directory, you can find: technical support contacts; service engineers; Bendix account managers; international contacts and more. www.foundationbrakes.com is your complete Bendix resource.

Bendix Technical Assistance Team

For direct personal technical support, call the Bendix technical assistance team at:

1-800-AIR-BRAKE (1-800-247-2725),

Monday through Friday, 8:00 A.M. to 6:00 P.M. EST, and follow the instructions in the recorded message.

Alternatively, you may e-mail the Bendix technical assistance team at: techteam@bendix.com.

To better serve you, please record the following information before you call the Bendix Tech Team, or include this information in your e-mail:

- Bendix product model number, part number and configuration.
- Vehicle make and model.
- Vehicle configuration. (Number of axles, tire size, etc.)
- System performance symptoms: When do they occur?
- What troubleshooting/measurements have been performed?
- What Bendix service data literature do you have or need?

3. INSPECT ADJUSTER MECHANISM

CAUTION: Follow all standard safety procedures including, but not limited to, those on page 2 of this service manual. 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 (see Page 14) finds that the running clearance is too small or too large.

The adjuster should then be checked as follows:

With the spring brake released (or caged), remove the adjuster cap (37) using the tab, taking care not to move the shear adapter (61). Note: One of two styles of adjuster cover (stamped metal or plastic) may be used.

Although exploded view (Figure 25) shows the adjuster (23) and shear adapter (61) separated, only turn the adjuster with the shear adapter installed on the adjuster. Using a box-end wrench or socket, turn the Shear Adapter (61) **counter-clockwise** and listen for the sound of 2 or 3 clicks as the mechanism increases the running clearance. Note: Do not use an open-ended wrench as this may damage the adapter.

CAUTION: Never turn the adjuster (23) without the shear adapter (61) 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.

With a box-end wrench (or socket) positioned so that it can turn freely without coming into contact with parts of the vehicle (See Figure 27) on the shear adapter, 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. NOTE: As the number of applications increases, the turning movement will decrease (as the brake reaches its normal calibration point).

If the box-end wrench or socket does not: (a) turn at all, or (b) turns only with the first application, or (c) turns forward and backward with every application, the automatic adjuster has failed and the caliper/carrier assembly must be replaced.

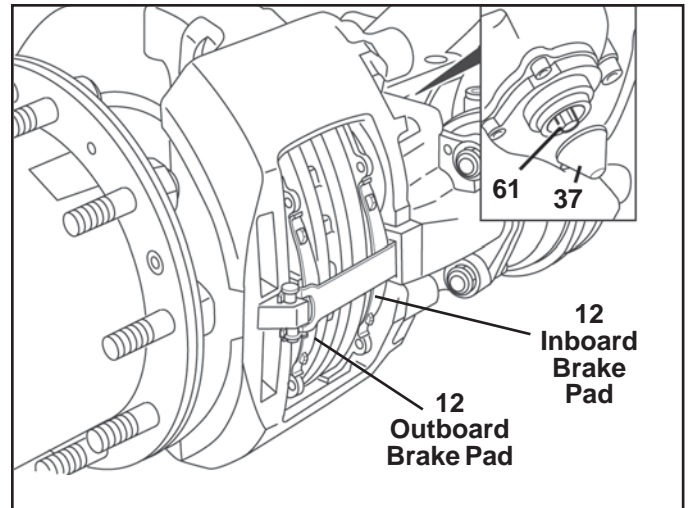


FIGURE 24 - COVER REMOVAL

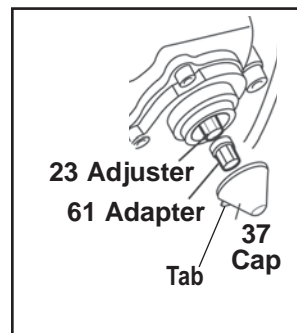


FIGURE 25 - EXPLODED VIEW OF ADJUSTER AND ADAPTER

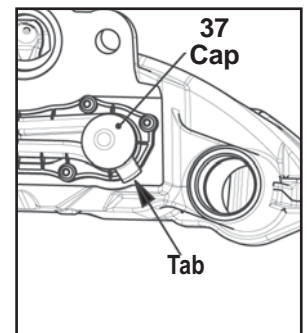


FIGURE 26 - TAB POSITION

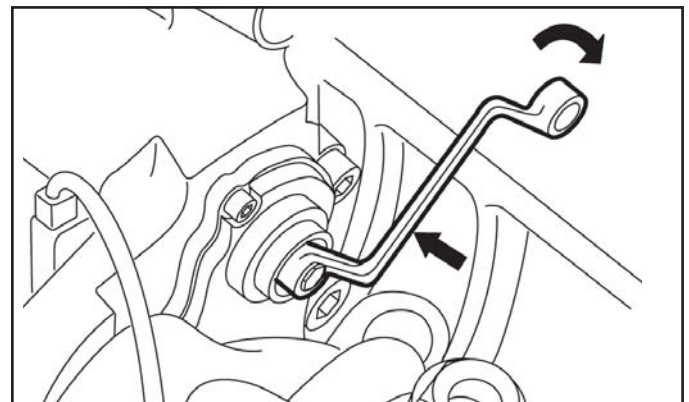


FIGURE 27 - ADJUSTMENT MECHANISM TEST

Bendix recommends installing a new adjuster cap (lightly greased using white lithium-based grease) when returning the air brake to service. Ensure that the tab is in the position shown in Figure 26.

GUIDE PINS

CAUTION: Follow all standard safety procedures including, but not limited to, those on page 2 of this service manual. 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, etc. 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 (see Page 13) is that the technician cannot move the caliper.

GUIDE PIN BEARING INSPECTION

Use the following procedure to check caliper movement along the guide pins:

Remove the Pads (see Page 18).

One of the three different styles of guide pin (A, B, or C) may be present (See Figure 28). The bearings for styles A and B use a rubber bushing, and style C uses a guide sleeve. Clean dirt, road grime, etc. from the guide pin or cover.

Using hand pressure only (no tools), the Caliper (1) 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 (20mm). If the movement is less than this amount, replace the caliper/carrier assembly.

To measure the clearance from the rubber bushing (6a, 6b) or guide sleeve (6c) to the guide pin:

See Figures 29 and 30. Remove the wheel. Remove the pad retainer (11), but leave the pads (12) in position. Attach a magnetic dial-gauge holder to the carrier (2) on the short bearing side of the caliper (1).

Use the measuring point on the caliper (1) - see the arrow in Figure 28. Press the caliper in the direction of carrier (2) and set the dial-gauge to zero.

Place a suitable tool (e.g. screwdriver) between Carrier (2) and Caliper (1) forcing them in opposite directions, and read the maximum value on the dial-gauge.

For styles A and B guide pins, if the value is greater than 0.079 in. (2.0 mm), or for style C guide pins, if the value is greater than 0.039 in. (1.0 mm), the caliper/carrier assembly must be replaced.

