BRAKES

CONTENTS

BASE BRAKE SYSTEM

INDEX

1998 RAM TRUCK
Publication No. 81-370-8108
TSB 26-12-99 December, 1999

GENERAL INFORMATION

BRAKE SYSTEM

This vehicle is equipped with front disc brakes and rear drum brakes. The front disc brakes consist of single piston calipers and ventilated rotors. The rear brakes are dual brake shoe, internal expanding units with cast brake drums. The parking brake mechanism is cable operated and connected to the rear brake trailing shoes. Power brake assist is standard equipment. A vacuum operated power brake booster is used on gas engine vehicles. A hydraulic booster is used on diesel engine vehicles.

Two antilock brake systems are used on this vehicle. A rear wheel antilock (RWAL) brake system is standard. An all-wheel antilock brake system (ABS) is available as an option. The RWAL and ABS systems are designed to retard wheel lockup while braking. Retarding wheel lockup is accomplished by modulating fluid pressure to the wheel brake units. Both systems are monitored by a microprocessor which controls the operation of the systems.

SERVICE WARNINGS & CAUTIONS

WARNING: DUST AND DIRT ACCUMULATING ON BRAKE PARTS DURING NORMAL USE MAY CONTAIN ASBESTOS FIBERS FROM PRODUCTION OR AFTERMARKET LININGS. BREATHING EXCESSIVE CONCENTRATIONS OF ASBESTOS FIBERS CAN CAUSE SERIOUS BODILY HARM. EXERCISE CARE WHEN SERVICING BRAKE PARTS. DO NOT CLEAN BRAKE PARTS WITH COMPRESSED AIR OR BY DRY BRUSHING. USE A VACUUM CLEANER SPECIFICALLY DESIGNED FOR THE REMOVAL OF ASBESTOS FIBERS FROM BRAKE COMPONENTS. IF A SUITABLE VACUUM CLEANER IS NOT AVAILABLE, CLEANING SHOULD BE DONE WITH A WATER DAMPENED CLOTH. DO NOT SAND, OR GRIND BRAKE LINING UNLESS EQUIPMENT USED IS DESIGNED TO CONTAIN THE DUST RESIDUE. DISPOSE OF ALL RESIDUE CONTAINING ASBESTOS FIBERS IN SEALED BAGS OR CONTAINERS TO MINIMIZE EXPOSURE TO YOURSELF AND OTHERS. FOLLOW PRACTICES PRESCRIBED BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION AND THE ENVIRONMENTAL PROTECTION AGENCY FOR THE HANDLING, PROCESSING, AND DISPOSITION OF DUST OR DEBRIS THAT MAY CONTAIN ASBESTOS FIBERS.

CAUTION: Never use gasoline, kerosene, alcohol, motor oil, transmission fluid, or any fluid containing mineral oil to clean the system components. These fluids damage rubber cups and seals. Use only fresh brake fluid or Mopar brake cleaner to clean or flush brake system components. These are the only cleaning materials recommended. If system contamination is suspected, check the fluid for dirt, discoloration, or separation into distinct layers. Also check the reservoir cap seal for distortion. Drain and flush the system with new brake fluid if contamination is suspected.

CAUTION: Use Mopar brake fluid, or an equivalent quality fluid meeting SAE/DOT standards J1703 and DOT 3. Brake fluid must be clean and free of contaminants. Use fresh fluid from sealed containers only to ensure proper antilock component operation.

CAUTION: Use Mopar multi-mileage or high temperature grease to lubricate caliper slide surfaces, drum brake pivot pins, and shoe contact points on the backing plates. Use multi-mileage grease or GE 661 or Dow 111 silicone grease on caliper bushings and slide pins to ensure proper operation.

DESCRIPTION AND OPERATION

BRAKE PEDAL

The brake booster is operated by a suspended type brake pedal. The pedal pivots on a shaft located in a mounting bracket attached to the dash panel. The pedal shaft is supported by bushings in the pedal and mounting bracket.

STOP LAMP SWITCH

The plunger type stop lamp switch is mounted on a bracket attached to the brake pedal support. The switch can be adjusted when necessary.

RED BRAKE WARNING LAMP

A red warning lamp is used for the service brake portion of the hydraulic system. The lamp is located in the instrument cluster. The red warning light alerts the driver if a pressure differential exists between the front and rear hydraulic systems or the parking brakes are applied.

The lamp is turned on momentarily when the ignition switch is turn to the on position. This is a self test to verify the lamp is operational.

POWER BRAKE BOOSTER

All gas engine vehicles are equipped with a tandem (dual) diaphragm power brake booster (Fig. 1). Two versions are used. A standard duty is used in all 1/2 ton models and a higher output version is used in 3/4 and 1 ton models. The standard and high output boosters are identified by code letters on the forward face of the booster (Fig. 1).

DESCRIPTION AND OPERATION (Continued)

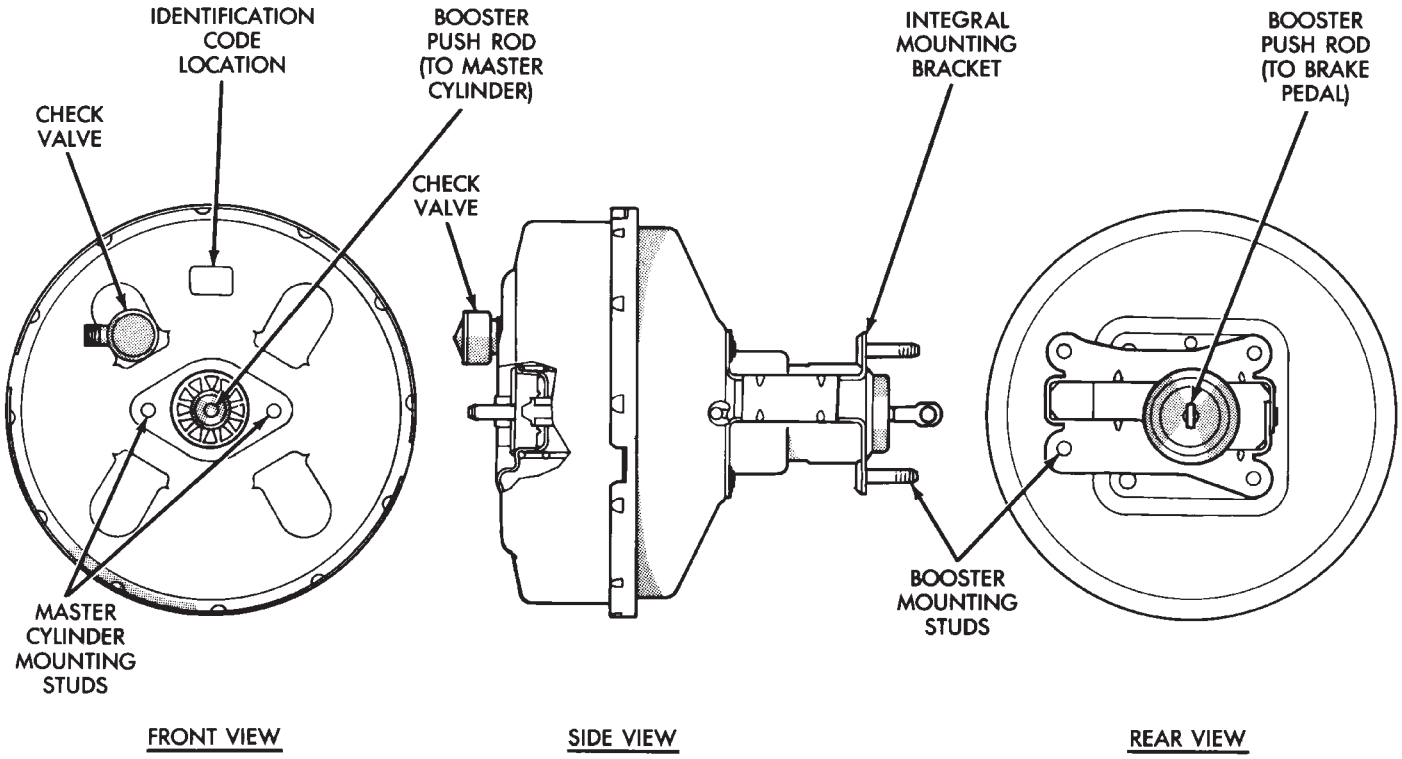


Fig. 1 Power Brake Booster

Booster I.D. code letters are as follows:

- 1/2 ton booster code: ZK
- 3/4 and 1 ton booster code: ZL

The only serviceable power brake booster components are the vacuum hose and check valve. The booster itself is not a repairable component. The booster must be replaced as an assembly whenever diagnosis indicates a fault has occurred.

VACUUM BRAKE BOOSTER OPERATION

The booster assembly consists of a housing divided into separate chambers by two internal diaphragms. The outer edge of each diaphragm is attached to the booster housing. The diaphragms are in turn, connected to the booster push rod.

Two push rods are used to operate the booster. One push rod connects the booster to the brake pedal. The second push rod (at the forward end of the housing), strokes the master cylinder pistons. The rear push rod is connected to the two diaphragms in the booster housing.

The atmospheric inlet valve is opened and closed by the push rod connected to the brake pedal. The booster vacuum supply is through a hose attached to a fitting on the intake manifold. The hose is connected to a vacuum check valve in the booster housing. The check valve is a one-way device that prevents vacuum leak back.

Power assist is generated by utilizing the pressure differential between normal atmospheric pressure and a vacuum. The vacuum needed for booster operation is taken directly from the engine intake manifold. The entry point for atmospheric pressure is through an inlet valve at the rear of the housing.

The forward portion of the booster housing (area in front of the two diaphragms), is exposed to manifold vacuum. The rear portion (area behind the diaphragms), is also under vacuum, but less vacuum then the forward portion.

Pressing the brake pedal causes the rear push rod to open the inlet valve. This exposes the area behind the diaphragms to atmospheric pressure. The resulting force applied to the diaphragms is what provides the extra boost in apply pressure for power assist. Pressure differential creates force imbalance and provides boost.

HYDRAULIC BRAKE BOOSTER

Vehicles equipped with a Hydraulic Booster (Fig. 2) use the booster to supply power assist to the brake system. The booster is mounted to the front cowl

DESCRIPTION AND OPERATION (Continued)

panel on a bracket. The master cylinder is mounted to the front of the booster.

The hydraulic pressure is supplied to the booster from the power steering pump. The pressure line from the pump is connected to the booster. From the booster a second pressure line is connected to the steering gear. Return lines from the booster and steering gear are connected to the power steering pump reservoir.

A nitrogen charged pneumatic accumulator on the booster provides reserve power assist pressure. If power steering pump pressure is not available (broken belt/pump failure) the accumulator reserve pressure is used. This provides 2 or 3 stops at partial boost.

BRAKE PEDAL RELEASED

With the brake pedal released most of the hydraulic fluid is routed through the booster power section and to the steering gear. A portion of the fluid is diverted into the booster power section, then returns to the power steering pump reservoir.

BRAKE PEDAL DEPRESSED

With the brake pedal depressed, the input rod and piston move forward. This causes the lever assembly to move the sleeve forward to close off the holes leading to the open center of the spool valve. A small additional lever movement, moves the spool valve forward in the spool valve bore. The spool valve then diverts some hydraulic fluid into the cavity behind the booster piston building up hydraulic pressure. This hydraulic pressure moves the piston and output rod forward. The output rod moves the primary and secondary master cylinder pistons which applies hydraulic pressure to the brake system. When the brake pedal is released, the spool and sleeve assembly returns to it's normal position. Excess fluid behind the piston returns to the power steering pump reservoir through the return hose.

MANUAL BRAKE APPLICATION

The system is designed to permit manual brake application in the event hydraulic pressure is interrupted. A somewhat greater pedal effort is required to apply the brakes manually.

MASTER CYLINDER

A two-piece master cylinder is used on all models. The cylinder body containing the primary and secondary pistons is made of aluminum. The removable fluid reservoir is made of nylon reinforced with glass fiber. The reservoir is the only serviceable component.

The fluid compartments of the nylon reservoir are interconnected to permit fluid level equalization. However, the equalization feature does not affect circuit separation in the event of a front or rear brake malfunction. The reservoir compartments will retain enough fluid to operate the functioning hydraulic circuit.

Care must be exercised when removing/installing the master cylinder connecting lines. The threads in the cylinder fluid ports can be damaged if care is not exercised. Start all brake line fittings by hand to avoid cross threading.

The cylinder reservoir can be replaced when necessary. However, the aluminum body section of the master cylinder is not a repairable component.

NOTE: If diagnosis indicates that an internal malfunction has occurred, the aluminum body section must be replaced as an assembly.

COMBINATION VALVE

The combination valve contains a pressure differential valve and switch, metering valve and a rear brake proportioning valve on 1500 models. The combination valve/rear brake proportioning valve are not repairable and must be replaced as an assembly.

PRESSURE DIFFERENTIAL SWITCH

The pressure differential switch is connected to the brake warning lamp. The switch is triggered by movement of the switch valve. The purpose of the switch is to monitor fluid pressure in the separate front/rear brake hydraulic circuits.

A decrease or loss of fluid pressure in either hydraulic circuit will cause the switch valve to shuttle forward or rearward in response to the pressure differential. Movement of the switch valve will push the switch plunger upward. This closes the switch internal contacts completing the electrical circuit to the warning lamp. The switch valve may remain in an actuated position until repair restores system pressures to normal levels.

METERING VALVE

The metering valve is used to balance brake action between the front disc and rear drum brakes. The valve holds-off the intial pressure to the front disc brakes until the rear brake shoes retracting springs are overcome. The valve is designed to maintain front brake fluid pressure at 241-517 kPa (35-75 psi) until the hold-off limit of 310-689 kPa (100 psi) is reached. At this point, the metering valve opens completely permitting full fluid apply pressure to the front disc brakes. This reduces front brake lining wear during low deceleration stops.

PROPORTIONING VALVE (1500 Model)

The proportioning valve is used to balance front-rear brake action at high decelerations. The valve

DESCRIPTION AND OPERATION (Continued)

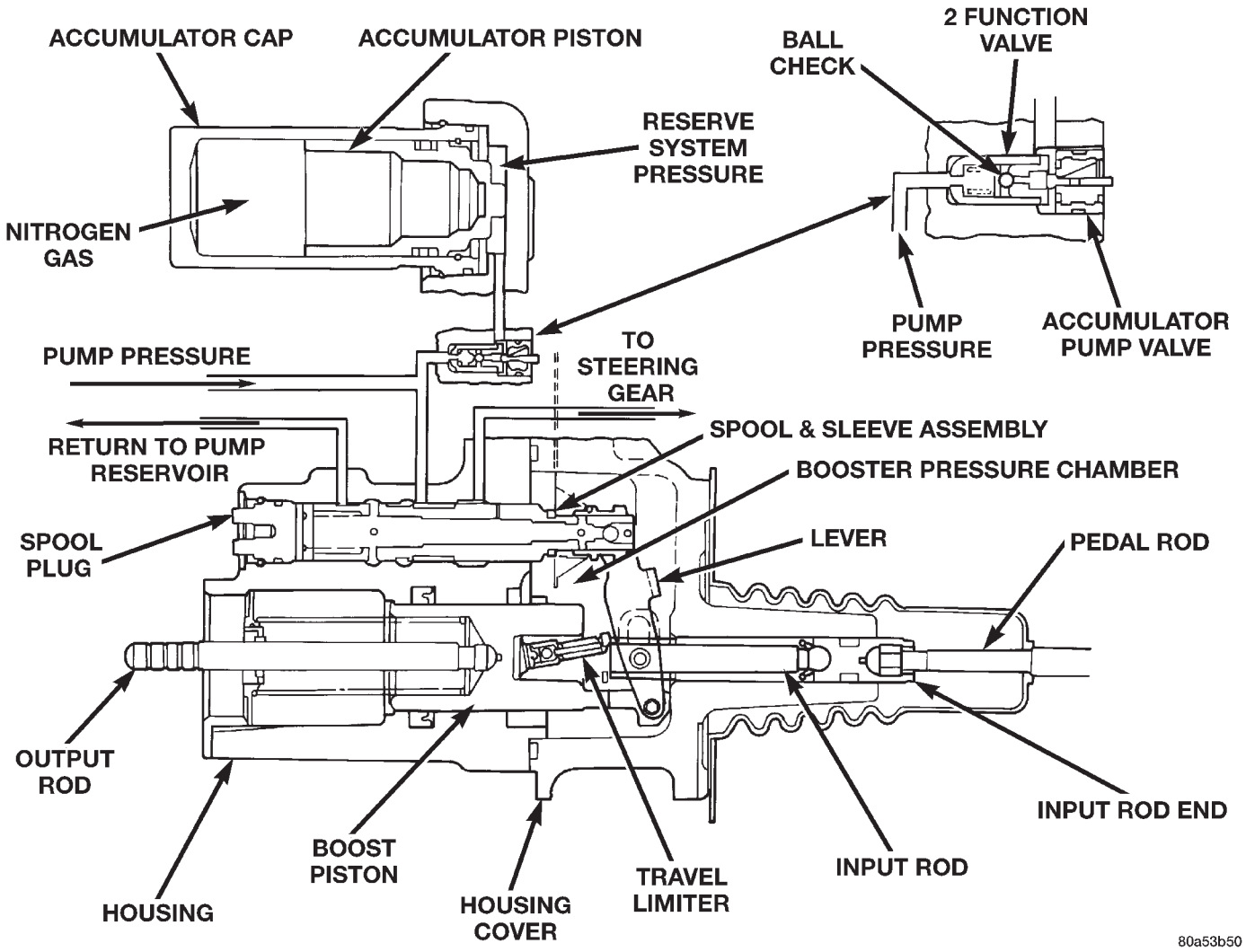


Fig. 2 Hydraulic Brake Booster

allows normal fluid flow during moderate braking. The valve only controls fluid flow during high decelerations brake stops, when a percentage of rear weight is transferred to the front wheels.

HEIGHT SENSING PROPORTIONING VALVE

The Height Sensing Proportioning Valve provides two different brake balance modes to the rear brake based on the vehicle load. This is accomplished by turning the valve on or off. When the vehicle is not loaded hydraulic pressure is reduced to the rear brakes after the split point. When the vehicle is carrying a full load the actuator lever moves up to change the valve setting. The valve now allows full hydraulic pressure to the rear brake. The valve contains a plunger, cam, torsional clutch spring and actuator shaft (Fig. 3). This valve is used on all 4WD 2500 vehicles with 8,800 GVW.

The valve is mounted to the left frame rail above the rear axle. The valve has an actuator lever connected by a link to the left lower shock bracket. The

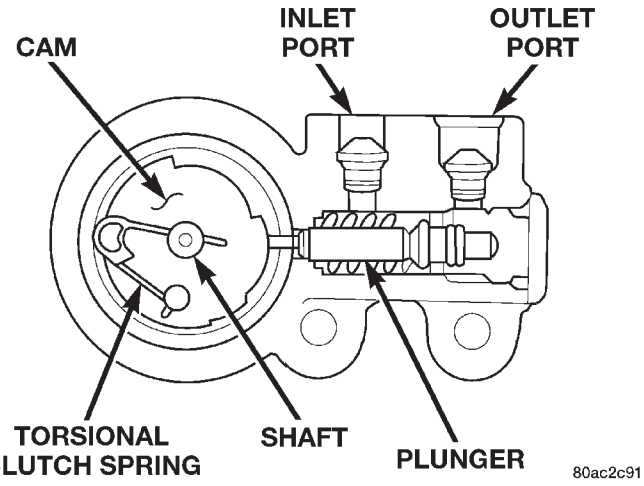


Fig. 3 Height Sensing Proportioning Valve

valve is turned on and off as the axle to frame height changes due to the load in the vehicle. A torsional clutch spring attached to the valve shaft and cam is used as an override feature. Once the valve is posi-

1998 Ram Truck BR/BE
Publication No. 81-370-8108
TSB 26-08-98 August, 1998

DESCRIPTION AND OPERATION (Continued)

tioned during brake application, the spring prevents the valve from changing position in the event of an abrupt suspension movement such as going over a bump. During this instance the cam is held in position while the shaft is allowed to rotate.

CAUTION: If the valve assembly is replaced for service, the lever must not be adjusted, it is preset at the factory. The Height Sensing Proportioning Valve is service as an assembly only.

FRONT DISC BRAKES

The calipers are a single piston type. The calipers are free to slide laterally, this allows continuous compensation for lining wear.

When the brakes are applied fluid pressure is exerted against the caliper piston. The fluid pressure is exerted equally and in all directions. This means pressure exerted against the caliper piston and within the caliper bore will be equal (Fig. 4).

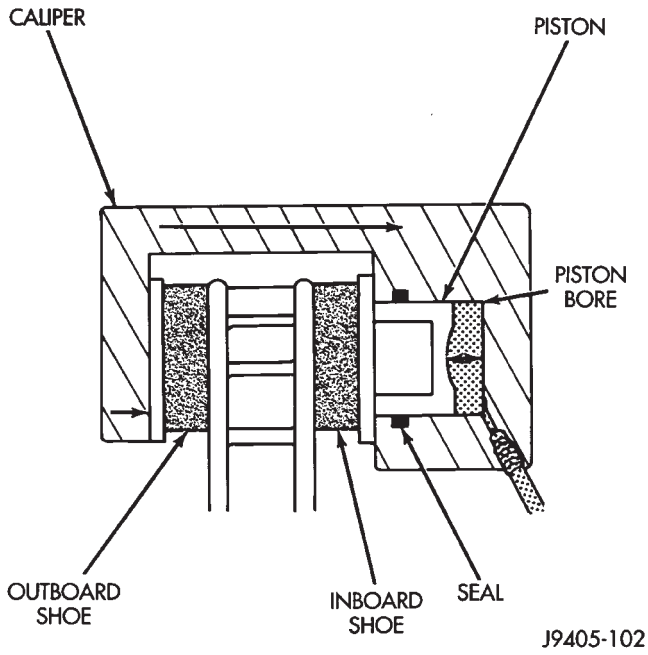


Fig. 4 Brake Caliper Operation

Fluid pressure applied to the piston is transmitted directly to the inboard brake shoe. This forces the shoe lining against the inner surface of the disc brake rotor. At the same time, fluid pressure within the piston bore forces the caliper to slide inward on the mounting bolts. This action brings the outboard brake shoe lining into contact with the outer surface of the disc brake rotor.

In summary, fluid pressure acting simultaneously on both piston and caliper, produces a strong clamping action. When sufficient force is applied, friction will stop the rotors from turning and bring the vehicle to a stop.

Application and release of the brake pedal generates only a very slight movement of the caliper and piston. Upon release of the pedal, the caliper and piston return to a rest position. The brake shoes do not retract an appreciable distance from the rotor. In fact, clearance is usually at, or close to zero. The reasons for this are to keep road debris from getting between the rotor and lining and in wiping the rotor surface clear each revolution.

The caliper piston seal controls the amount of piston extension needed to compensate for normal lining wear.

During brake application, the seal is deflected outward by fluid pressure and piston movement (Fig. 5). When the brakes (and fluid pressure) are released, the seal relaxes and retracts the piston.

The amount of piston retraction is determined by brake lining wear. Generally the amount is just enough to maintain contact between the piston and inboard brake shoe.

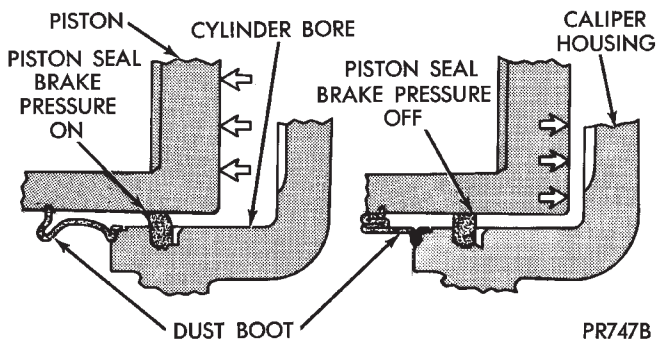


Fig. 5 Lining Wear Compensation By Piston Seal

DRUM BRAKES

All models are equipped with rear drum brake assemblies. They are two-shoe, duo-servo units with an automatic adjuster mechanism.

Three different size drum brake assemblies are used:

- 1/2 ton (1500) models: 11 x 2 in.
- 3/4 ton (2500) models: 13 x 2.5 in.
- 1 ton (3500) models: 13 x 3.5 in.

Two different wheel cylinders are used. The difference being cylinder bore size. The cylinders used are 23.8 mm (0.937 or 15/16 in.) and 27 mm (1.06 or 1-1/16 in.) diameter.

The drum brakes are a semi-floating, self-energizing, servo action design. The brake shoes are not fixed on the support plate. This type of brake allows the shoes to pivot and move vertically to a certain extent.

DESCRIPTION AND OPERATION (Continued)

In operation, fluid apply pressure causes the wheel cylinder pistons to move outward. This movement is transferred directly to the brake shoes by the cylinder connecting links. The resulting brake shoe expansion brings the lining material into contact with the rotating brake drum.

Two forces affect the brake shoes once they contact the drum. The first force being hydraulic pressure exerted through the wheel cylinder pistons. And the second force is the friction generated turning torque of the rotating drum.

The drum forces both brake shoes to move in the same direction of rotation. Servo action begins with the primary brake shoe which begins to wedge (or wrap) itself against the rotating drum surface. This force is transmitted equally to the secondary brake shoe through the adjuster screw and anchor pin. The net result is that each shoe helps the other exert extra force against the drum. It is servo action that creates the wedging (or wrap) effect which produces increased force on the drum braking surface.

All drum brake assemblies are equipped with a self adjusting mechanism. The components forming the mechanism consist of the: adjuster screw, adjuster lever, actuating lever (11 inch brake), lever return spring and the adjuster lever spring. The adjuster lever on the 13 inch brake, is also equipped with a lever and tension spring.

The adjuster mechanism performs two important functions. First, is in maintaining proper brake shoe operating clearance. And second, is to maintain brake pedal height. The mechanism does so, by adjusting the shoes in small increments to compensate for lining wear. The adjustment process is continuous throughout the useful life of the brake lining.

The adjuster components are all connected to the secondary brake shoes. Actual adjustment only occurs during reverse brake stops. Secondary brake shoe movement (during reverse stops), is what activates the adjuster components.

In operation, secondary shoe movement causes the adjuster lever spring to exert pull on the lever. This pivots the lever away from the adjuster screw teeth. When the stop is completed and the brakes released, the adjuster lever pivots back to a normal position. It is during this return movement of the lever when adjustment occurs. At this point, the lever comes back into contact with the adjuster screw teeth as it moves upward. The lever will then rotate the adjuster screw one or two teeth as needed for adjustment.

NOTE: The adjustment process requires a complete stop to actually occur. Rolling stops will NOT activate the adjuster components. In addition, the adjuster screws are left and right hand parts and must NOT be interchanged.

PARKING BRAKES

The parking brakes are operated by a system of cables and levers attached to the rear brake secondary shoes.

The rear drum brake shoes serve as the parking brakes. The shoes make contact with the brake drum surface by a cable and lever mechanism attached to the secondary brake shoe.

The front parking brake cable is connected to the parking brake pedal and to an intermediate cable. The intermediate cable connects the front cable to the rear cables.

The parking brake pedal assembly is mounted on the driver side cowl panel. The front cable is directly attached to the assembly. The pedal assembly contains a spring loaded, ratchet-type mechanism that will hold the cable in the applied position and allow the pedal to return. A rod used to release the ratchet mechanism and return the pedal to normal position.

BRAKE HOSES AND LINES

Flexible rubber hose is used at both front brakes and at the rear axle junction block. Double walled steel tubing is used to connect the master cylinder to the major hydraulic braking components and then to the flexible rubber hoses.

DIAGNOSIS AND TESTING

BASE BRAKE SYSTEM

Base brake components consist of the brake shoes, calipers, wheel cylinders, brake drums, rotors, brake lines, master cylinder, booster, and parking brake components.

Brake diagnosis involves determining if the problem is related to a mechanical, hydraulic, or vacuum operated component.

The first diagnosis step is the preliminary check.

PRELIMINARY BRAKE CHECK

(1) Check condition of tires and wheels. Damaged wheels and worn, damaged, or underinflated tires can cause pull, shudder, vibration, and a condition similar to grab.

(2) If complaint was based on noise when braking, check suspension components. Jounce front and rear of vehicle and listen for noise that might be caused by loose, worn or damaged suspension or steering components.

(3) Inspect brake fluid level and condition. Note that the brake reservoir fluid level will decrease in proportion to normal lining wear. **Also note that brake fluid tends to darken over time. This is normal and should not be mistaken for contamination.**

DIAGNOSIS AND TESTING (Continued)

(a) If fluid level is abnormally low, look for evidence of leaks at calipers, wheel cylinders, brake lines, and master cylinder.

(b) If fluid appears contaminated, drain out a sample to examine. System will have to be flushed if fluid is separated into layers, or contains a substance other than brake fluid. The system seals and cups will also have to be replaced after flushing. Use clean brake fluid to flush the system.

(4) Check parking brake operation. Verify free movement and full release of cables and pedal. Also note if vehicle was being operated with parking brake partially applied.

(5) Check brake pedal operation. Verify that pedal does not bind and has adequate free play. If pedal lacks free play, check pedal and power booster for being loose or for bind condition. Do not road test until condition is corrected.

(6) Check booster vacuum check valve and hose.

(7) If components checked appear OK, road test the vehicle.

ROAD TESTING

(1) If complaint involved low brake pedal, pump pedal and note if it comes back up to normal height.

(2) Check brake pedal response with transmission in Neutral and engine running. Pedal should remain firm under constant foot pressure.

(3) During road test, make normal and firm brake stops in 25-40 mph range. Note faulty brake operation such as low pedal, hard pedal, fade, pedal pulsation, pull, grab, drag, noise, etc.

(4) Attempt to stop the vehicle with the parking brake only and note grab, drag, noise, etc.

PEDAL FALLS AWAY

A brake pedal that falls away under steady foot pressure is generally the result of a system leak. The leak point could be at a brake line, fitting, hose, or caliper/wheel cylinder. If leakage is severe, fluid will be evident at or around the leaking component.

Internal leakage (seal by-pass) in the master cylinder caused by worn or damaged piston cups, may also be the problem cause. However, internal leakage in the master cylinder, ABS or RWAL system may not be physically evident.

An internal leak in the ABS or RWAL system may also be the problem with no physically evident.

LOW PEDAL

If a low pedal is experienced, pump the pedal several times. If the pedal comes back up worn linings, rotors, drums, or rear brakes out of adjustment are the most likely causes. The proper course of action is to inspect and replace all worn component and make the proper adjustments.

SPONGY PEDAL

A spongy pedal is most often caused by air in the system. However, thin brake drums or substandard brake lines and hoses can also cause a spongy pedal. The proper course of action is to bleed the system, and replace thin drums and substandard quality brake hoses if suspected.

HARD PEDAL OR HIGH PEDAL EFFORT

A hard pedal or high pedal effort may be due to lining that is water soaked, contaminated, glazed, or badly worn. The power booster or check valve could also be faulty.

PEDAL PULSATION

Pedal pulsation is caused by components that are loose, or beyond tolerance limits.

The primary cause of pulsation are disc brake rotors with excessive lateral runout or thickness variation, or out of round brake drums. Other causes are loose wheel bearings or calipers and worn, damaged tires.

NOTE: Some pedal pulsation may be felt during ABS activation.

BRAKE DRAG

Brake drag occurs when the lining is in constant contact with the rotor or drum. Drag can occur at one wheel, all wheels, fronts only, or rears only.

Drag is a product of incomplete brake shoe release. Drag can be minor or severe enough to overheat the linings, rotors and drums.

Minor drag will usually cause slight surface charring of the lining. It can also generate hard spots in rotors and drums from the overheat-cool down process. In most cases, the rotors, drums, wheels and tires are quite warm to the touch after the vehicle is stopped.

Severe drag can char the brake lining all the way through. It can also distort and score rotors and drums to the point of replacement. The wheels, tires and brake components will be extremely hot. In severe cases, the lining may generate smoke as it chars from overheating.

Common causes of brake drag are:

- Seized or improperly adjusted parking brake cables.
- Loose/worn wheel bearing.
- Seized caliper or wheel cylinder piston.
- Caliper binding on corroded bushings or rusted slide surfaces.
- Loose caliper mounting.
- Drum brake shoes binding on worn/damaged support plates.
- Mis-assembled components.

