



BRAKE & FRICTION

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CARLISLE MAINTENANCE MANUAL 440-1088

SCL 19 Dry Disc Brake Calipers SCL 56 Dry Disc Brake Calipers

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Service Notes

About This Manual

This manual provides service and repair information for the following Carlisle dry disc brake calipers:

SCL 19 dry disc brake calipers

SCL 56 dry disc brake calipers

Before You Begin

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

Hazard Alert Messages and Torque Symbols

WARNING

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

CAUTION

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

How to Obtain Additional Maintenance and Service Information

Visit www.carlislecbf.com

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ASBESTOS FIBERS WARNING

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

Hazard Summary

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

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

Recommended Work Practices

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

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

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

3. Procedures for Servicing Brakes.

- a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.
 - b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.
 - c. If an enclosed vacuum system or brake washing equipment is not available, employers may adopt their own written procedures for servicing brakes, provided that the exposure levels associated with the employer's procedures do not exceed the levels associated with the enclosed vacuum system or brake washing equipment. Consult OSHA regulations for more details.
 - d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.
 - e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.
4. Cleaning Work Areas. Clean work areas with a vacuum equipped with a HEPA filter or by wet wiping. **NEVER** use compressed air or dry sweeping to clean work areas. When you empty vacuum cleaners and handle used rags, wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA for use with asbestos. When you replace a HEPA filter, wet the filter with a fine mist of water and dispose of the used filter with care.

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

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

Regulatory Guidance

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

NON-ASBESTOS FIBERS WARNING

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

Hazard Summary

Most recently manufactured brake linings do not contain asbestos fibers. These brake linings may contain one or more of a variety of ingredients, including glass fibers, mineral wool, aramid fibers, ceramic fibers and silica that can present health risks if inhaled.

Scientists disagree on the extent of the risks from exposure to these substances. Nonetheless, exposure to silica dust can cause silicosis, a non-cancerous lung disease. Silicosis gradually reduces lung capacity and efficiency and can result in serious breathing difficulty. Some scientists believe other types of non-asbestos fibers, when inhaled, can cause similar diseases of the lung. In addition, silica dust and ceramic fiber dust are known to the State of California to cause lung cancer. U.S. and international agencies have also determined that dust from mineral wool, ceramic fibers and silica are potential causes of cancer.

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

Recommended Work Practices

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

2. Respiratory Protection. OSHA has set a maximum allowable level of exposure for silica of 0.1 mg/m³ as an 8-hour time-weighted average. Some manufacturers of non-asbestos brake linings recommend that exposures to other ingredients found in non-asbestos brake linings be kept below 1.0 f/cc as an 8-hour time-weighted average. Scientists disagree, however, to what extent adherence to these maximum allowable exposure levels will eliminate the risk of disease that can result from inhaling non-asbestos dust.

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

3. Procedures for Servicing Brakes.

- a. Enclose the brake assembly within a negative pressure enclosure. The enclosure should be equipped with a HEPA vacuum and worker arm sleeves. With the enclosure in place, use the HEPA vacuum to loosen and vacuum residue from the brake parts.
- b. As an alternative procedure, use a catch basin with water and a biodegradable, non-phosphate, water-based detergent to wash the brake drum or rotor and other brake parts. The solution should be applied with low pressure to prevent dust from becoming airborne. Allow the solution to flow between the brake drum and the brake support or the brake rotor and caliper. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.
- c. If an enclosed vacuum system or brake washing equipment is not available, carefully clean the brake parts in the open air. Wet the parts with a solution applied with a pump-spray bottle that creates a fine mist. Use a solution containing water, and, if available, a biodegradable, non-phosphate, water-based detergent. The wheel hub and brake assembly components should be thoroughly wetted to suppress dust before the brake shoes or brake pads are removed. Wipe the brake parts clean with a cloth.
- d. Wear a respirator equipped with a HEPA filter approved by NIOSH or MSHA when grinding or machining brake linings. In addition, do such work in an area with a local exhaust ventilation system equipped with a HEPA filter.
- e. **NEVER** use compressed air by itself, dry brushing, or a vacuum not equipped with a HEPA filter when cleaning brake parts or assemblies. **NEVER** use carcinogenic solvents, flammable solvents, or solvents that can damage brake components as wetting agents.

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

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

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

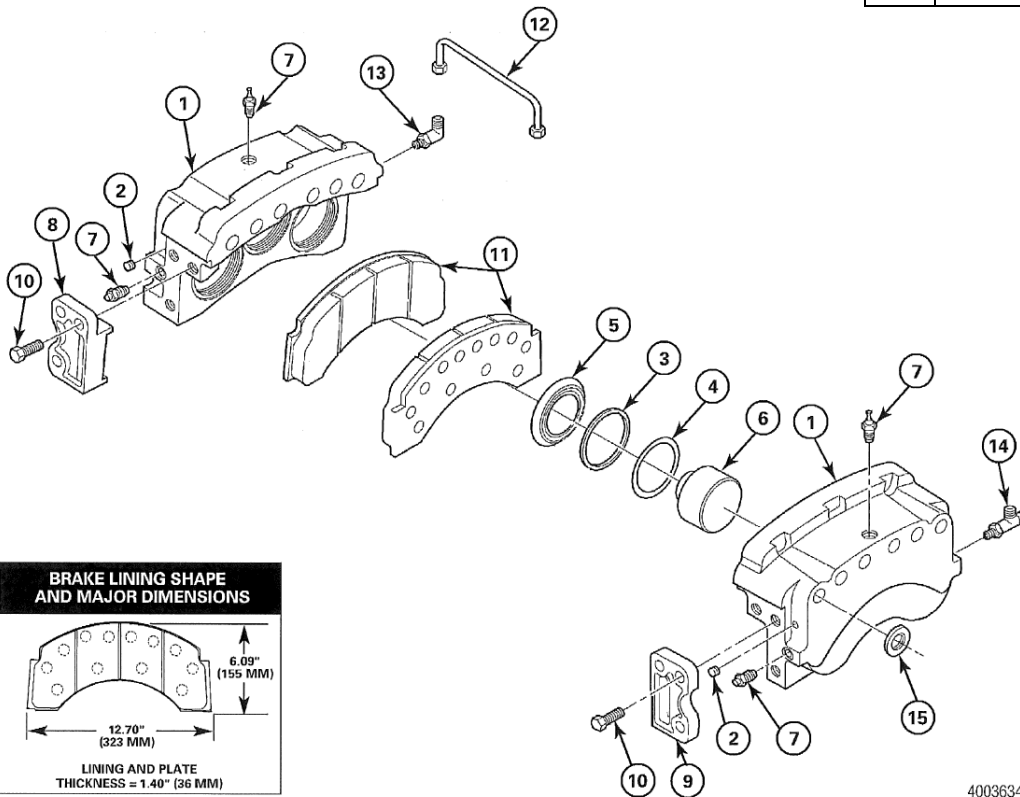
Regulatory Guidance

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

1. Exploded Views

SCL 19 Series

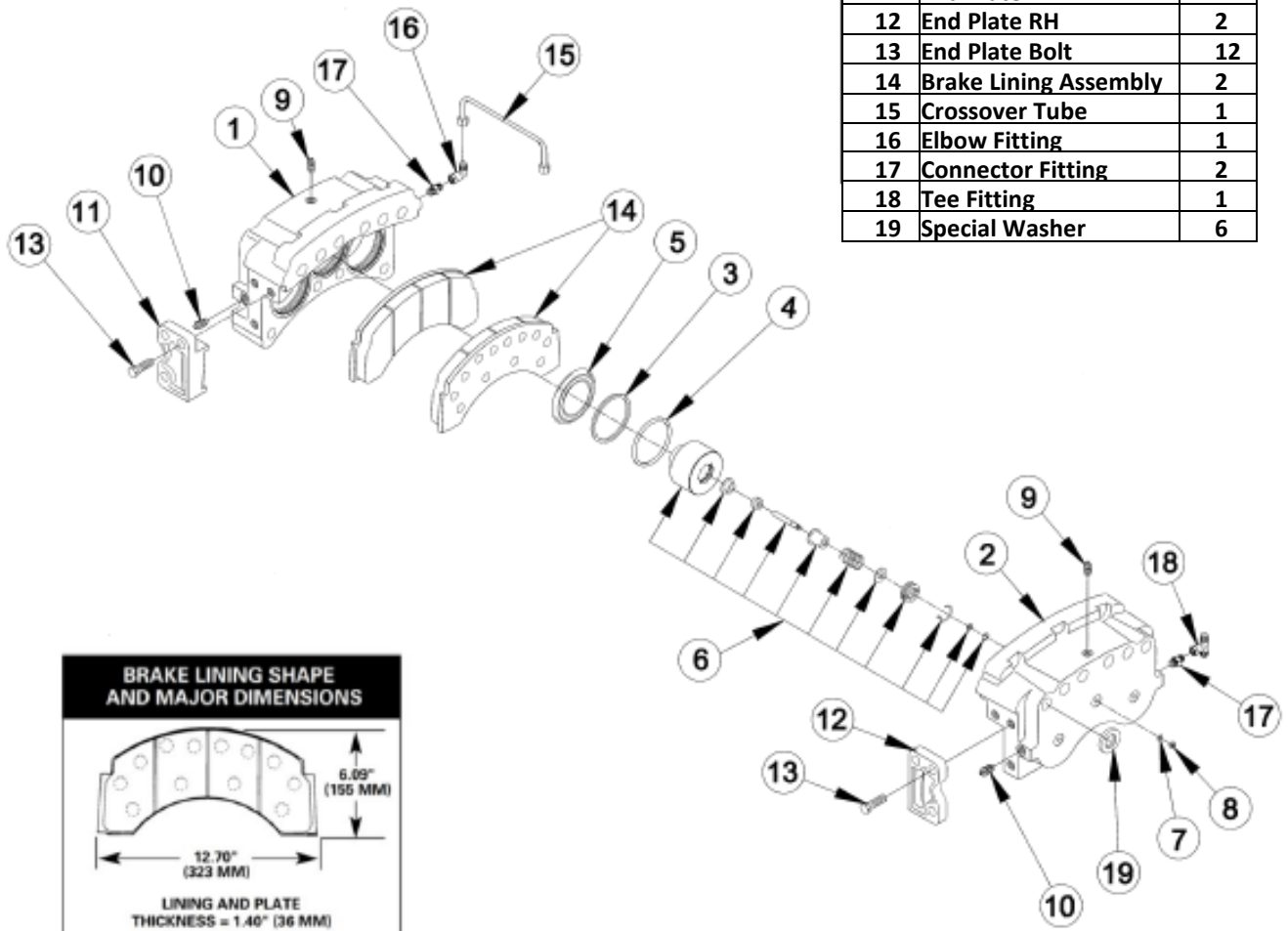
ITEM	DESCRIPTION	QTY.
1	Brake Housing	2
2	Plug	4
3	Backup Ring	6
4	Seal	6
5	Dust Boot	6
6	Piston	6
7	Bleeder Screw	4
8	End Plate LH	2
9	End Plate RH	2
10	End Plate Bolt	12
11	Brake Lining	2
12	Crossover Tube	1
13	Elbow Fitting	1
14	Tee Fitting	1
15	Special Washer	12