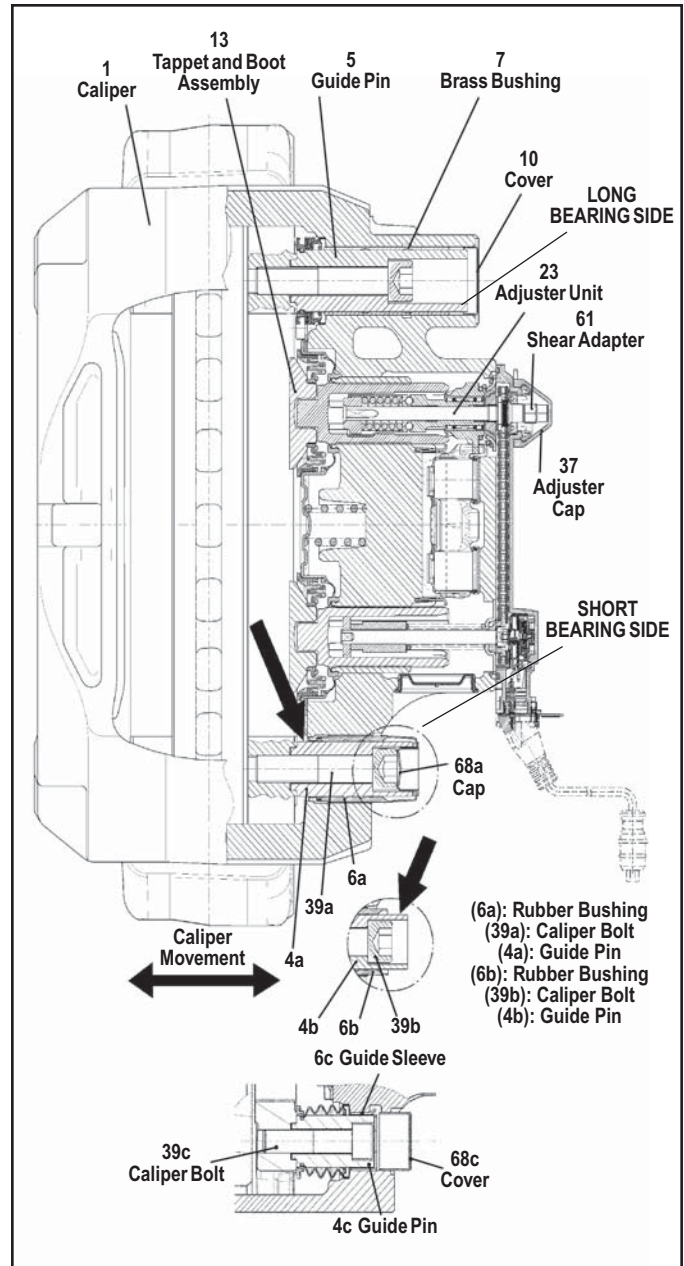


FIGURE 28 - GUIDE PINS

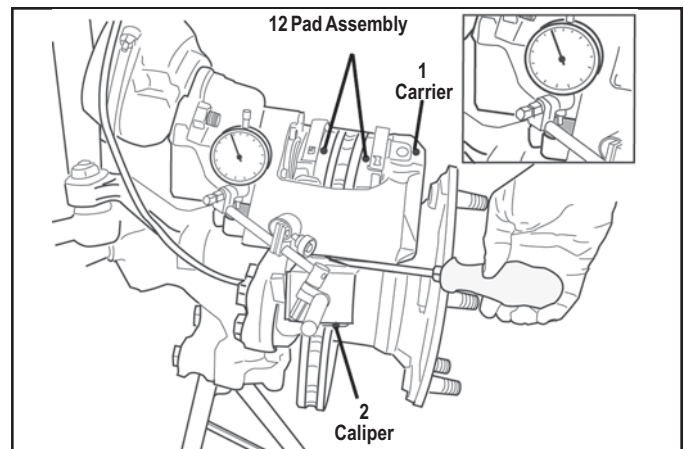


FIGURE 29 - MAGNETIC DIAL-GAUGE

GUIDE PIN SEAL INSPECTION

Caliper Guide Pin Seals

The long bearing side guide pin (5) is sealed with the cover (10) and with the inner boot (9). See Figure 28. Note: It may be necessary to remove the pads to inspect the inner boots (9) if pad wear is minimal. The guide pin (4a, 4b, or 4c, depending on the style) is also sealed with an inner boot (9) and a cover (style C), or a flexible rubber wear indicator in the case of style A guide pins.

Inspect the above components, and 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

In order to inspect the tappet and boot assembly, it may be necessary to remove the pads (12) (see Page 18) and advance the shear adapter (61) clockwise (see Page 15) until the boots are clearly visible.

CAUTION: 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.

Inspect the tappet and boot assemblies (13) for evidence of damage, corrosion, etc. The penetration of dirt and moisture into the brake can lead to corrosion and impair the function of the air disc brake. Replace as necessary (see Pages 22-24).

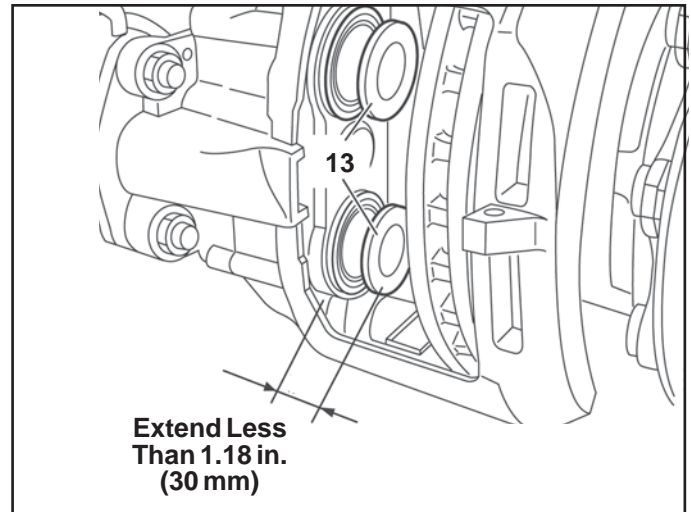


FIGURE 30 - TAPPET EXTENSION LIMIT

After re-installing a wheel according to the vehicle manufacturer's recommendations, please ensure that there is sufficient clearance between the tire inflation valve stem, the caliper and the wheel rim, to avoid damage.

WARNING: Not all wheels and valve stems are compatible with Bendix Air Disc Brakes. Use only wheels and valve stems approved by the vehicle manufacturer to avoid risk of valve stem shear and other compatibility issues.

MAINTENANCE PROCEDURES

PAD REPLACEMENT

CAUTION: Follow all standard safety procedures including, but not limited to, those on page 2 of this service manual. 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.

PAD REMOVAL

Bendix strongly recommends that when replacing brake pads, pads are replaced as an axle set.

Release or cage spring brakes and remove the wheel (refer to the vehicle manufacturer's recommendations).

Note: Before removing the brake pads it is strongly recommended that the adjuster mechanism be checked for correct operation (see Page 15).

Remove the clip (26) and washer (45), depress the pad retainer (11) and remove the pad retainer pin (44). Discard these four items - replacements are included in the service kits. As necessary remove any in-pad wear sensor components and discard.