DIAGNOSIS AND TESTING (Continued)

If brake drag occurs at all wheels, the problem may be related to a blocked master cylinder return port, or faulty power booster (binds-does not release).

BRAKE FADE

Brake fade is usually a product of overheating caused by brake drag. However, brake overheating and resulting fade can also be caused by riding the brake pedal, making repeated high deceleration stops in a short time span, or constant braking on steep mountain roads. Refer to the Brake Drag information in this section for causes.

BRAKE PULL

Front brake pull condition could result from:

- Contaminated lining in one caliper
- Seized caliper piston
- Binding caliper
- Loose caliper
- Rusty caliper slide surfaces
- Improper brake shoes
- Damaged rotor

A worn, damaged wheel bearing or suspension component are further causes of pull. A damaged front tire (bruised, ply separation) can also cause pull.

A common and frequently misdiagnosed pull condition is where direction of pull changes after a few stops. The cause is a combination of brake drag followed by fade at one of the brake units.

As the dragging brake overheats, efficiency is so reduced that fade occurs. Since the opposite brake unit is still functioning normally, its braking effect is magnified. This causes pull to switch direction in favor of the normally functioning brake unit.

An additional point when diagnosing a change in pull condition concerns brake cool down. Remember that pull will return to the original direction, if the dragging brake unit is allowed to cool down (and is not seriously damaged).

REAR BRAKE GRAB OR PULL

Rear grab or pull is usually caused by improperly adjusted or seized parking brake cables, contaminated lining, bent or binding shoes and support plates, or improperly assembled components. This is particularly true when only one rear wheel is involved. However, when both rear wheels are affected, the master cylinder or proportioning valve could be at fault.

BRAKES DO NOT HOLD AFTER DRIVING THROUGH DEEP WATER PUDDLES

This condition is generally caused by water soaked lining. If the lining is only wet, it can be dried by driving with the brakes very lightly applied for a mile or two. However, if the lining is both soaked and dirt contaminated, cleaning and/or replacement will be necessary.

BRAKE LINING CONTAMINATION

Brake lining contamination is mostly a product of leaking calipers or wheel cylinders, worn seals, driving through deep water puddles, or lining that has become covered with grease and grit during repair. Contaminated lining should be replaced to avoid further brake problems.

WHEEL AND TIRE PROBLEMS

Some conditions attributed to brake components may actually be caused by a wheel or tire problem.

A damaged wheel can cause shudder, vibration and pull. A worn or damaged tire can also cause pull.

Severely worn tires with very little tread left can produce a grab-like condition as the tire loses and recovers traction. Flat-spotted tires can cause vibration and generate shudder during brake operation. A tire with internal damage such as a severe bruise, cut, or ply separation can cause pull and vibration.

BRAKE NOISES

Some brake noise is common with rear drum brakes and on some disc brakes during the first few stops after a vehicle has been parked overnight or stored. This is primarily due to the formation of trace corrosion (light rust) on metal surfaces. This light corrosion is typically cleared from the metal surfaces after a few brake applications causing the noise to subside.

BRAKE SQUEAK/SQUEAL

Brake squeak or squeal may be due to linings that are wet or contaminated with brake fluid, grease, or oil. Glazed linings and rotors with hard spots can also contribute to squeak. Dirt and foreign material embedded in the brake lining will also cause squeak/squeal.

A very loud squeak or squeal is frequently a sign of severely worn brake lining. If the lining has worn through to the brake shoes in spots, metal-to-metal contact occurs. If the condition is allowed to continue, rotors and drums can become so scored that replacement is necessary.

BRAKE CHATTER

Brake chatter is usually caused by loose or worn components, or glazed/burnt lining. Rotors with hard spots can also contribute to chatter. Additional causes of chatter are out-of-tolerance rotors, brake lining not securely attached to the shoes, loose wheel bearings and contaminated brake lining.

DIAGNOSIS AND TESTING (Continued)

THUMP/CLUNK NOISE

Thumping or clunk noises during braking are frequently **not** caused by brake components. In many cases, such noises are caused by loose or damaged steering, suspension, or engine components. However, calipers that bind on the slide surfaces can generate a thump or clunk noise. In addition, worn out, improperly adjusted, or improperly assembled rear brake shoes can also produce a thump noise.

STOP LAMP SWITCH

Stop lamp switch operation can be tested with an ohmmeter. The ohmmeter is used to check continuity between the pin terminals at different plunger positions (Fig. 6).

NOTE: The switch wire harness must be disconnected before testing switch continuity.

SWITCH CIRCUIT IDENTIFICATION

- Terminals 1 and 2 are for the RWAL/ABS module and Powertrain Control Module (PCM) circuit
- Terminals 5 and 6 are for the stop lamp circuit
- Terminals 3 and 4 are for the speed control circuit

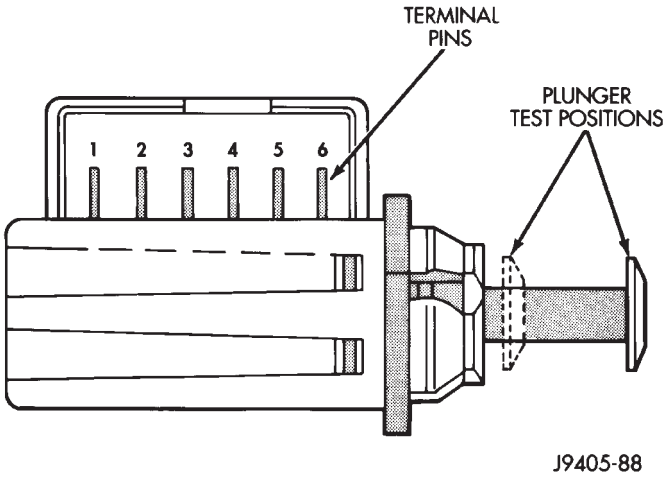


Fig. 6 Stop Lamp Switch Terminal Identification

SWITCH CONTINUITY TEST

(1) Check continuity between terminal pins 5 and 6 as follows:

(a) Pull plunger all the way out to fully extended position.

(b) Attach test leads to pins 5 and 6 and note ohmmeter reading.

(c) If continuity exists, proceed to next test. Replace switch if meter indicates lack of continuity (shorted or open).

(2) Check continuity between terminal pins 1 and 2 and pins 3 and 4 as follows:

(a) Push switch plunger inward to fully retracted position.

(b) Attach test leads to pins 1 and 2 and note ohmmeter reading.

(c) If continuity exists, switch is OK. Replace switch if meter indicates lack of continuity (switch is open).

RED BRAKE WARNING LAMP

The red warning lamp is in circuit with the parking brake switch and pressure differential switch in the combination valve.

The red lamp illuminates when the parking brakes are applied, or when a pressure drop occurs in the front or rear brake hydraulic circuit.

The lamp illuminates for approximately 2-4 seconds at every engine start up. This is a self test feature designed to check bulb and circuit operation.

A pressure drop in the front or rear brake hydraulic circuit activates the pressure differential valve inside the combination valve. A pressure decrease moves the valve toward the low pressure side. As the valve moves, it pushes the pressure differential switch contact plunger upward. This closes the switch internal contacts and completes the circuit to the red warning lamp. The lamp will remain on until repairs are made and normal fluid pressure restored.

MASTER CYLINDER/POWER BOOSTER

(1) Start engine and check booster vacuum hose connections. A hissing noise indicates vacuum leak. Correct any vacuum leak before proceeding.

(2) Stop engine and shift transmission into Neutral.

(3) Pump brake pedal until all vacuum reserve in booster is depleted.

(4) Press and hold brake pedal under light foot pressure. The pedal should hold firm, if the pedal falls away master cylinder is faulty (internal leakage).

(5) Start engine and note pedal action it should fall away slightly under light foot pressure then hold firm. If no pedal action is discernible, power booster, vacuum supply, or vacuum check valve is faulty. Proceed to the POWER BOOSTER VACUUM TEST.

(6) If the POWER BOOSTER VACUUM TEST passes, rebuild booster vacuum reserve as follows: Release brake pedal. Increase engine speed to 1500 rpm, close the throttle and immediately stop turn off ignition to stop engine.

(7) Wait a minimum of 90 seconds and try brake action again. Booster should provide two or more vacuum assisted pedal applications. If vacuum assist is not provided, booster is faulty.

DIAGNOSIS AND TESTING (Continued)

POWER BOOSTER VACUUM TEST

(1) Connect vacuum gauge to booster check valve with short length of hose and T-fitting (Fig. 7).

(2) Start and run engine at curb idle speed for one minute.

(3) Observe the vacuum supply. If vacuum supply is not adequate, repair vacuum supply.

(4) Clamp hose shut between vacuum source and check valve.

(5) Stop engine and observe vacuum gauge.

(6) If vacuum drops more than one inch HG (33 millibars) within 15 seconds, booster diaphragm or check valve is faulty.

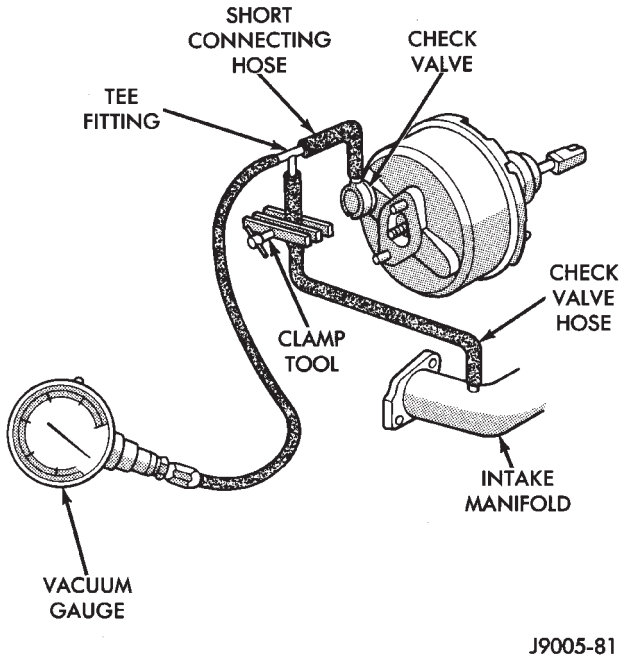


Fig. 7 Typical Booster Vacuum Test Connections

POWER BOOSTER CHECK VALVE TEST

(1) Disconnect vacuum hose from check valve.

(2) Remove check valve and valve seal from booster.

(3) Use a hand operated vacuum pump for test.

(4) Apply 15-20 inches vacuum at large end of check valve (Fig. 8).

(5) Vacuum should hold steady. If gauge on pump indicates vacuum loss, check valve is faulty and should be replaced.

HYDRAULIC BOOSTER

The hydraulic booster uses hydraulic pressure from the power steering pump. Before diagnosing a booster problem, first verify the power steering pump is operating properly. Perform the following checks.

- Check the power steering fluid level.
- Check the brake fluid level.
- Check all power steering hoses and lines for leaks and restrictions.

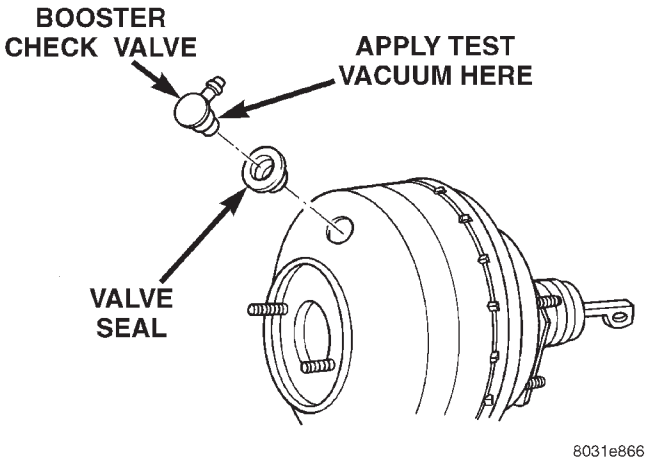


Fig. 8 Vacuum Check Valve And Seal

- Check power steering pump pressure.

NOISES

The hydraulic booster unit will produce certain characteristic booster noises. The noises may occur when the brake pedal is used in a manner not associated with normal braking or driving habits.

HISSING

A hissing noise may be noticed when above normal brake pedal pressure is applied, 40 lbs. or above. The noise will be more noticeable if the vehicle is not moving. The noise will increase with the brake pedal pressure and an increase of system operating temperature.

CLUNK-CHATTER-CLICKING

A clunk-chatter-clicking may be noticed when the brake pedal is released quickly, after above normal brake pedal pressure is applied 50-100 lbs..

BOOSTER FUNCTION TEST

With the engine off depress the brake pedal several times to discharge the accumulator. Then depress the brake pedal using 40 lbs. of force and start the engine. The brake pedal should fall and then push back against your foot. This indicates the booster is operating properly.

ACCUMULATOR LEAKDOWN

(1) Start the engine, apply the brakes and turn the steering wheel from lock to lock. This will ensure the accumulator is charged. Turn off the engine and let the vehicle sit for one hour. After one hour there should be at least two power assisted brake application with the engine off. If the system does not retain a charge the booster must be replaced.

(2) With the engine off depress the brake pedal several times to discharge the accumulator. Grasp the accumulator and see if it wobbles or turns. If it

DIAGNOSIS AND TESTING (Continued)

does the accumulator has lost a gas charge and the booster must be replaced.

SEAL LEAKAGE

If the booster leaks from any of the seals the booster assembly must be replaced (Fig. 9).

- **INPUT ROD SEAL:** Fluid leakage from rear end of the booster.
- **PISTON SEAL:** Fluid leakage from vent at front of booster.
- **HOUSING SEAL:** Fluid leakage between housing and housing cover.
- **SPOOL VALVE SEAL:** Fluid leakage near spool plug.
- **RETURN PORT FITTING SEAL:** Fluid leakage from port fitting.

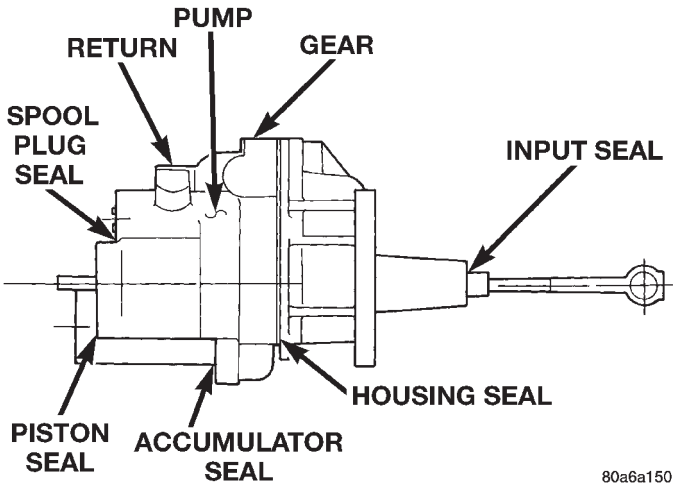


Fig. 9 Hydraulic Booster Seals

HEIGHT SENSING PROPORTIONING VALVE

The valve has a fixed split point when the vehicle is unloaded. The pressure is equal into and out of the valve up to the 150 psi. split point. After that the output pressure deceases on a .43 slope (Fig. 10). When the vehicle is loaded the actuator lever is moved upward, allowing full hydraulic pressure to the rear brakes. Hydraulic pressure into the valve is equal to the pressure coming out of the valve at all times.

COMBINATION VALVE

Pressure Differential Switch

(1) Have helper sit in drivers seat to apply brake pedal and observe red brake warning light.

(2) Raise vehicle on hoist.

(3) Connect bleed hose to a rear wheel cylinder and immerse hose end in container partially filled with brake fluid.

(4) Have helper press and hold brake pedal to floor and observe warning light.

HYDRAULIC BOOSTER DIAGNOSIS CHART

CONDITION	POSSIBLE CAUSES	CORRECTION
Slow Brake Pedal Return	1. Excessive seal friction in booster. 2. Faulty spool valve action. 3. Restriction in booster return hose. 4. Damaged input rod.	1. Replace booster. 2. Replace booster. 3. Replace hose. 4. Replace booster.
Excessive Brake Pedal Effort.	1. Internal or external seal leakage. 2. Faulty steering pump.	1. Replace booster. 2. Replace pump.
Brakes Self Apply	1. Dump valve faulty. 2. Contamination in hydraulic system. 3. Restriction in booster return hose.	1. Replace booster. 2. Flush hydraulic system and replace booster. 3. Replace hose.
Booster Chatter, Pedal Vibration	1. Slipping pump belt. 2. Low pump fluid level.	1. Replace power steering belt. 2. Fill pump and check for leaks.
Grabbing Brakes	1. Low pump flow. 2. Faulty spool valve action.	1. Test and repair/replace pump. 2. Replace booster.

(a) If warning light illuminates, switch is operating correctly.

(b) If light fails to illuminate, check circuit fuse, bulb, and wiring. The parking brake switch can be used to aid in identifying whether or not the brake light bulb and fuse is functional. Repair or replace parts as necessary and test differential pressure switch operation again.

(5) If warning light still does not illuminate, switch is faulty. Replace combination valve assembly, bleed brake system and verify proper switch and valve operation.

DIAGNOSIS AND TESTING (Continued)

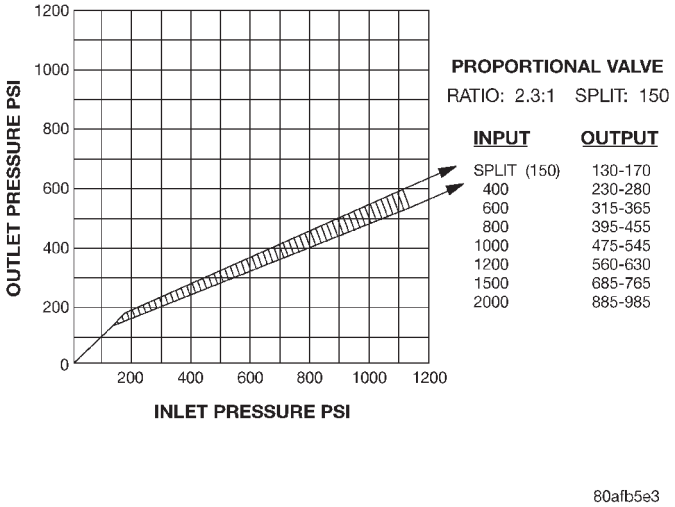


Fig. 10 Pressure Chart

DISC BRAKE ROTOR

The rotor braking surfaces should not be refinished unless necessary.

Light surface rust and scale can be removed with a lathe equipped with dual sanding discs. The rotor surfaces can be restored by machining in a disc brake lathe if surface scoring and wear are light.

Replace the rotor under the following conditions:

- severely scored
- tapered
- hard spots
- cracked
- below minimum thickness

ROTOR MINIMUM THICKNESS

Measure rotor thickness at the center of the brake shoe contact surface. Replace the rotor if worn below minimum thickness, or if machining would reduce thickness below the allowable minimum.

Rotor minimum thickness is usually specified on the rotor hub. The specification is either stamped or cast into the hub surface.

ROTOR RUNOUT

Check rotor lateral runout with dial indicator C-3339 (Fig. 11). Excessive lateral runout will cause brake pedal pulsation and rapid, uneven wear of the brake shoes. Position the dial indicator plunger approximately 25.4 mm (1 in.) inward from the rotor edge.

NOTE: Be sure wheel bearing has zero end play before checking rotor runout.

Maximum allowable rotor runout is 0.127 mm (0.005 in.).

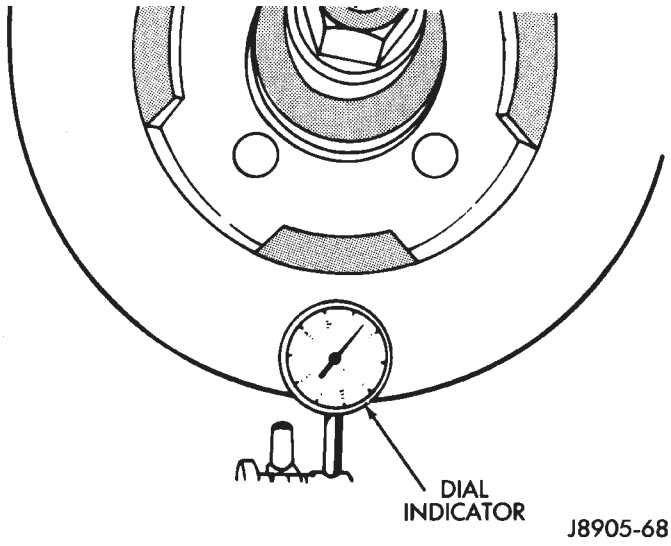


Fig. 11 Checking Rotor Runout And Thickness Variation

ROTOR THICKNESS VARIATION

Variations in rotor thickness will cause pedal pulsation, noise and shudder.

Measure rotor thickness at 6 to 12 points around the rotor face (Fig. 12).

Position the micrometer approximately 25.4 mm (1 in.) from the rotor outer circumference for each measurement.

Thickness should not **vary** by more than 0.025 mm (0.001 in.) from point-to-point on the rotor. Machine or replace the rotor if necessary.

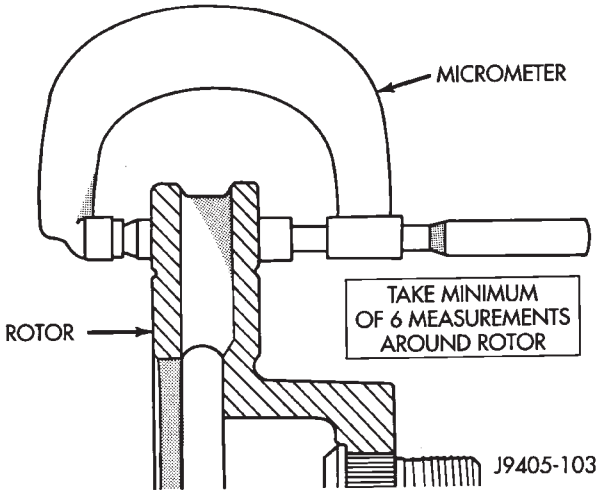


Fig. 12 Measuring Rotor Thickness

BRAKE DRUM

The maximum allowable diameter of the drum braking surface is stamped or cast into the drum outer edge. Generally, a drum can be machined to a maximum of 1.52 mm (0.060 in.) oversize. Always

DIAGNOSIS AND TESTING (Continued)

replace the drum if machining would cause drum diameter to exceed the size limit indicated on the drum.

BRAKE DRUM RUNOUT

Measure drum diameter and runout with an accurate gauge. The most accurate method of measurement involves mounting the drum in a brake lathe and checking variation and runout with a dial indicator.

Variations in drum diameter should not exceed 0.076 mm (0.003 in.). Drum runout should not exceed 0.20 mm (0.008 in.) out of round. Machine the drum if runout or variation exceed these values. Replace the drum if machining causes the drum to exceed the maximum allowable diameter.

BRAKE LINE AND HOSES

Flexible rubber hose is used at both front brakes and at the rear axle junction block. Inspect the hoses whenever the brake system is serviced, at every engine oil change, or whenever the vehicle is in for service.

Inspect the hoses for surface cracking, scuffing, or worn spots. Replace any brake hose immediately if the fabric casing of the hose is exposed due to cracks or abrasions.

Also check brake hose installation. Faulty installation can result in kinked, twisted hoses, or contact with the wheels and tires or other chassis components. All of these conditions can lead to scuffing, cracking and eventual failure.

The steel brake lines should be inspected periodically for evidence of corrosion, twists, kinks, leaks, or other damage. Heavily corroded lines will eventually rust through causing leaks. In any case, corroded or damaged brake lines should be replaced.

Factory replacement brake lines and hoses are recommended to ensure quality, correct length and superior fatigue life. Care should be taken to make sure that brake line and hose mating surfaces are clean and free from nicks and burrs. Also remember that right and left brake hoses are not interchangeable.

Use new copper seal washers at all caliper connections. Be sure brake line connections are properly made (not cross threaded) and tightened to recommended torque.

BRAKE FLUID CONTAMINATION

Indications of fluid contamination are swollen or deteriorated rubber parts.

Swollen rubber parts indicate the presence of petroleum in the brake fluid.

To test for contamination, put a small amount of drained brake fluid in clear glass jar. If fluid separates into layers, there is mineral oil or other fluid contamination of the brake fluid.

If brake fluid is contaminated, drain and thoroughly flush system. Replace master cylinder, proportioning valve, caliper seals, wheel cylinder seals, Antilock Brakes hydraulic unit and all hydraulic fluid hoses.

SERVICE PROCEDURES

BRAKE FLUID LEVEL

Always clean the master cylinder reservoir and caps before checking fluid level. If not cleaned, dirt could enter the fluid.

The fluid fill level is indicated on the side of the master cylinder reservoir (Fig. 13).

The correct fluid level is to the FULL indicator on the side of the reservoir. If necessary, add fluid to the proper level.

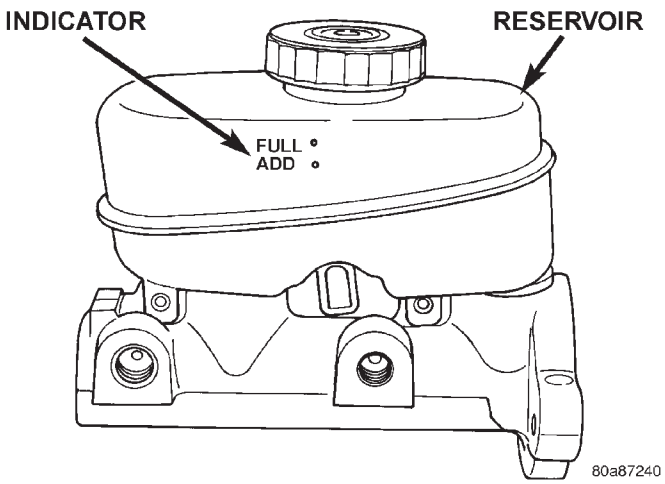


Fig. 13 Master Cylinder Fluid Level - Typical

FLUSHING HYDRAULIC BOOSTER

Flushing is required when the power steering/hydraulic booster system has become contaminated. Contaminated fluid in the booster system can cause seal deterioration and affect booster spool valve operation. Refer to Group 19 for flushing service procedure.

MASTER CYLINDER BLEEDING

A new master cylinder should be bled before installation on the vehicle. Required bleeding tools include bleed tubes and a wood dowel to stroke the pistons. Bleed tubes can be fabricated from brake line.

BLEEDING PROCEDURE

(1) Mount master cylinder in vise.

(2) Attach bleed tubes to cylinder outlet ports. Then position each tube end into reservoir (Fig. 14).

(3) Fill reservoir with fresh brake fluid.

(4) Press cylinder pistons inward with wood dowel. Then release pistons and allow them to return under

SERVICE PROCEDURES (Continued)

spring pressure. Continue bleeding operations until air bubbles are no longer visible in fluid.

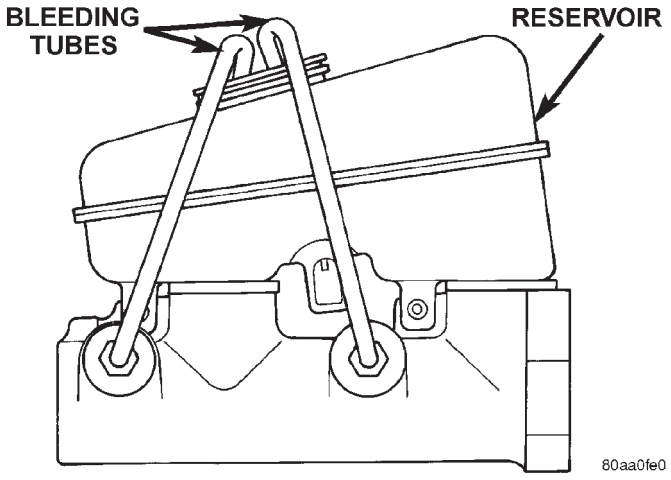


Fig. 14 Master Cylinder Bleeding–Typical

HYDRAULIC BOOSTER BLEEDING

The hydraulic booster is generally self-bleeding, this procedure will normally bleed the air from the booster. Normal driving and operation of the unit will remove any remaining trapped air.

BLEEDING

(1) Fill power steering pump reservoir.

(2) Disconnect fuel shutdown relay and crank the engine for several seconds. Refer to Group 14 Fuel System for relay location and WARNING.

(3) Check fluid level and add if necessary.

(4) Connect fuel shutdown relay and start the engine.

(5) Turn the steering wheel slowly from lock to lock twice.

(6) Stop the engine and discharge the accumulator by depressing the brake pedal 5 times.

(7) Start the engine and turn the steering wheel slowly from lock to lock twice.

(8) Turn off the engine and check fluid level and add if necessary.

NOTE: If fluid foaming occurs, wait for foam to dissipate and repeat steps 7 and 8.

BRAKE BLEEDING

Use Mopar brake fluid, or an equivalent quality fluid meeting SAE J1703-F and DOT 3 standards only. Use fresh, clean fluid from a sealed container at all times.

Do not pump the brake pedal at any time while bleeding. Air in the system will be compressed into small bubbles that are distributed throughout the hydraulic system. This will make additional bleeding operations necessary.

Do not allow the master cylinder to run out of fluid during bleed operations. An empty cylinder will allow additional air to be drawn into the system. Check the cylinder fluid level frequently and add fluid as needed.

Bleed only one brake component at a time in the following sequence:

- master cylinder
- combination valve
- right rear wheel
- left rear wheel
- right front wheel
- left front wheel

MANUAL BLEEDING

(1) Remove reservoir filler caps and fill reservoir with Mopar, or equivalent quality DOT 3 brake fluid.

(2) If calipers, or wheel cylinders were overhauled, open all caliper and wheel cylinder bleed screws. Then close each bleed screw as fluid starts to drip from it. Top off master cylinder reservoir once more before proceeding.

(3) Attach one end of bleed hose to bleed screw and insert opposite end in glass container partially filled with brake fluid (Fig. 15). Be sure end of bleed hose is immersed in fluid.

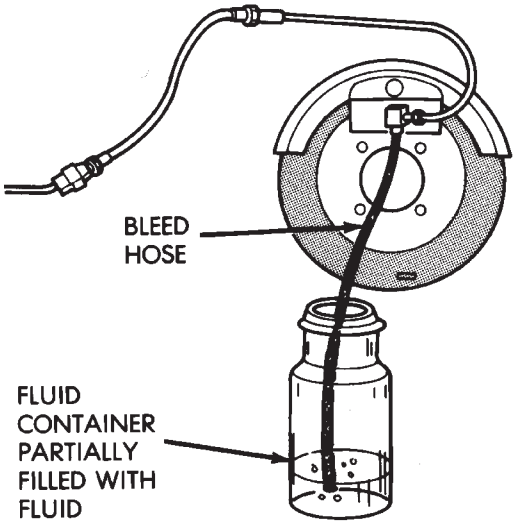


Fig. 15 Bleed Hose Setup

(4) Open up bleeder, then have a helper press down the brake pedal. Once the pedal is down close the bleeder. Repeat bleeding until fluid stream is clear and free of bubbles. Then move to the next wheel.

SERVICE PROCEDURES (Continued)

PRESSURE BLEEDING

Follow the manufacturers instructions carefully when using pressure equipment. Do not exceed the tank manufacturers pressure recommendations. Generally, a tank pressure of 15-20 psi is sufficient for bleeding.

Fill the bleeder tank with recommended fluid and purge air from the tank lines before bleeding.

Do not pressure bleed without a proper master cylinder adapter. The wrong adapter can lead to leakage, or drawing air back into the system. Use adapter provided with the equipment or Adapter 6921.

DISC ROTOR MACHINING

Rotor braking surfaces can be sanded or machined in a disc brake lathe.

The lathe must machine both sides of the rotor simultaneously with dual (two) cutter heads (Fig. 16). Equipment capable of machining only one side at a time will produce a tapered rotor.

The lathe should also be equipped with a grinder attachment or dual sanding discs for final cleanup or light refinishing (Fig. 17).

If the rotor surfaces only need minor cleanup of rust, scale, or minor scoring, use abrasive discs to clean up the rotor surfaces. However, when a rotor is scored or worn, machining with cutting tools will be required.

CAUTION: Do not machine the rotor if it will cause the rotor to fall below minimum allowable thickness.

BRAKE DRUM MACHINING

The brake drums can be machined on a drum lathe when necessary. Initial machining cuts should be limited to 0.12 - 0.20 mm (0.005 - 0.008 in.) at a time as heavier feed rates can produce taper and surface variation. Final finish cuts of 0.025 to 0.038 mm (0.001 to 0.0015 in.) are recommended and will generally provide the best surface finish.