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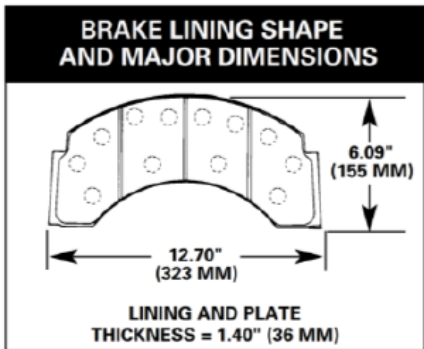
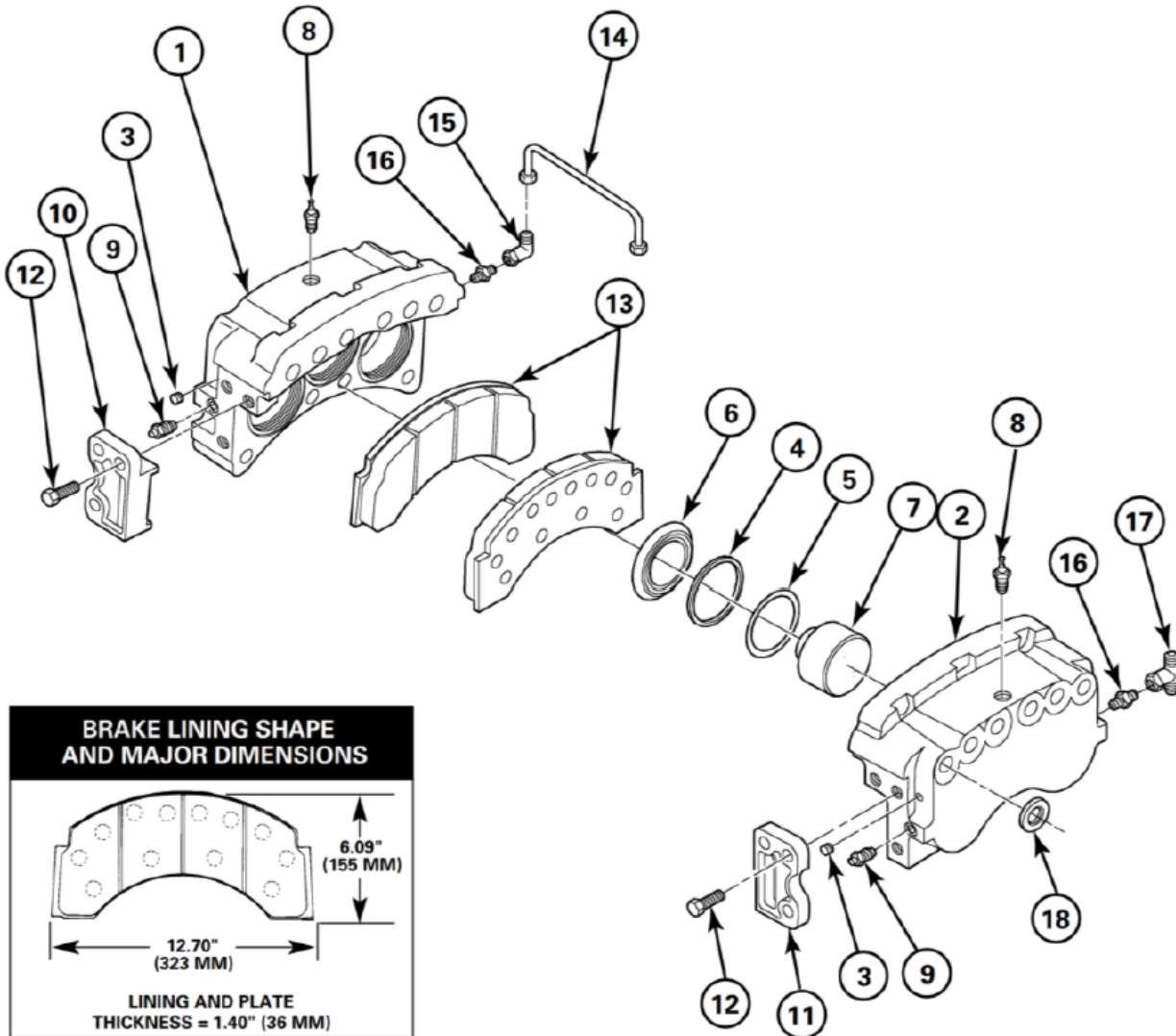
SCL 56 Series With Piston Retractors

ITEM	DESCRIPTION	QTY.
1	Brake Housing	1
2	Brake Housing	1
3	Backup Ring	6
4	Seal	6
5	Dust Boot	6
6	Piston Assembly	6
7	Lock Washer	6
8	Lock Nut	6
9	Bleeder Screw	2
10	Bleeder Screw	2
11	End Plate LH	2
12	End Plate RH	2
13	End Plate Bolt	12
14	Brake Lining Assembly	2
15	Crossover Tube	1
16	Elbow Fitting	1
17	Connector Fitting	2
18	Tee Fitting	1
19	Special Washer	6



SCL 56 Series Without Piston Retractors

ITEM	DESCRIPTION	QTY.
1	Brake Housing	1
2	Brake Housing	1
3	Plug	4
4	Backup Ring	6
5	Seal	6
6	Dust Boot	6
7	Piston	6
8	Bleeder Screw	2
9	Bleeder Screw	2
10	End Plate LH	2
11	End Plate RH	2
12	End Plate Bolt	12
13	Brake Lining Assembly	2
14	Crossover Tube	1
15	Elbow Fitting	1
16	Connector Fitting	2
17	Tee Fitting	1
18	Special Washer	6



2. Introduction

Description

The SCL 56 dry disc brake calipers are intended only for use on hydraulic brake systems. Figure 2.2.



Figure 2.2

The SCL 56 is a heavy-duty version of the SCL 19. The SCL 56 has a larger caliper housing. It has four extra mounting bolts. All other parts, except the crossover tube, elbow fittings, tee fittings, connector fittings and bleeders are interchangeable.

Both calipers mount to a fixed position on fixed position discs and have two-piece housings. Three pistons are installed in each housing half. End plates hold the non-asbestos lining assemblies in the housing.

One, two or three calipers can be installed on one disc.

- If one caliper is installed, install it at the 12 o'clock position.
- If two calipers are installed, install them at the three and nine o'clock positions.
- If three calipers are installed, install them at the four, eight and 12 o'clock positions.

Hydraulic Fluid

⚠ WARNING

Use only the type of hydraulic fluid specified by the equipment manufacturer. Do not use or mix different types of hydraulic fluid. The wrong hydraulic fluid will damage the rubber parts of the caliper and cause damage, loss of braking and serious personal injury.

Do not reuse hydraulic fluid. Used fluid can be contaminated and can cause incorrect operation which could result in serious personal injury.

The brake systems use one of two types of hydraulic fluid.

- Petroleum base hydraulic fluid (mineral oil) Example: Meets MIL-H-5606 specifications.
- Non-petroleum base hydraulic fluid (automotive brake fluid) Example: Glycol DOT 3 meets SAE J-1703 specifications.