Pull off the adjuster cap (37) using the tab, taking care to keep the shear adapter (61) in position on the adjuster (23).

Using a box-end wrench or socket, fully wind back the tappet and boot assemblies (13) by rotating the shear adapter (61) in an counter-clockwise direction (see Page 15). Note: Do not use an open-ended wrench as this may damage the adapter.

CAUTION: Never turn the adjuster (23) without the shear adapter (61) 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.**

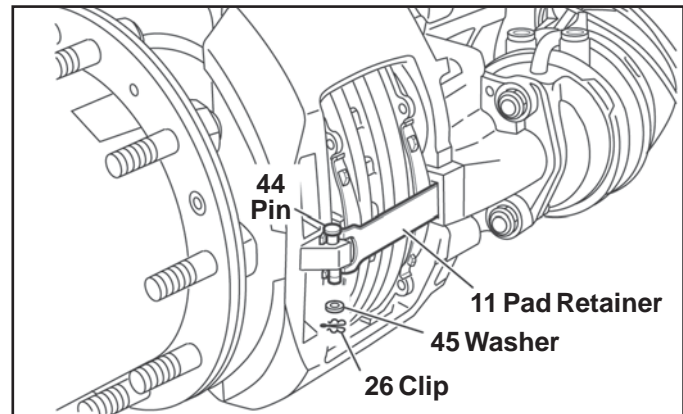


FIGURE 31 - BRAKE PAD REMOVAL

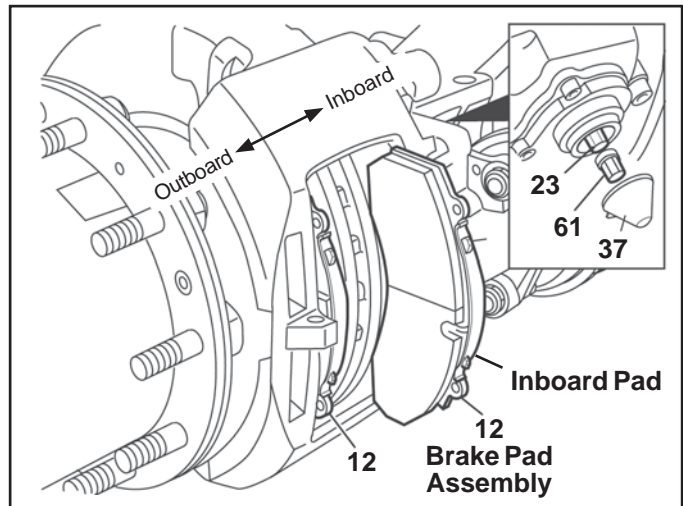


FIGURE 32 - BRAKE PAD REMOVAL

To remove the outboard brake pad (12), slide the caliper (1) fully to the outboard position first. Similarly, to remove the inboard pad, first move the caliper fully to the inboard position, and then remove the pad. See Figure 32.

Inspect the rotor. See Page 13 for full information.

PAD INSTALLATION

CAUTION: 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 vehicle within spec's 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.

As noted above, 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.**

Check that the tappet and boot assemblies have been fully retracted, as outlined above. Clean the brake as needed - see the vehicle manufacturer's recommendations.

To install the outboard brake pad (12), slide the caliper (1) fully to the outboard position before inserting the pad (with the brake lining material facing the rotor). Similarly, to install the inboard pad, move the caliper fully to the inboard position, and then install the brake pad (with the lining material facing the rotor). See Figure 30.

Install new in-pad wear indicator kit, if appropriate (see Pages 20-21).

Using a box-end wrench or socket, turn the shear adapter (61) clockwise until the pads come into contact with the rotor. Then turn back the shear adapter counter-clockwise two clicks to set the initial running clearance.

Note: Use only pads with the same backing plate thickness as originally specified for the vehicle's brakes.

Note: The Bendix air disc brakes covered by this service manual use more than one pad retainer design. Be sure to install the correct part number for the vehicle.

After installing the pad retainer (11) supplied with the kit, into the groove of the caliper (1), it must be depressed to enable the insertion of the pad retainer pin (44).

Install the supplied washer (45) and spring clip (26) to the pad retainer pin (44). It is recommended that the pad retainer pin (44) be installed pointing downwards (see Figure 35).

Apply and release the brake and then check that the hub turns easily by hand.

Lightly grease and install a new adjuster cap (37) using white lithium-based grease. Note: The tab of the adjuster cap should be positioned as shown by the arrow in Figure 34 for ease of access.

Re-install the wheel according to the vehicle manufacturer's recommendations. **Note: Not all wheels (and or valve stems) are compatible with Bendix Air Disc Brakes. Use only wheels and valve stems approved by the vehicle manufacturer.**

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

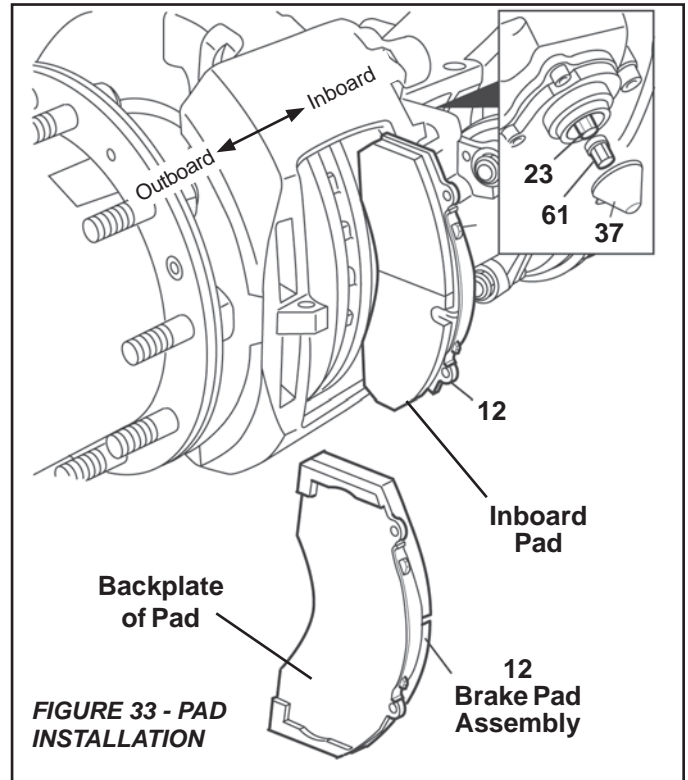


FIGURE 33 - PAD INSTALLATION

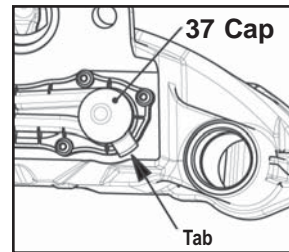


FIGURE 34 - TAB POSITION

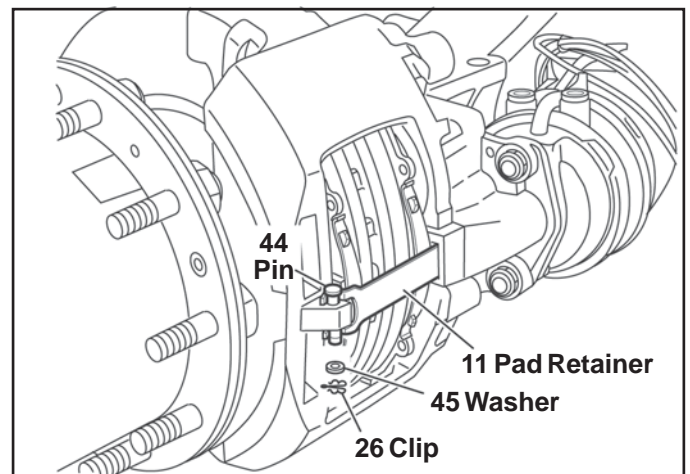


FIGURE 35 - BRAKE PAD INSTALLATION

ELECTRONIC WEAR INDICATOR REPLACEMENT

(Normally-Closed or Normally-Open Type) See page 10.