Be sure the drum is securely mounted in the lathe before machining operations. A damper strap should always be used around the drum to reduce vibration and avoid chatter marks.

The maximum allowable diameter of the drum braking surface is stamped or cast into the drum outer edge. Always replace the drum if machining would cause drum diameter to exceed the size limit indicated on the drum.

BRAKE LINE

Mopar preformed metal brake line is recommended and preferred for all repairs. However, double-wall steel line can be used for emergency repair when factory replacement parts are not readily available.

Special, heavy duty tube bending and flaring equipment is required to prepare double wall brake line. Special bending tools are needed to avoid kinking or twisting metal brake line. In addition, special flaring tools are needed to provide the inverted-type, double flare required on metal brake lines.

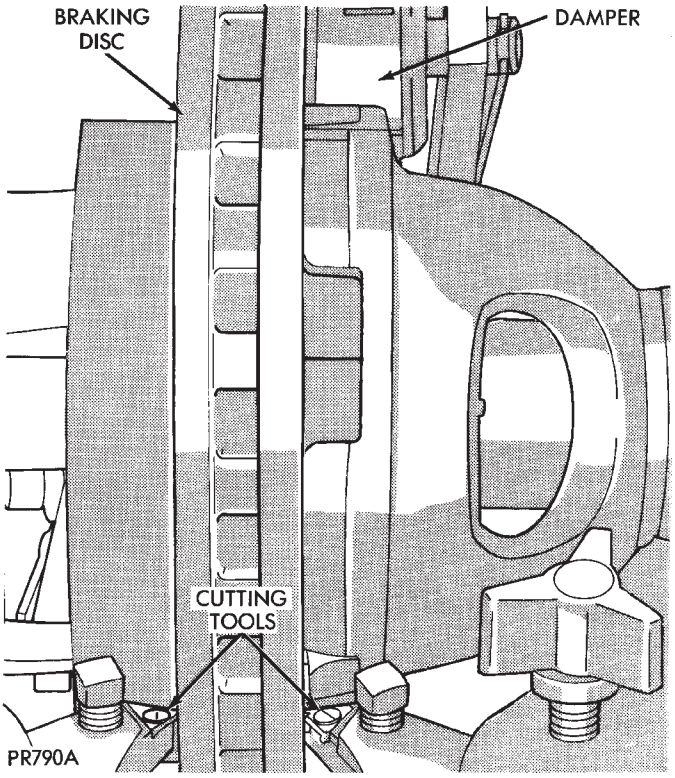


Fig. 16 Rotor Refinishing

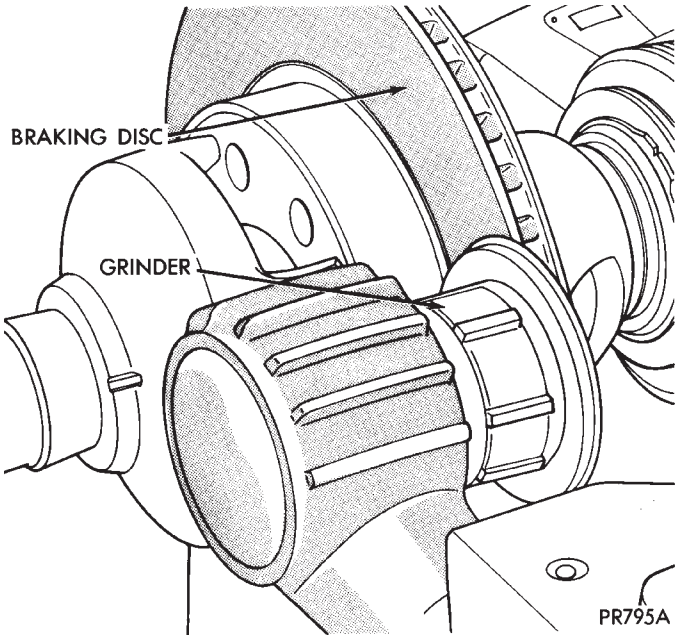


Fig. 17 Rotor Grinder

SERVICE PROCEDURES (Continued)

FLARING PROCEDURE

(1) Cut off damaged tube with Tubing Cutter.

(2) Ream cut edges of tubing to ensure proper flare.

(3) Install replacement tube nut on section of tube to be repaired.

(4) Insert tube in flaring tool. Center tube in area between vertical posts.

(5) Place gauge form over the end of the tube.

(6) Push tubing through flaring tool jaws until tube contacts recessed notch in gauge that matches tube diameter.

(7) Squeeze flaring tool jaws to lock tubing in place.

(8) Insert plug on gauge in the tube. Then swing compression disc over gauge and center tapered flaring screw in recess of compression disc (Fig. 18).

(9) Tighten tool handle until plug gauge is seated on jaws of flaring tool. This will start the inverted flare.

(10) Remove the plug gauge and complete the inverted flare.

(11) Remove the flaring tools and verify that the inverted flare is correct.

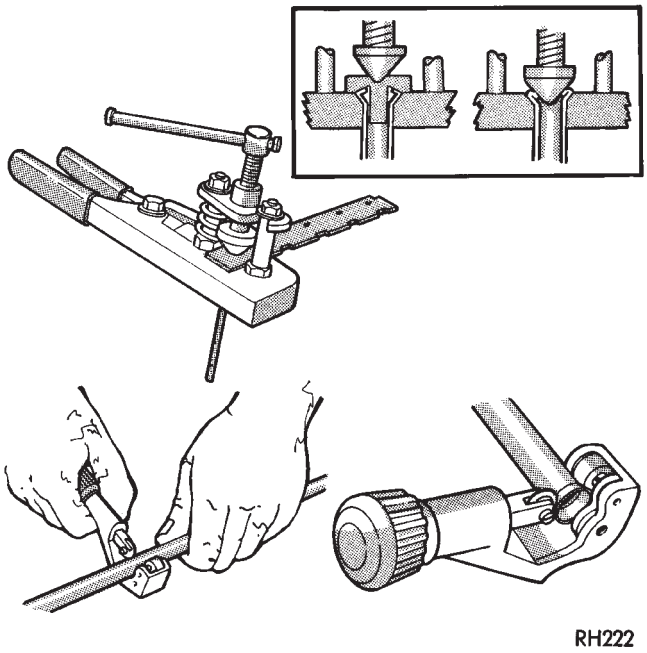


Fig. 18 Inverted Flare Tools

REMOVAL AND INSTALLATION

STOP LAMP SWITCH

REMOVAL

(1) Remove knee bolster for access to stop lamp switch and pedal.

(2) Disconnect switch harness (Fig. 19).

(3) Press and hold brake pedal in applied position.

(4) Rotate switch counterclockwise about 30° to align switch lock tab with notch in bracket.

(5) Pull switch rearward out of mounting bracket and release brake pedal.

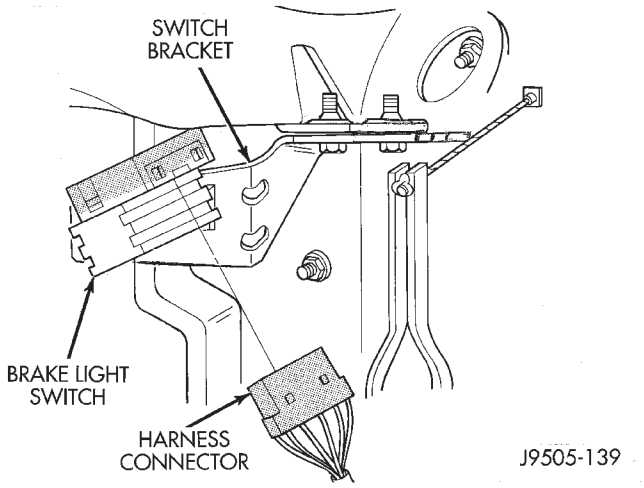


Fig. 19 Stop Lamp Switch & Harness Connector

INSTALLATION

(1) Pull switch plunger all the way out to fully extended position.

(2) Push switch plunger inward 4 detent positions (or clicks). This is required preset position for switch installation. Plunger will extend approximately 14 mm (0.55 in.) out of housing at this setting.

(3) Connect harness wires to switch.

(4) Press and hold brake pedal down.

(5) Install switch. Align tab on switch with notch in switch bracket (Fig. 20). Then insert switch in bracket and turn it clockwise about 30° to lock it in place.

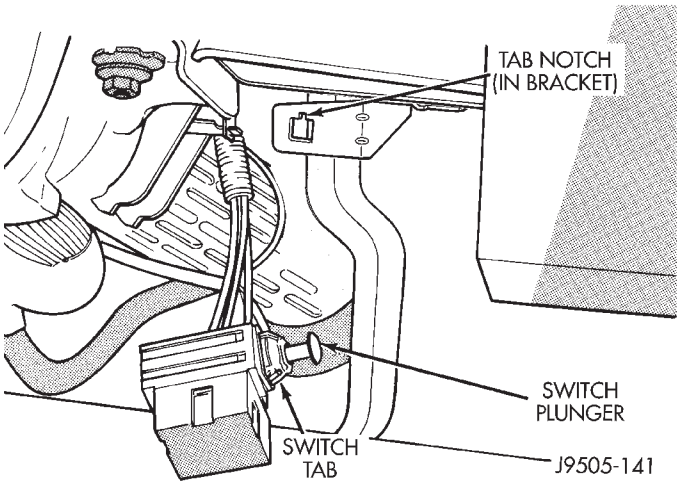


Fig. 20 Stop Lamp Switch

(6) Release brake pedal. Then lightly pull pedal fully rearward. Pedal will adjust switch plunger to correct position as pedal is moved to rear.

REMOVAL AND INSTALLATION (Continued)

CAUTION: Do not use excessive force to move the pedal rearward for switch adjustment. Excessive force will damage the switch.

BRAKE PEDAL

REMOVAL

(1) Remove knee bolster.
(2) Remove stop lamp switch.
(3) Remove switches from tabs on stop lamp switch bracket.
(4) Remove stop lamp switch bracket bolts and remove bracket (Fig. 21).

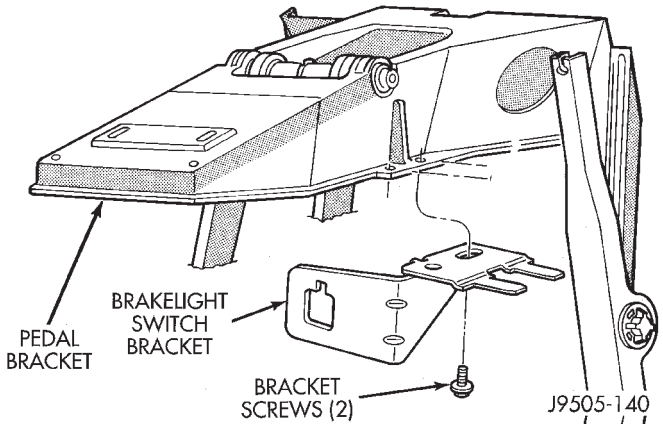


Fig. 21 Brake Lamp Switch Bracket

(5) Remove clip and washer attaching booster push rod and slide push rod off pedal.
(6) Remove E-clip from passenger side of pedal shaft (Fig. 22). Use flat blade screwdriver to pry clip out of shaft groove.
(7) Push shaft toward driver side of bracket just enough to expose opposite E-clip. Then remove E-clip with flat blade screwdriver.
(8) Push pedal shaft back and out of passenger side of bracket (Fig. 22).
(9) Remove pedal shaft, brake pedal, wave washer and bushings from vehicle.

INSTALLATION

(1) Replace bracket and pedal bushings if necessary. Lubricate shaft bores in bracket and pedal before installing bushings with Mopar Multi-mileage silicone grease.
(2) Apply liberal quantity of Mopar multi-mileage grease to pedal shaft and to pedal and bracket bushings.
(3) Position brake pedal in mounting bracket.
(4) Slide pedal shaft into bracket and through pedal from passenger side.

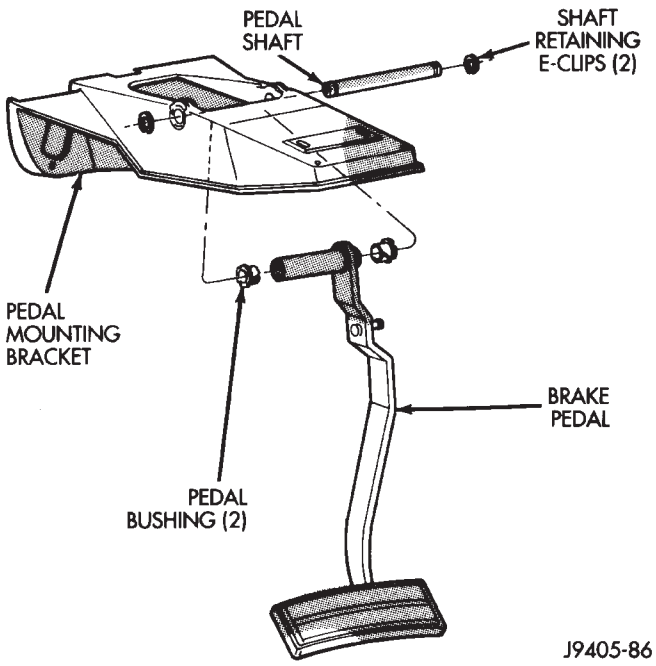


Fig. 22 Brake Pedal Mounting (With Automatic Transmission)

(5) Push pedal shaft out driver side of mounting bracket just enough to allow installation of retaining E-clip.
(6) Install the wave washer between the bracket and the pedal bushing on the passenger side.
(7) Push pedal shaft back toward passenger side of bracket and install remaining E-clip on pedal shaft.
(8) Install booster push rod on brake pedal. Secure push rod to pedal with washer and retaining clip.
(9) Install stop lamp switch bracket and switch.
(10) Install knee bolster.

COMBINATION VALVE

REMOVAL

(1) Remove pressure differential switch wire connector (Fig. 23) from the valve.
(2) Remove the brake lines from the valve.
(3) Remove the valve mounting bolt and remove the valve from the bracket.

INSTALLATION

(1) Position the valve on the bracket and install the mounting bolt. Tighten the mounting bolt to 23 N·m (210 in. lbs.).
(2) Install the brake lines into the valve and tighten to19-23 N·m (170-200 in. lbs.).
(3) Connect the pressure differential switch wire connector.
(4) Bleed the brake system.

1998 Ram Truck
Publication No. 81-370-8108
TSB 26-04-99 April 1999

REMOVAL AND INSTALLATION (Continued)

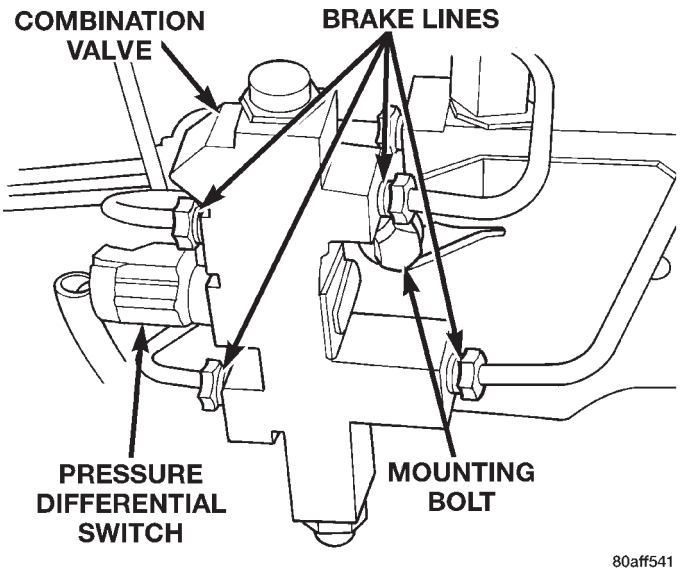


Fig. 23 Pressure Differential Switch

HEIGHT SENSING PROPORTIONING VALVE

REMOVAL

(1) Raise and support vehicle.
(2) Remove the link from the bracket (Fig. 24).
(3) Remove the link from the actuator lever (Fig. 25).
(4) Remove brake line and hose from the valve.
(5) Remove the two nuts from the frame mounting bracket and remove the valve assembly.

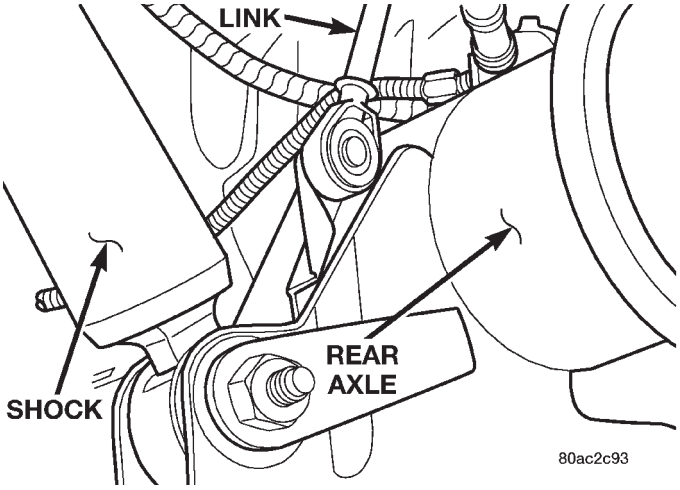


Fig. 24 Valve Link

INSTALLATION

(1) Install the valve assembly on the frame rail and tighten the mounting nut to 34 N·m (25 ft. lbs.).
(2) Install the brake line to the valve and tighten to 19 N·m (170 in. lbs.).
(3) Install the brake hose to the valve and tighten the bolt to 31 N·m (276 in. lbs.)

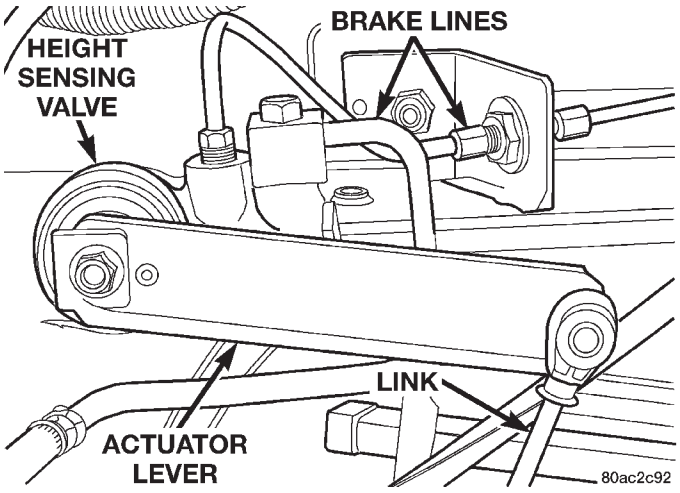


Fig. 25 Height Sensing Proportioning Valve

(4) Install the link to the actuator lever and bracket.
(5) Bleed rear brakes.
(6) Remove support and lower the vehicle.

MASTER CYLINDER

REMOVAL

(1) Remove brake lines from the master cylinder (Fig. 26).
(2) Remove mounting nut from the master cylinder (Fig. 26).
(3) Remove master cylinder.

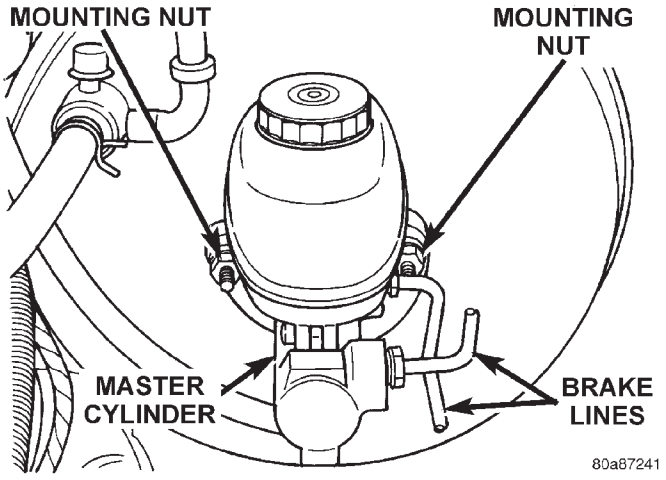


Fig. 26 Master Cylinder

INSTALLATION

NOTE: If master cylinder is replaced, bleed the cylinder before installation.

(1) Install master cylinder on booster mounting studs.
(2) Install mounting nuts and tighten to 23 N·m (17 ft. lbs.).

1998 Ram Truck
Publication No. 81-370-8108
TSB 26-04-99 April 1999

REMOVAL AND INSTALLATION (Continued)

(3) Install brake lines and tighten to 19-23 N·m (170-200 in. lbs.).

(4) Fill and bleed brake system.

VACUUM BRAKE BOOSTER

REMOVAL

(1) Remove the brake lines from the master cylinder.

(2) Remove nuts attaching the master cylinder to the booster studs. Then remove master cylinder.

(3) Disconnect vacuum hose at booster check valve.

(4) Remove knee bolster for access to brake pedal.

(5) Remove clip and washer securing booster push rod to brake pedal and slid rod off pedal (Fig. 27).

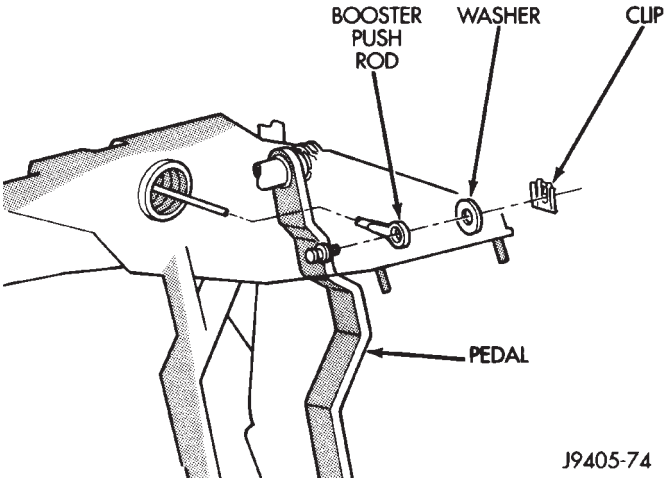


Fig. 27 Booster Push Rod

(6) Remove nuts attaching booster mounting studs to dash panel and pedal mounting bracket and remove booster (Fig. 28).

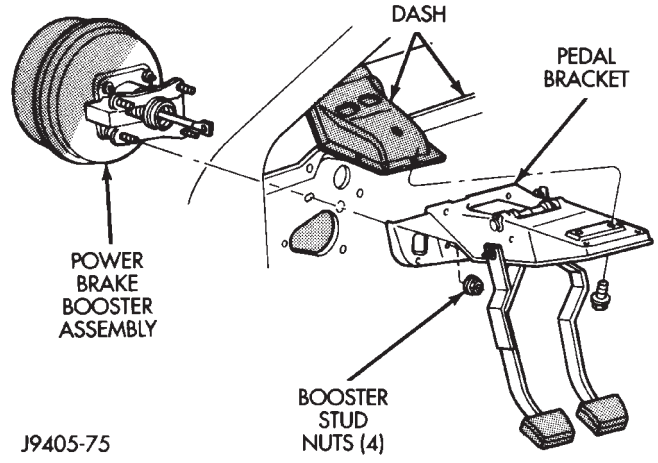


Fig. 28 Booster Mounting

INSTALLATION

(1) Position booster on engine compartment dash panel.

(2) Install and tighten booster mounting stud nuts to 28 N·m (21 ft. lbs.).

(3) Connect booster push rod to brake pedal.

(4) Install knee bolster.

(5) Connect vacuum hose to booster check valve.

(6) Install master cylinder on the booster and tighten mounting nuts to 23 N·m (17 ft. lbs.).

(7) Install the brake lines to master cylinder. Tighten brake line to 19-200 N·m (170-200 in. lbs.).

(8) Fill and bleed the brake system.

HYDRAULIC BOOSTER

WARNING: THE ACCUMULATOR CONTAINS HIGH PRESSURE GAS. DO NOT CARRY THE BOOSTER BY THE ACCUMULATOR OR DROP THE UNIT ON THE ACCUMULATOR.

REMOVAL

NOTE: If the booster is being replaced because the power steering fluid is contaminated, flush the power steering system before replacing the booster.

(1) With engine off depress the brake pedal several times to discharge the accumulator.

(2) Remove the brake lines from the master cylinder.

(3) Remove master cylinder mounting nuts.

(4) Remove the bracket from the hydraulic booster lines and master cylinder mounting studs.

(5) Remove the master cylinder.

(6) Remove the return hose and the two pressure lines from the hydraulic booster (Fig. 29).

(7) Remove the booster push rod clip, washer and rod remove from the brake pedal. (Fig. 30).

(8) Remove the mounting nuts from the hydraulic booster and remove the booster (Fig. 31).

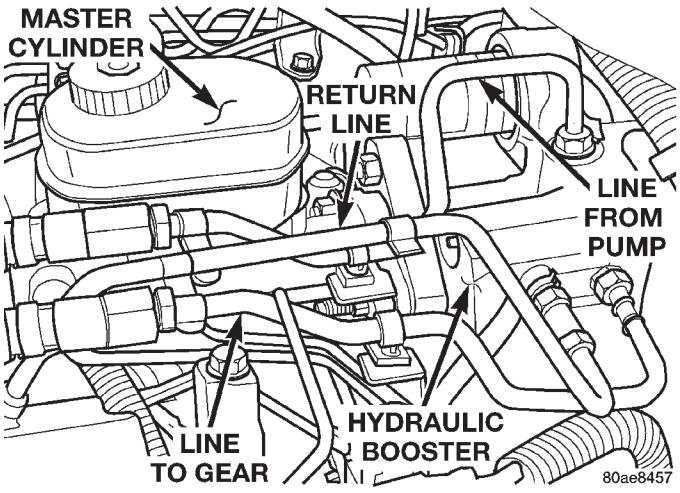


Fig. 29 Master Cylinder And Booster

REMOVAL AND INSTALLATION (Continued)

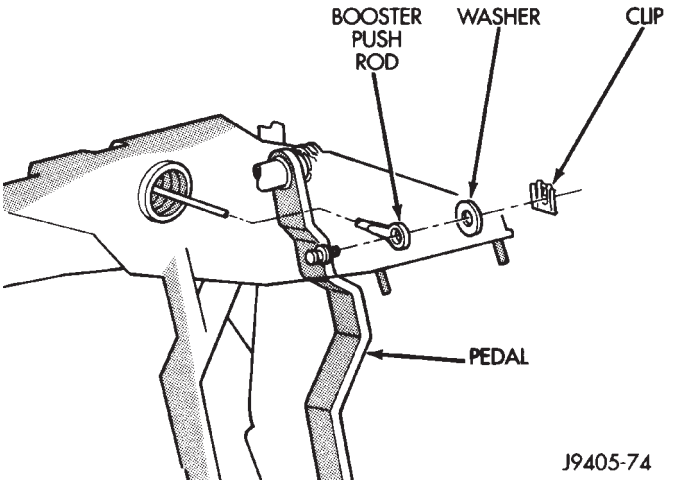


Fig. 30 Booster Push Rod

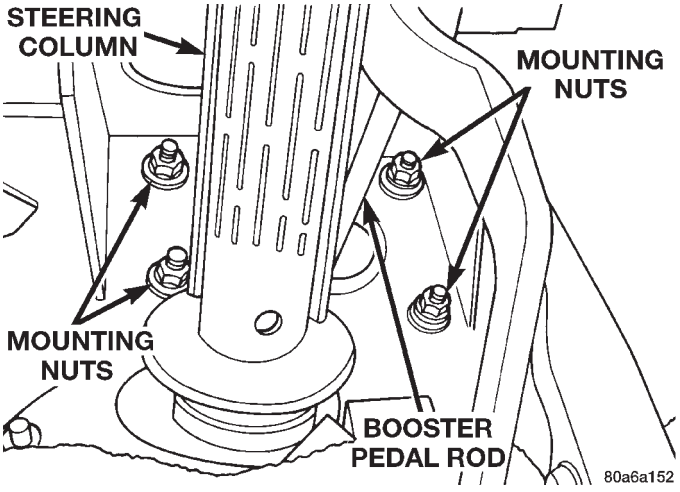


Fig. 31 Booster Mounting

INSTALLATION

(1) Install the hydraulic booster and tighten the mounting nuts to 28 N·m (21 ft. lbs.).

(2) Install the booster push rod, washer and clip onto the brake pedal.

(3) Install the master cylinder on the mounting studs. and tighten the mounting nuts to 23 N·m (17 ft. lbs.).

(4) Install the brake lines to the master cyclinder and tighten to 19-200 N·m (170-200 in. lbs.).

(5) Install the hydraulic booster line bracket onto the master cylinder mounting studs.

(6) Install the master cylinder mounting nuts and tighten to 23 N·m (17 ft. lbs.).

(7) Install the hydraulic booster pressure lines to the bracket and booster.

(8) Tighten the pressure lines to 28 N·m (21 ft. lbs.).

NOTE: Inspect o-rings on the pressure line fittings to insure they are in good condition before installation. Replace o-rings if necessary.

(9) Install the return hose to the booster.

(10) Fill and bleed the brake system.

(11) Fill the power steering pump with fluid.

CAUTION: Use only MOPAR power steering fluid or equivalent. Do not use automatic transmission fluid and do not overfill.

(12) Bleed the hydraulic booster.

DISC BRAKE CALIPER

REMOVAL

(1) Raise vehicle.

(2) Remove wheel and tire assemblies.

(3) Press caliper piston back into bore with large flat blade screwdriver (Fig. 32). Use large C-clamp to bottom piston in bore if additional force is required.

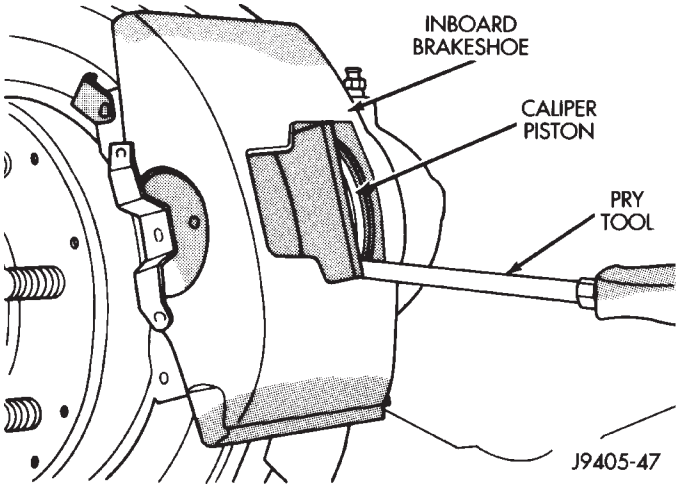


Fig. 32 Pressing Caliper Piston Into Bore

(4) Remove caliper mounting bolts with 3/8 hex wrench or socket (Fig. 33) and (Fig. 34).

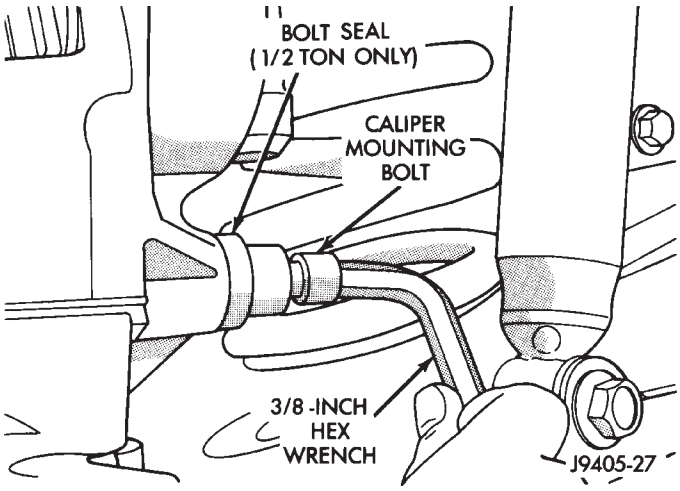


Fig. 33 Caliper Mounting Bolt (1/2 Ton)

REMOVAL AND INSTALLATION (Continued)

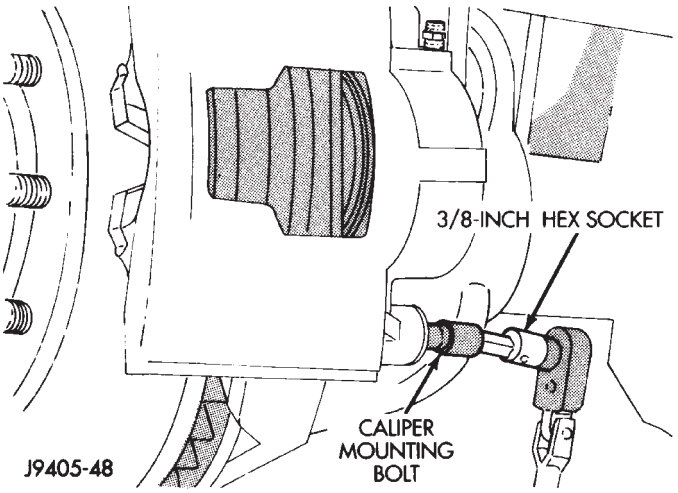


Fig. 34 Caliper Mounting Bolt (3/4 and 1 Ton)

(5) Rotate caliper rearward off rotor and out of steering knuckle support ledges (Fig. 35).