2. Introduction

Identification

The assembly number can be located in two different places.

For older assemblies, the assembly number is located on side of the caliper opposite from the mounting plate on an identification tag on the inside radius of the caliper opposite from the mounting plate. Figure 2.3

For current assemblies, the assembly number is impression stamped on a raised pad. Figure 2.4

CAUTION

Use only the specified components when you assemble the caliper. Do not mix components from other calipers. If you install the incorrect components, the caliper cannot operate correctly and may cause damage to the equipment. Use of non-Carlisle parts may cause incorrect operation of the brakes.

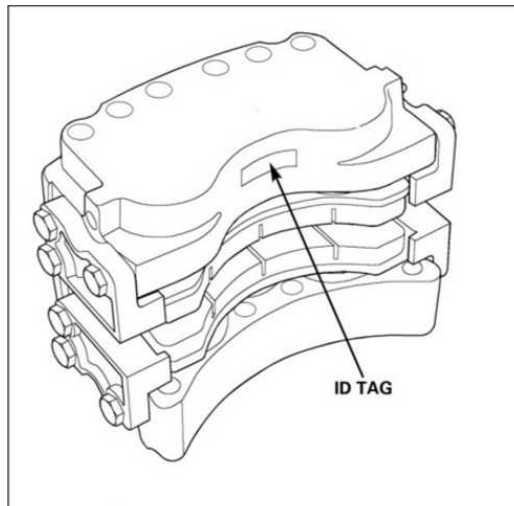


Figure 2.3

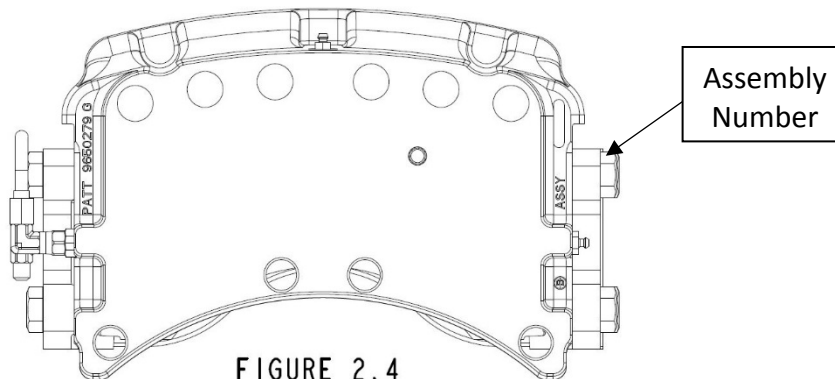


FIGURE 2.4

3. Removal and Disassembly

Hazard Alert Messages

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

WARNING

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

Removal

Caliper

WARNING

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

1. Park the vehicle on a level surface. Block the wheels not being serviced to prevent the vehicle from moving.
2. If necessary, raise the vehicle so that the wheels to be serviced are off the ground. Support the vehicle with safety stands.

WARNING

The housings are very heavy. The housings must be supported during removal and installation. Serious personal injury or damage to the caliper can occur if the caliper housings fall.

NOTE: Remove the brake linings from the caliper before you remove the caliper from the vehicle.

Brake Linings

1. Loosen the bleeder screws in the caliper housings to release hydraulic pressure.
2. Use a pry bar to pry the linings away from the disc and push the pistons completely into the housing. Tighten the bleeder screws.
3. Remove the bolts that fasten the end plates to one side of the caliper housing. Remove the end plates. Replace worn or damaged end plates and bolts.
4. Remove the linings from the housing. Inspect the linings. Refer to Section 4.

Caliper Housing

1. Disconnect the brake line from the inlet fittings. Remove the crossover tube from the housings. Place plugs in the brake lines and the fittings to prevent contamination of the system.
2. Remove the two centers O.D. brake mounting fasteners. Replace them with two long brake installation studs. Figure 3.1.

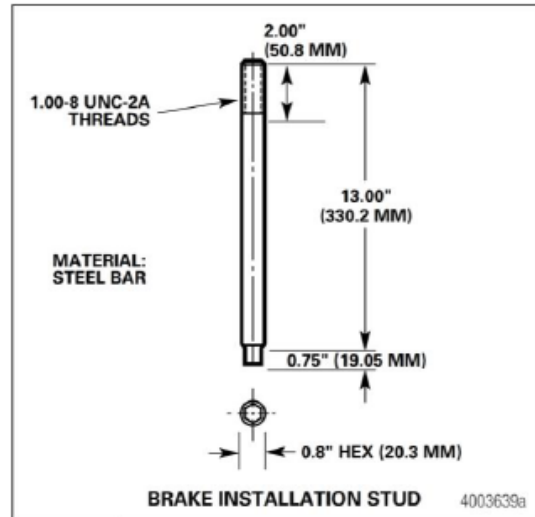


Figure 3.1

3. Remove the remaining brake mounting fasteners.
4. Slide the outer housing subassembly off over the studs.
5. If the disc is to be removed, remove it. Slide the remaining housing subassembly off over the studs.

WARNING

To avoid serious personal injury and possible damage to components, be very careful when you use lifting devices.

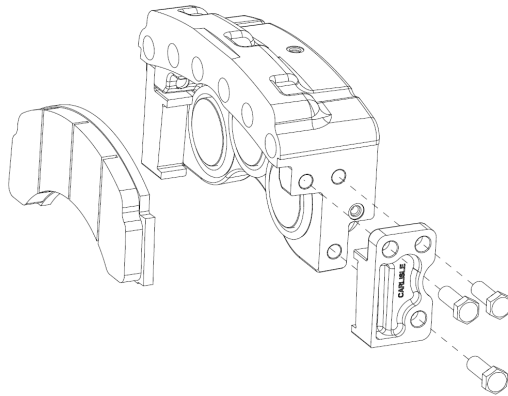
- Verify that the lifting straps are not damaged.
 - Always use both lifting straps when lifting.
 - Do not subject lifting straps to any shock or drop loading.
6. If the disc is not removed, support the housing subassembly with a lifting device while the studs are being removed. Lift the caliper housing clear of the disc.
 7. If any shims are removed, mark the shim positions for reassembly later.

3. Removal and Disassembly

Disassembly

Caliper

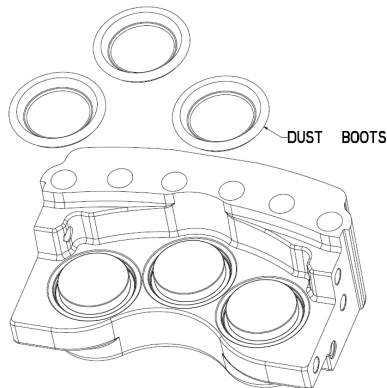
1. Remove the brake linings from each brake half. Remove the bolts that fasten the end plates to each housing. Remove the end plates. Replace worn or damaged end plates and bolts.



⚠ WARNING

Do not put your hand in front of the pistons when you force out the pistons. Serious personal injury may occur.

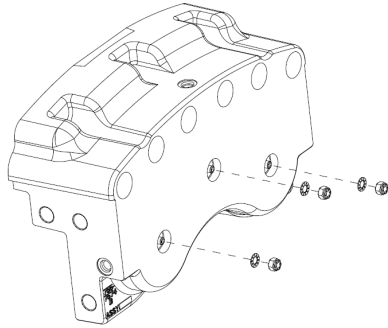
2. Loosen bleeder screws and use a C-Clamp to push the pistons completely into the housing.
3. Remove and discard the dust boots or wiper seals.



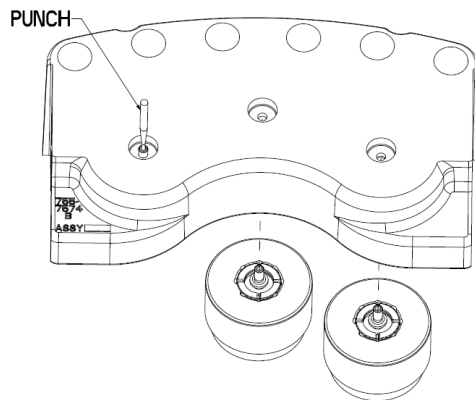
4. For brakes without piston retractors, use a pry bar in the groove on the piston to remove the pistons and skip to step 7.

Note: A regulated, low amount of hydraulic pressure or air pressure may be used to remove the pistons without piston retractors if they cannot be removed by hand.

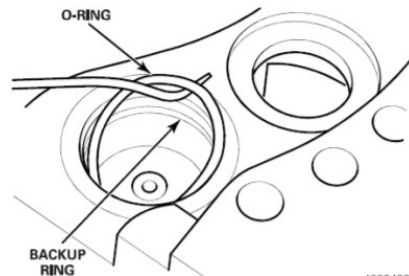
- For brakes with piston retractors: Use a hex wrench to hold the pin from turning and remove the 3 lock nuts on the back of each housing.



- Use a suitable dowel or drift punch that fits into the adjuster pin to push the service pistons out of each caliper housing.



- Use a pick or suitable tool to remove the 3 O-rings and backup rings in each housing.



- Remove all bleeder screws and fittings from each housing.