New wear indicators are normally installed whenever brake pads are replaced. Please see Brake Pad Installation on Page 18 for cautions and procedures. The wear indicator is installed after the new brake pads are installed into the brake, but before the retainer hardware.

Remove and retain the pad holder springs.

See page 6 for typical contents of wear indicator kits.

Installation: The longer branch of the wear indicator cable (see arrow) must be installed in the outboard pad. Insert the Wear Indicator Cables (101) into the pre-cut slot in the pads. The wear indicators snap into place.

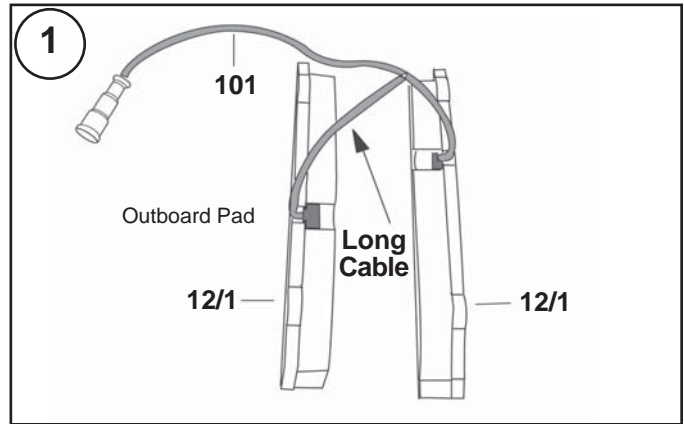
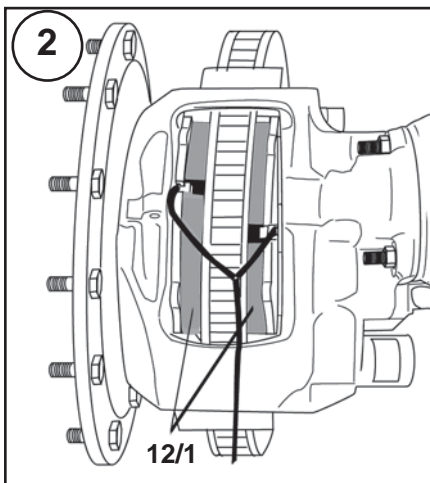
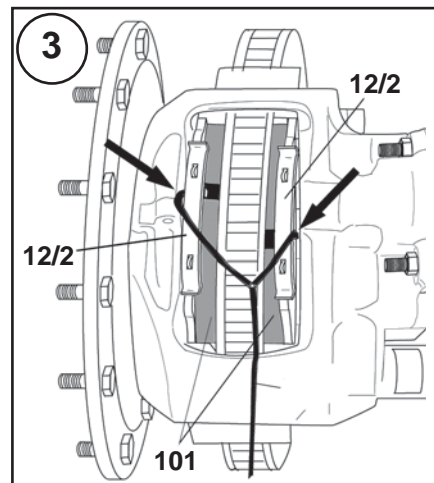


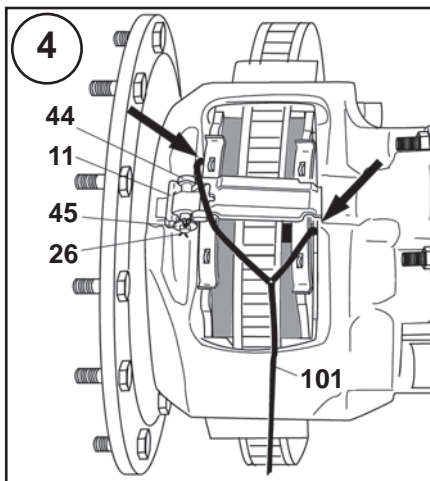
FIGURE 36 - WEAR INDICATOR CABLE



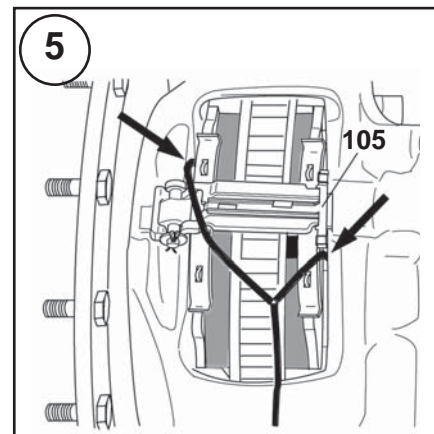
2. Insert wear indicator sensors into the pads.



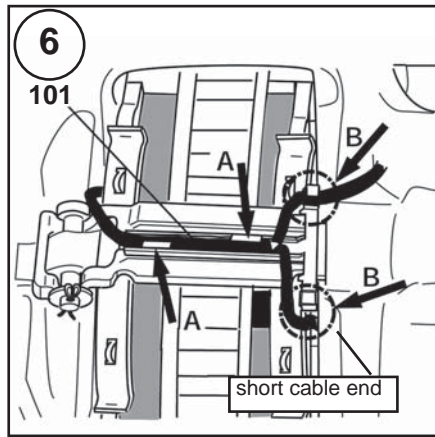
3. Install the pad holder springs (12/2) onto the pads (12/1) with the wear indicator cable (101) as shown.



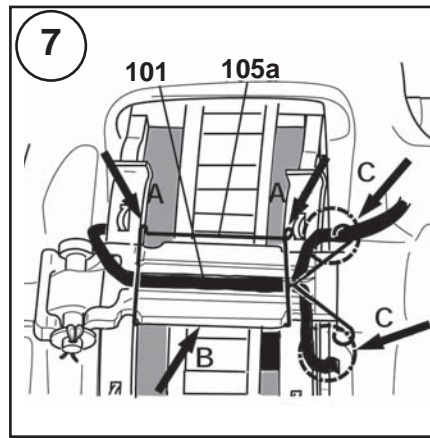
4. Install the pad retainer (11), pad retainer pin (44), washer (45) and spring clip (26) with the wear indicator cable (101) as shown.



5. Install the cable guide (105) onto the pad retainer (11). The cable guide (105) snaps into place when pressing lightly onto the pad retainer (11).