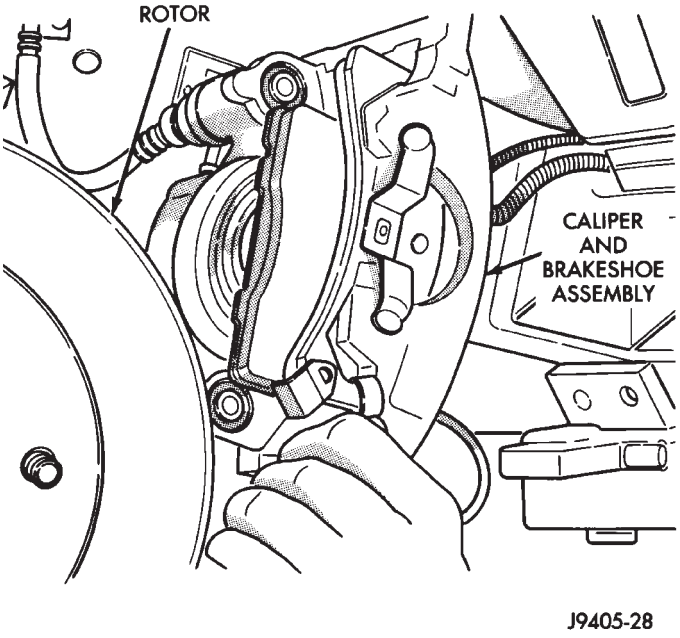


Fig. 35 Caliper Removal/Installation

(6) Remove front brake hose fitting bolt completely and remove caliper and brake shoes as assembly.

(7) Cover open end of front brake hose fitting to prevent dirt entry.

INSTALLATION

(1) Clean caliper and steering knuckle slide surfaces with wire brush. Then apply coat of silicone grease to slide surfaces.

(2) Install caliper over rotor and seat it on steering knuckle mounting arms.

(3) Start caliper mounting bolts by hand to avoid cross threading. Then tighten mounting bolts to 51 N·m (38 ft. lbs.).

(4) Connect brake hose to caliper (Fig. 36) and (Fig. 37). **Inure brake hose fitting is correctly seated against locating shoulder on caliper and hose is not twisted, or kinked before tightening fitting bolt.**

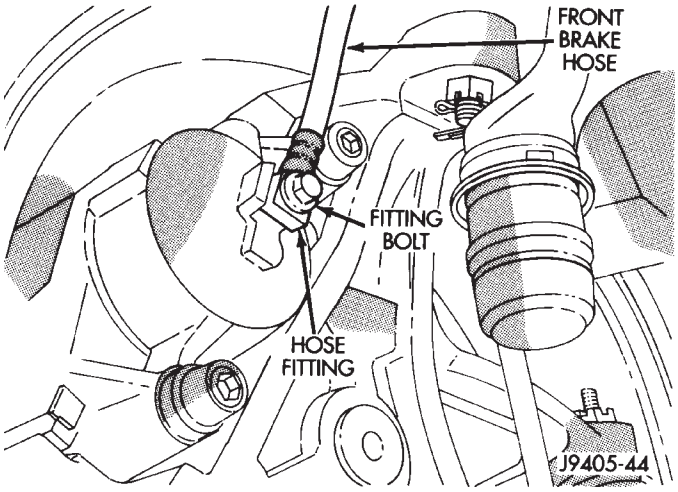


Fig. 36 Front Brake Hose Attachment

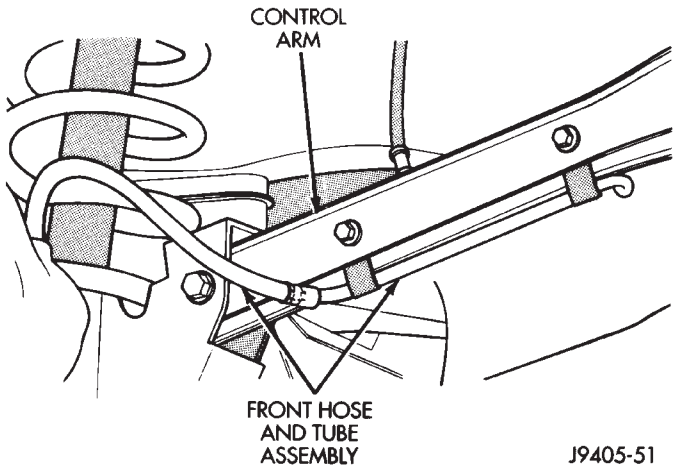


Fig. 37 Front Brake Hose Routing (4WD)

(5) Fill and bleed brake system. Refer to procedure in appropriate antilock brake section.

(6) Install wheel and tire assemblies and lower vehicle.

DISC BRAKE SHOES

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assemblies.

(3) Press caliper piston back into bore with large flat blade screwdriver. Use large C-clamp if more force is required to bottom piston in bore.

(4) Loosen bolt that secures front brake hose fitting bolt in caliper.

REMOVAL AND INSTALLATION (Continued)

(5) Remove caliper mounting bolts with 3/8 hex wrench or socket.

(6) Rotate caliper rearward off rotor and out of steering knuckle support ledges.

(7) Remove inboard and outboard brake shoes (Fig. 38) and (Fig. 39). Inboard shoe has spring clip that holds it in caliper piston. Tilt this shoe out at top to unseat clip. Outboard shoe has retaining spring that secures it in caliper. Unseat one spring end and rotate shoe out of caliper.

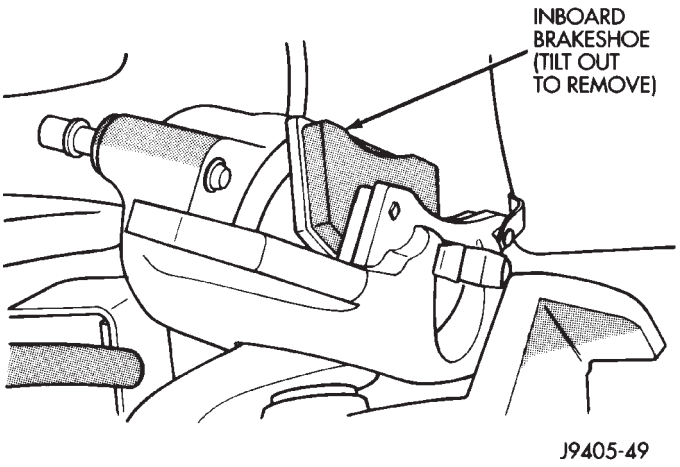


Fig. 38 Inboard Brake Shoe Removal

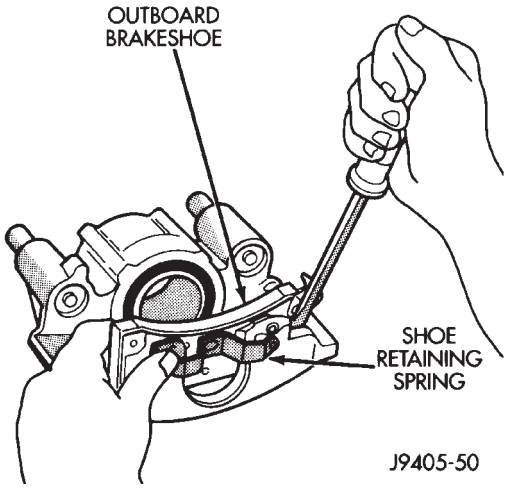


Fig. 39 Outboard Brake Shoe Removal

(8) Secure caliper to convenient chassis or suspension component with wire.

CAUTION: Do not allow the brake hose to support the caliper. Suspending the caliper by the brake hose can damage the hose and fitting joints. Use wire to support and secure the caliper to a chassis or suspension component.

If the brake shoes will be reused, do not intermix them. Keep the brake shoes with the caliper they were removed from.

INSTALLATION

NOTE: Replace riveted lining if worn to within 1.5 mm (1/16 in.) of rivet heads. Replace bonded lining if thickness is 3 mm (3/16 in.) or less.

(1) Clean caliper and steering knuckle slide surfaces with wire brush (Fig. 40). Then apply coat of Mopar multi-mileage grease to slide surfaces.

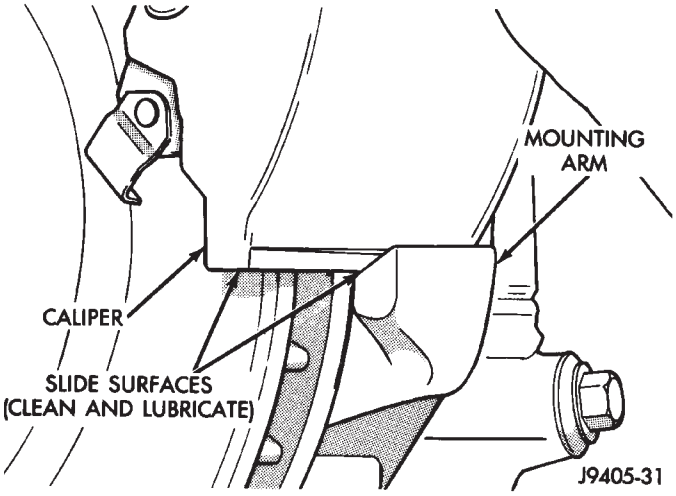


Fig. 40 Caliper And Steering Knuckle Slide Surfaces

(2) Lubricate caliper mounting bolts, collars, bushings and bores with silicone grease as follows:

- 1/2 ton models with 75 mm caliper, apply silicone grease to mounting pins and collars. Then fill space between bushings in caliper (Fig. 41).

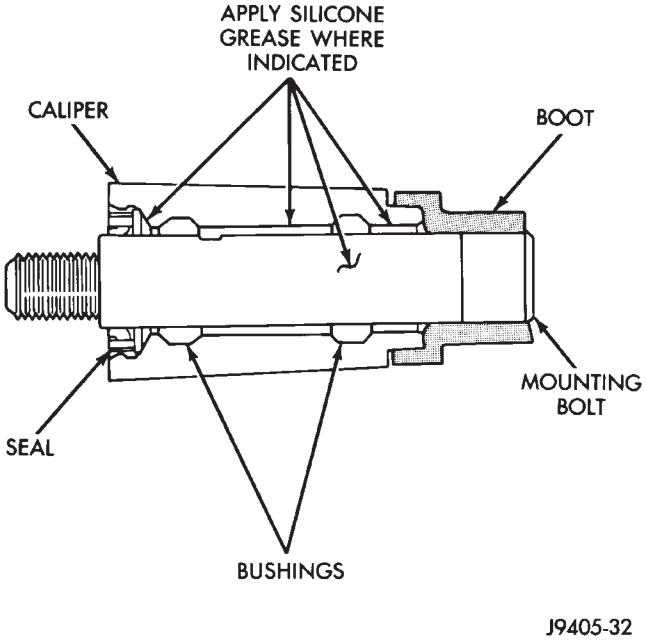


Fig. 41 Mounting Bolt Lubrication (75mm Caliper)

REMOVAL AND INSTALLATION (Continued)

• 3/4 and 1 ton models with 80 or 86 mm calipers, coat mounting pin and interior of bushing with silicone grease (Fig. 42).

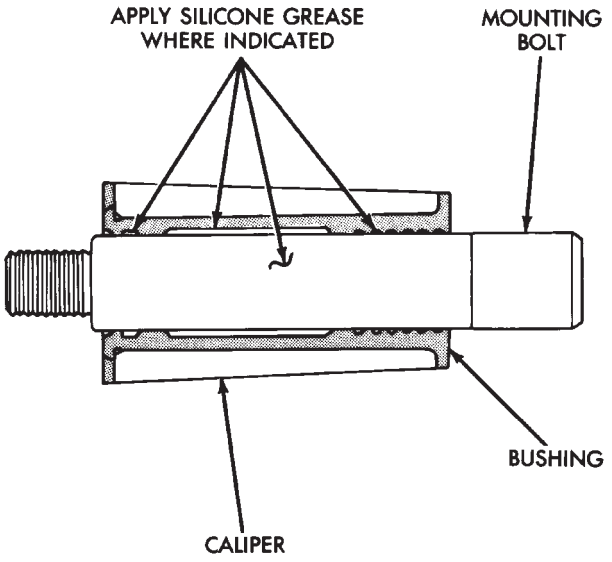


Fig. 42 Mounting Bolt Lubrication (80 or 86mm Caliper)

(3) Install inboard brake shoe in caliper. Be sure spring clip on shoe is properly aligned and seated in caliper piston (Fig. 43).

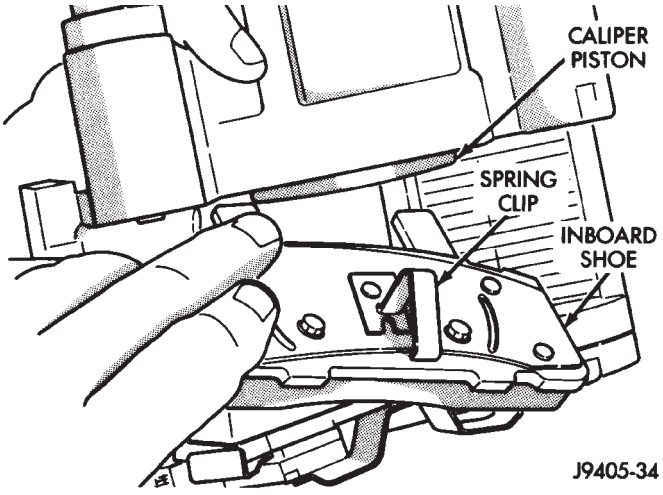


Fig. 43 Inboard Brake Shoe Installation

(4) Install outboard brake shoe in caliper. Be sure spring ends are seated in dimples in caliper (Fig. 44).

(5) Install caliper over rotor and into steering knuckle mounting arms (Fig. 45). **Be sure caliper is seated flush on mounting arm surfaces as shown.**

(6) Start caliper mounting bolts by hand to avoid cross threading. Then tighten mounting bolts to 51 N·m (38 ft.lbs.) torque.

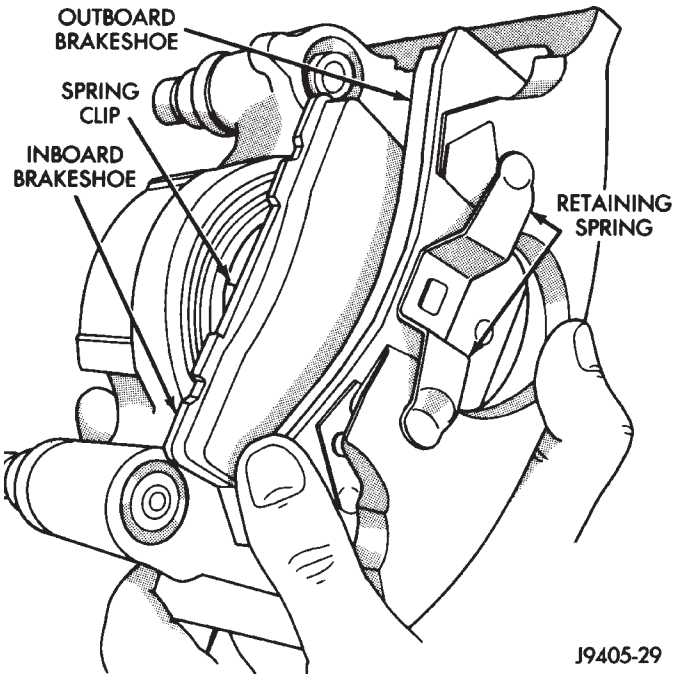


Fig. 44 Brake Shoe Position In Caliper

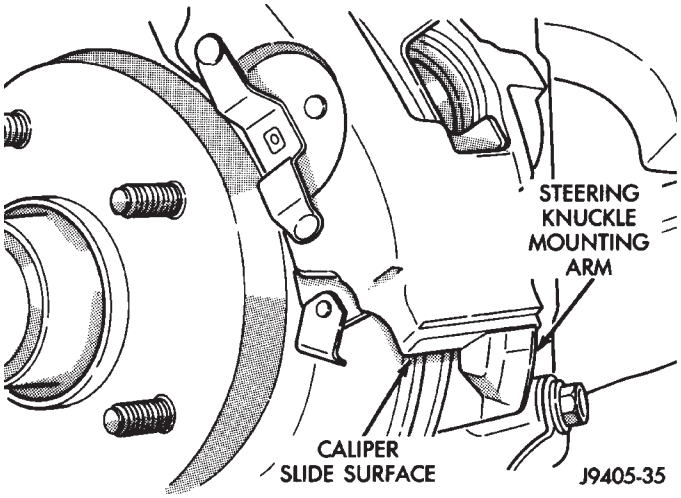


Fig. 45 Caliper Installation

(7) Install wheel and tire assemblies.

(8) Pump brake pedal to reseat caliper pistons and brake shoes. **Do not move vehicle until shoes have been properly seated.**

(9) Check brake fluid level and add fluid if necessary.

DISC BRAKE ROTOR – WITH TAPERED BEARINGS

REMOVAL

(1) Raise vehicle.
(2) Remove wheel and tire assembly.
(3) Remove caliper from rotor.
(4) Remove hub extension if equipped.

REMOVAL AND INSTALLATION (Continued)

(5) Remove grease cap that covers cotter pin and hub nut.

(6) Remove cotter pin from spindle and wheel bearing adjusting nut (Fig. 46).

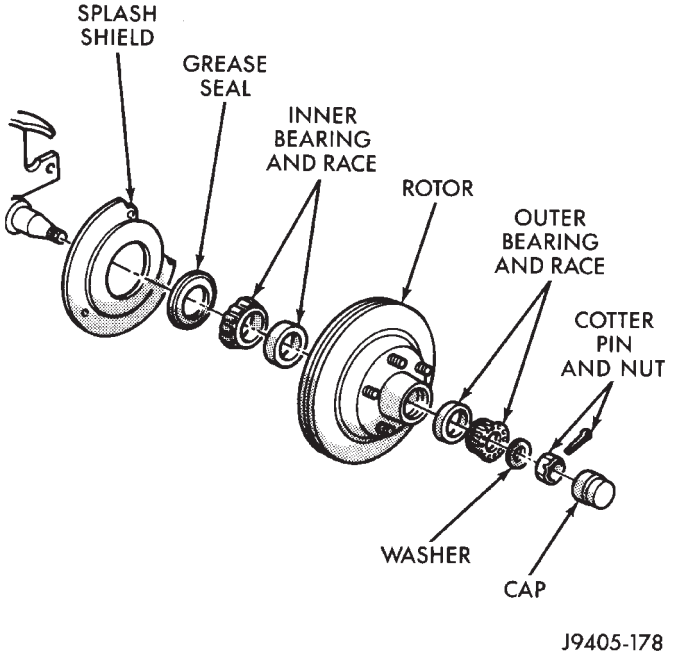


Fig. 46 Rotor And Hub Assembly (With Tapered Bearings)

(7) Remove locknut from wheel bearing adjusting nut. Then remove thrust washer and outer wheel bearing.

(8) Remove rotor and hub assembly from spindle.

(9) Inspect wheel bearings and interior of hub. If bearings need repacking, remove grease seal and inner wheel bearing from rotor hub.

INSTALLATION

(1) Repack wheel bearings with Mopar high temperature bearing grease. Apply grease to bearing races as well. Then install inner bearing in hub and install new grease seal.

(2) Apply liberal coat of bearing grease to spindle, interior of rotor hub, grease seal lip and seal surface of spindle.

(3) Install rotor and hub assembly on spindle.

(4) Install outer wheel bearing thrust washer and bearing adjusting nut. Tighten nut only enough to remove end play at this time.

(5) Install disc brake caliper. **Do not seat caliper pistons at this time. Pistons must not be seated until after wheel bearing adjustment has been completed.**

(6) Install wheel and tire assembly. Tighten wheel nuts snug but not to final torque at this time.

(7) Adjust wheel bearings by rotate wheel and fully tighten bearing adjusting nut to seat bearings. Loosen and tighten bearing adjusting nut once again while rotating wheel.

(8) Continue rotating wheel and back off adjusting nut until wheel end play is no more than 0.025 to 0.051 mm (0.001 to 0.002 in.).

(9) Install nut lock on adjusting nut and install new cotter pin. Adjusting nut can be tightened slightly to align cotter pin holes if necessary. Verify that wheel bearing adjustment is still OK.

(10) Install grease cap and wheel cover/hub cap.

(11) Install hub extension if equipped.

(12) Tighten lug nuts to proper torque.

DISC BRAKE ROTOR WITH 5 STUDS AND HUB BEARINGS

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Remove brake caliper.

(4) Remove rotor from hub bearing.

INSTALLATION

(1) Install rotor on hub bearing.

(2) Install brake caliper

(3) Install wheel and tire assemblies.

(4) Remove support and lower vehicle.

(5) Apply brakes several times to seat brake shoes and caliper piston. Do not move vehicle until firm brake pedal is obtained.

DISC BRAKE ROTOR WITH 8 STUDS AND HUB/BEARING

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Remove hub extension mounting nuts and remove the extension from the rotor if equipped (Fig. 47).

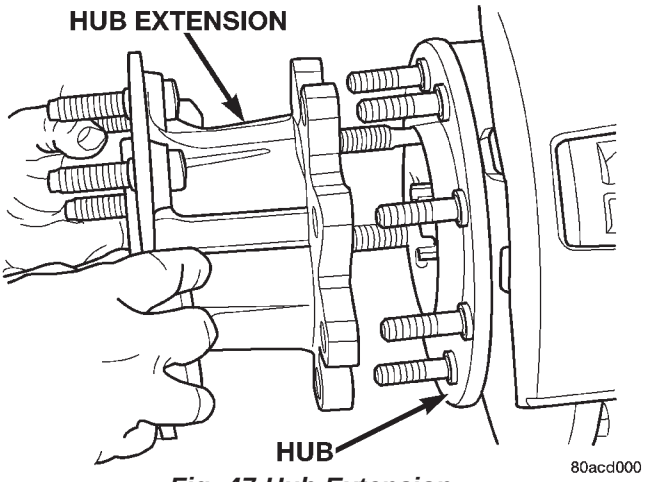


Fig. 47 Hub Extension

(4) Remove brake caliper.

REMOVAL AND INSTALLATION (Continued)

(5) Remove the cotter pin and hub nut from the axle shaft (Fig. 48).

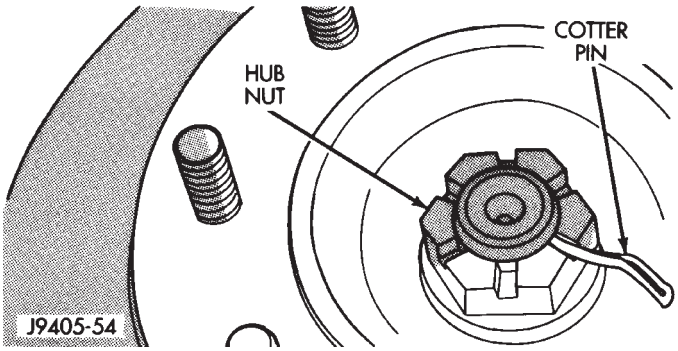


Fig. 48 Hub Nut Cotter Pin

(6) Disconnect the ABS wheel speed sensor wire from under the hood. Remove sensor wire from the frame and steering knuckle.

(7) Remove hub/bearing mounting bolts from inboard side of steering knuckle (Fig. 49).

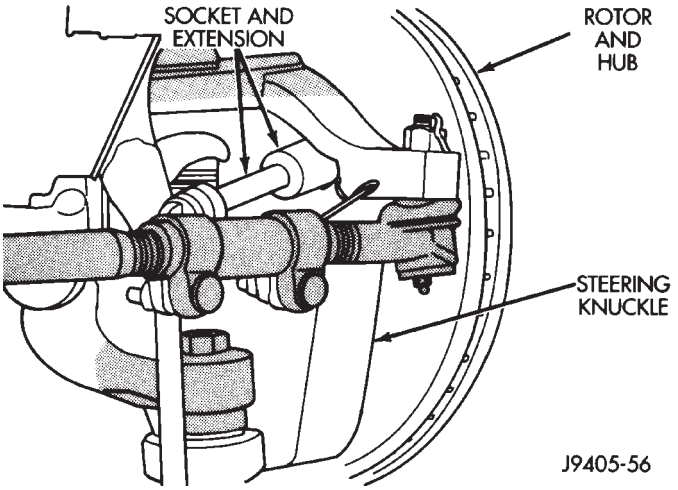


Fig. 49 Hub/Bearing Mounting Bolts

(8) Remove rotor hub/bearing assembly (Fig. 50), brake shield and spacer from the steering knuckle.

NOTE: If rotor hub assembly will not come out of the knuckle, use Puller C-844 with extra Puller Leg C-884-1 (Fig. 51) to remove the remove the assembly.

(9) Press out the wheel studs/hub extension studs and separate the rotor from the hub (Fig. 52).

INSTALLATION

(1) Position rotor on the hub/bearing.

(2) Press wheel studs/hub extension studs through the back side of the rotor and through the hub/bearing flange (Fig. 53).

(3) Apply liberal quantity of anti-seize compound to splines of front drive shaft.

(4) Insert two rearmost, top and bottom rotor hub bolts in steering knuckle. Insert bolts through back

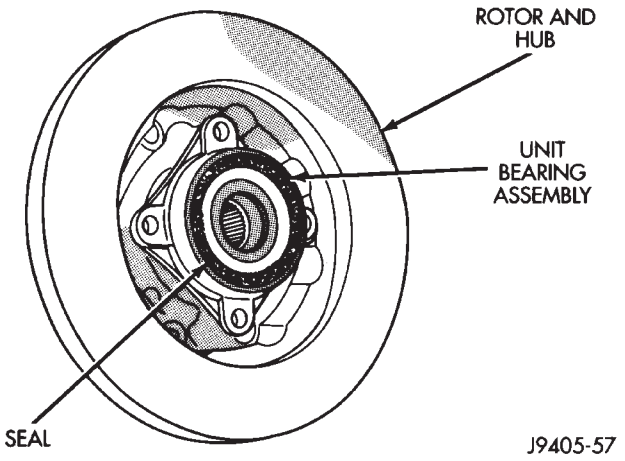


Fig. 50 Rotor Hub/Bearing Assembly

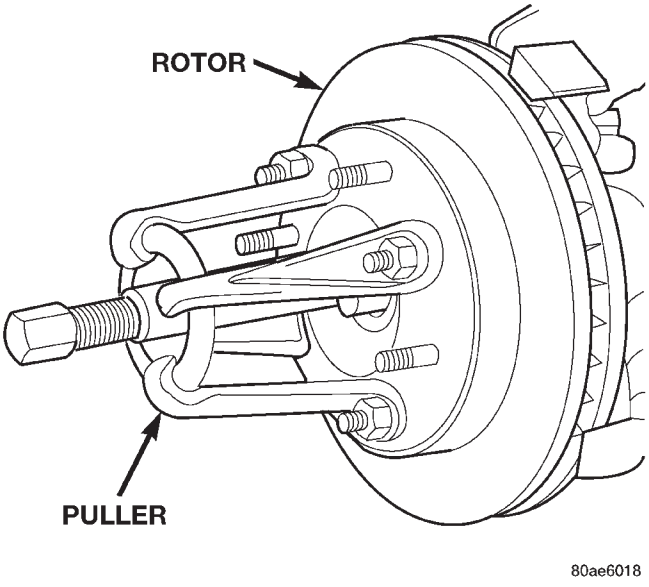


Fig. 51 Rotor Hub/Bearing Removal

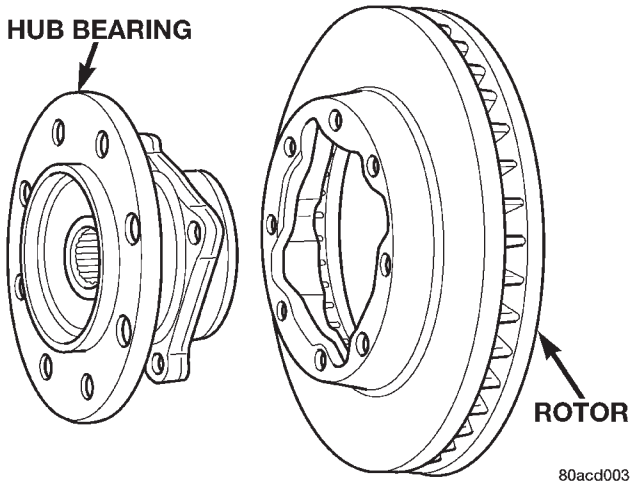


Fig. 52 Rotor And Hub/Bearing

REMOVAL AND INSTALLATION (Continued)

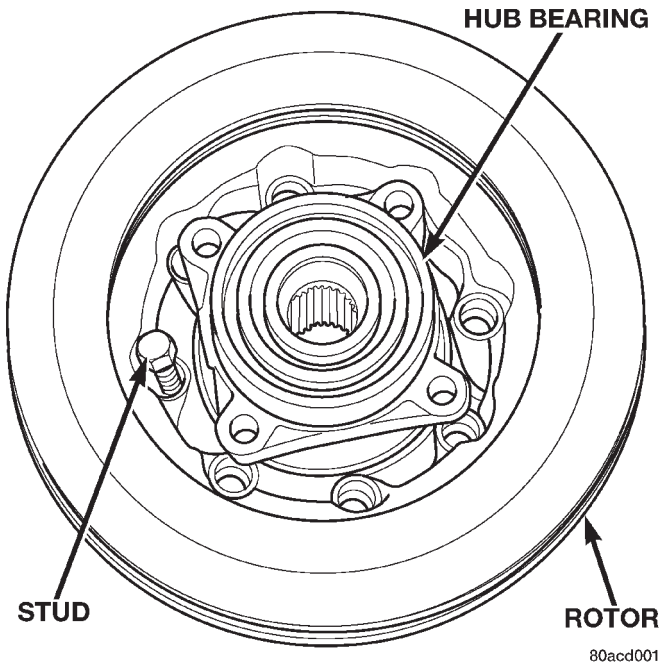


Fig. 53 Rotor, Hub/Bearing And Stud

side of knuckle so they extend out front face as shown.

(5) Position hub spacer (Fig. 54) and brake shield (Fig. 55) on bolts just installed in knuckle.

NOTE: If the vehicle is equipped with a wheel speed sensor the brake shield must be positioned on the hub bearing (Fig. 56).

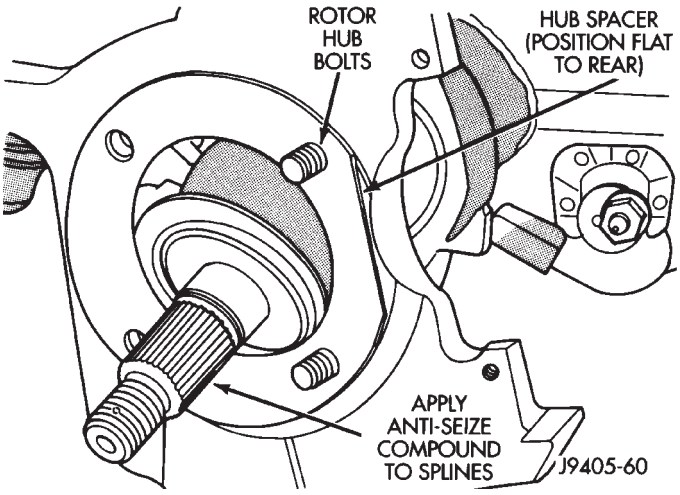


Fig. 54 Hub Spacer

(6) Align rotor hub with drive shaft and start shaft into rotor hub splines.

NOTE: Position wheel speed sensor wire at the top of the knuckle if equipped.