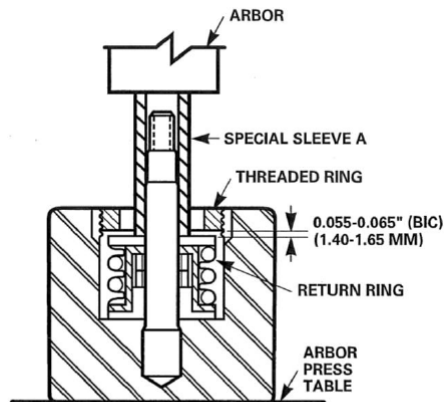
Piston Assembly

Note: Disassembly of the piston subassembly during brake overhaul is not mandatory. Clean piston subassembly thoroughly. If the piston surface and wear limit are within acceptable limits and the piston assembly passes the function tests for adjusting grip force, spring force, and built in clearance (BIC) it may be returned to service. See Section 4 for inspection and testing procedures.

WARNING

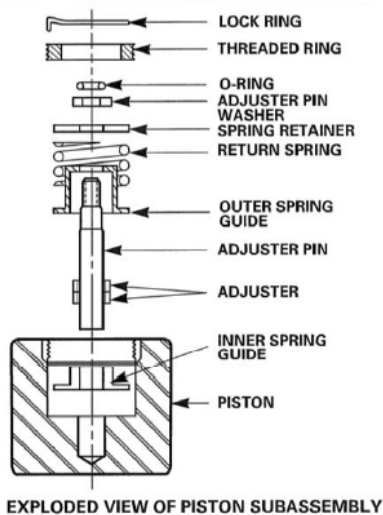
Observe all warnings and cautions provided by the press manufacturer to avoid damage to components and serious personal injury.

9. Remove lock ring from the piston assembly.
10. Place the piston subassembly on an arbor press table. Use special sleeve A, **Figure 5.3**, over the adjuster pin. Lower the arbor and compress the return spring to minimum height and hold. See below illustration.



Arbor press setup for disassembly and reassembly of piston subassembly, and setting of BIC adjustment.

11. Back out the threaded ring. Use a spanner wrench if the threaded ring will not unscrew by hand.
12. Slowly raise the arbor until all compression of the piston return spring is relieved.
13. Remove the spring retainer, return spring, outer spring guide, adjusting pin with adjuster assemblies, inner spring guide and piston.



4. Inspection and Cleaning

Hazard Alert Messages

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

WARNING

To prevent serious eye injury, always wear safe eye protection when doing maintenance or service.

Inspection

Inspect the caliper, components, and disc as specified in this maintenance manual.

Linings and End Plates

CAUTION

Always replace both linings. If only one lining is replaced, possible disc damage can occur.

Remove the linings. To help prevent abnormal lining wear, replace worn, bent or cracked end plates and distorted backing plate. End plate bolts are highly stressed. Inspect end plate bolts for wear. Replace the bolts if worn.

Inspect the linings for:

- **Lining wear:** Replace the linings when the thickness of the lining is 0.125-inch (3.2 mm) from the backing plate.
- **Lining wear not even:** Replace the linings if the thickness of the two linings is significantly different. Check the pistons for correct operation. Replace the piston and/or housing if a piston is cocked in the bore. Check that the disc surface is flat and parallel to the linings.
- **Oil or grease on linings:** Replace the linings.
- **Cracks on linings:** Replace linings that have larger or deeper cracks than the small, tight cracks on the surface of the lining which are normal when the caliper is used under high temperature conditions. These cracks are referred to as "heat check cracks."

Caliper Leaks

Inspect the following areas for fluid leaks.

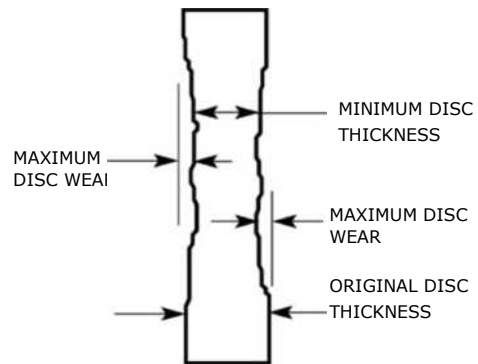
- **Pistons.** If fluid leaks at a piston, disassemble the caliper. Inspect the piston, the bore, the seals and the backup rings. Service as necessary.
- **Elbow fitting, tee fitting or connector.** If fluid leaks at the fitting, tighten the fitting. If the leak continues, replace the O-ring and the fitting.
- **Tube assembly.** If fluid leaks from the tube assembly, tighten or replace the tube or fitting.
- **Bleeder screw.** If fluid leaks at the bleeder screw, tighten the bleeder screw. If the leak continues, replace the bleeder screw.
- **Inlet fitting.** If fluid leaks at the inlet fitting, tighten the fitting. If the leak continues, replace the O-ring.

Dust Boots

Verify that the dust boots are soft and flexible or that the wiper seals are not worn or damaged. Disassemble the caliper and replace dust boots or wiper seals that are worn or damaged.

Disc

If the disc is worn beyond the wear limits, replace the disc. Refer to the specifications of the vehicle manufacturer for wear limits that may be different from those shown below.



TYPICAL SECTION THROUGH DISC SHOWING RECOMMENDED MAXIMUM WEAR LIMITS

Original Disc Thickness (in.)	Lining Part Number	Maximum Disc Wear (in.)	Minimum Disc Thickness (in.)
1.250	244-8011	0.055	1.140
1.250	244-8128	0.125	1.000
1.275	244-8011	0.070	1.135
1.275	244-8128	0.128	1.000

4. Inspection and Cleaning

Caliper Parts

1. Inspect the pistons, housing bores, and O-ring grooves for scratches or corrosion. Remove small scratches or corrosion with fine emery cloth. Replace the component if it is worn beyond wear limits or if there are large scratches or large amounts of corrosion.
2. Measure the outer diameter of the piston. Replace the piston if the outer diameter is less than 3.619-inches (91.92 mm).
3. Measure the diameter of the housing bore. Replace the housing if the diameter exceeds 3.629- inches (92.18 mm).
4. Inspect the linings as described in this section.

NOTE: Replace any component that has thread damage that cannot be repaired.

5. Inspect caliper ports and end plate bolt holes for thread damage. Use the appropriate taps lubricated with light oil to inspect tapped holes for thread damage and to clean up minor thread damage.

Fluid ports	0.4375-20 UNF-2B Tap 0.5625-18 UNF-2B Tap
End plate bolt holes	0.7500-16 UNF-2B Tap

6. Discard all backup rings, seals and dust boots. Use new ones when you assemble the caliper.

Cleaning

WARNING

Solvent cleaners can be flammable, poisonous and cause burns. Examples of solvent cleaners are carbon tetrachloride, and emulsion-type and petroleum-based cleaners. Read the manufacturer's instructions before using a solvent cleaner, then carefully follow the instructions. Also follow the procedures below.

- * Wear safe eye protection,
- * Wear clothing that protects your skin.
- * Work in a well-ventilated area.
- * Do not use gasoline, or solvents that contain gasoline. Gasoline can explode.
- * You must use hot solution tanks or alkaline solutions correctly. Read the manufacturer's instructions before using hot solution tanks and alkaline solutions. Then carefully follow the instructions.

CAUTION

Do not use hot solution tanks or water and alkaline solutions to clean ground or polished parts. Damage to parts can result.

1. Use solvent cleaners to clean all metal parts that have ground or polished surfaces. Examples of ground or polished parts are the piston and the piston bore in the caliper.
2. Use solvent cleaners or alkaline solutions to clean metal parts with rough surfaces.
3. Use a wire brush to clean the threads of fasteners, and fittings.
4. Use soap and water to clean parts that are not made of metal.
5. Scrape away build-ups of mud and dirt on the linings. Replace all linings contaminated with oil or grease.
6. Immediately after cleaning, dry all parts with clean paper or rags.

Corrosion Protection

Apply brake system fluid to the cleaned and dried parts that are not damaged and are to be immediately assembled. Do NOT apply fluid to the brake linings or the disc.

If parts are to be stored, apply a special material that prevents corrosion to all surfaces. Do NOT apply the material to the brake linings or the disc. Store the parts inside special paper or other material that prevents corrosion.

Prepare Parts for Assembly

Check

Piston Assembly Return Spring Force and Built-In Clearance (BIC)

Note: Spring force can be checked on each individual spring. See Piston return spring section.

WARNING

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

1. Place the piston subassembly onto a spring tester table. Install special sleeve Figure 5.3. over the exposed adjuster pin. Figure 4.1.
2. Set a dial indicator between the spring tester arbor and table. Use a dial indicator with a total range of 0.100-0.125-inch (2.54-3.1 mm) such as Federal Mod 06K or C71, or equivalent, having a ± 0.020 or 0.025-inch (0.508 or 0.635 mm) scale with 0.0005-inch (0.0127 mm) increments.
3. Lower the spring tester arbor to compress the spring to minimum height. Figure 4.1. The indicator pointer will stop rotating.

4. Hold the spring compressed and rotate the indicator dial to indicate ZERO.
5. Raise the arbor slowly until the spring tester force scale reads ZERO; indicator dial reading will be the BIC (Built-In Clearance).
6. Lower the arbor slowly until the indicator again reads ZERO; the spring tester force scale will now indicate the spring return force.