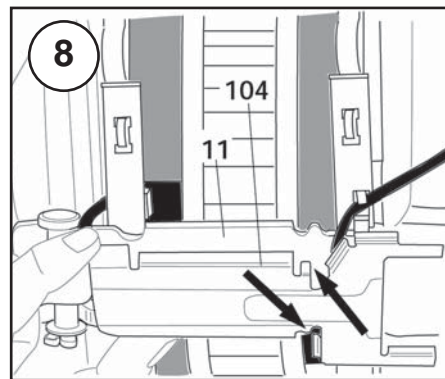


6. Press the wear indicator cable (101) into the locating tabs of the cable guide (105) (see arrows A). The short cable end of the wear indicator cable (101) must not be secured by locating tabs of the cable guide (105). According to vehicle type, install the cable that leads to the electrical supply of the vehicle, in one of the two locating tabs (see arrows B).



7. Install the indicator cable (101) in the middle of the pad retainer (11). Insert the cable guide (105a) at one side of the pad retainer (11) (see arrow B). Slightly press in on the other side of the pad retainer (11) (see arrows A). The cable guide (105a) 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 (101) must not be secured by a wire loop of the cable guide (105a) (see arrows C).



8. Carefully install the cable protection plate (104) with attention to the correct position of the cable protection plate's catch (see arrows).

The cable protection plate (104) will snap into place.

TAPPET AND BOOT ASSEMBLIES REPLACEMENT

CAUTION: Follow all standard safety procedures including, but not limited to, those on page 2 of this service manual. 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 (see Page 25 for instructions on caliper/carrier removal).

REMOVAL OF TAPPET AND BOOT ASSEMBLIES (13)

Follow the procedure for removing brake pads (12) on Page 18.

CAUTION: Never turn the adjuster (23) without the shear adapter (61) 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 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.

Removal of the tappet and boot assembly (13) requires the use of the wedge fork (A). See Figure 39. Extend the tappets less than 1.18 in. (30 mm) by turning the shear adapter (61) clockwise until there is sufficient access to the boots to remove the tappet boot from the caliper bore. A screwdriver (B) should be used to move the boot location ring - see Figure 40 and allow the wedge fork (A) to be inserted. **CAUTION:** Take care not to damage the inner sealing face (see arrow "X" in Figure 40). Gouges or grooves that would prevent a good seal necessitate caliper replacement.

The tappet and boot assemblies (13) can then be removed from the threaded tubes (16) by using the wedge fork (A).

Remove the old tappet bushing(s) (161). Inspect the inner sealing face (see arrow "X") for damage. If damage is found to the inner seal the caliper/carrier assembly must be replaced.