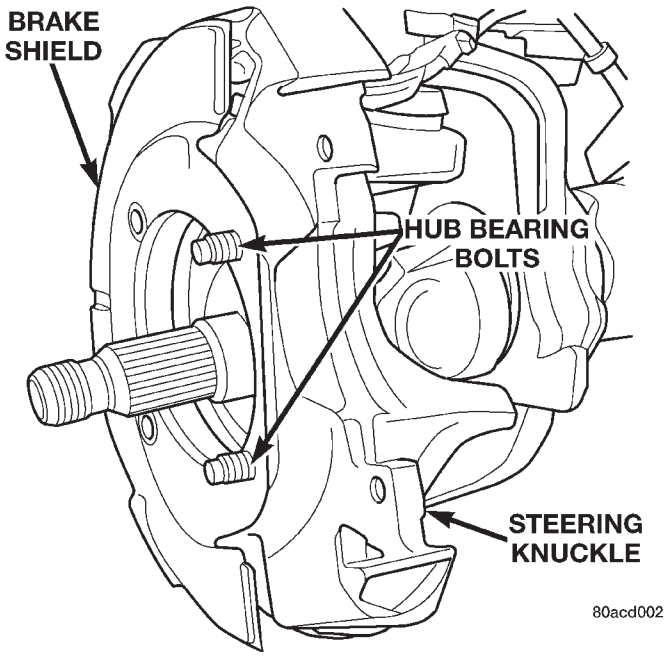


Fig. 55 Brake Shield

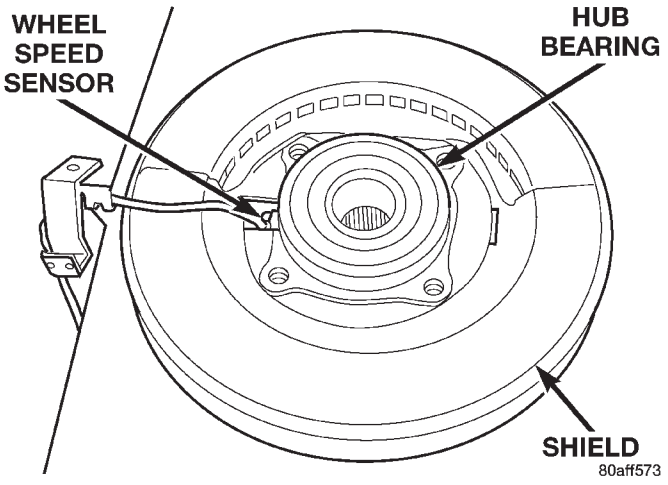


Fig. 56 Brake Shield With Wheel Speed Sensor

(7) Align bolt holes in hub/bearing flange with bolts installed in knuckle. Then thread bolts into bearing flange far enough to hold assembly in place.

(8) Install remaining bolts. Tighten hub/bearing bolts to 170 N·m (125 ft. lbs.).

(9) Install washer and hub nut and tighten to 237 N·m (175 ft. lbs.).

(10) Install new cotter pin in hub nut. Tighten nut as needed to align cotter pin hole in shaft with opening in nut.

(11) Install brake caliper.

(12) Install sensor wire to the steering knuckle and frame if equipped. Connect the wheel speed sensor wire under the hood.

(13) Install wheel and tire assemblies.

(14) Remove support and lower the vehicle.

REMOVAL AND INSTALLATION (Continued)

(15) Apply brakes several times to seat brake shoes and caliper piston. Do not move vehicle until firm brake pedal is obtained.

FRONT WHEEL BEARING

On models with tapered roller front wheel bearings, the bearings and races can be serviced when necessary. The bearing races do not require special tools for removal. The race can be removed with a long tapered brass drift. Race installation is performed with a bearing race driver set.

On vehicles with unit style hub bearings the unit is a bolted to the knuckle. 2500 and 3500 model vehicles with unit style hub bearing have the disc brake rotor pressed onto the unit with the wheel studs. The wheel studs must be pressed or driven out in order to separate the rotor from the hub bearing for replacement.

BRAKE SHOES – 11 INCH BRAKE

REMOVAL

(1) Raise vehicle.
(2) Remove rear wheels.
(3) Remove brake drums.

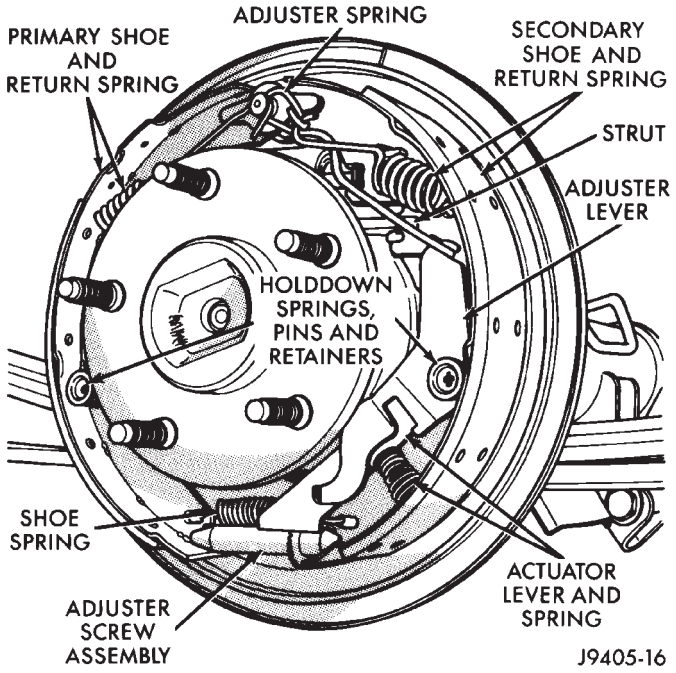


Fig. 57 Brake Shoe Mounting

(4) Remove primary (front) brake shoe return spring (Fig. 57) and (Fig. 58). Use brake spring pliers to unseat and remove spring from anchor pin.

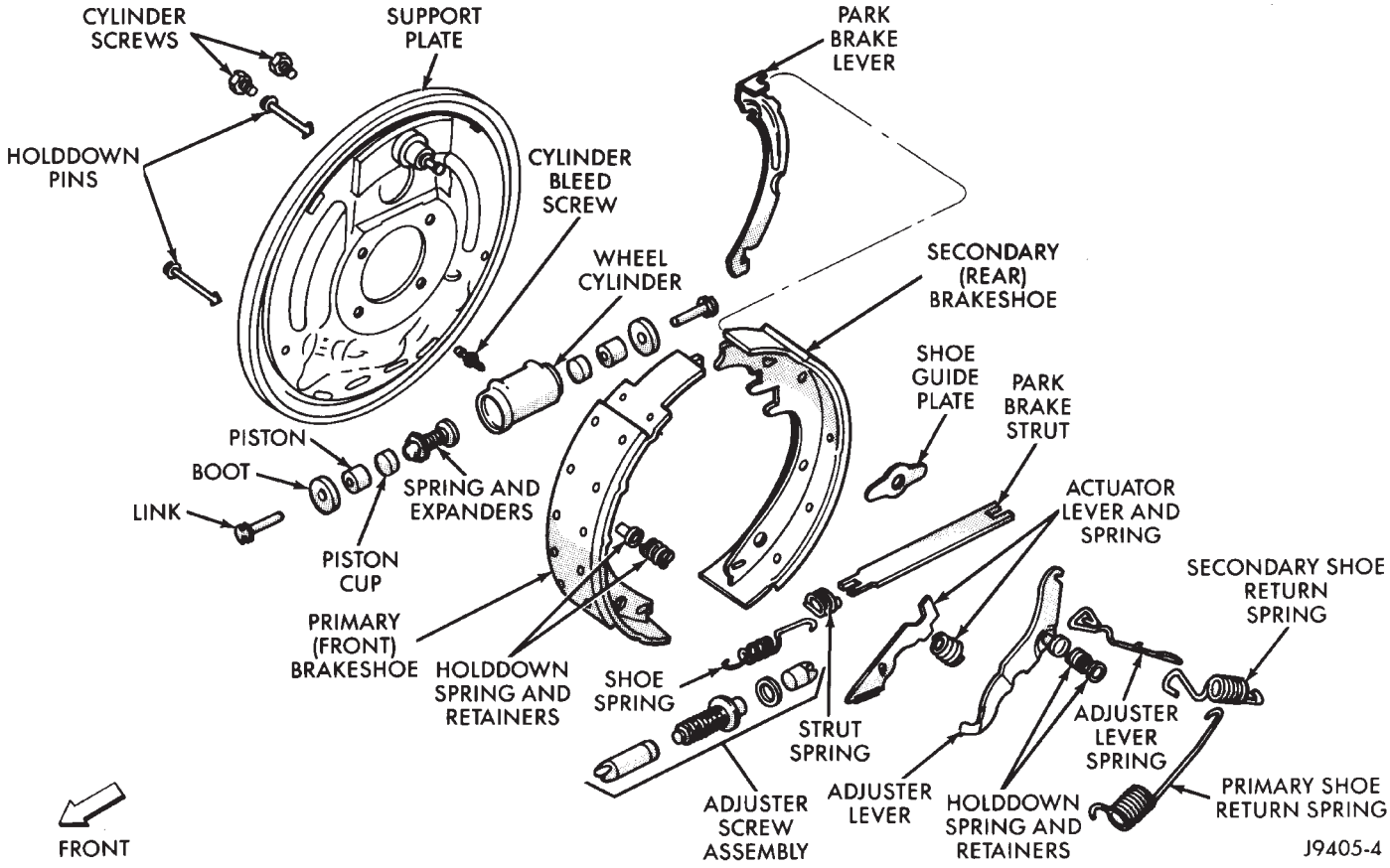


Fig. 58 Brake Shoes and Hardware

REMOVAL AND INSTALLATION (Continued)

(5) Remove primary shoe hold-down spring, pin and retainers. Use brake spring tool to rotate retainers and disengage pins.

(6) Tilt primary brake shoe outward. Then disengage shoe spring and remove primary brake shoe.

(7) Remove adjuster screw, shoe spring and park brake strut and spring.

CAUTION: The driver side adjuster screw has a right hand thread. The passenger side adjuster screw has a left hand thread. Do not interchange them as the brake shoes will not adjust properly.

(8) Remove secondary brake shoe hold-down spring, pin and retainers.

(9) Pull adjuster lever and retainer out of secondary brake shoe. Then rotate brake shoe out and up and remove adjuster spring and secondary shoe return spring.

(10) Disconnect park brake cable from lever on secondary brake shoe. Then remove brake shoe.

(11) If brake shoes are to be replaced, remove E-clip (or U-clip) that attaches park brake lever to secondary brake shoe and remove lever.

INSTALLATION

(1) Clean support plate with brake cleaner. Then smooth shoe contact pads with wire brush or emery cloth.

(2) Apply coat of high temperature bearing grease to each shoe contact pad on support plate (Fig. 59).

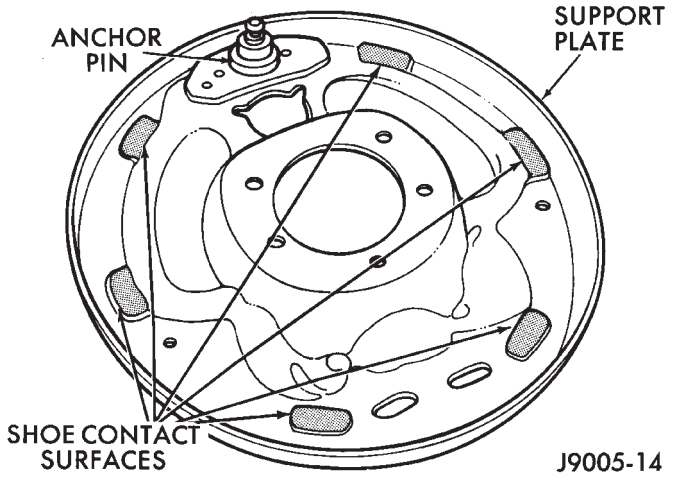


Fig. 59 Typical Brake Shoe Contact Pad Locations

(3) Lubricate adjuster levers and anchor pin and shoe contact surfaces on support plate with high temperature bearing grease.

(4) Clean and check operation of adjuster screw assemblies. Make sure each screw assembly rotates freely. Lubricate screw threads with spray lube. Replace either assembly if threads are heavily rusted, corroded, or damaged.

(5) Attach park brake lever to secondary brake shoe. use new U-clip to secure lever to shoe. If U-clip is used to secure shoe, pinch clip together with channel lock pliers to secure it. If E-clip is used, be sure clip is fully seated in notch.

(6) Attach park brake cable to lever.

(7) Position adjuster lever on secondary brake shoe. Then install spring retainer with shoulder on in lever and into shoe.

(8) Position secondary brake shoe on support plate. Use new hold-down spring, pin and retainer to secure shoe and adjuster lever.

(9) Attach shoe spring to secondary brake shoe. Connect long end of spring in secondary shoe.

(10) Engage parking brake strut in secondary brake shoe and install oval shaped spring on opposite end of strut (spring end of strut goes in primary shoe).

(11) Install primary brake shoe on support plate. Use new hold-down spring, pin and retainers to secure shoe. Be sure parking brake strut is seated in both brake shoes.

(12) Install actuator lever and spring. Hook actuator lever under adjuster lever as shown. Large diameter end of spring goes on shoe and small end on lever.

(13) Install adjuster screw assembly. Be sure star wheel is positioned adjacent to adjuster lever and that notches in buttons are properly seated on brake shoes.

CAUTION: Be sure the adjuster screws are installed on the correct side. The driver side adjuster screw has right hand threads and the passenger side has left hand threads. Also be sure the short end of the screw is toward the secondary brake shoe.

(14) Attach shoe spring to primary brake shoe.

(15) Install guide plate on anchor pin.

(16) Attach adjuster spring to adjuster lever.

(17) Install secondary brake shoe return spring in shoe.

(18) Attach secondary shoe return spring to adjuster spring. Then install adjuster spring on anchor pin.

(19) Install primary brake shoe return spring.

(20) Verify that adjuster and return springs are properly installed.

(21) Adjust brake shoes to drum with brake gauge.

(22) Install brake drum and wheel and tire assemblies.

(23) Lower vehicle.

REMOVAL AND INSTALLATION (Continued)

BRAKE SHOES – 13 INCH BRAKE

REMOVAL

(1) Raise vehicle.
(2) Remove rear wheel and tire assemblies.
(3) Remove brake drums.
(4) Remove primary (front) brake shoe return spring from anchor pin with brake spring pliers (Fig. 60).
(5) Remove primary brake shoe hold-down spring, pin and retainers with hold-down spring tool.
(6) Disconnect shoe spring and remove primary brake shoe and parking brake lever strut.
(7) Remove adjuster screw assembly.
(8) Remove secondary brake shoe hold-down spring, pin and retainers. Then remove adjuster lever, spring and spring retainer assembly. It is not necessary to disassemble adjuster lever components unless they are worn, or damaged.
(9) Disconnect parking brake cable from lever attached to secondary brake shoe. Then remove brake shoe.
(10) If brake shoes are to be replaced, remove E-clip attaching parking brake lever to secondary brake shoe and remove lever.
(11) Inspect wheel cylinder. If leakage is evident, remove and overhaul cylinder. Refer to overhaul procedure in this section.

INSTALLATION

(1) Clean support plate with brake cleaner. Then smooth shoe contact pads with wire brush or emery cloth.
(2) Lubricate adjuster levers and anchor pin and shoe contact surfaces on support plate with high temperature bearing grease.
(3) Clean and check operation of both adjuster screw assemblies. Replace either assembly if threads are heavily rusted, corroded, or damaged. Make sure each screw assembly rotates freely. Then lubricate adjuster screw threads with spray lube.
(4) Attach parking brake lever to secondary brake shoe. Use new E-clip to secure lever to shoe. If lever is secured with U-clip, pinch new clip together with channel lock pliers to secure it.
(5) Attach parking brake cable to parking brake lever.
(6) If adjuster lever was disassembled, reassemble it as follows:
(a) Clamp adjuster lever in vise (Fig. 61). **Clamp center portion of lever in vise only. Do not clamp bottom end of lever in vise. Lever**

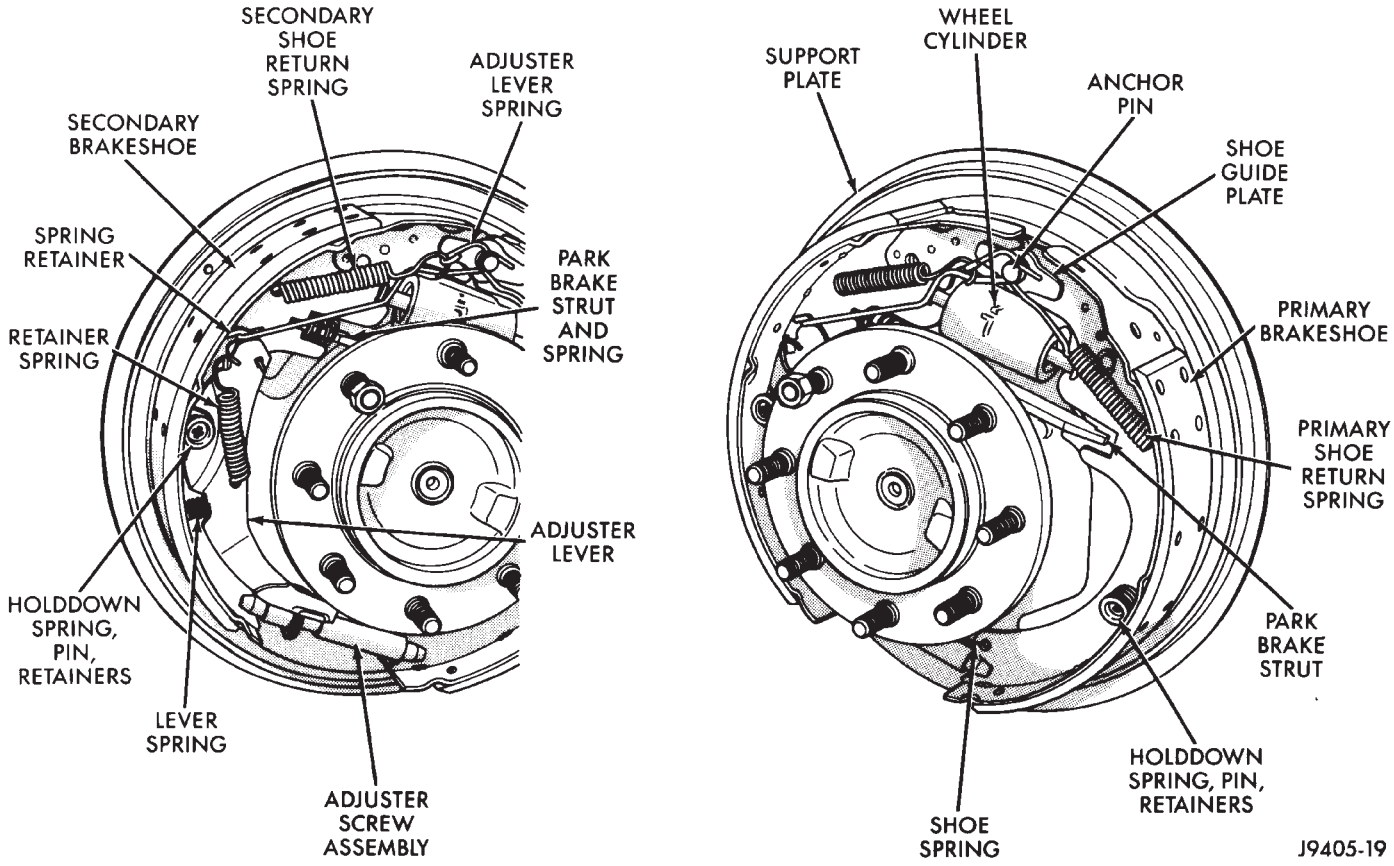


Fig. 60 Brake Shoes and Hardware (13 Inch Brake)

REMOVAL AND INSTALLATION (Continued)

flange that rotates adjuster screw star wheel teeth is at bottom of lever and will be damaged.

(b) Position small, hooked spring retainer in upper end of lever (Fig. 61). Be sure tang on retainer is securely engaged in hole in lever. Locking pliers can be used to hold retainer in place after positioning.

(c) Secure retainer in lever with retainer spring. Hook spring over end of retainer as shown (Fig. 62). Needlenose pliers and number 2 Phillips screwdriver can be used to attach spring to lever and retainer.

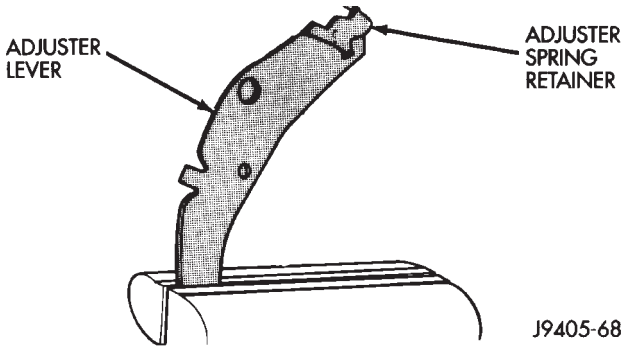


Fig. 61 Positioning Retainer On Adjuster Lever

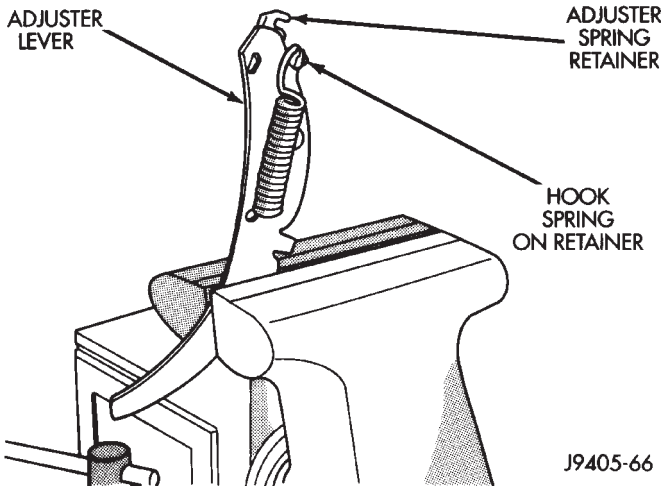


Fig. 62 Assembling Adjuster Lever, Spring And Retainer

(7) Install secondary brake shoe and adjuster lever as follows:

(a) Insert secondary shoe hold-down pin through support plate.

(b) Position secondary brake shoe on support plate and insert pin through shoe.

(c) Position adjuster lever on brake shoe and insert hold-down spring inner retainer into lever and shoe. Inner retainer has shoulder on it which seats in lever and shoe.

(d) Install hold-down spring over pin and seat it in inner retainer. Then install and seat hold-down spring outer retainer on pin with hold-down spring tool.

(8) Install adjuster lever spring between brake shoe and lever. Be sure spring is seated on lever tang.

(9) Attach shoe spring to secondary brake shoe. Long end of spring goes in secondary shoe.

(10) Install oval shaped spring on park brake strut and engage spring end of strut in secondary brake shoe.

(11) Install primary brake shoe on support plate. Use new hold-down spring, pin and retainers to secure shoe. Be sure parking brake strut is seated in both brake shoes.

(12) Install adjuster screw assembly. Be sure star wheel is positioned adjacent to adjuster lever and that notches in adjuster screw are properly seated on brake shoes.

CAUTION: Be sure the adjuster screws were not intermixed and are installed on the correct side. The driver side adjuster screw has right hand threads and the passenger side has left hand threads. Also be sure the short end of the screw is toward the secondary brake shoe.

(13) Attach shoe spring to primary brake shoe. Use brake spring pliers and long screwdriver to seat spring in shoe.

(14) Install shoe guide plate on anchor pin.

(15) Attach adjuster spring to spring retainer at top of adjuster lever. Then seat spring on anchor pin with brake spring pliers.

(16) Install secondary brake shoe return spring. Attach short end of spring to brake shoe. Then hook opposite end on adjuster spring. Use brake spring pliers, or a long shank screwdriver to engage return spring in adjuster spring.

(17) Install primary brake shoe return spring.

(18) Check component installation. Be sure adjuster screw, wheel cylinder links and park brake strut are all seated in brake shoes.

(19) Adjust brake shoes to drum with brake gauge.

(20) Install brake drums.

(21) Install wheel and tire assemblies and lower vehicle.

(22) Install wheel cover or hub cap.

WHEEL CYLINDER

REMOVAL

(1) Raise vehicle and remove tire and wheel assembly.

(2) Remove brake drum.

(3) Lift adjuster lever away from adjuster screw. Then turn screw star wheel until screw is fully retracted.

REMOVAL AND INSTALLATION (Continued)

(4) Remove brake shoe return springs, adjuster spring and adjuster screw. Move upper ends of brake shoes apart to provide removal clearance for wheel cylinder links.

(5) Disconnect brake line from wheel cylinder.

(6) Remove wheel cylinder attaching screws and remove cylinder from support plate

INSTALLATION

(1) Apply thin coat of silicone sealer to wheel cylinder mounting surface of support plate (Fig. 63). Sealer prevents road splash from entering brake drum past cylinder.

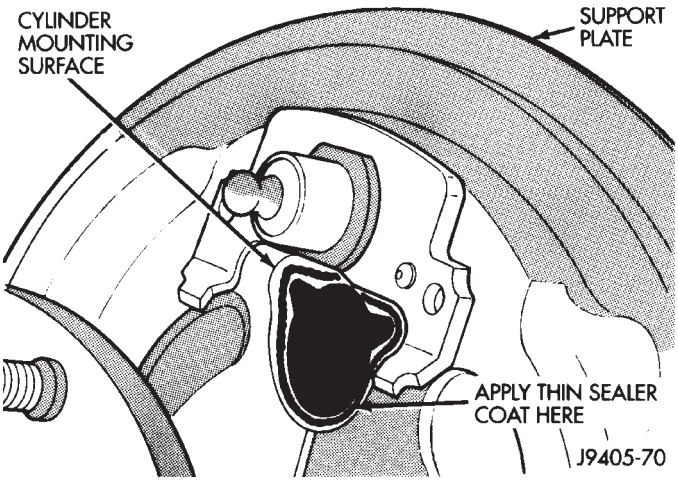


Fig. 63 Wheel Cylinder Mounting Surface

(2) Start brake line in cylinder inlet by hand. Do not tighten fitting at this time.

(3) Mount wheel cylinder on support plate and install cylinder attaching screws. Tighten screws to 20 N·m (15 ft. lbs.).

(4) Tighten brake line fitting to 13 N·m (115 in. lbs.).

(5) Install brake shoe components.

(6) Adjust brake shoes to drum using brake gauge.

(7) Install brake drum.

(8) Fill and bleed brake system.

(9) Install wheel and tire assemblies and lower vehicle.

BRAKE SUPPORT PLATE

REMOVAL

(1) Remove wheel and tire assemblies.

(2) Remove brake drums

(3) Remove axle shaft, refer to Group 3 for procedures.

(4) Remove brake shoes and hardware for access to parking brake cable.

(5) Remove parking brake cable from support plate.

(6) Disconnect brake line at wheel cylinder and remove cylinder.

(7) Remove bolts attaching support plate to axle and remove support plate.

INSTALLATION

(1) Apply thin bead of silicone sealer around axle mounting surface of support plate.

(2) Install support plate on axle flange. Tighten attaching bolts to 47-68 N·m (35-50 ft. lbs.).

(3) Apply thin bead of silicone sealer around wheel cylinder mounting surface. Install wheel cylinder on new support plate.

(4) Install parking brake cable in support plate.

(5) Install brake shoes and hardware.

(6) Install axle shaft, refer to Group 3 for procedure.

(7) Adjust brake shoes to drum with brake gauge.

(8) Install brake drums.

(9) Fill and bleed brake system.

(10) Install wheel and tire assemblies and lower vehicle.

FRONT PARKING BRAKE CABLE

REMOVAL

(1) Remove knee bolster.

(2) Release parking brake pedal completely.

(3) Raise vehicle.

(4) Loosen tensioner nut to create slack in front cable and extension cable (Fig. 64).

(5) Disengage front cable from extension cable connector. Extension cable also be removed at this time if necessary.

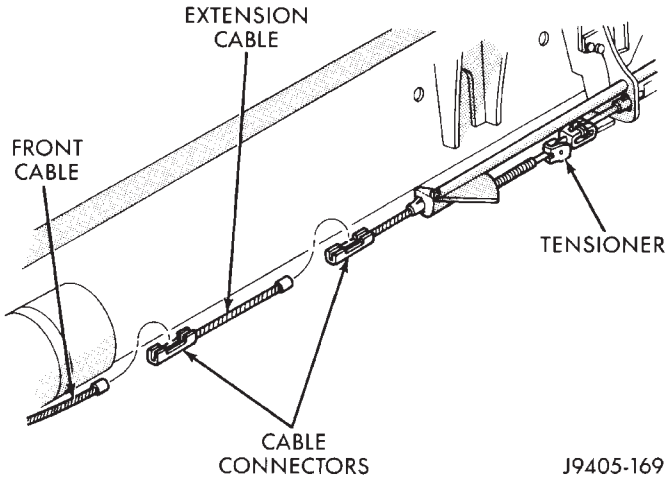


Fig. 64 Extension-To-Front Cable Attachment

(6) Lower vehicle.

(7) Roll back carpet and loosen cable grommet and cable retainer (Fig. 65). Then pull cable through floorpan grommet and remove cable.

REMOVAL AND INSTALLATION (Continued)

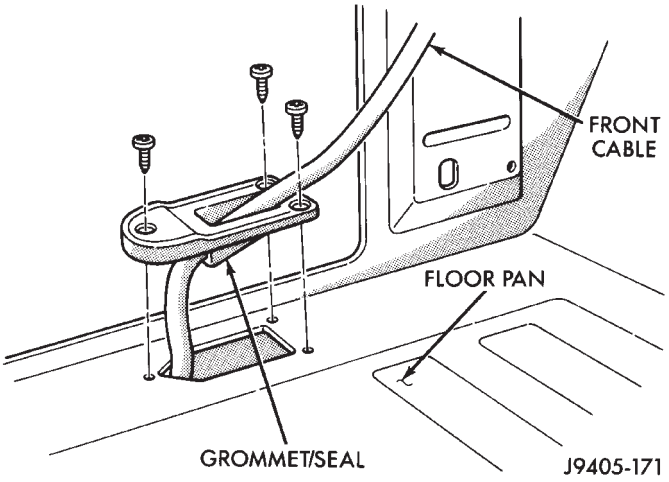


Fig. 65 Cable Grommet In Floorpan

(8) Disengage front cable from arm on foot pedal assembly (Fig. 66).

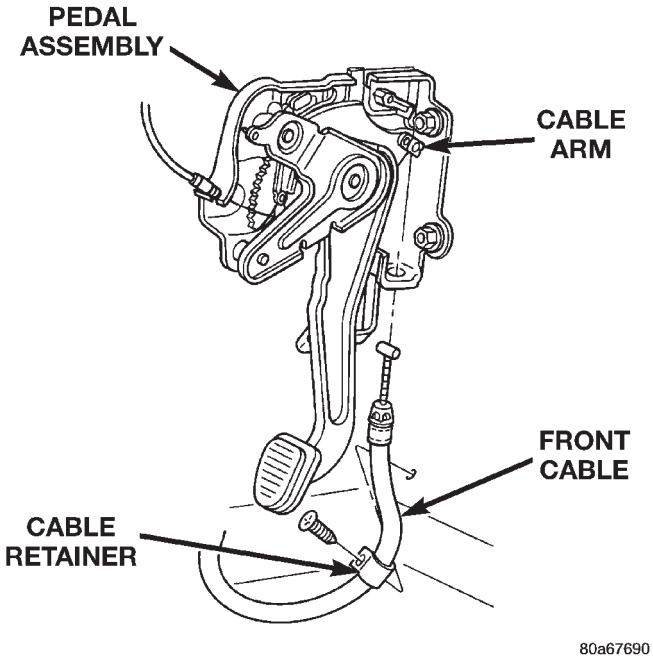


Fig. 66 Cable Attachment At Foot Pedal

INSTALLATION

(1) Insert new cable through floorpan grommet and up to arm on pedal assembly.

(2) Hook cable T-connector in arm on pedal assembly.

(3) Secure floorpan grommet/seal and cable retainer.

(4) Realign floor carpet.

(5) Install knee bolster.

(6) Engage front cable and extension cable in cable connectors. Make sure right rear cable is secured in tensioner connector.

(7) Adjust cable tensioner. Refer to procedure in this section.