NOTE: The return spring force should be a minimum of 250 lbs. (113 kg) when the spring is compressed the maximum

7. Slowly raise and lower the arbor several times to verify both BIC and spring return force. The BIC should be between 0.055-0.065-inch (1.40-1.65 mm). If not in this range, readjust the BIC. Refer to Section 5. Recheck for the correct BIC, Step 3 through Step 5 above.

CAUTION

If one defective spring is found, the other return springs in the same brake assembly should also be replaced. Overheating of the brake in service usually causes this condition. Also check for hardening and compression set of the piston seals and backup rings and for bluing of steel back plates of the linings, etc. The free height of the return springs should be 0.872-inches (22.15 mm). The springs must not be reinstalled it below 0.850-inches (21.59 mm) free height.

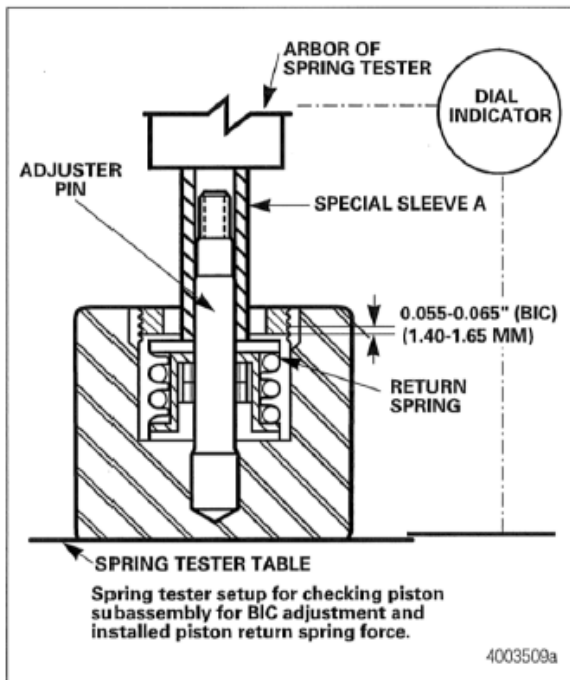


Figure 4.1

Prepare Parts for Assembly

Check

Piston Assembly Adjuster Grip Force

Note: Grip force can be checked with on each individual adjuster pin assembly. See adjuster force section.

1. Inspect the piston assembly adjuster grip force. This is the force required to cause the adjuster pin to slip in the pair of adjuster grip subassemblies.
2. See Figure 4.2 and Figure 4.3 for recommended tools needed to perform the grip force test.

Note: The Calibrate Spring Pod (Figure 4.2) is not needed if the press has a gauge capable of reading up to 800lbs of force.

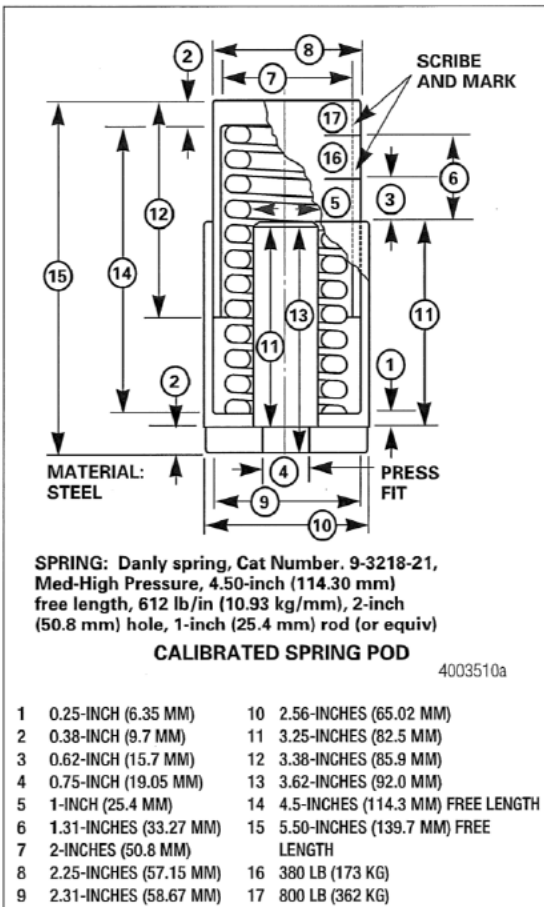


Figure 4.2

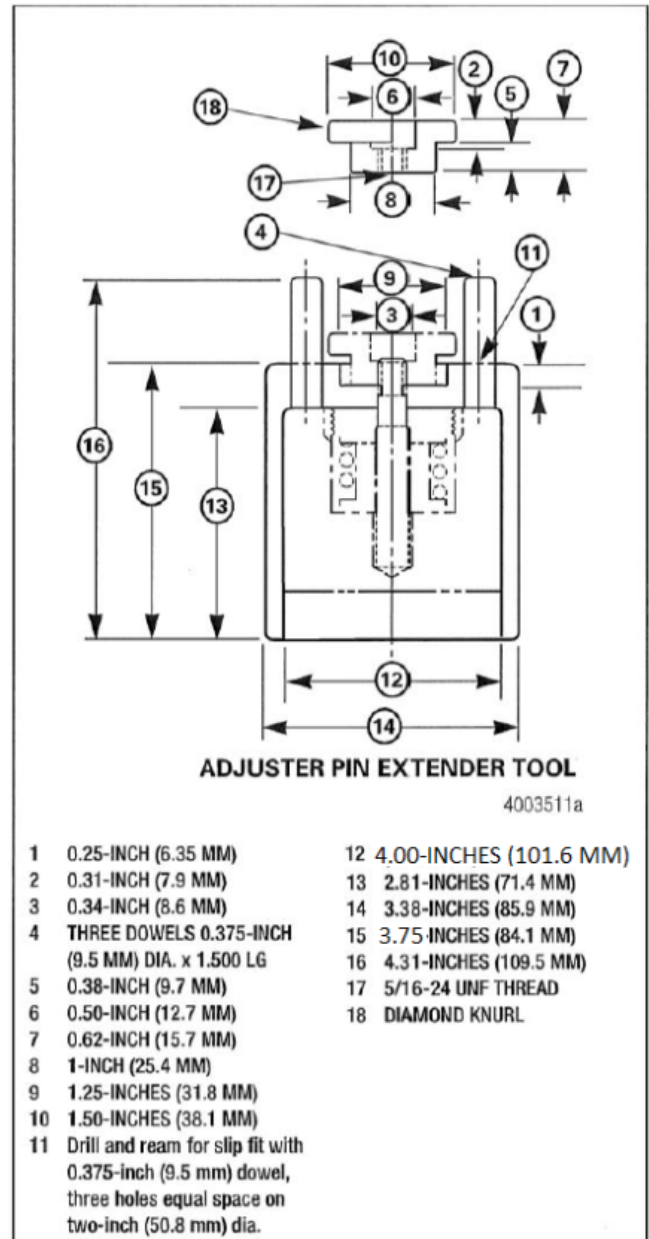


Figure 4.3

CAUTION

Do not use a commercially available spring tester for making adjuster force measurements. Sudden adjuster force release can damage such a tester, requiring repair and recalibration.

- At the arbor press, place the piston assembly on top of the special calibrated spring pod. Slowly lower the arbor to push in the extended adjuster pin as shown in View A, Figure 4.4. The adjuster pin should slip into the adjuster and move downward at a force between 380-800 lbs. (173-362 kg).

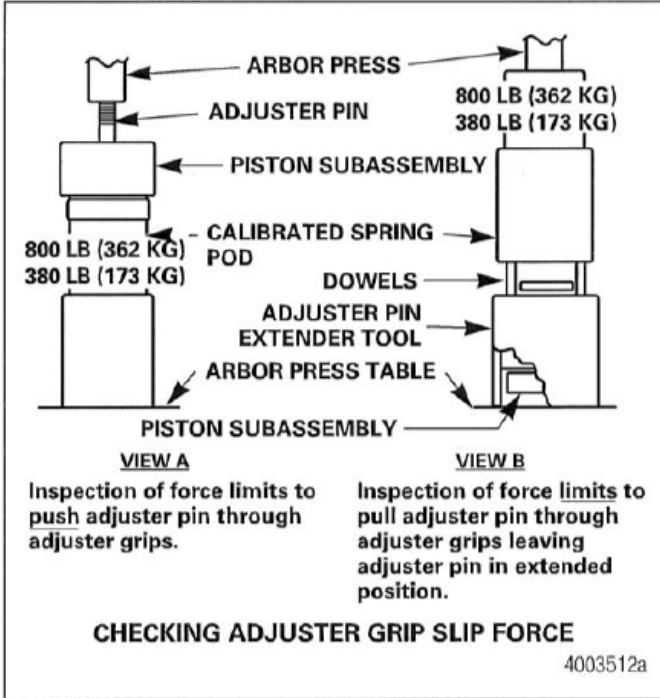


Figure 4.4

- Insert the piston assembly into the adjuster pin extender tool and secure firmly using the knurled nut on the threads of the adjuster pin. Place the special tool and piston assembly under the arbor and drop in three 0.375-inch (9.5 mm) dowel pins as shown in View B, Figure 4.4. Place the calibrated spring pod on top of the dowels.
- Apply arbor force slowly to the top of the calibrated spring pod and observe that slippage occurs between 380-800 lbs. (173-362 kg).
- If adjuster slippage occurs below 380 lbs. (173 kg) minimum or above 800 lbs. (362 kg) maximum force, replace the adjuster pin and adjuster in the piston assembly. Refer to Section 3.