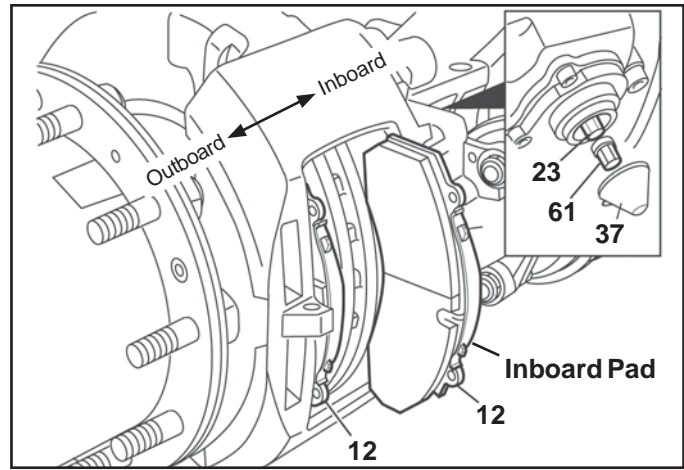


FIGURE 37 - BRAKE PAD REMOVAL

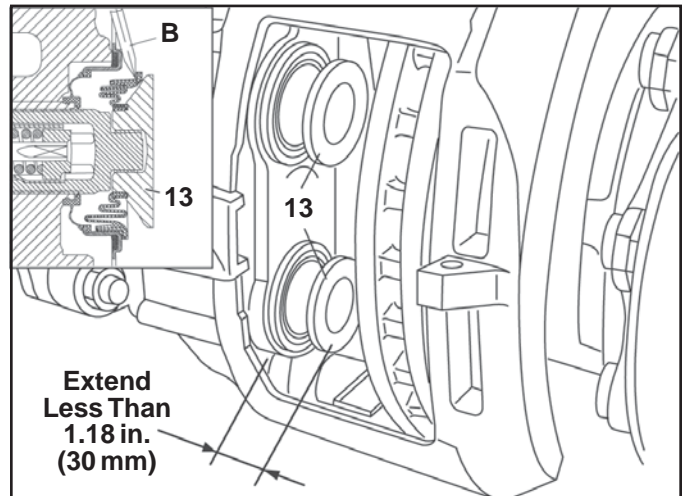


FIGURE 38 - TAPPET EXTENSION

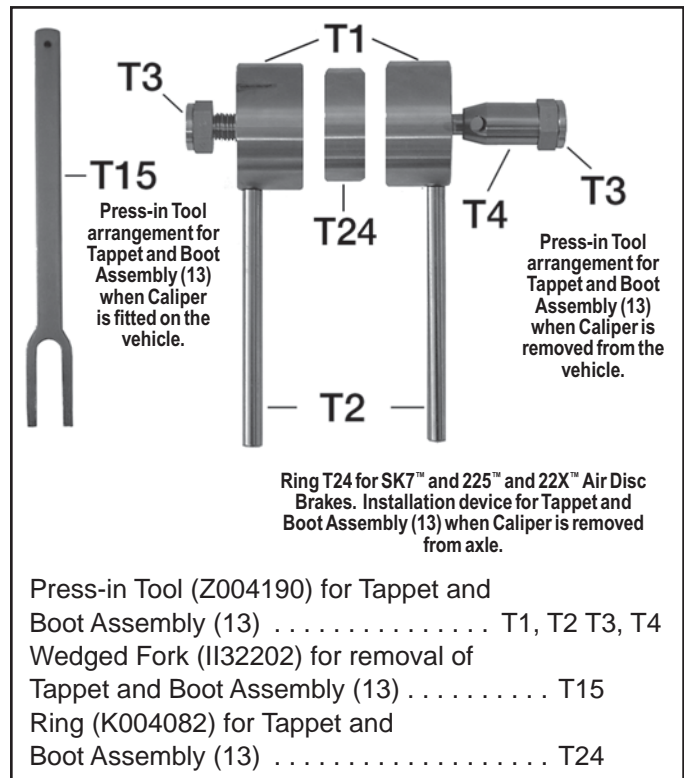


FIGURE 39 - TAPPET REMOVAL TOOL

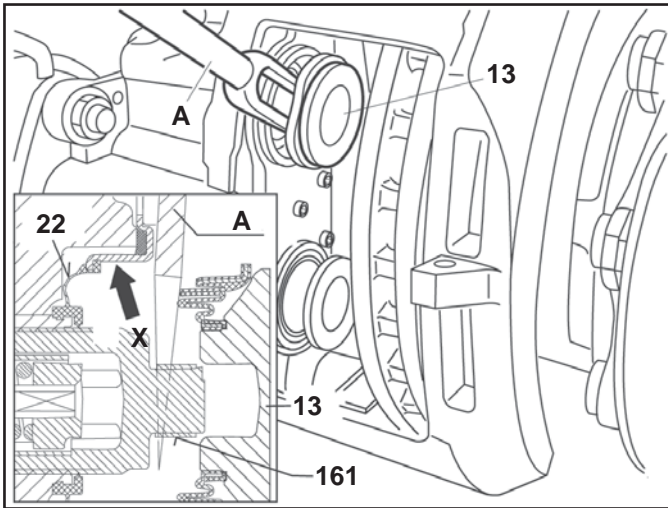


FIGURE 40 - WEDGE TOOL USE

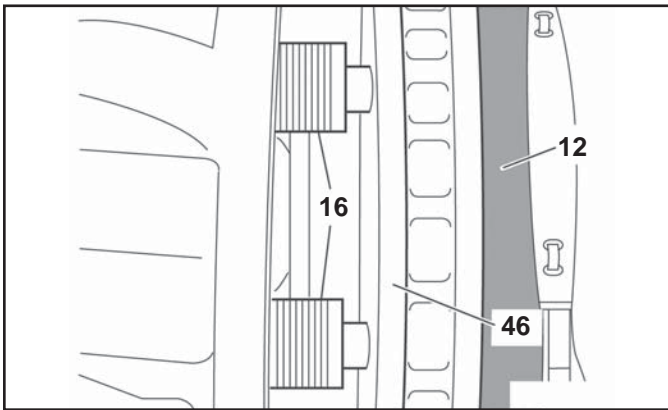


FIGURE 41 - USE OF A NEW BRAKE PAD AS A SPACER

INSPECT THE THREADED TUBES (16)

For the inspection of the threads, the tubes must be extended, but by less than 1.18 in. (30mm), by turning the shear adapter (61) clockwise. If working with the caliper on the vehicle, the technician may place a new brake pad (12) 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 in. (70 mm) spacer (E) into the caliper (1) to help avoid the loss of thread engagement. See CAUTION on Page 22.

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 (see Page 25).

If the threads are in good condition, fully wind back the threaded tubes (16) by turning the shear adapter (61) counter-clockwise.

INSTALLING THE TAPPET AND BOOT ASSEMBLIES (13)

Grease threads with white grease (Part No. II14525 or II32868).

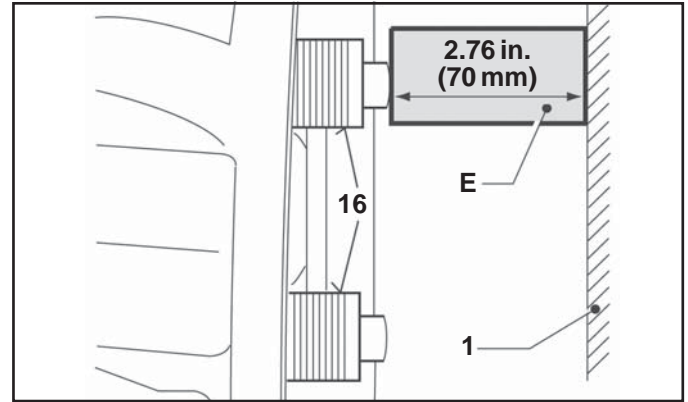


FIGURE 42 - USE OF A SPACER (OFF VEHICLE USE)

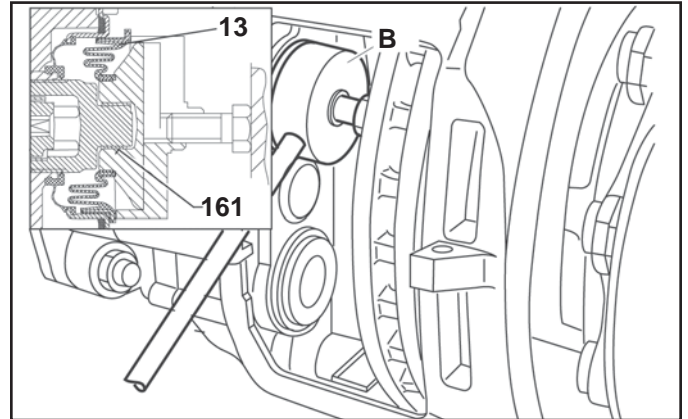


FIGURE 43 - ON VEHICLE BOOT INSTALLATION

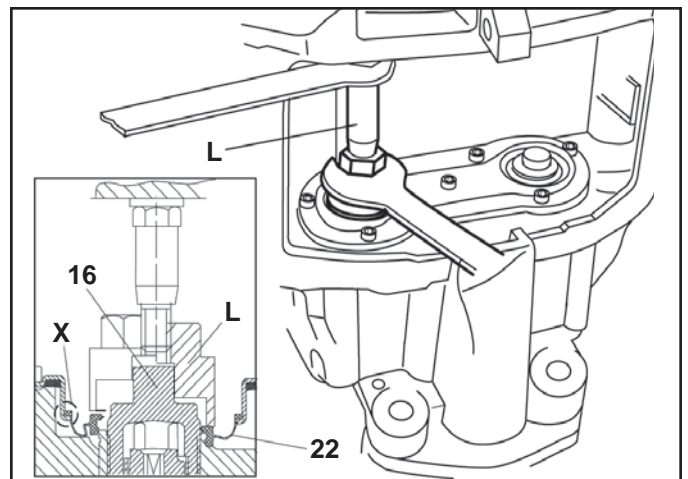


FIGURE 44 - INNER SEAL INSTALLATION

Screw back the threaded tubes (16), by turning the shear adapter (61) counter-clockwise (see Cautions earlier in these instructions).

The sealing seat in the caliper for tappet and boot assemblies (13) must be clean and free of grease. See Figure 44.

Fit a new tappet bushing (161) onto the center post of each threaded tube (16).

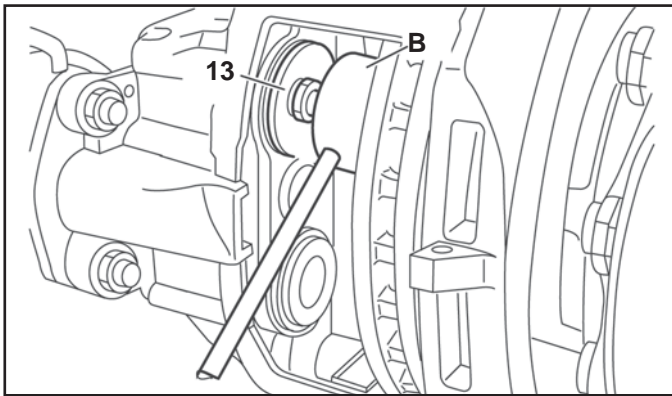


FIGURE 45 - ON VEHICLE TAPPET INSTALLATION

Technicians working with the caliper installed on vehicle:

- Install the boots using the press-in tool (B) with the short press-in extension (T3) for positioning and pressing into place - see Figure 43.
- Position a tappet assembly (13) onto each tappet bushing. Using press-in tool (B) in a reversed orientation with the press-in extension (T3) towards the threaded tube, install each tappet onto its tappet bushing - see Figure 45.