REAR PARK BRAKE CABLE

REMOVAL

(1) Raise vehicle and remove necessary wheel and brake drum.

(2) Remove secondary brake shoe and disconnect cable from parking lever attached to secondary shoe.

(3) Compress rear cable retainer with hose clamp or pliers and pull cable out of support plate.

(4) Remove one (or both) cables reaction bracket on left rear fame rail.

(5) Disengage rear cable from tensioner (Fig. 67).

(6) Compress cable retainer with hose clamp or pliers and slide cable out of bracket.

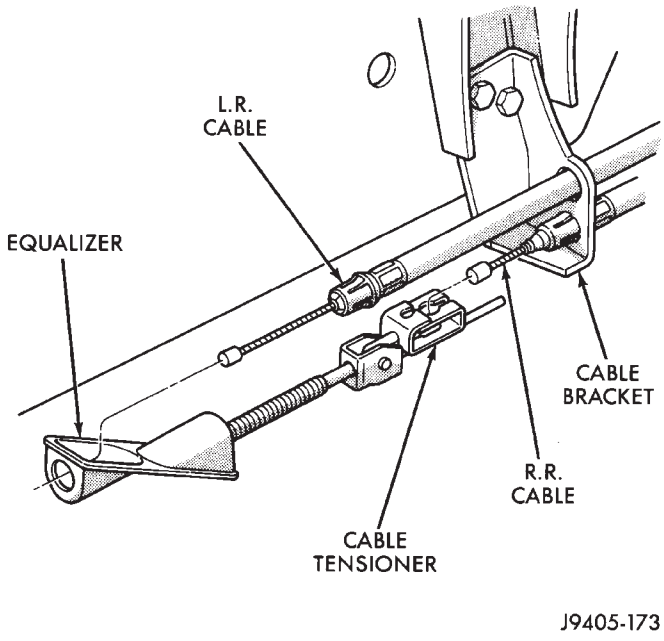


Fig. 67 Cable And Tensioner Attachment

INSTALLATION

(1) Route new cable to rear brake support plate.

(2) Insert cable through support plate, seat cable retainers and attach cable to parking brake lever on secondary brake shoe.

(3) Install brake shoes.

(4) Seat cable in body clips, reaction bracket, and frame bracket.

(5) Connect cable to tensioner.

(6) Adjust cable tensioner, Refer to procedure in this section.

(7) Install wheel and tire assemblies.

(8) Lower vehicle.

(9) Verify parking brake operation.

REMOVAL AND INSTALLATION (Continued)

PARKING BRAKE PEDAL

REMOVAL

(1) Release parking brakes.
(2) Raise vehicle.
(3) Loosen cable tensioner nut at equalizer to create slack in front cable.
(4) Lower vehicle.
(5) Remove knee bolster.
(6) Disconnect brakelamp wire from switch on pedal assembly.
(7) Roll carpet back, loosen front cable grommet from floorpan and cable retainer.
(8) Disengage cable end connector from arm on pedal assembly.
(9) Remove bolts/nuts from pedal assembly and remove assembly (Fig. 68).

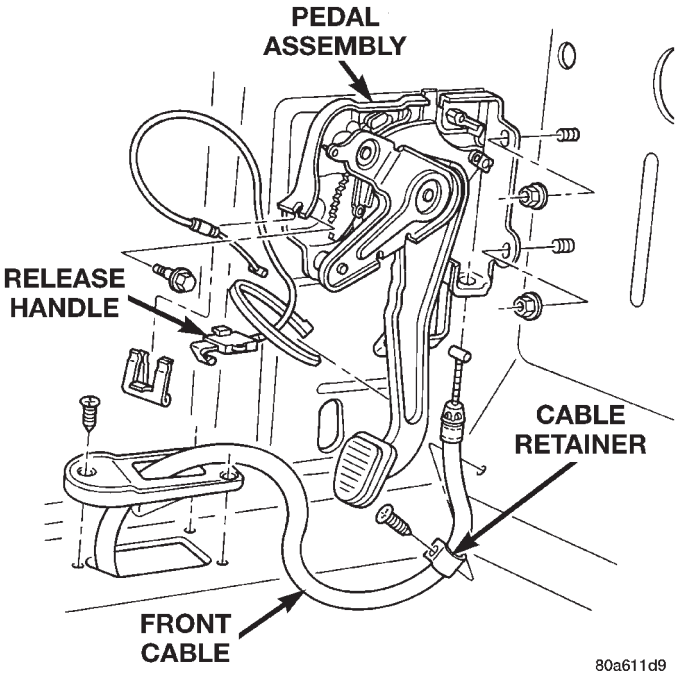


Fig. 68 Parking Brake Pedal Assembly

INSTALLATION

(1) Position replacement pedal assembly on dash and cowl.
(2) Install bolts/nuts and tighten to 28 N·m (21 ft. lbs.).
(3) Connect front cable to arm on pedal assembly.
(4) Tighten front cable grommet to floorpan and cable retainer, roll carpet back.
(5) Connect wires to brakelamp switch.
(6) Install knee bolster.
(7) Raise vehicle.
(8) Adjust parking brake cable tensioner.

DISASSEMBLY AND ASSEMBLY

MASTER CYLINDER RESERVOIR

REMOVAL

(1) Remove reservoir cap and empty fluid into drain container.
(2) Clamp cylinder body in vise with brass protective jaws.
(3) Remove pins that retain reservoir to master cylinder. Use hammer and pin punch to remove pins (Fig. 69).

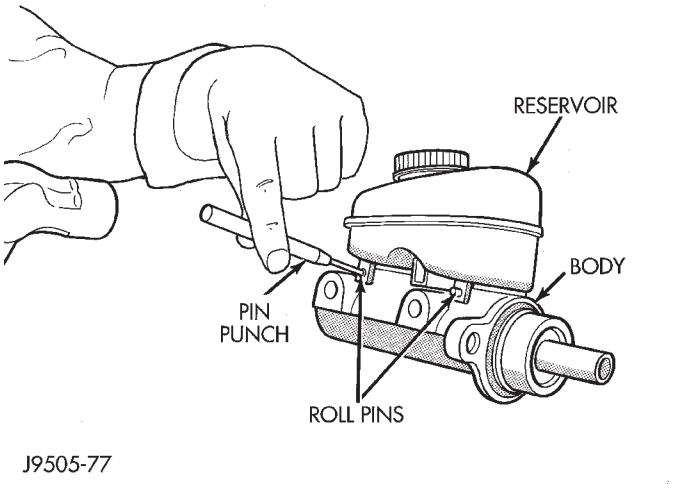


Fig. 69 Reservoir Retaining Pins

(4) Loosen reservoir from grommets with pry tool (Fig. 70).

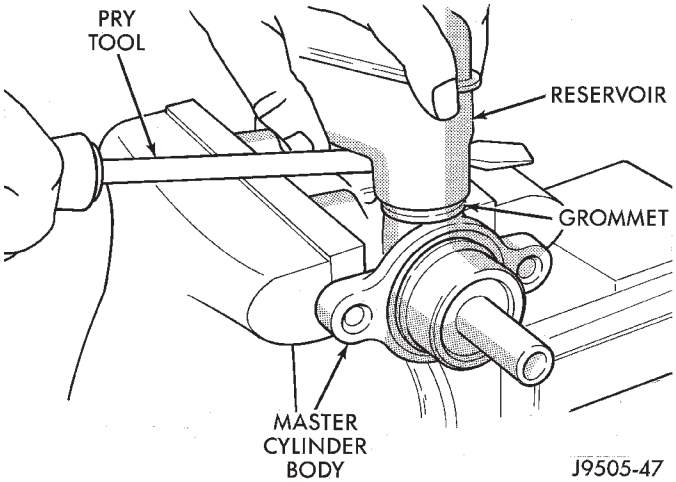


Fig. 70 Loosening Reservoir

(5) Remove reservoir by rocking it to one side and pulling free of grommets (Fig. 71).
(6) Remove old grommets from cylinder body (Fig. 72).

DISASSEMBLY AND ASSEMBLY (Continued)

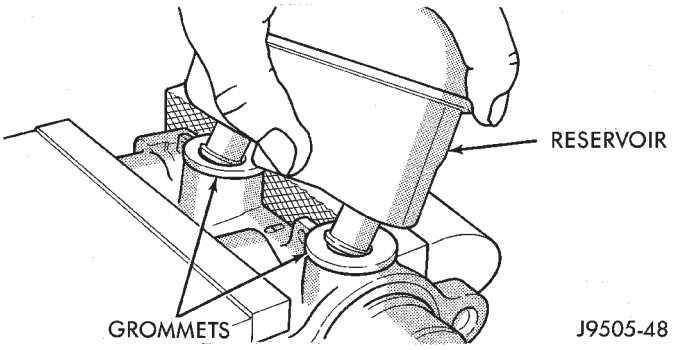


Fig. 71 Reservoir Removal

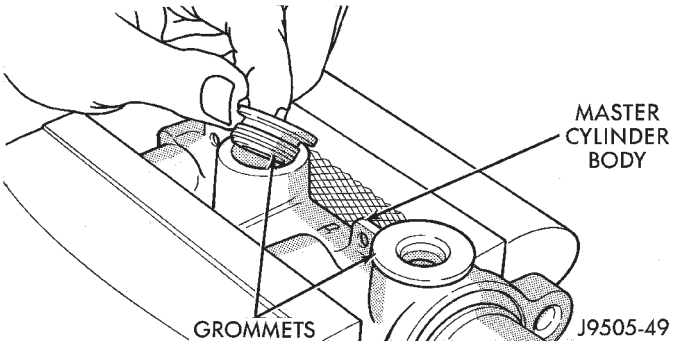


Fig. 72 Grommet Removal

INSTALLATION

CAUTION: Do not use any type of tool to install the grommets. Tools may cut, or tear the grommets creating a leak problem after installation. Install the grommets using finger pressure only.

(1) Lubricate new grommets with clean brake fluid and Install new grommets in cylinder body (Fig. 73). Use finger pressure to install and seat grommets.

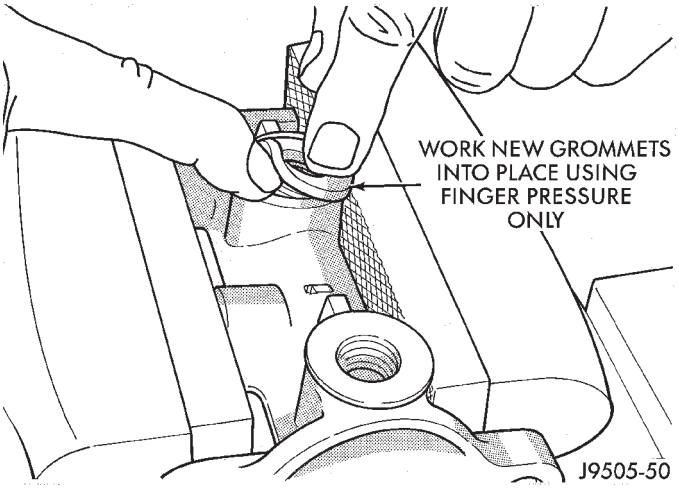


Fig. 73 Grommet Installation

(2) Start reservoir in grommets. Then rock reservoir back and forth while pressing downward to seat it in grommets.

(3) Install pins that retain reservoir to cylinder body.

(4) Fill and bleed master cylinder on bench before installation in vehicle.

DISC BRAKE CALIPER

DISASSEMBLY

(1) Drain brake fluid from caliper.

(2) Remove brake shoes from caliper.

(3) Pad interior of caliper with one-inch thickness of shop towels to cushion and protect caliper piston during removal (Fig. 74).

(4) Remove caliper piston with several **short bursts** of low pressure compressed air. Direct air through fluid inlet port to ease piston out of bore (Fig. 74).

CAUTION: Do not blow the piston out of the bore with sustained air pressure. This could result in a cracked piston. Use only enough air pressure to ease the piston out.

WARNING: NEVER ATTEMPT TO CATCH THE PISTON AS IT LEAVES THE BORE. THIS WILL RESULT IN PERSONAL INJURY.

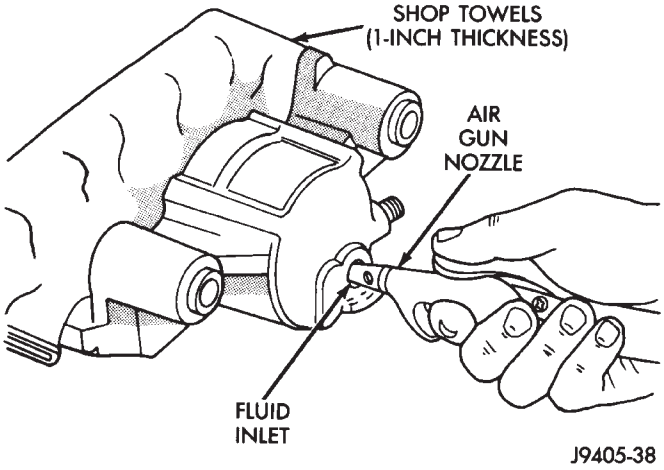


Fig. 74 Caliper Piston Removal

(5) Remove piston dust boot with a suitable pry tool (Fig. 75). **Do not scratch piston bore while removing boot.** Discard dust boot as it is not reusable.

(6) Remove piston seal from caliper and discard seal it is not reusable (Fig. 76) and (Fig. 77).

(7) Remove mounting bolts from calipers and inspect seals, boots, and bushings (Fig. 76) and (Fig. 77). Remove these components only if cut, worn, or damaged.

(8) Remove caliper bleed screw.

DISASSEMBLY AND ASSEMBLY (Continued)

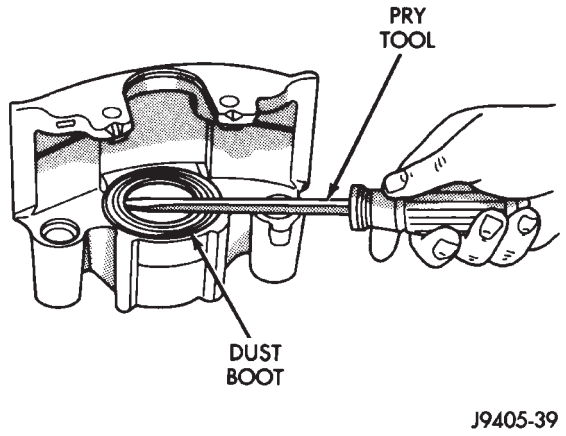


Fig. 75 Dust Boot Removal

ASSEMBLY

NOTE: Be sure caliper assembly area of workbench is clean and dry. This is important as dust, dirt, foreign material, oil, or solvents can damage seals, harm piston surfaces and contaminate fluid.

(1) Clean the caliper and piston with brake cleaner, clean brake fluid, or denatured alcohol. Do not use any other cleaning agents.

(2) Inspect condition of the caliper piston bore. The piston must be free of corrosion, rust, pitting, or scoring. replace the piston if it exhibits any of these conditions.

(3) A fiber brush can be used to clean the bore if necessary. The bore should be free of corrosion, pitting, or scoring. Discoloration of the bore is a normal condition and not cause for replacement. The bore can be lightly polished by hand but only with crocus cloth.

CAUTION: Never hone the caliper piston bore, or use any kind of abrasive material on the piston surface. Honing will result in an oversize bore and abrasives will damage the piston coating. Either of these practices will result in piston bind and eventual seizure.

(4) Inspect condition of the threads in the inlet and bleed screw ports. Replace the caliper if thread damage is evident. Do not attempt to salvage the threads.

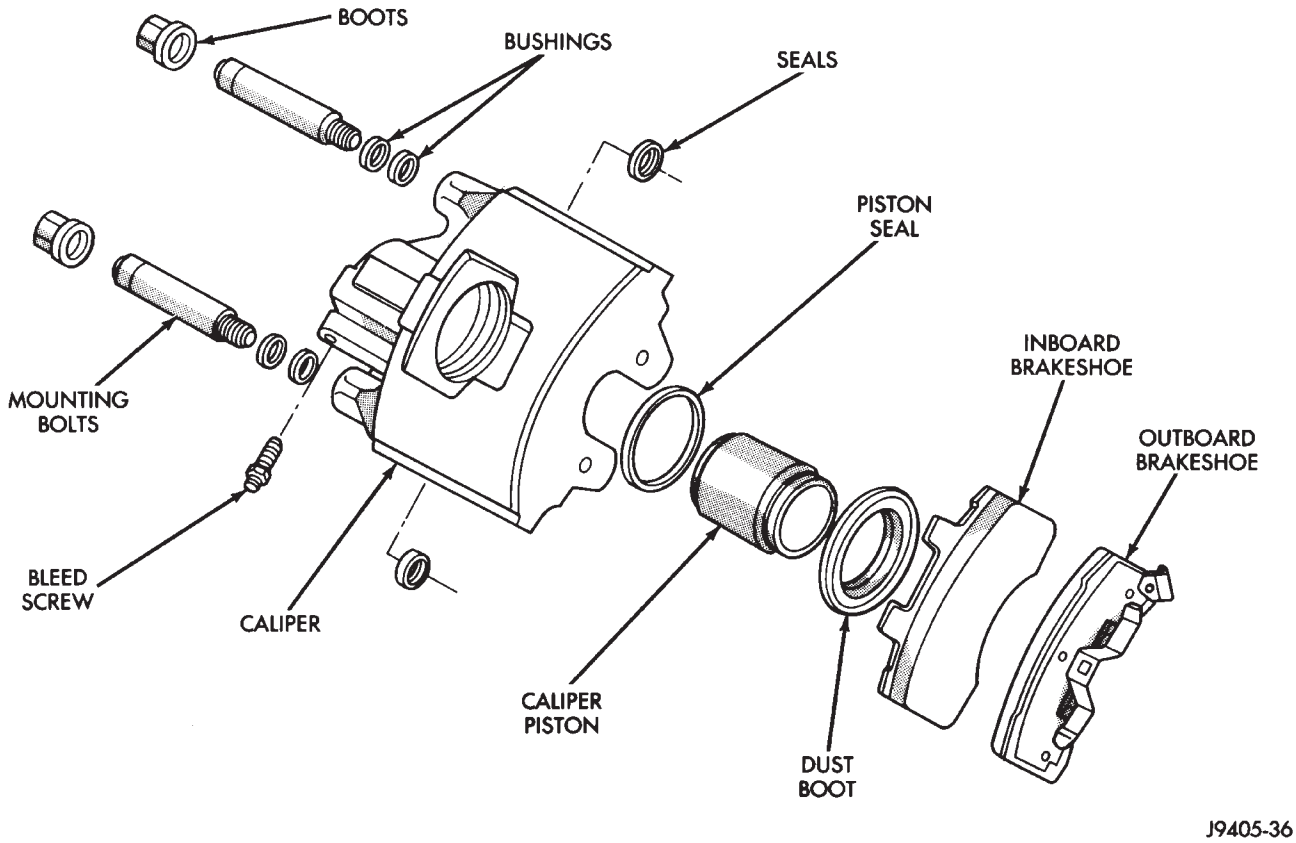


Fig. 76 Caliper Components (75/80 mm Caliper)

DISASSEMBLY AND ASSEMBLY (Continued)

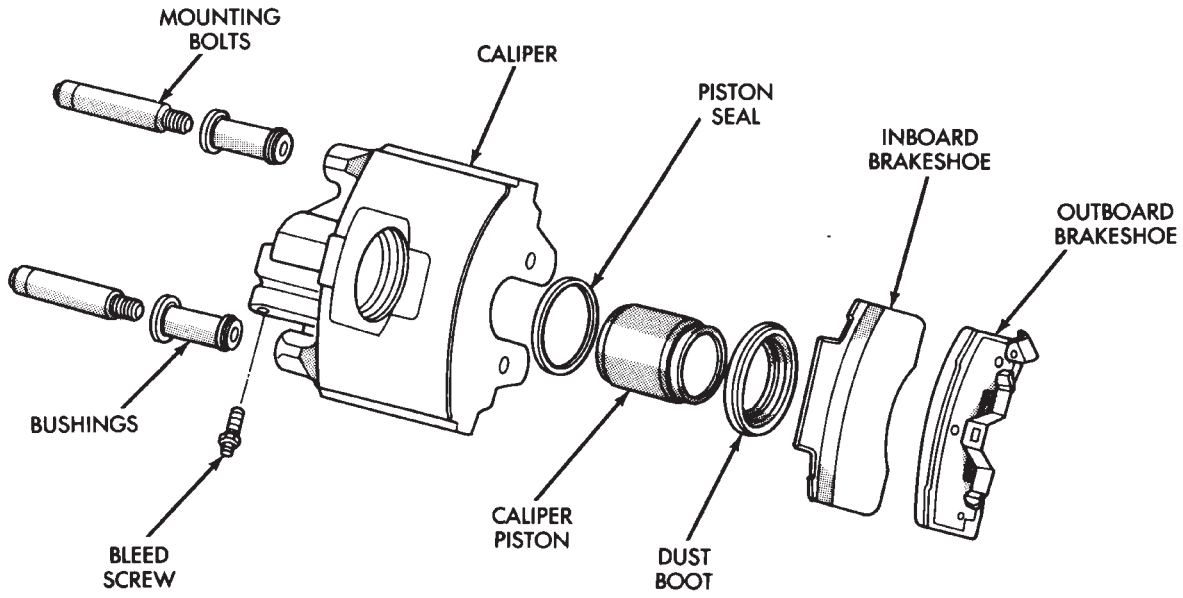


Fig. 77 Caliper Components (86 mm Caliper)

(5) Check the bushings in the caliper mounting bolt bores. Replace the bushings if worn, cut, or torn.

(6) Lubricate caliper piston, piston seal and piston bore with liberal quantity of clean, fresh brake fluid.

(7) Lightly lubricate lip of new boot with silicone grease. Install boot on piston and work boot lip into the groove at the top of piston (Fig. 78).

(8) Stretch boot rearward to straighten boot folds, then move boot forward until folds snap into place (Fig. 78).

(9) Install new piston seal into caliper bore. **Be sure square cut seal is fully seated and is not twisted.**

(10) Install piston down into the caliper bore by hand or with hammer handle. Push the piston down to the bottom of the caliper bore.

(11) Seat dust boot in caliper with installer (Fig. 79):

- 1/2 ton 75 mm caliper: Installer 6753
- 3/4 ton 80 mm caliper: Installer 6754
- 1 ton 86 mm caliper: Installer 6755

(12) Lubricate caliper mounting bolts, collars, bushings and bores with silicone grease.

(13) Install bushings, seals, boots and mounting bolts in caliper.

(14) Install caliper bleed screw.

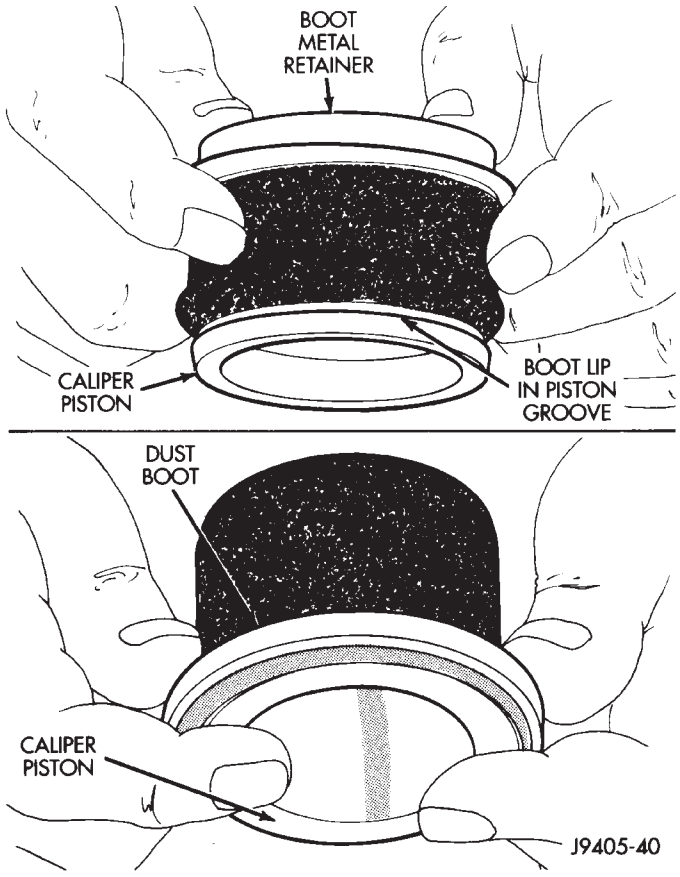


Fig. 78 Installing Dust Boot

WHEEL CYLINDER

DISASSEMBLY

(1) Remove push rods and boots (Fig. 80).

(2) Press pistons, cups and spring and expander out of cylinder bore.

(3) Remove bleed screw.

DISASSEMBLY AND ASSEMBLY (Continued)

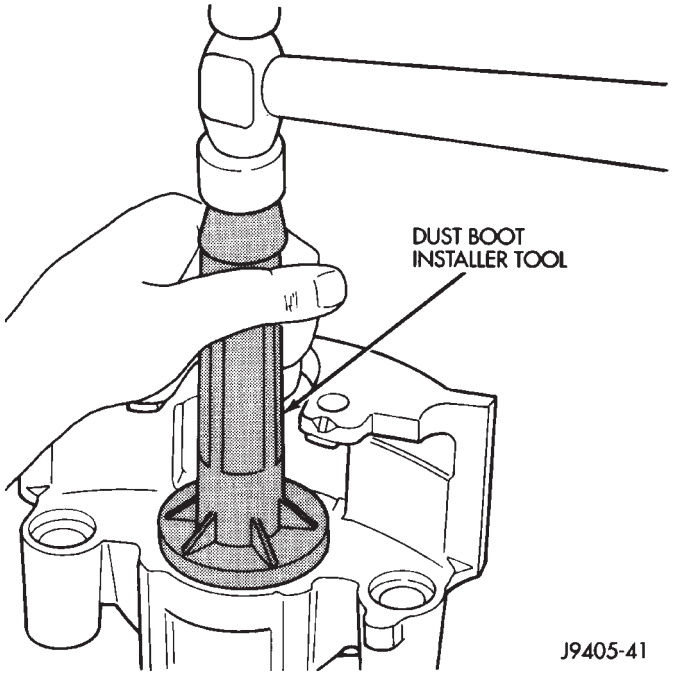


Fig. 79 Seating Dust Boot

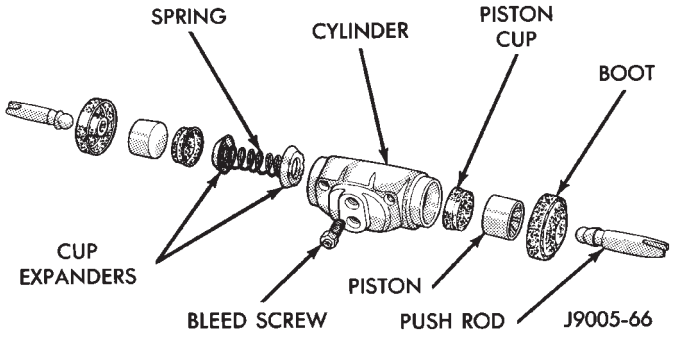


Fig. 80 Wheel Cylinder Components–Typical

ASSEMBLY

(1) Lubricate wheel cylinder bore, pistons, piston cups and spring and expander with clean brake fluid.

(2) Install first piston in cylinder bore. Then install first cup in bore and against piston. **Be sure lip of piston cup is facing inward (toward spring and expander) and flat side is against piston.**

(3) Install spring and expander followed by remaining piston cup and piston.

(4) Install boots on each end of cylinder and insert push rods in boots.

(5) Install cylinder bleed screw.

CLEANING AND INSPECTION

REAR DRUM BRAKE

CLEANING

Clean the individual brake components, including the support plate and wheel cylinder exterior, with a water dampened cloth or with brake cleaner. Do not use any other cleaning agents. Remove light rust and scale from the brake shoe contact pads on the support plate with fine sandpaper.

INSPECTION

As a general rule, riveted brake shoes should be replaced when worn to within 0.78 mm (1/32 in.) of the rivet heads. Bonded lining should be replaced when worn to a thickness of 1.6 mm (1/16 in.).

Examine the lining contact pattern to determine if the shoes are bent or the drum is tapered. The lining should exhibit contact across its entire width. Shoes exhibiting contact only on one side should be replaced and the drum checked for runout or taper.

Inspect the adjuster screw assembly. Replace the assembly if the star wheel or threads are damaged, or the components are severely rusted or corroded.

Discard the brake springs and retainer components if worn, distorted or collapsed. Also replace the springs if a brake drag condition had occurred. Overheating will distort and weaken the springs.

Inspect the brake shoe contact pads on the support plate, replace the support plate if any of the pads are worn or rusted through. Also replace the plate if it is bent or distorted (Fig. 81).

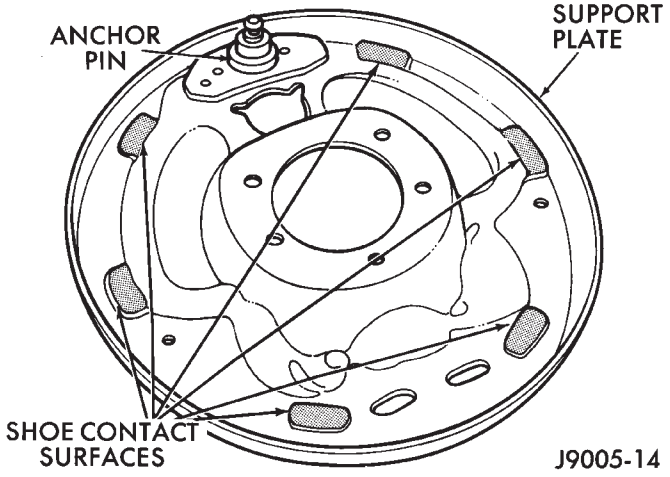


Fig. 81 Shoe Contact Surfaces

CALIPER

CLEANING

Clean the caliper components with clean brake fluid or brake clean only. Wipe the caliper and piston

CLEANING AND INSPECTION (Continued)

dry with lint free towels or use low pressure compressed air.

CAUTION: Do not use gasoline, kerosene, thinner, or similar solvents. These products may leave a residue that could damage the piston and seal.

INSPECTION

The piston is made from a phenolic resin (plastic material) and should be smooth and clean.

The piston must be replaced if cracked or scored. Do not attempt to restore a scored piston surface by sanding or polishing.

CAUTION: If the caliper piston is replaced, install the same type of piston in the caliper. Never interchange phenolic resin and steel caliper pistons. The pistons, seals, seal grooves, caliper bore and piston tolerances are different.

The bore can be **lightly** polished with a brake hone to remove very minor surface imperfections (Fig. 82). The caliper should be replaced if the bore is severely corroded, rusted, scored, or if polishing would increase bore diameter more than 0.025 mm (0.001 inch).

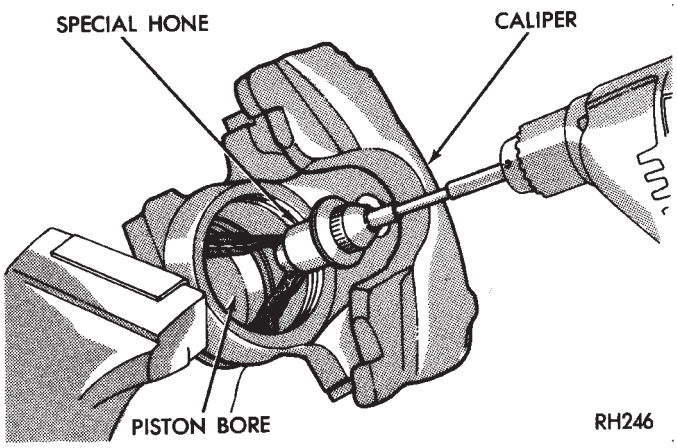


Fig. 82 Polishing Piston Bore

WHEEL CYLINDER

CLEANING

Clean the cylinder and pistons with clean brake fluid or brake cleaner only. Do not use any other cleaning agents.

Dry the cylinder and pistons with compressed air. Do not use rags or shop towels to dry the cylinder components. Lint from cloth material will adhere to the cylinder bores and pistons.

INSPECTION

Inspect the cylinder bore. Light discoloration and dark stains in the bore are normal and will not impair cylinder operation.

The cylinder bore can be lightly polished but only with crocus cloth. Replace the cylinder if the bore is scored, pitted or heavily corroded. Honing the bore to restore the surface is not recommended.