Prepare Parts for Assembly

Adjuster Force

WARNING

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

CAUTION

Do not use the spring tester for making adjuster force measurements. Sudden adjuster force release can destroy calibration and possibly result in damage to the tester.

To obtain adjuster force measurements of the adjuster subassemblies installed onto the adjuster pin, it is necessary to have either a force-calibrated hydraulic shop press, or a calibrated spring pod, Figure 4.2, available for use with a standard arbor press. Obtain force measurements as illustrated in Figure 4.5.

1. Place the spring pod on the arbor press table. Use both special sleeves, Figure 5.3, as shown in Views A and B of Figure 4.5 to slip the adjuster back and forth several times on the adjuster pin.

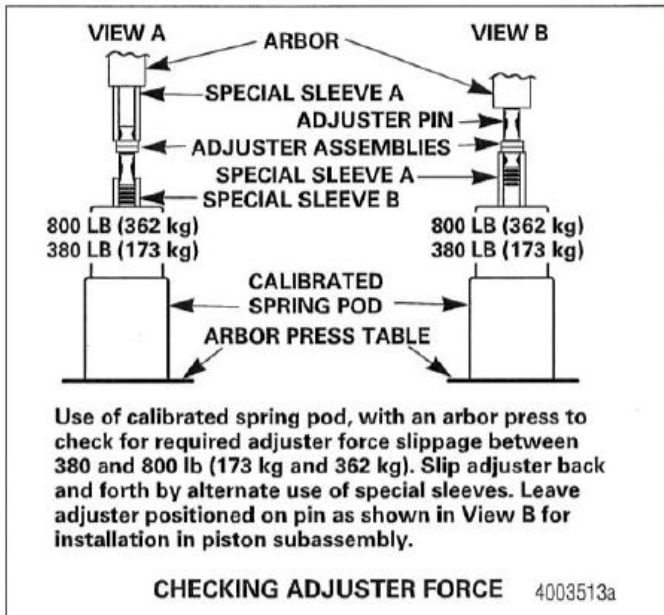


Figure 4.5

2. Apply force from the arbor slowly to observe that slippage occurs between the 380 and 800 lb. (173 and 362 kg) markings on the spring pod.
3. If slippage occurs between the specified force limits, slip the adjuster to position on the pin as shown in Figure 4.5, View B, and reinstall it into the piston subassembly.

NOTE: Any rework of the adjuster pin must be avoided unless absolutely necessary.

4. If slippage occurs below the 380 lb. (173 kg) limit, either the adjuster or adjuster and adjuster pin must be replaced. Use special sleeve A and the arbor press to slip both adjuster assemblies off the adjuster pin. Inspect the adjuster pin for nicks and wear. Adjuster pins with slight nicks that can be polished out by hand can be reused if subsequent slip inspection is acceptable. Replace adjuster pins that are bent or worn to less than 0.374-inch (9.499 mm) diameter. Burred adjuster pin threads can be repaired with a 5/16-24 UNF-3A thread die.

CAUTION

Adjusters and adjuster pins are critical items in the operation of the piston return mechanism and must not be mishandled. Under no circumstances should the pin diameter be clamped in a vise or gripped with pliers. In normal use, the surface of the pin will show only a very slow rate of wear and both pins and adjusters will normally outlast many brake lining changes and brake overhauls.

5. If required, install the adjuster on the adjuster pin as follows. Figure 4.6.

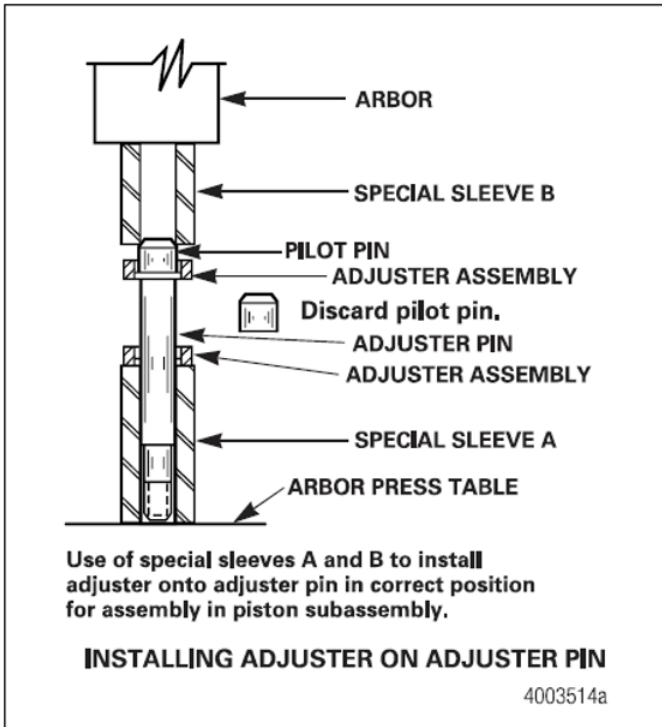


Figure 4.6

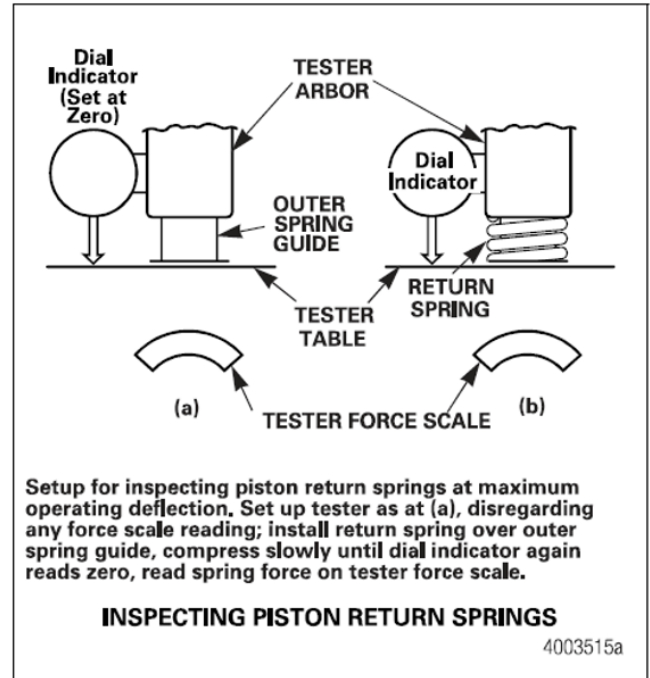


Figure 4.7

- A. Place the adjuster and pilot pin subassembly onto the end of the adjuster pin.
- B. Press the adjuster off the expendable pilot pin, onto the adjuster pin. Figure 4.6.
- C. Press the second adjuster onto the adjuster pin.
- D. Continue to push the adjuster along the adjuster pin until it contacts the previously installed adjuster.
- E. After assembly, check the adjuster force of the adjuster assembly.

Inspection

Piston Return Spring

1. Inspect the return spring for a free height dimension of 0.872-inch (22.15 mm). A measured height of less than 0.850-inch (21.59 mm) is an indication that the brake assembly has been subjected to high temperature operation, resulting in permanent set of the spring. This causes loss of spring force at working height.
2. Measure the spring force at maximum service deflection of a spring tester. Use an outer spring guide for test setup purposes. Figure 4.7.

3. Set up the dial indicator between the tester arbor and the table. Place the outer spring guide under the tester arbor. Lower the arbor firmly onto the spring guide. Disregard any tester reading. Hold the arbor in this position and set the indicator dial to ZERO, as shown in View A. Figure 4.7.
4. Raise the arbor. Place the return spring over the spring guide and lower the arbor slowly until the dial indicator again reads ZERO. Read the spring force on the tester scale, as shown in View B. Figure 4.7.

This value is the spring return force exerted under maximum deflection installed in the piston subassembly. Because of the manufacturing tolerances, this can be as low as 250 lbs. (113 kg) but will usually measure greater than 300 lbs. (136 kg). It is recommended that springs measuring a lower force than 250 lbs. (113 kg) under these test conditions be replaced.

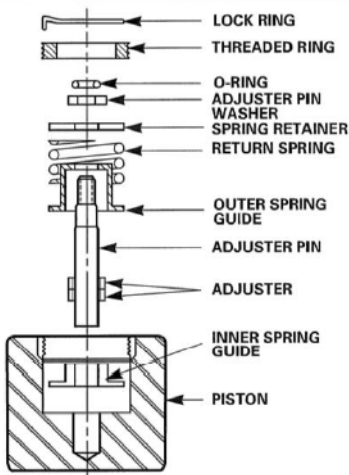
5. Assembly and Installation

WARNING

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

Piston Subassembly

1. Install the inner spring guide into the piston cavity.
2. Install the adjuster pin with the adjuster assemblies installed onto the adjuster pin.