Technicians working with the caliper not installed on vehicle:

- Install the boots using the press-in tool (B) with the long press-in extension (T3 + T4) for positioning and pressing into place - see Figure 43.
- Position a tappet (13) 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 - see Figure 45.

After assembly, check that the tappet (13) 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) - see Figure 48 - to assist the installation, since the caliper's back plate is too thin using only Tool (B) to achieve the correct position.

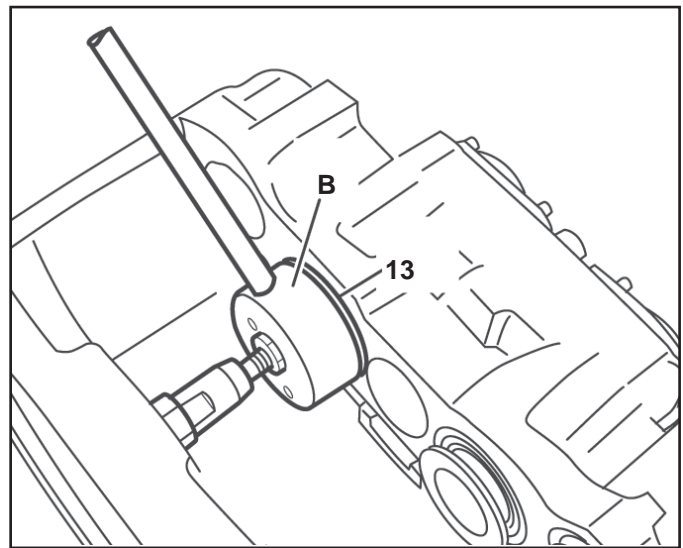


FIGURE 46 - OFF VEHICLE BOOT INSTALLATION

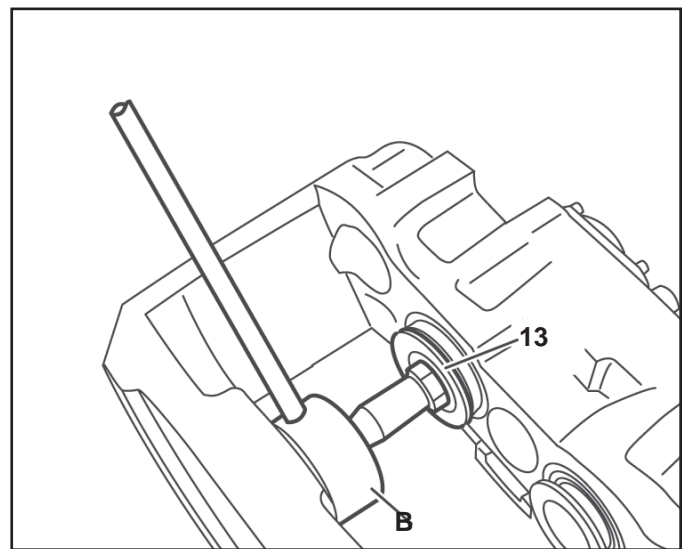


FIGURE 47 - OFF VEHICLE TAPPET INSTALLATION

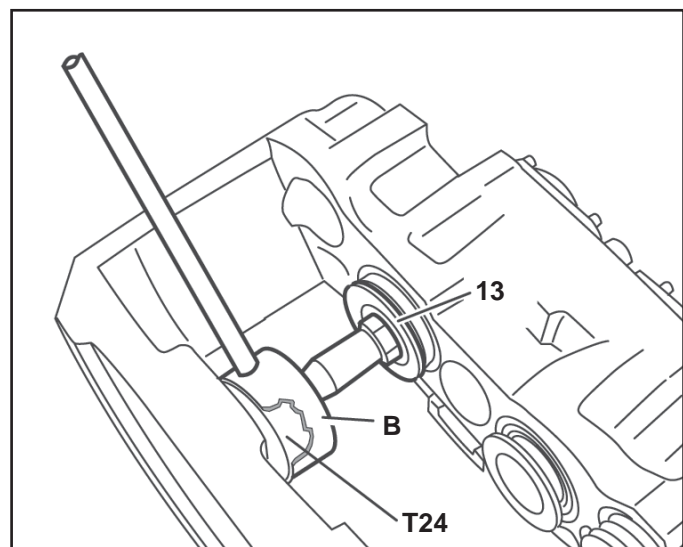


FIGURE 48 - OFF VEHICLE - USE OF EXTRA TOOL FOR SOME STYLES

CALIPER/CARRIER ASSEMBLY REPLACEMENT

CAUTION: Follow all standard safety procedures including, but not limited to, those on page 2 of this service manual. 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.

With the caliper/carrier assembly securely supported, remove and discard the six bolts attaching the carrier to the axle.

CAUTION: Do not attempt to use the pad retainer (11) 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.

Clean and inspect the axle contact area. See axle or vehicle manual for instructions if damage is found.

CALIPER/CARRIER ASSEMBLY INSTALLATION

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. See Page 6.

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.

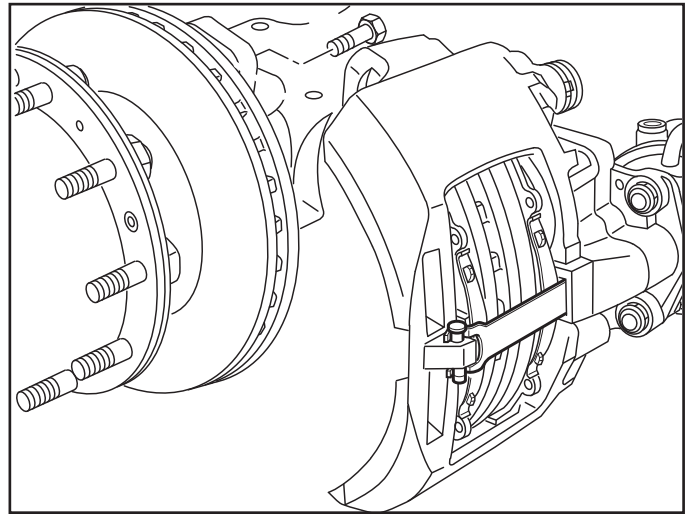


FIGURE 49 - CALIPER/CARRIER ASSEMBLY REPLACEMENT

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.

CAUTION: See the cautions in this document with regard to possible pinch hazard, and the restriction against using the pad retainer (11) as a place to secure lifting devices.

With the replacement carrier/caliper assembly held in position, install with new bolts. Note: 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.

BRAKE ACTUATOR AND SPRING BRAKE REPLACEMENT

CAUTION: 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.

CAUTION: Follow all standard safety procedures including, but not limited to, those on page 2 of this service manual. 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 (18/2).

Remove and discard brake chamber mounting nuts (see Figure 50, arrows B).

Brake Chamber Installation

Note: New brake chambers (18/2) have drain plugs installed (see Figure 50, arrows A). 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 $\pm 30^\circ$) when installed on the vehicle.

Before installing the new brake chamber, the actuator flange (see Figure 51, arrow C) must be cleaned, and inspected. Consult the vehicle manual. The spherical cup in the lever (19) must be greased with white grease (Part No. II14525 or II32868).