Inspect the cylinder pistons. The piston surfaces should be smooth and free of scratches, scoring and corrosion. Replace the pistons if worn, scored, or corroded. Do attempt to restore the surface by sanding or polishing.

Discard the old piston cups and the spring and expander. These parts are not reusable. The original dust boots may be reused but only if they are in good condition.

ADJUSTMENTS

STOP LAMP SWITCH

(1) Push and hold brake pedal down

(2) Pull switch plunger all the way out to fully extended position.

(3) Push switch plunger inward 4 detent positions (or clicks). This is required preset position. Plunger will extend approximately 14 mm (0.55 in.) out of housing at this setting.

(4) Release brake pedal. Then lightly pull pedal fully rearward. Pedal will adjust switch plunger to correct position as pedal is moved to rear.

CAUTION: Do not use excessive force to move the pedal rearward for switch adjustment. Excessive force will damage the switch.

REAR DRUM BRAKE

The rear drum brakes are equipped with a self-adjusting mechanism. Under normal circumstances, the only time adjustment is required is when the shoes are replaced, removed for access to other parts, or when one or both drums are replaced.

Adjustment can be made with a standard brake gauge or with adjusting tool. Adjustment is performed with the complete brake assembly installed on the backing plate.

ADJUSTMENT WITH BRAKE GAUGE

(1) Be sure parking brakes are fully released.

(2) Raise rear of vehicle and remove wheels and brake drums.

(3) Verify that left and right automatic adjuster levers and cables are properly connected.

(4) Insert brake gauge in drum. Expand gauge until gauge inner legs contact drum braking surface. Then lock gauge in position (Fig. 83).

(5) Reverse gauge and install it on brake shoes. Position gauge legs at shoe centers as shown (Fig. 84). If gauge does not fit (too loose/too tight), adjust shoes.

ADJUSTMENTS (Continued)

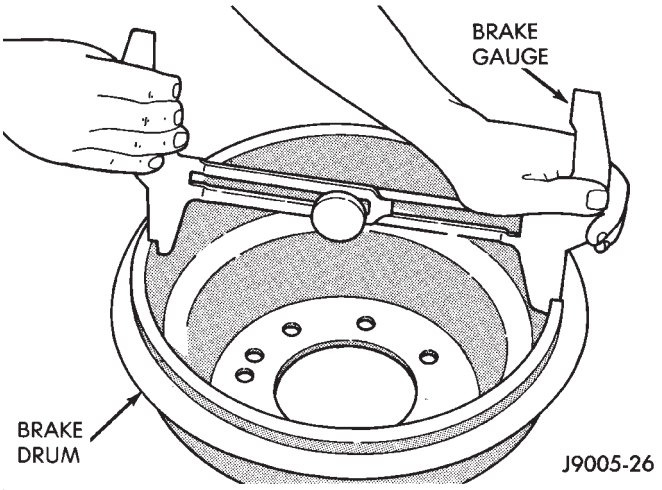


Fig. 83 Adjusting Gauge On Drum

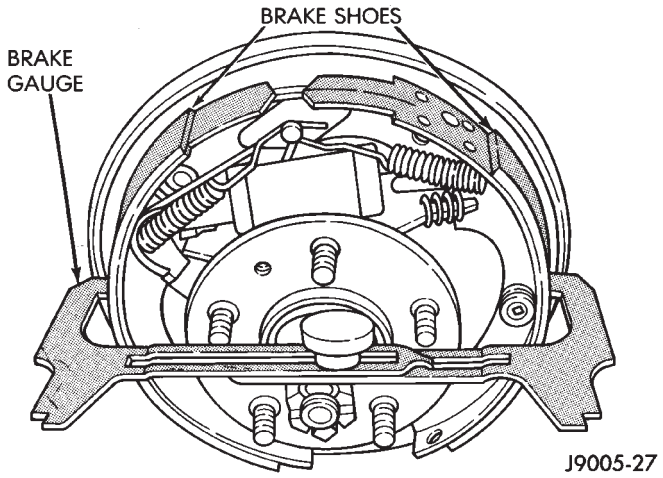


Fig. 84 Adjusting Gauge On Brake Shoes

(6) Pull shoe adjuster lever away from adjuster screw star wheel.

(7) Turn adjuster screw star wheel (by hand) to expand or retract brake shoes. Continue adjustment until gauge outside legs are light drag-fit on shoes.

(8) Install brake drums and wheels and lower vehicle.

(9) Drive vehicle and make one forward stop followed by one reverse stop. Repeat procedure 8-10 times to operate automatic adjusters and equalize adjustment.

NOTE: Bring vehicle to complete standstill at each stop. Incomplete, rolling stops will not activate automatic adjusters.

ADJUSTMENT WITH ADJUSTING TOOL

(1) Be sure parking brake lever is fully released.

(2) Raise vehicle so rear wheels can be rotated freely.

(3) Remove plug from each access hole in brake support plates.

(4) Loosen parking brake cable adjustment nut until there is slack in front cable.

(5) Insert adjusting tool through support plate access hole and engage tool in teeth of adjusting screw star wheel (Fig. 85).

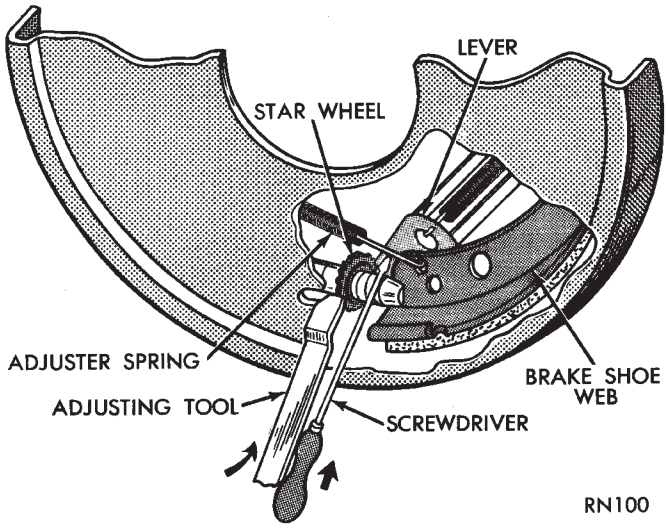


Fig. 85 Brake Adjustment

(6) Rotate adjuster screw star wheel (move tool handle upward) until slight drag can be felt when wheel is rotated.

(7) Push and hold adjuster lever away from star wheel with thin screwdriver.

(8) Back off adjuster screw star wheel until brake drag is eliminated.

(9) Repeat adjustment at opposite wheel. Be sure adjustment is equal at both wheels.

(10) Install support plate access hole plugs.

(11) Adjust parking brake cable and lower vehicle.

(12) Install brake drums and wheels and lower vehicle.

(13) Drive vehicle and make one forward stop followed by one reverse stop. Repeat procedure 8-10 times to operate automatic adjusters and equalize adjustment.

NOTE: Bring vehicle to complete standstill at each stop. Incomplete, rolling stops will not activate automatic adjusters.

PARKING BRAKE CABLE TENSIONER

NOTE: Tensioner adjustment is only necessary when the tensioner, or a cable has been replaced or disconnected for service. When adjustment is necessary, perform adjustment only as described in the following procedure. This is necessary to avoid faulty parking brake operation.

(1) Raise vehicle.

1998 Ram Truck BR/BE
Publication No. 81-370-8108
TSB 26-08-98 August, 1998

ADJUSTMENTS (Continued)

(2) Back off cable tensioner adjusting nut to create slack in cables.
(3) Remove rear wheel and tire assemblies. Then remove brake drums.
(4) Check rear brake shoe adjustment with standard brake gauge.
(5) Replace worn brake shoes if necessary.
(6) Verify parking brake cables operate freely. Replace faulty cables if necessary.
(7) Install drums and verify that drums rotate freely without drag.
(8) Install wheel/tire assemblies.
(9) Lower vehicle enough for access to parking brake foot pedal.
(10) Fully apply parking brakes and leave brakes applied until adjustment is complete.
(11) Raise vehicle again.
(12) Mark tensioner rod 6.5 mm (1/4 in.) from edge of tensioner bracket (Fig. 86).
(13) Tighten adjusting nut at equalizer until mark on tensioner rod moves into alignment with tensioner bracket (Fig. 86).

CAUTION: Do not loosen, or tighten the tensioner adjusting nut for any reason after completing adjustment.

(14) Release parking brake and verify rear wheels rotate freely without drag. Then lower vehicle.

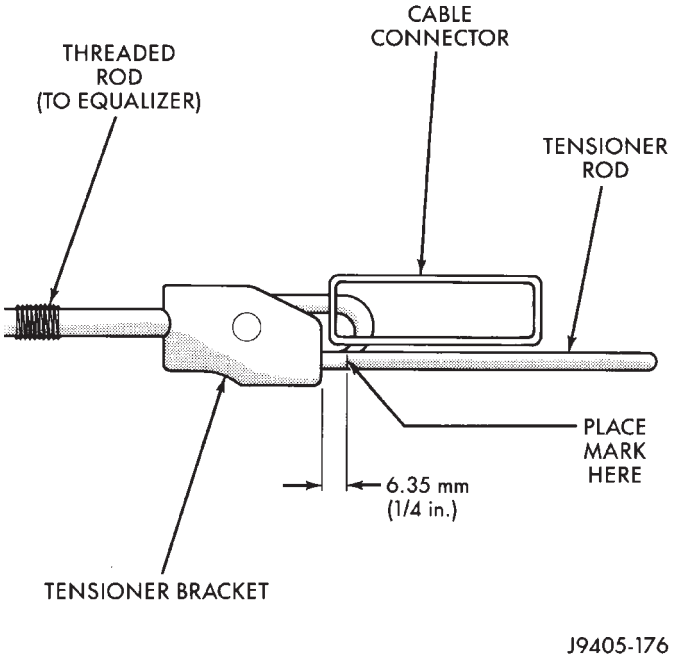


Fig. 86 Adjustment Mark On Cable Tensioner Rod

SPECIFICATIONS

BRAKE FLUID

The brake fluid used in this vehicle must conform to DOT 3 specifications and SAE J1703 standards. No other type of brake fluid is recommended or approved for usage in the vehicle brake system. Use only Mopar brake fluid or an equivalent from a tightly sealed container.

CAUTION: Never use reclaimed brake fluid or fluid from an container which has been left open. An open container will absorb moisture from the air and contaminate the fluid.

CAUTION: Never use any type of a petroleum-based fluid in the brake hydraulic system. Use of such type fluids will result in seal damage of the vehicle brake hydraulic system causing a failure of the vehicle brake system. Petroleum based fluids would be items such as engine oil, transmission fluid, power steering fluid ect.

BASE BRAKE

Disc Brake Caliper
Type . . . . . .Sliding
Caliper Piston Diameter
1500 . . . . . .75 mm (2.95 in.)
2500 . . . . . .80 mm (3.14 in.)
3500 . . . . . .86 mm (3.38 in.)
Disc Brake Rotor
1500 . . . . . .294×32 mm (11.57×1.26 in.)
2500 . . . . . .317.5×38 mm (12.5×1.5 in.)
3500 . . . . . .317.5×38 mm (12.5×1.5 in.)
Max. Runout . . . . . .0.127 mm (0.005 in.)
Max. Thickness Variation. . . .0.025 mm (0.001 in.)
Minimum Rotor Thickness
1500 4X2 . . . . . .30.86 mm (1.215 in.)
1500 4X4 . . . . . .32.23 mm (1.2689 in.)
2500 4X2 . . . . . .32.24 mm (1.2693 in.)
2500 4X4 LD . . . . . .32.24 mm (1.2693 in.)
2500 4X4 HD . . . . . .38.64 mm (1.5213 in.)
3500 4X2 . . . . . .38.56 mm (1.5182 in.)
2500 4X4 . . . . . .38.64 mm (1.5213 in.)
Drum Brake
1500 . . . . . .279×51 mm (11×2 in.)
2500 . . . . . .330×63.5 mm (13×2.5 in.)
3500. . . . . .330×89 mm (13×3.5 in.)
Max. Runout . . . . . .0.20 mm (0.008 in.)
Max. Thickness Variation. . . .0.076 mm (0.003 in.)
Wheel Cylinder Bore Size
1500. . . . . .23.8 mm (0.937 in.)
2500 4x2 . . . . . .23.8 mm (0.937 in.)

1998 Ram Truck
Publication No. 81-370-8108
TSB 26-04-99 April 1999

SPECIFICATIONS (Continued)

2500 4x4 . . . . . .27 mm (1.06 in.)
3500/2500 . . . . . .27 mm (1.06 in.)

Master Cylinder Bore
Size . . . . . .31.8 mm (1.25 in.)

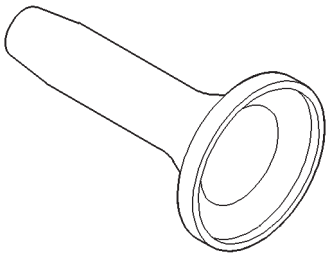
Brake Boosters
Type . . . . . .Vacuum Dual Diaphragm
Type . . . . . .Hydraulic

TORQUE CHART

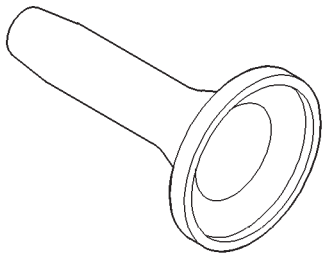
DESCRIPTION	TORQUE
Booster	
Mounting Nuts	.28 N·m (21 ft. lbs.)
Diesel Hydraulic Booster	
Mounting Bolts	.28 N·m (21 ft. lbs.)
Booster Lines	.28 N·m (21 ft. lbs.)
Booster Hoses	.31 N·m (23 ft. lbs.)
Master Cylinder	
Mounting Nuts	.23 N·m (17 ft. lbs.)
Brake Lines	.19-23 N·m (170-200 in. lbs.)
Combination Valve	
Mounting Bolt	.23 N·m (210 in. lbs.)
Brake Lines	.19-200 N·m (170-200 in. lbs.)
Proportioning Valve	
Mounting Nuts	.34 N·m (25 dt. lbs.)
Brake Hose	.31 N·m (276 in. lbs.)
Brake Lines	.19-200 N·m (170-200 in. lbs.)
Caliper	
Mounting Bolts	.51 N·m (38 ft. lbs.)
Wheel Cylinder	
Mounting Bolts	.20 N·m (15 ft. lbs.)
Brake Line	.13 N·m (115 in. lbs.)
Support Plate	
Mounting Bolts	.47-68 N·m (35-50 ft. lbs.)
Park Brake Pedal Assembly	
Mounting Bolts/Nuts	.28 N·m (21 ft. lbs.)

SPECIAL TOOLS

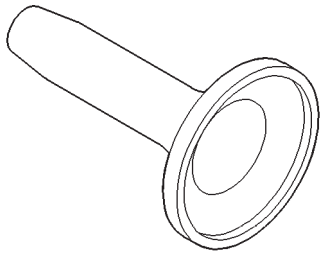
BASE BRAKES



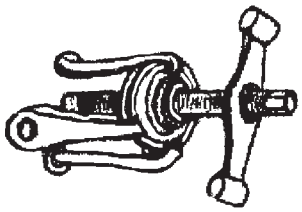
Installer, Brake Caliper Dust Boot 6753



Installer, Brake Caliper Dust Boot 6754



Installer, Brake Caliper Dust Boot 6755



Puller, Hub/Bearing C-844

Puller Leg C-844-1

REAR WHEEL ANTILOCK BRAKES

INDEX

DESCRIPTION AND OPERATION

REAR WHEEL ANTILOCK

Rear Wheel Antilock (RWAL) brake system is standard equipment on all Dodge trucks and full size vans. The RWAL brake system is designed to prevent rear wheel lock-up under heavy braking conditions on virtually all types of road surfaces. Antilock braking is desirable because a vehicle which is stopped without locking the wheels will retain directional stability and some steering capability. This allows the driver to retain greater control of the vehicle during braking.

When the brakes are applied, hydraulic fluid is routed from the master cylinder's secondary circuit, through the combination valve, to the RWAL valve Hydraulic Control Unit (HCU). From there hydraulic fluid is routed to the rear brake wheel cylinders. The Controller Antilock Brake (CAB) monitors rear wheel speed through the rear wheel speed sensor (WSS). If a wheel is about to lock-up, the CAB signals the RWAL valve (HCU). The HCU modulates the hydraulic brake pressure to the rear wheels to prevent wheel lock-up.

NORMAL BRAKING

During light brake application, rear wheel deceleration is not sufficient to activate the antilock system components. During a normal stop hydraulic brake fluid flows unrestricted to the rear wheel cylinders to stop the vehicle. The antilock solenoid valves are inactive. The isolation valve is open and the dump valve is closed allowing normal fluid flow to the rear wheel cylinders.

ANTILOCK BRAKING

If the CAB senses that rear wheel speed deceleration is excessive, it will energize the isolation solenoid. This prevents a further increase of driver induced brake pressure to the rear wheels. If this initial action is not enough to prevent rear wheel lock-up, the CAB will momentarily energize a dump solenoid. This opens the dump valve to vent a small amount of isolated rear brake pressure to an accumulator. The action of fluid moving to the accumulator reduces the isolated brake pressure at the wheel cylinders. The dump (pressure venting) cycle is limited to very short time periods (milliseconds). The CAB will pulse the dump valve until rear wheel deceleration matches the vehicle's deceleration rate or the desired slip rate programmed into the CAB. The system will switch to normal braking once wheel locking tendencies are no longer present.

RWAL PERFORMANCE CHARACTERISTICS

WHEEL/TIRE SIZE AND INPUT SIGNALS

The antilock system depends on accurate signals from the rear wheel speed sensor, to achieve maximum antilock performance. Vehicle's wheels and tires should all be the same size and type to ensure an accurate signal. Tires other than those specified by the manufacturer may result in unsatisfactory antilock performance.

LOW VEHICLE SPEED

The RWAL braking system will revert to normal braking and automatically turn off if the vehicle is moving less than a few mph. The lower limit at which RWAL is cancelled may be different depending on tire and wheel diameters.

DESCRIPTION AND OPERATION (Continued)

HYDRAULIC PRESSURE

The RWAL system controls hydraulic pressure to both rear wheels simultaneously, not each one independently. If one rear wheel starts to decelerate too rapidly, the RWAL system affects the hydraulic pressure to both rear brakes (Fig. 1).

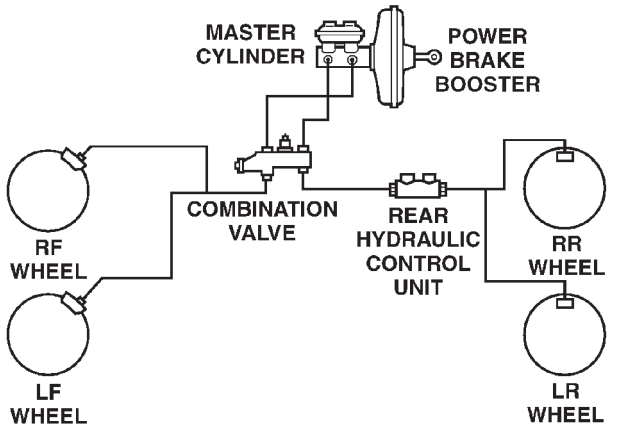


Fig. 1 RWAL Hydraulic Circuit

DIRECTIONAL STABILITY

The RWAL system operates on the rear wheels only, it is possible to lock the front wheels of the vehicle during a high deceleration stop. In this event, the vehicle will be stable, but the driver will be unable to alter the direction of the vehicle with the steering wheel (Fig. 2).

STOPPING DISTANCE

The RWAL brake system limits wheel slip to approximately 20%. This provides for maximum brake effectiveness. Wheel slip means how well the tires grip the road surface. With light or no braking there is no wheel slip. With the wheels locked (not rotating) during a panic stop, there is 100% wheel slip. To obtain the shortest stopping distance and the greatest control over the vehicle during heavy braking, approximately 20% wheel slip is most efficient, under most conditions.

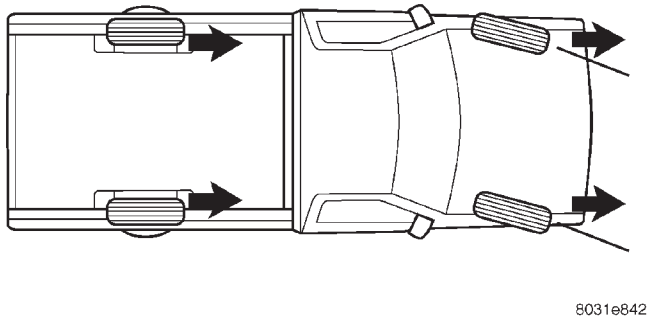


Fig. 2 Directional Stability

PEDAL FEEL

The brake pedal feel is similar to that of a conventional brake system. Under certain conditions the pedal may drop slightly when there is a need for pressure increase during a long antilock stop. The sequence of antilock events is to isolate, decrease, and then increase pressure to maintain brake effectiveness. When the system is in the increase mode is when the pedal will drop slightly.

TIRE NOISE

The RWAL system prevents complete rear wheel lock-up, but some wheel slip is desired to obtain optimum braking performance. During brake pressure modulation brake pressure is increased and wheel slip controlled by the CAB is allowed to reach up to approximately 20%. This means that the wheel rolling speed is approximately 20% less than that of a free rolling wheel at any given vehicle speed. The wheel slip may result in some tire “chirping”, depending upon the road surface. This sound should not be interpreted as a total wheel lock-up and can be considered normal under most conditions.

BRAKE PEDAL

During antilock braking, the RWAL valve cycles rapidly in response to CAB inputs. The driver may experience a pulsing sensation in the brake pedal and vehicle as the valves modulate brake fluid pressure as needed. Brake pedal and vehicle pulsations during an antilock stop should be considered as normal.

DESCRIPTION AND OPERATION (Continued)

RWAL COMPONENT LOCATION

COMPONENT	LOCATION	FUNCTION
CONTROLLER ANTILOCK BRAKE	Driver side inner fender on a bracket.	Tests, monitors and controls the rear brake system.
HYDRAULIC CONTROL UNIT/ RWAL VALVE	Driver side inner fender on a bracket.	Modulates hydraulic pressure to rear brakes during an ABS stop.
REAR WHEEL SPEED SENSOR	Top of the rear axle housing.	Sends an AC voltage sinewave to the CAB whose frequency is proportional to vehicle speed.
EXCITER RING	Ring gear inside the differential housing.	Used to pull the magnetic field across the wheel speed sensor's windings.
RED BRAKE WARNING LAMP	Instrument cluster.	Indicator for park brake engagement, hydraulic brake malfunction, or ABS malfunction.
AMBER ABS WARNING LAMP	Instrument cluster.	Indicator of an ABS malfunction.
BRAKE WARNING LAMP DIODE	Instrument panel harness near the parking brake switch.	Isolates the park brake switch circuit from the CAB for proper red brake warning lamp operation.
ISOLATION AND DUMP VALVE FUSE	Inside the CAB.	Fail-safe device for unwanted control of the isolation and dump solenoid/valves
ISOLATION AND DUMP SOLENOID/VALVES	Inside the HCU/RWAL valve.	Used to modulation hydraulic pressure to the rear brakes during an ABS stop.

CONTROLLER ANTILOCK BRAKES

The Controller Antilock Brakes (CAB) is a microprocessor which handles testing, monitoring and controlling the ABS brake system operation (Fig. 3). The CAB functions are:

- Perform self-test diagnostics.
- Monitors the RWAL brake system for proper operation.
- Controls the RWAL valve solenoids.

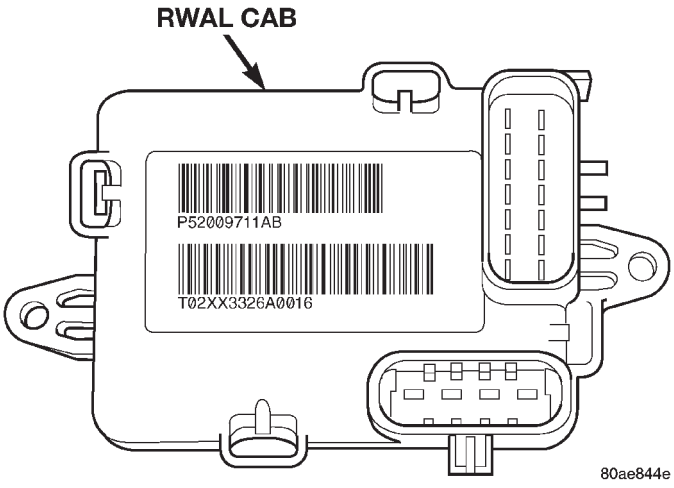


Fig. 3 RWAL CAB

NOTE: If the CAB needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile refer to Group 22 Tire and Wheels. To program the CAB refer to the Chassis Diagnostic Manual.

SYSTEM SELF-TEST

When the ignition switch is turned-on the microprocessor RAM and ROM are tested. If an error occurs during the test a DTC will be set into the RAM memory. However it is possible the DTC will not be stored in memory if the error has occurred in the RAM module were the DTC's are stored. Also it is possible a DTC may not be stored if the error has occurred in the ROM which signals the RAM to store the DTC.

CAB INPUTS

The CAB continuously monitors the speed of the differential ring gear by monitoring signals generated by the rear wheel speed sensor. The CAB determines a wheel locking tendency when it recognizes the ring gear decelerating too rapidly. The CAB monitors the

DESCRIPTION AND OPERATION (Continued)

following inputs to determine when a wheel locking tendency may exists:

- Rear Wheel Speed Sensor
- Brake Lamp Switch
- Brake Warning Lamp Switch
- Reset Switch
- 4WD Switch (If equipped)

CAB OUTPUTS

The CAB controls the following outputs for antilock braking and brake warning information:

- RWAL Valve
- ABS Warning Lamp
- Brake Warning Lamp

RWAL VALVE

If the CAB senses that rear wheel speed deceleration is excessive, it will energize a isolation solenoid by providing battery voltage to the solenoid. This prevents a further increase of driver induced brake pressure to the rear wheels. If this initial action is not enough to prevent rear wheel lock-up, the CAB will momentarily energize a dump solenoid (the CAB energizes the dump solenoid by providing battery voltage to the solenoid). This opens the dump valve to vent a small amount of isolated rear brake pressure to an accumulator. The action of fluid moving to the accumulator reduces the isolated brake pressure at the wheel cylinders. The dump (pressure venting) cycle is limited to very short time periods (milliseconds). The CAB will pulse the dump valve until rear wheel deceleration matches the vehicle deceleration rate or the desired slip rate programmed into the CAB. The system will switch to normal braking once wheel locking tendencies are no longer present.

A predetermined maximum number of consecutive dump cycles can be performed during any one antilock stop. If excessive dump cycles occur, a DTC will be set and stored in the CAB memory. If during an antilock stop, the driver releases the brake pedal, the reset switch contacts will open. This signal to the CAB is an indication that pressure has equalized across the RWAL valve. The CAB will then reset the dump cycle counter in anticipation of the next antilock stop. Additionally, any fluid stored in the accumulator will force its way past the dump valve, back into the hydraulic circuit and return to the master cylinder.

A fuse internal to the CAB, provides a fail-safe device which prevents unwanted control over the isolation and dump solenoids. The fuse is in series with the isolation and dump solenoids output circuits. If the internal fuse is open, the CAB cannot provide voltage to energize either solenoid and antilock stops are prevented. If the fuse is open, the braking system will operate normally but without antilock control over rear brake pressure.

REAR WHEEL SPEED SENSOR AND EXCITER RING

The rear Wheel Speed Sensor (WSS) is mounted in the rear differential housing (Fig. 4). The WSS consists of a magnet surrounded by windings from a single strand of wire. The sensor sends a small AC signal to the CAB. This signal is generated by magnetic induction. The magnetic induction is created when a toothed sensor ring (exciter ring or tone wheel) passes the stationary magnetic WSS.

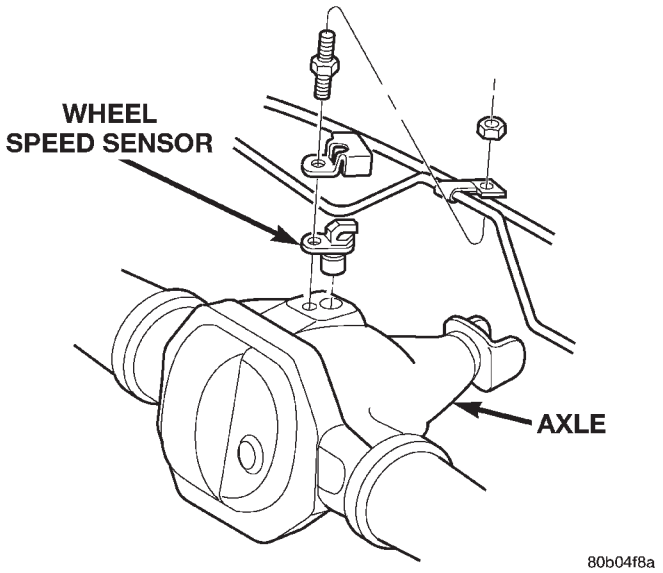


Fig. 4 Rear Wheel Speed Sensor Location

The exciter ring is press fitted onto the differential carrier next to the final drive ring gear (Fig. 5). For replacement procedure of the exciter ring, refer to Group 3 Differential and Driveline.

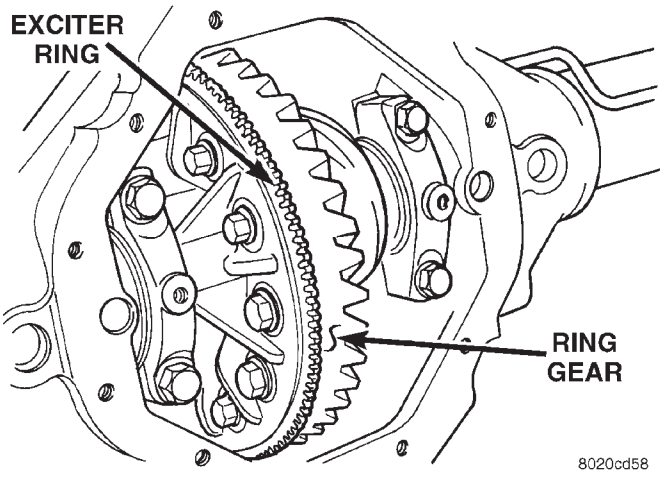


Fig. 5 Exciter Ring Location

When the ring gear is rotated, the exciter ring passes the tip of the WSS. As the exciter ring passes the tip of the WSS, the magnetic lines of force of the sensor are cut, causing the magnetic field to be moved across the sensor's windings. This, in turn

DESCRIPTION AND OPERATION (Continued)

causes current to flow through the WSS circuit (Fig. 6). Every time a tooth of the exciter ring passes the tip of the WSS, an AC signal is generated. Each AC signal (positive to negative signal or sinewave) is interpreted by the CAB. It then compares the frequency of the sinewave to a time value to calculate vehicle speed. The CAB continues to monitor the frequency to determine a deceleration rate that would indicate a possible wheel-locking tendency.

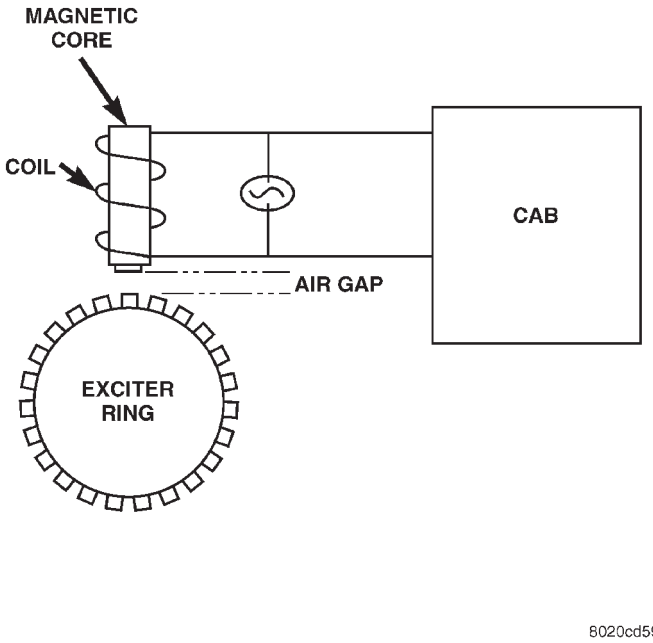


Fig. 6 Operation of the Wheel Speed Sensor

The signal strength of any magnetic induction sensor is directly affected by:

- Magnetic field strength; the stronger the magnetic field, the stronger the signal
- Number of windings in the sensor; more windings provide a stronger signal
- Exciter ring speed; the faster the exciter ring rotates, the stronger the signal will be
- Distance between the exciter ring teeth and WSS; the closer the WSS is to the exciter ring, the stronger the signal will be

The rear WSS is not adjustable. A clearance specification has been established for manufacturing tolerances. If the clearance is not within these specifications, then either the WSS or other components may be damaged. The clearance between the WSS and the exciter ring is 0.005 – 0.050 in.