EXPLODED VIEW OF PISTON SUBASSEMBLY

3. Install the outer spring guide.
4. Install the return spring.
5. Install the spring retainer.
6. Position the piston assembly onto an arbor press table. Figure 4.1. Use special sleeve A shown in figure 5.3 over the adjuster pin. Position the threaded ring over the special sleeve.

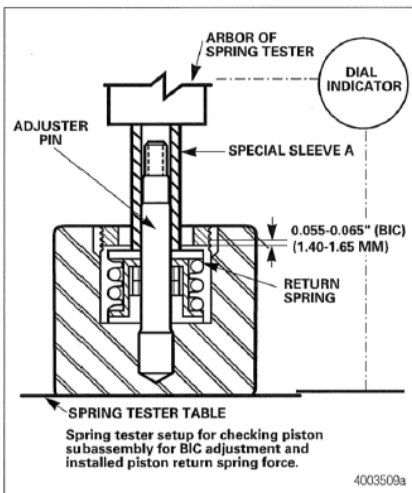


Figure 4.1

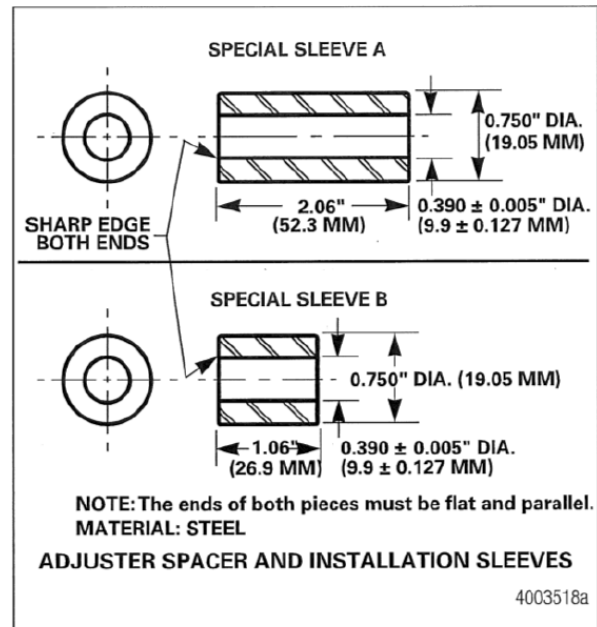


Figure 5.3

7. Slowly lower the arbor and compress the return spring to minimum height and hold.
8. Screw the threaded ring against the spring retainer, using a spanner wrench to ensure that the threaded ring is bottomed. Holding the spring compressed, back off the threaded ring one full turn, plus the additional amount needed to install the lock ring into the first available lock ring position.

NOTE: This procedure provides the required built-in clearance (BIC).

9. Raise the arbor, removing the piston assembly from the arbor press and install lock ring.

5. Assembly and Installation

Hazard Alert Messages

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

WARNING

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

CAUTION

Use only the specified components when you assemble the caliper. Do not mix components from other calipers. If you install the incorrect components, the caliper will not operate correctly and may cause damage to the equipment. Use of non-Carlisle parts may cause incorrect operation of the brakes.

Assembly

Caliper

1. Lubricate all pistons, bores, new seals and new backup rings with silicone grease such as Dow Corning DC-4 or equivalent. If silicone grease is not available, use the same type of fluid that is used in the brake system. Do not use lubrication on the dust boot.

NOTE: Rubber spring return (RSR) seals provide slightly more piston retraction than O-rings when the brake is disengaged. Brakes equipped with RSR seals instead of O-rings will have slightly more running clearance between the linings and the disc and maintain the running clearance with slightly higher pressure present when the brakes are disengaged. RSR seals may be obtained as a service kit and installed into brakes that originally were equipped with O-rings.

2. Install new seals and new backup rings into the bore grooves.
 - If the brake is equipped with O-rings seals: Refer to Figure 5.1.
 - If the brake is equipped with rubber spring return (RSR) seals: Refer to Figure 5.2.

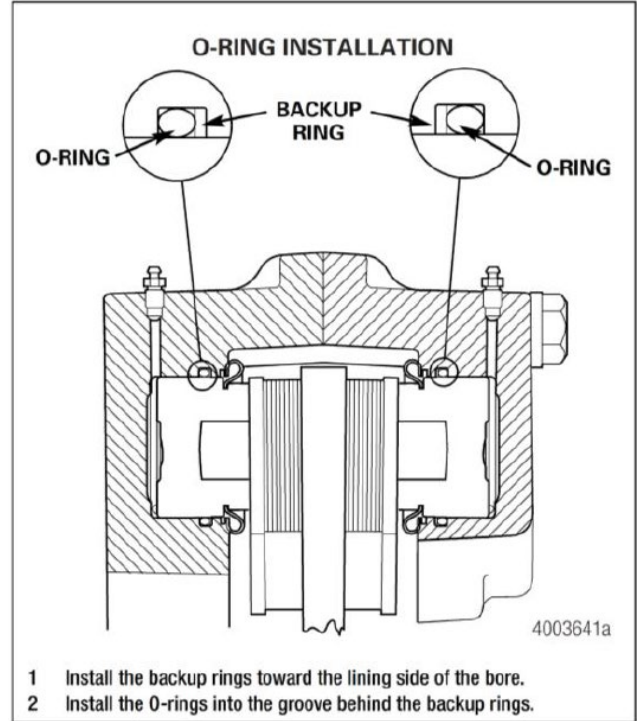


Figure 5.1

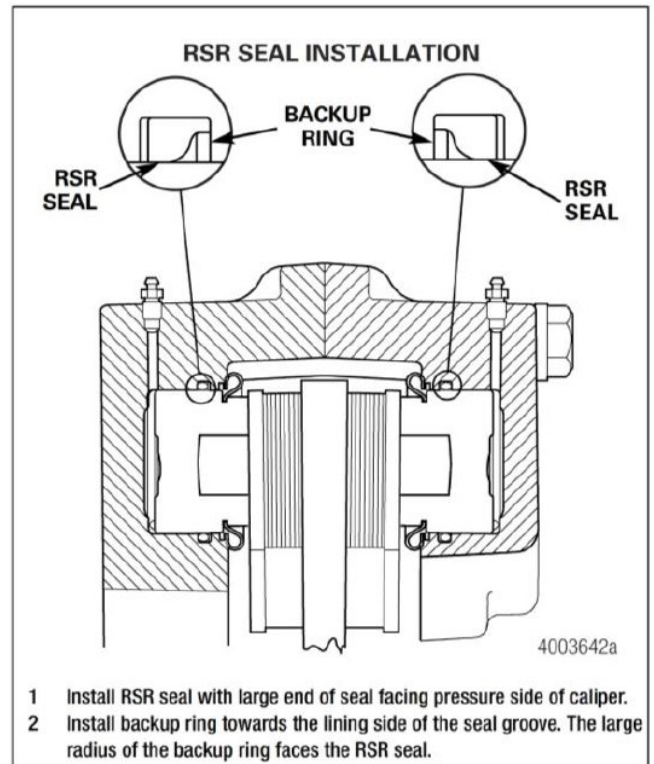


Figure 5.2

5. Assembly and Installation

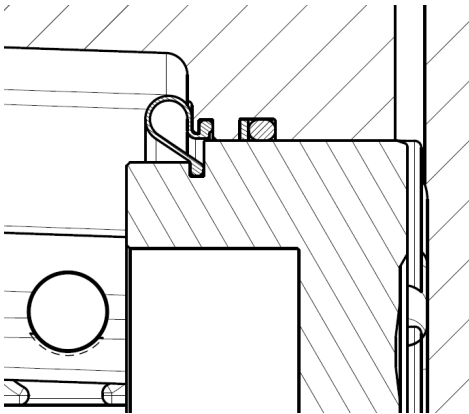
3. Install the pistons into the housings.

- A. Seat each piston evenly around each O-ring seal and with even pressure, push the pistons through the O-ring and backup ring. Prevent the piston from cocking in the bore.
- B. For pistons with retractors:
 1. Ensure the retractor pin is aligned with its hole in the housing.
 2. Install a lock washer and lock nut onto each piston pin.
 3. Hold the adjuster pin using a 5/32-inch Allen wrench and tighten the nuts to 120-150 lb.-in. (13.6-17.00 N.m).
 4. Use a C-Clamp or arbor press to bottom the piston out in the housing. Re-Torque locknuts to 120-150 lb.-in. (13.6-17.00 N.m).

CAUTION

When tightening the nuts, avoid turning the adjuster pins. This can cause damage to the O-ring and cause the seal to leak.

4. Install the dust boots. Verify that they are completely installed into the housing groove and into the piston groove, as shown below



CAUTION

If the dust boots are not completely installed into the housing groove, the piston will cut and damage the dust boot when pressure is applied.

4. Apply Loctite® 271 thread locker or equivalent to the threads of the end plate bolts. Install the end plates onto the housing. Tighten the bolts to 380-460 lb.-ft. (515-624 N.m).

WARNING

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

6. Install the lining into each half of the brake. Make sure the linings interface with the endplates properly and slides freely. Keep the face of the lining free from any oil, grease, paint or other contaminants. Use masking tape if necessary.

CAUTION

Always replace both linings. If only one lining is replaced, possible disc damage can occur.