CAUTION: Do not use grease containing molybdenum disulfate.

See Figure 52. 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.

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

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. Test for leakage and check the brake operation and effectiveness before returning vehicle to service.

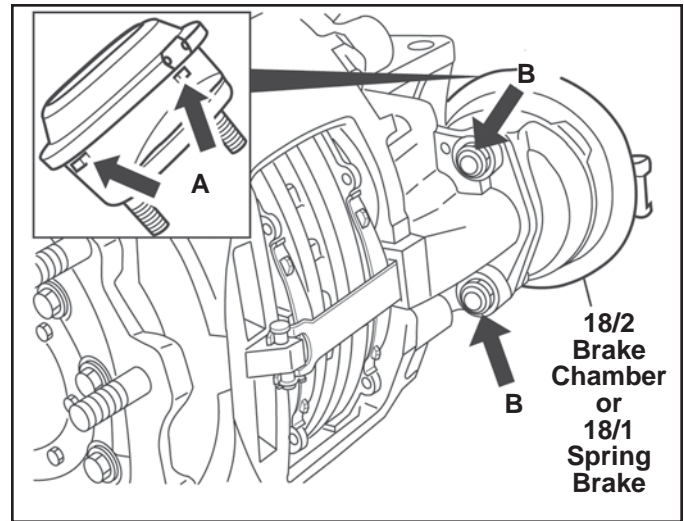


FIGURE 50 - ACTUATOR INSTALLATION

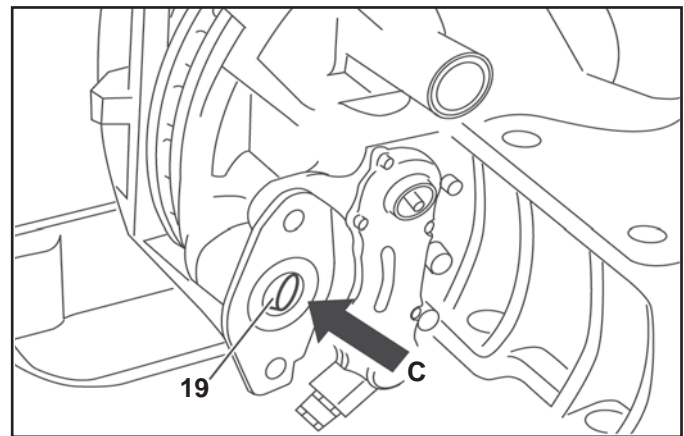


FIGURE 51 - ACTUATOR FLANGE

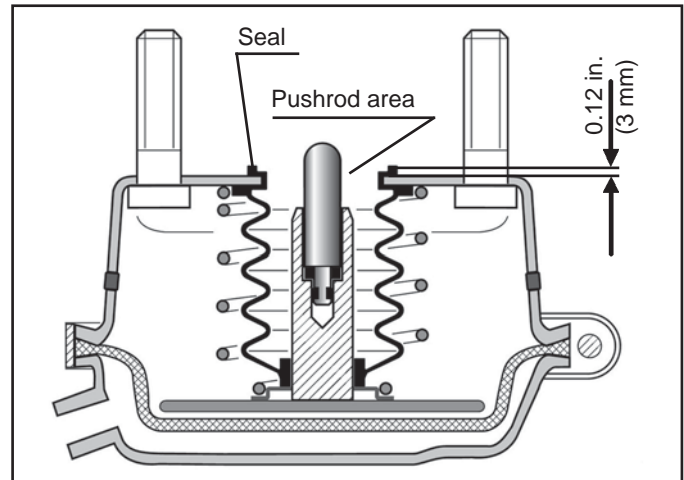


FIGURE 52 - CAP INSTALLATION

Spring Brake Removal

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

With all air pressure drained from the air brake system, disconnect the air hose from the brake chamber (18/1).

Back out the release bolt (Figure 53, arrow D) 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. While supporting the spring brake in position, remove and discard brake chamber mounting nuts (see Figure 53, arrows B). Remove the spring brake.

Spring Brake Chamber Installation

Note: New spring brake chambers (18/1) have drain plugs installed (see Figure 53, arrows A). 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 $\pm 30^\circ$) when installed on the vehicle.

Before installing the new brake chamber, the actuator flange (see Figure 51, arrow C) must be cleaned, and inspected. Consult the vehicle manual. The spherical cup in the lever (19) must be greased with white grease (Part No. II14525 or II32868).

CAUTION: Do not use grease containing molybdenum disulfate.

See Figure 54. 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.

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

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. Test for leakage and check the brake operation and effectiveness before returning vehicle to service.

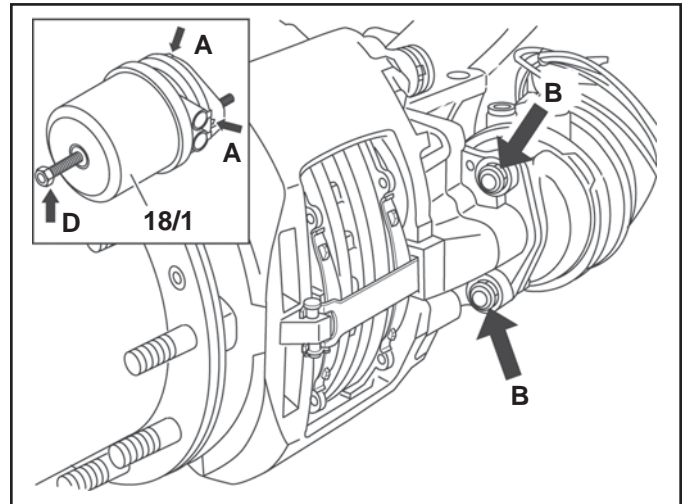


FIGURE 53 - SPRING BRAKE INSTALLATION

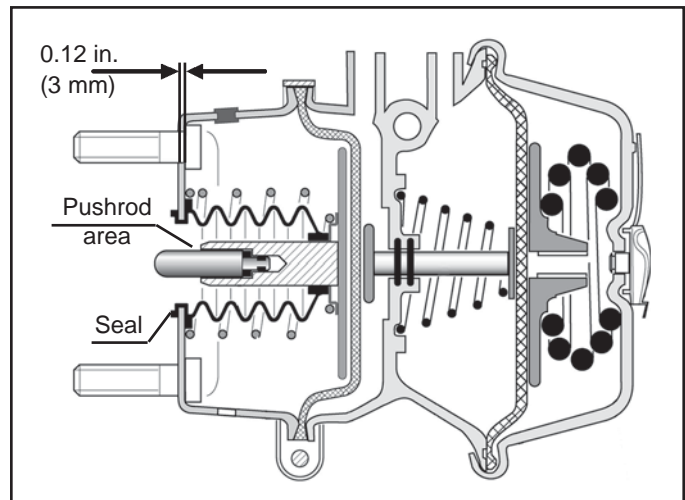


FIGURE 54 - CAP INSTALLATION



**Bendix Spicer
Foundation Brake LLC**
A Bendix CVS and Dana Joint Venture