7. Install the inlet fittings and bleeders so the bleeders are at the high end of the housing when installed onto the vehicle. Tighten the bleeders to 100-180 lb.-in. (11.3-20.3 N.m).

Test

1. Caliper can be tested as a whole brake with mounting bolts installed or each half brake can be tested individually.
2. Ensure there are bleeders in all ports except one port to be used for oil supply. Install hydraulic inlet line to this port
3. Place a 1.25 inch thick steel spacer in the caliper between linings to limit piston travel during test, if testing the caliper as a whole. Use a fixture or some other method to limit piston movement when testing the halves individually.
4. Evacuate air from the caliper assembly using bleeder(s) oriented at the top of the caliper.
5. Clean the assembly of any oil or debris.
6. Apply 3,000 psi to the assembly and allow pressure to stabilize for 2-3 minutes.
7. Inspect caliper for any signs of oil leakage
8. After successful test results (no observed oil leakage), remove the spacer and linings.
9. Press pistons back into their bores completely before completing assembly and installing caliper to vehicle.

5. Assembly and Installation

Installation

Caliper

1. If shims are used, place the shims in the position marked during removal.

▲ WARNING

The housings are very heavy. The housings must be supported during installation. Serious personal injury or damage to the caliper can occur if the caliper housings fall.

2. Use a lifting device to move the inner caliper housing in position. Install special studs in the center two O.D. mounting holes. Figure 3.1.

3. If the disc was removed, reinstall the disc. Tighten the disc fasteners to the vehicle manufacturer's specified torque.

4. Slide the outer housing subassembly over the studs.

▲ CAUTION

The fasteners must be tightened to the specified torque. The torque places preload on the caliper housings. If the fasteners are not tightened to the specified torque, the brake will be damaged when hydraulic pressure is applied.

5. Install the fasteners that attach the housings to the vehicle.

- If the fastener threads are lubricated with oil:
Tighten the fasteners to 725 lb.-ft. (982 N.m).
- If the fastener threads are dry: Tighten the fasteners to 967 lb.-ft. (1311 N.m).

6. Verify that the disc is within ± 0.06 -inch (1.5 mm) of being centered between the lining end plates.

• **To increase outboard clearance and decrease inboard clearance:**

Install a shim either between the housing and mounting bracket or between the hub and disc. The shims must be steel, ground flat and parallel and must cover the entire mounting surface of the hub or housing. The linings must move freely in the housing and between the end plates.

Figure 5.35

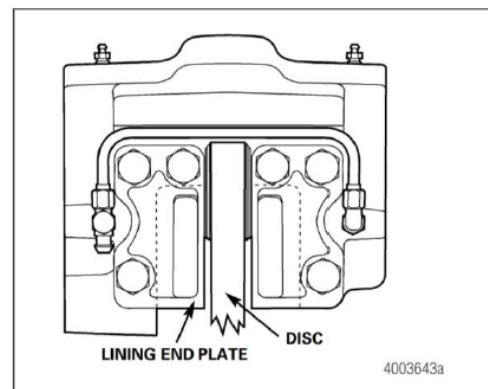


Figure 5.35

7. If necessary, reverse the locations of the bleeders and the inlet fittings so the bleeders are at the highest end of the housings. Install the bleeder screws, T-fitting and elbow fitting. Connect the crossover tube to the fittings. Tighten all the fittings.

8. Remove the plug from the brake line. Connect the brake line to the inlet fitting.

9. If not installed during caliper assembly, install the brake linings. Refer to the procedure in this section.

10. Bleed the brakes. Refer to the procedure in this section.

11. Apply and release the brakes three times to verify that the caliper operates correctly. Check for fluid leaks. Verify that the linings move freely in the caliper.

12. Burnish new brake linings before releasing vehicle for operation. Refer to the procedure in this section.

Bleeding the Brakes

WARNING

When you loosen any brake system hydraulic connection, you must bleed the brakes to remove all air from the system. Air can prevent hydraulic pressure from applying the brakes correctly which could increase the stopping distances. Serious personal injury and damage to components can result.

Note: The SCL 19 and SCL 56 are designed to bleed correctly when mounted at the three, nine or 12 o'clock position.

Always start at the point in the system that is furthest from the master cylinder and work back toward the master cylinder. Bleed every bleeder screw on every caliper on every wheel. When you complete a bleeder screw, go to the next closest bleeder screw on the same caliper. When you complete a caliper, go to the next closest caliper on the same wheel. When you complete a wheel, go to the furthest bleeder screw on the next closest wheel.

WARNING

Use only the type of hydraulic fluid specified by the equipment manufacturer. Do not use or mix different types of hydraulic fluid. The incorrect hydraulic fluid will damage the rubber parts of the caliper and cause loss of braking. Serious personal injury and damage to components can result. Do not reuse hydraulic fluid. Used fluid can be contaminated and can cause incorrect operation. Serious personal injury and damage to components can result.

1. Verify that the master cylinder is filled to the specified level with the type of hydraulic fluid specified by the equipment manufacturer. Keep the master cylinder filled during bleeding so that you do not pull air into the system through the master cylinder. Verify that the master cylinder is filled when you are done bleeding the system.
2. Place a clear tube on the bleeder screw. Submerge the other end of the tube in a clear container of the specified fluid.

3. Bleed the brakes.

- **For full hydraulic systems:** Slowly apply low hydraulic pressure to the caliper. Loosen the bleeder screw. Continue to apply pressure until there are no air bubbles in the fluid. Tighten the bleeder screw 100-120 lb.-in. (11.3-13.5 N.m) and then release the pressure to the caliper.
- **For air/hydraulic or mechanical actuator systems:** Apply the brake pedal and then loosen the bleeder screw. Tighten the bleeder screw 100-120 lb.-in. (11.3-13.5 N.m) before you release the brake pedal so that air is not pulled back into the system. Repeat until there are no air bubbles in the fluid when you apply the brake pedal and loosen the bleeder screw.

4. Check for fluid leaks.

Burnish the Linings

CAUTION

Front brakes may require burnishing independently from rear brakes in order to control disc temperatures. Do not exceed 800° F (427° C) disc temperatures during burnish.

1. If necessary, disconnect the rear brakes so that the front brakes can be burnished independently.
2. Drive the vehicle on level terrain while dragging only the front brakes until the front disc temperatures reach or exceed 600° F (316° C).
3. Cool the front brake discs to approximately 250° F (121° C) between brake dragging cycles.
4. Repeat Step 2 to burnish the front brakes a second cycle.
5. If the linings smoke or smell, continue burnishing until the smoke and smell are gone.
6. Reconnect the system to operate the front and rear brakes. After the front brakes are cooled to approximately 250° F (121° C), release the vehicle for operation.

6. Diagnostics

Troubleshooting

Table A: Brake Does Not Apply

Condition	Possible Causes	Actions Required
No pressure to brake	Empty fluid reservoir	Fill the reservoir to the correct level with the specified fluid
	Damage to hydraulic system	Repair the hydraulic system
Piston does not move	No pressure to brake	Fill the reservoir to the correct level with the specified fluid
	Piston cocked in bore	Tear the brake down and check piston diameter and bore diameter to the specifications listed in this manual.
Brake leaking	Loose bleeder screw	Tighten the bleeder screw to 100-180 lb-in (11.3-20.3 N.m.)
	Loose inlet fitting	Tighten inlet fitting to vehicle manufacturer's specification
	Damaged bleeder screw or inlet fitting	Replace bleeder screw or inlet fitting
	Worn or damaged seals or backup ring	Replace the seals and backup rings. Inspect piston for piston and housing bore for wear or damage. Service as necessary.
Damaged Linings	Lining thickness less than .125 inch (3mm)	Replace the linings
	Lining wear not even	Check piston diameter and bore diameter to the specifications listed in this manual. Inspect housings for clogged fluid passages. Service as needed. Replace worn end plates.
	Cracked or broken linings	Replace the linings
	Oil or grease on linings	Replace the linings

Troubleshooting

Table B: Brake Does Not Release

Condition	Possible Causes	Actions Required
Vehicle does not move	Parking brake applied	Release the parking brake.
	Damaged hydraulic system	Repair the hydraulic system.
Brakes dragging on disc and running too hot	Pressure (more than 3 psi or 0.207 bar) Applied when brakes are released	Repair the hydraulic system so that the pressure is less than 3 psi (0.207 bar) when brakes are released. If the pressure is not significantly greater than 3 psi (0.207 bar), a rubber spring return (RSR) seal may correct the problem. Refer to Section 5.
	Vehicle or equipment not operated correctly	Advise the operator on correct vehicle or equipment operation.
	Piston cocked in bore	Tear the brake down and check piston diameter and bore diameter to the specifications listed in this manual. Replace the linings wear is tapered. Remove dirt and other material between the lining and piston.
	Worn or damaged end plates	Replace worn or damaged end plates. Verify that the linings move freely between the end plates.

7. Specifications

Torque Specifications			
Description	Lb-Ft	Lb-In	N.m
Bleeder Screw		100-180	11.3-20.3
End Plate Bolts	380-460		515.2-623.6
Mounting Bolts Lubricated	725		982
Mounting Bolts Dry	967		1311
Piston Lock Nut		120-150	13.6-17.0