The assembly plant performs a “Rolls Test” on every vehicle that leaves the assembly plant. One of the test performed is a test of the WSS. To properly test the sensor, the assembly plant connects test equipment to the Data Link Connector (DLC). This connector is located to the right of the steering column and attached to the lower portion of the instrument panel (Fig. 7). The rolls test terminal is spliced to the WSS circuit. The vehicle is then driven on a set of rollers and the WSS output is monitored for proper operation.

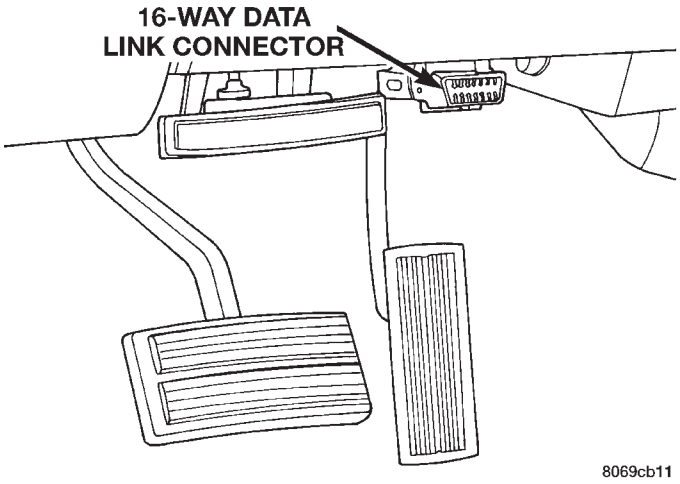


Fig. 7 Data Link Connector - Typical

BRAKE WARNING LAMPS

RED WARNING LAMP

The red brake warning lamp is used to alert the driver of a hydraulic fault or that the parking brake is applied. For the RWAL system, the red brake warning lamp also is used to alerts the driver of a problem with the RWAL system.

The brake warning lamp illuminates when ignition voltage is supplied to the bulb and a ground is provided for the bulb. The bulb has ignition voltage supplied to it any time the ignition switch is in the RUN or START positions. A ground for the bulb is provided when:

- The ignition switch is turned to the START position.
- The parking brakes are applied and the park brake switch is actuated.
- A hydraulic fault has occurred and the pressure differential switch is actuated.
- A RWAL fault has occurred.

ABS WARNING LAMP

The amber ABS warning lamp is used to alerts the driver of RWAL problem and identify DTCs stored in the CABs memory.

The ABS warning lamp illuminates when ignition voltage is supplied to the bulb and a ground is provided for the bulb. The bulb has ignition voltage supplied to it anytime the ignition switch is in the RUN or START positions. A ground for the bulb is provided by the CAB only. A circuit in the CAB monitors the brake warning lamp switch and the ignition switch bulb check circuit (grounds the brake warning lamp bulb during the START position). When the CAB

DESCRIPTION AND OPERATION (Continued)

identifies a ground on this circuit, the CAB illuminates the ABS warning lamp.

STOP LAMP SWITCH

The primary function of the switch is to turn on the stop lamps during braking. The switch is also used to send signals to components that must know when the brakes are applied, such as the Powertrain Control Module (PCM), which uses the signal to cancel speed control. The CAB uses the brake switch signal to monitor brake pedal application. When the switch contacts open (brakes applied), the CAB receives the brake applied signal. The CAB then monitors the ABS system to anticipate the need for an ABS stop.

DIAGNOSIS AND TESTING

REAR WHEEL ANTILOCK

Diagnosis of base brake conditions which are mechanical in nature should be performed first. This includes brake noise, lack of power assist, parking brake, or vehicle vibration during normal braking.

The RWAL brake system performs several self-tests every time the ignition switch is turned on and the vehicle is driven. The CAB monitors the system inputs and outputs circuits to verify the system is operating properly. If the CAB senses a malfunction in the system it will set a DTC into memory and trigger the warning lamp.

NOTE: The MDS or DRB III scan tool is used to diagnose the RWAL system. For test procedures refer to the Chassis Diagnostic Manual. For additional information refer to the Antilock brake section in Group 8W.

SERVICE PROCEDURES

ABS SERVICE PRECAUTIONS

The ABS uses an electronic control module, the CAB. This module is designed to withstand normal current draws associated with vehicle operation. Care must be taken to avoid overloading the CAB circuits. **In testing for open or short circuits, do not ground or apply voltage to any of the circuits unless instructed to do so for a diagnostic procedure.** These circuits should only be tested using a high impedance multi-meter or the DRB tester as described in this section. Power should never be removed or applied to any control module with the ignition in the ON position. Before removing or connecting battery cables, fuses, or connectors, always turn the ignition to the OFF position.

CAUTION: Use only factory wiring harnesses. Do not cut or splice wiring to the brake circuits. The addition of after-market electrical equipment (car phone, radar detector, citizen band radio, trailer lighting, trailer brakes, ect.) on a vehicle equipped with antilock brakes may affect the function of the antilock brake system.

RWAL BRAKE BLEEDING

RWAL brake bleeding can be performed manually, or with pressure bleeding equipment.

Use Mopar DOT 3 brake fluid, or an equivalent meeting SAE J1703-F and DOT 3 standards, to fill and bleed the brake system.

Bleed only one brake component at a time. Recommended bleed sequence is:

- master cylinder
- combination valve
- rear antilock valve
- left rear wheel
- right rear wheel
- right front wheel
- left front wheel

MANUAL BLEEDING

Use a bleed hose at each caliper/cylinder bleed screw. Attach one end of the hose to the bleed screw and insert the opposite end in glass container partially filled with brake fluid. A glass container makes it easier to see air bubbles as they exit the bleed hose. Be sure the end of the bleed hose remains immersed in fluid. This prevents air from being drawn back into the system.

Do not allow the master cylinder to run out of fluid when bleeding the brakes. An empty cylinder will allow air to be drawn back into the system. Check fluid level frequently during bleeding operations.

Be sure to tighten each brake line fitting, or bleed screw once bleeding is completed. Loose fittings and bleed screws allows air to enter the system.

PRESSURE BLEEDING

If pressure bleeding equipment will be used, the front brake metering valve will have to be held open to bleed the front brakes. The valve stem is located in the forward end or top of the combination valve. The stem must either be pressed inward, or held outward slightly. a spring clip tool or helper is needed to hold the valve stem in position.

Follow the manufacturers instructions carefully when using pressure equipment. Do not exceed the tank manufacturers pressure recommendations. Generally, a tank pressure of 15-20 psi is sufficient for bleeding.

Fill the bleeder tank with recommended fluid and purge air from the tank lines before bleeding.

SERVICE PROCEDURES (Continued)

Do not pressure bleed without a proper master cylinder adapter. The wrong adapter can lead to leakage, or drawing air back into the system.

REMOVAL AND INSTALLATION

CONTROLLER

NOTE: If the CAB needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile refer to Group 22 Tire and Wheels. To program the CAB refer to the Chassis Diagnostic Manual.

REMOVAL

(1) Pull up on the CAB harness connector lock release and remove the connector (Fig. 8) from the controller.

(2) Remove the RWAL valve harness connector (Fig. 8) from the controller.

(3) Remove the controller mounting screws (Fig. 9) and remove the controller from the mounting bracket.

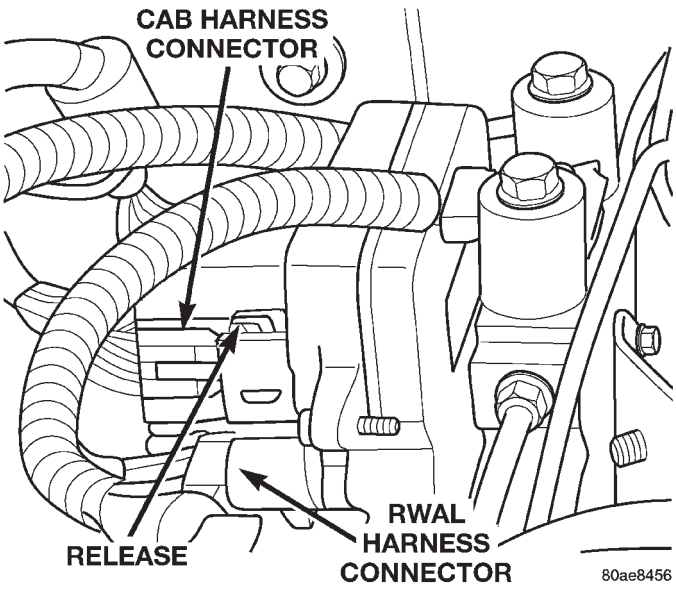


Fig. 8 CAB Harness Connections

INSTALLATION

(1) Position the controller on the bracket and install the mounting screws. Tighten the screws to 2.5-3.5 N·m (22-31 in. lbs.).

(2) Install the RWAL valve harness connector into the controller.

(3) Install the CAB harness connector into the controller and push down on the connector lock.

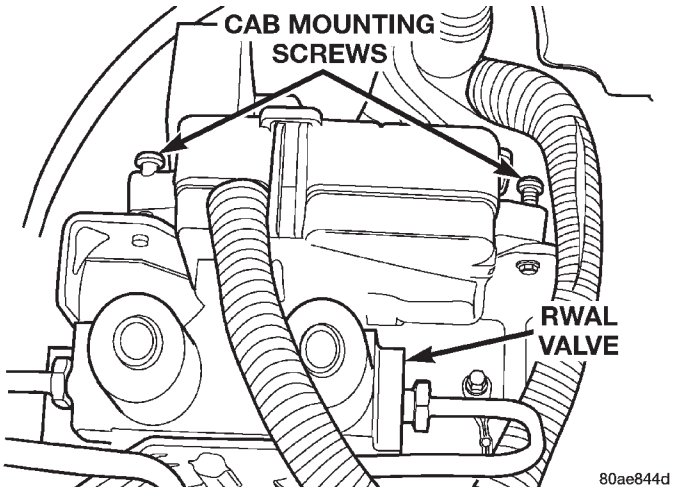


Fig. 9 CAB Mounting Screws

RWAL VALVE

REMOVAL

(1) Remove RWAL valve harness connector (Fig. 10) from the RWAL controller.

(2) Remove the brake lines from the valve.

(3) Remove the valve mounting bolt (Fig. 11) and remove the valve from the bracket.

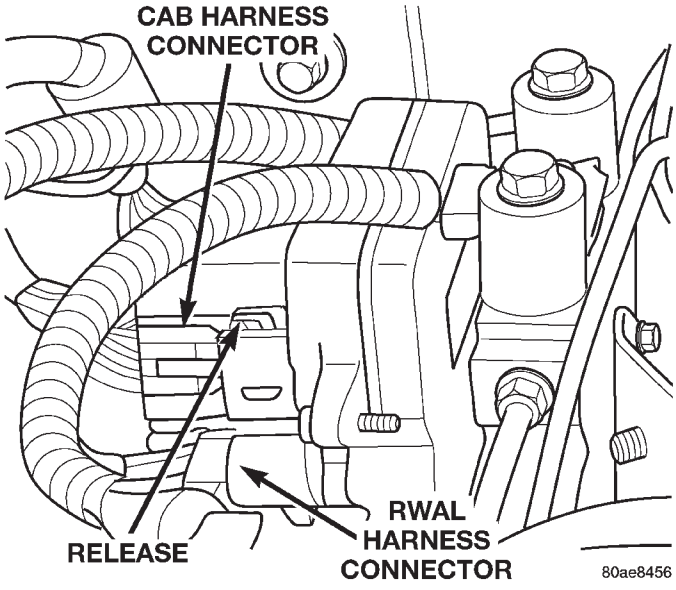


Fig. 10 RWAL Valve Harness Connector

INSTALLATION

(1) Position the valve on the bracket and install the mounting bolt. Tighten the mounting bolt to 20-27 N·m (180-240 in. lbs.).

(2) Install the brake lines and tighten to 19-23 N·m (170-200 in. lbs.).

(3) Install the RWAL valve harness connector into the RWAL controller.

(4) Bleed the brake system.

REMOVAL AND INSTALLATION (Continued)

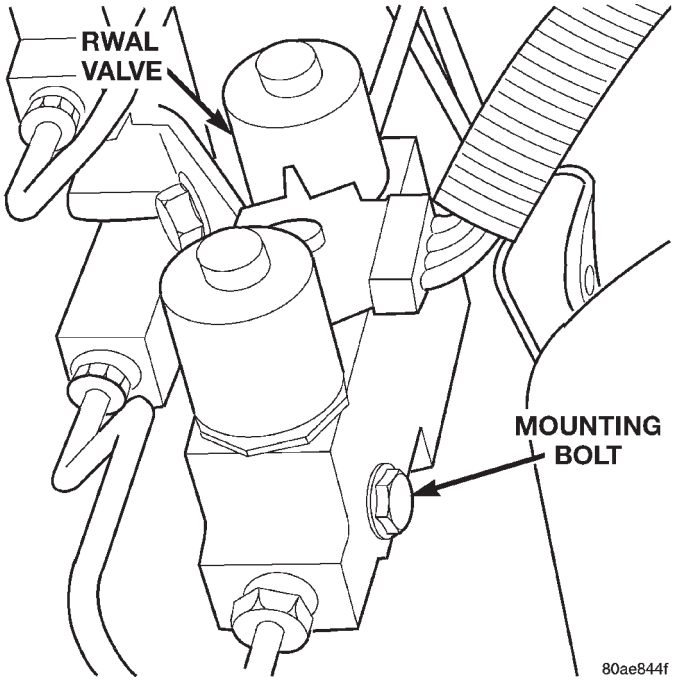


Fig. 11 RWAL Valve

REAR WHEEL SPEED SENSOR

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove brake line mounting nut and remove the brake line from the sensor stud.

(3) Remove mounting stud from the sensor and shield (Fig. 12).

(4) Remove sensor and shield from differential housing.

(5) Disconnect sensor wire harness and remove sensor.

INSTALLATION

(1) Connect harness to sensor. **Be sure seal is securely in place between sensor and wiring connector.**

(2) Install O-ring on sensor (if removed).

(3) Insert sensor in differential housing.

(4) Install sensor shield.

(5) Install the sensor mounting stud and tighten to 24 N·m (18 ft. lbs.).

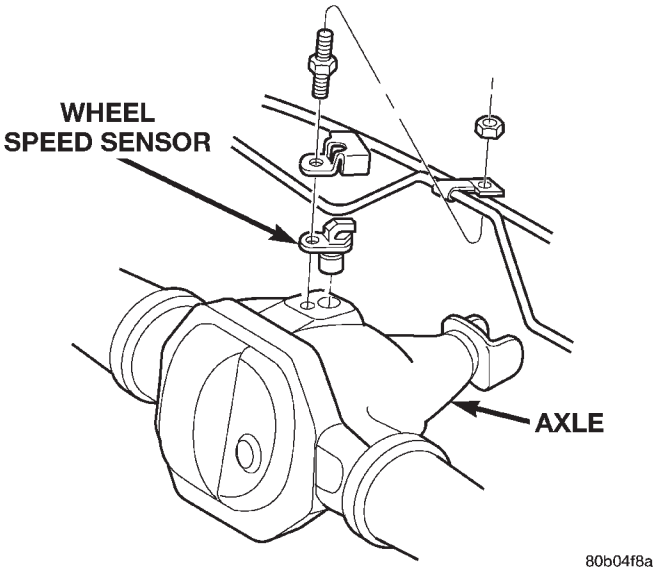


Fig. 12 Rear Speed Sensor Mounting

(6) Install the brake line on the sensor stud and install the nut.

(7) Lower vehicle.

EXCITER RING

The exciter ring is mounted on the differential case. If the ring is damaged refer to Group 3 Differential and Driveline for service procedures.

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
CONTROLLER	
Mounting Screws	2.5-3.5 N·m (22-31 in. lbs.)
RWAL Valve	
Mounting Bolt	20-27 N·m (180-240 in. lbs.)
Brake Line Fittings	19-23 N·m (170-200 in. lbs.)
Wheel Speed Sensor	
Mounting Bolt	24 N·m (18 ft. lbs.)

FOUR WHEEL ANTILOCK BRAKE SYSTEM

INDEX

GENERAL INFORMATION

ANTILOCK BRAKE SYSTEM

The antilock brake system (ABS) is an electronically operated, all wheel brake control system.

The system is designed to prevent wheel lockup and maintain steering control during periods of high wheel slip when braking. Preventing lockup is accomplished by modulating fluid pressure to the wheel brake units.

The hydraulic system is a three channel design. The front wheel brakes are controlled individually and the rear wheel brakes in tandem (Fig. 1). The ABS electrical system is separate from other electrical circuits in the vehicle. A specially programmed controller antilock brake unit operates the system components.

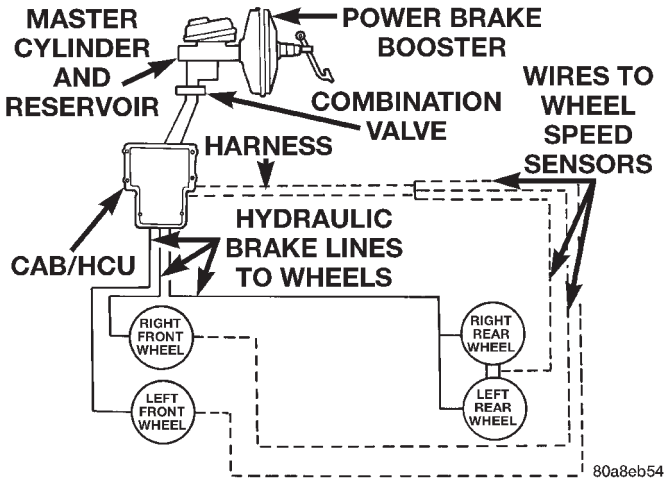


Fig. 1 Antilock Brake System

ABS system major components include:

- Controller Antilock Brakes (CAB)
- Hydraulic Control Unit (HCU)
- Wheel Speed Sensors (WSS)
- ABS Warning Light

DESCRIPTION AND OPERATION

ANTILOCK BRAKE SYSTEM

Battery voltage is supplied to the CAB ignition terminal when the ignition switch is turned to Run position. The CAB performs a system initialization procedure at this point. Initialization consists of a static and dynamic self check of system electrical components.

The static and dynamic checks occurs at ignition start up. During the dynamic check, the CAB briefly cycles the pump and solenoids to verify operation. An audible noise may be heard during this self check. This noise should be considered normal.

If an ABS component exhibits a fault during initialization, the CAB illuminates the amber warning light and registers a fault code in the microprocessor memory.

NORMAL BRAKING

The CAB monitors wheel speed sensor inputs continuously while the vehicle is in motion. However, the CAB will not activate any ABS components as long as sensor inputs indicate normal braking.

During normal braking, the master cylinder, power booster and wheel brake units all function as they would in a vehicle without ABS. The HCU components are not activated.

DESCRIPTION AND OPERATION (Continued)

ANTILOCK BRAKING

The purpose of the antilock system is to prevent wheel lockup during periods of high wheel slip. Preventing lockup helps maintain vehicle braking action and steering control.

The antilock CAB activates the system whenever sensor signals indicate periods of high wheel slip. High wheel slip can be described as the point where wheel rotation begins approaching 20 to 30 percent of actual vehicle speed during braking. Periods of high wheel slip occur when brake stops involve high pedal pressure and rate of vehicle deceleration.

The antilock system prevents lockup during high slip conditions by modulating fluid apply pressure to the wheel brake units.

Brake fluid apply pressure is modulated according to wheel speed, degree of slip and rate of deceleration. A sensor at each wheel converts wheel speed into electrical signals. These signals are transmitted to the CAB for processing and determination of wheel slip and deceleration rate.

The ABS system has three fluid pressure control channels. The front brakes are controlled separately and the rear brakes in tandem. A speed sensor input signal indicating a high slip condition activates the CAB antilock program.

Two solenoid valves are used in each antilock control channel. The valves are all located within the HCU valve body and work in pairs to either increase, hold, or decrease apply pressure as needed in the individual control channels.

The solenoid valves are not static during antilock braking. They are cycled continuously to modulate pressure. Solenoid cycle time in antilock mode can be measured in milliseconds.

CONTROLLER ANTILOCK BRAKES

The CAB is mounted on the top of the hydraulic control unit (Fig. 2).

The CAB operates the ABS system and is separate from other vehicle electrical circuits. CAB voltage source is through the ignition switch in the RUN position.

The CAB contains dual microprocessors. A logic block in each microprocessor receives identical sensor signals. These signals are processed and compared simultaneously.

The CAB contains a self check program that illuminates the ABS warning light when a system fault is detected. Faults are stored in a diagnostic program memory and are accessible with the DRB scan tool.

ABS faults remain in memory until cleared, or until after the vehicle is started approximately 50 times. Stored faults are **not** erased if the battery is disconnected.

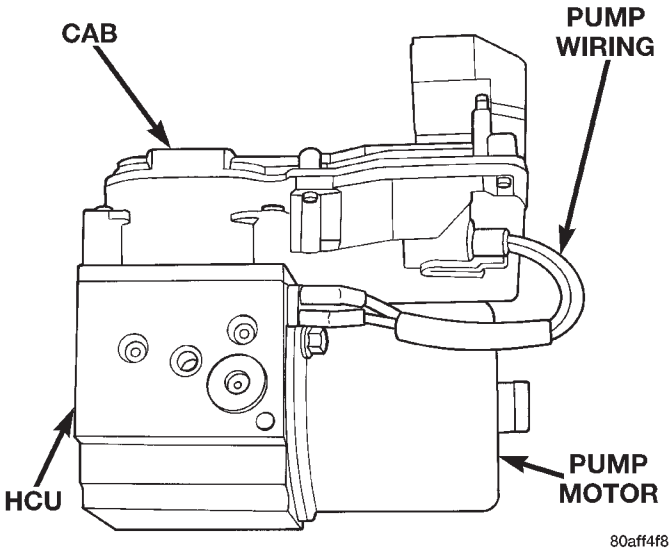


Fig. 2 CAB/HCU

NOTE: If the CAB needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile refer to Group 22 Tire and Wheels. To program the CAB refer to the Chassis Diagnostic Manual.

HYDRAULIC CONTROL UNIT

The hydraulic control unit (HCU) consists of a valve body, pump, accumulator and motor (Fig. 2).

The pump, motor, and accumulator are combined into an assembly attached to the valve body. The accumulator store the extra fluid which had to be dumped from the brakes. This is done to prevent the wheels from locking up. The pump provides the fluid volume needed and is operated by a DC type motor. The motor is controlled by the CAB.

The valve body contains the solenoid valves. The valves modulate brake pressure during antilock braking and are controlled by the CAB.

The HCU provides three channel pressure control to the front and rear brakes. One channel controls the rear wheel brakes in tandem. The two remaining channels control the front wheel brakes individually.

During antilock braking, the solenoid valves are opened and closed as needed. The valves are not static. They are cycled rapidly and continuously to modulate pressure and control wheel slip and deceleration.

During normal braking, the HCU solenoid valves and pump are not activated. The master cylinder and power booster operate the same as a vehicle without an ABS brake system.

DESCRIPTION AND OPERATION (Continued)

During antilock braking, solenoid valve pressure modulation occurs in three stages, pressure decrease, pressure hold, and pressure increase. The valves are all contained in the valve body portion of the HCU.

Pressure Decrease

The inlet valve is closed and the outlet valve is opened during the pressure decrease cycle.

A pressure decrease cycle is initiated when speed sensor signals indicate high wheel slip at one or more wheels. At this point, the CAB closes the inlet to prevent the driver from further increasing the brake pressure and locking the brakes. The CAB then opens the outlet valve, which also opens the return circuit to the accumulators. Fluid pressure is allowed to bleed off (decrease) as needed to prevent wheel lock.

Once the period of high wheel slip has ended, the CAB closes the outlet valve and begins a pressure increase or hold cycle as needed.

Pressure Hold

Both solenoid valves are closed in the pressure hold cycle. Fluid apply pressure in the control channel is maintained at a constant rate. The CAB maintains the hold cycle until sensor inputs indicate a pressure change is necessary.

Pressure Increase

The inlet valve is open and the outlet valve is closed during the pressure increase cycle. The pressure increase cycle is used to counteract unequal wheel speeds. This cycle controls re-application of fluid apply pressure due to changing road surfaces or wheel speed.

WHEEL SPEED SENSOR

The ABS brake system uses 3 wheel speed sensors. A sensor is mounted to each front steering knuckles. The third sensor is mounted on top of the rear axle differential housing. The sensor is a magnet coil that is mounted over a tone wheel front/exciter ring rear with an air gap between them.

The sensors measure the wheel speed by monitoring the rotation of the tone wheels front/exciter ring rear. As the teeth of the tone wheels front/exciter ring rear move through the magnetic field of the sensor an AC voltage is generated. This signal frequency increases or decreases proportionally to the speed of the wheel. The CAB monitors these signals for changes in wheel deceleration. If the CAB detects a sudden wheel or wheels deceleration within a predetermined amount the CAB will activate the ABS system.

ABS WARNING LAMP

The amber ABS warning lamp is located in the instrument cluster. The lamp illuminates at start-up to perform a self check. The lamp goes out when the self check program determines the system is operating normal. If an ABS component exhibits a fault the CAB will illuminate the lamp and register a trouble code in the microprocessor. The lamp is controlled by the CAB. The CAB controls the lamp by directly grounding the circuit.

DIAGNOSIS AND TESTING

ANTILOCK BRAKES

The ABS brake system performs several self-tests every time the ignition switch is turned on and the vehicle is driven. The CAB monitors the systems input and output circuits to verify the system is operating correctly. If the on board diagnostic system senses that a circuit is malfunctioning the system will set a trouble code in its memory.

NOTE: An audible noise may be heard during the self-test. This noise should be considered normal.

NOTE: The MDS or DRB III scan tool is used to diagnose the ABS system. For additional information refer to the Antilock Brake section in Group 8W. For test procedures refer to the Chassis Diagnostic Manual.

SERVICE PROCEDURES

BLEEDING ABS BRAKE SYSTEM

ABS system bleeding requires conventional bleeding methods plus use of the DRB scan tool. The procedure involves performing a base brake bleeding, followed by use of the scan tool to cycle and bleed the HCU pump and solenoids. A second base brake bleeding procedure is then required to remove any air remaining in the system.

(1) Perform base brake bleeding. Refer to base brake section for procedure.

(2) Connect scan tool to the Data Link Connector.

(3) Select ANTILOCK BRAKES, followed by MISCELLANEOUS, then ABS BRAKES. Follow the instructions displayed. When scan tool displays TEST COMPLETE, disconnect scan tool and proceed.

(4) Perform base brake bleeding a second time. Refer to base brake section for procedure.

(5) Top off master cylinder fluid level and verify proper brake operation before moving vehicle.

REMOVAL AND INSTALLATION

CONTROLLER ANTILOCK BRAKES

NOTE: If the CAB needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile refer to Group 22 Tire and Wheels. To program the CAB refer to the Chassis Diagnostic Manual.

REMOVAL

(1) Disconnect battery negative cable.

(2) Push the harness connector locks to release the locks, (Fig. 3) then remove the connectors from the CAB.

(3) Disconnect the pump motor connector (Fig. 4).

(4) Remove screws attaching CAB to the HCU (Fig. 5).

(5) Remove the CAB.

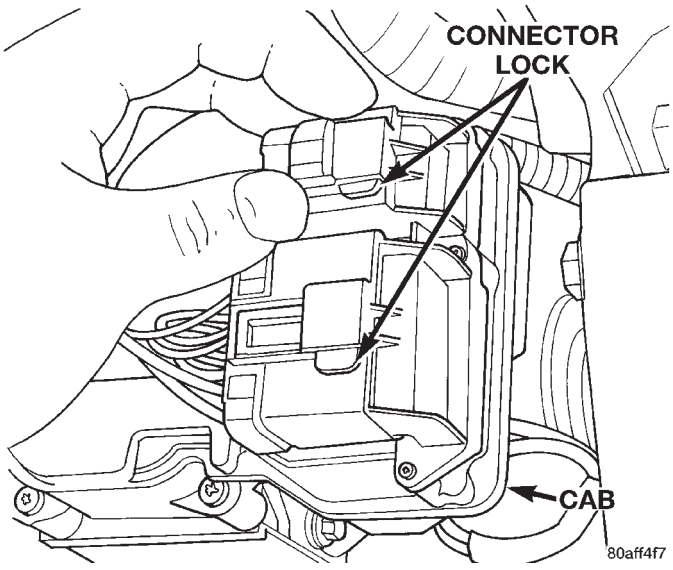


Fig. 3 Harness Connector Locks

INSTALLATION

(1) Place the CAB onto the HCU.

NOTE: Insure the CAB seal is in position before installation.

(2) Install the mounting screws and tighten to 4-4.7 N·m (36-42 in. lbs.).

(3) Connect the pump motor harness.

(4) Connect the harnesses to the CAB and lock the connectors.

(5) Connect battery.

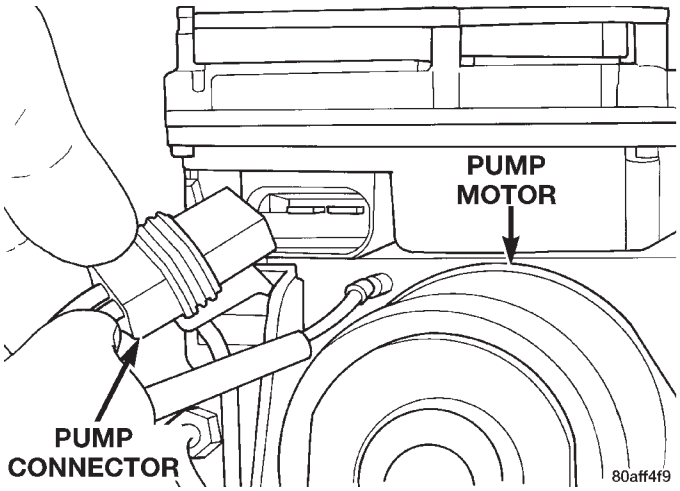


Fig. 4 Pump Motor Connector

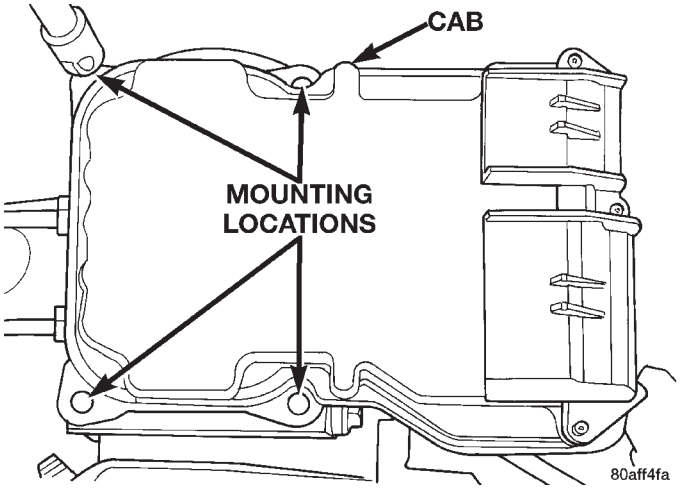


Fig. 5 Controller Mounting Screws

ANTILOCK CONTROL ASSEMBLY

NOTE: If the antilock control assembly needs to be replaced, the rear axle type and tire revolutions per mile must be programed into the new CAB. For axle type refer to Group 3 Differential and Driveline. For tire revolutions per mile refer to Group 22 Tire and Wheels. To program the CAB refer to the Chassis Diagnostic Manual.

REMOVAL

(1) Disconnect battery negative cable.

(2) Push the harness connector locks to release the locks, (Fig. 3) then remove the connectors from the CAB.

(3) Disconnect brake lines from HCU (Fig. 6).

(4) Remove the two mounting bolts on either side of the assembly which attach the assembly to the mounting bracket.

(5) Tilt the assembly upward were the brake lines attach and remove the assembly from the mounting bracket.

REMOVAL AND INSTALLATION (Continued)

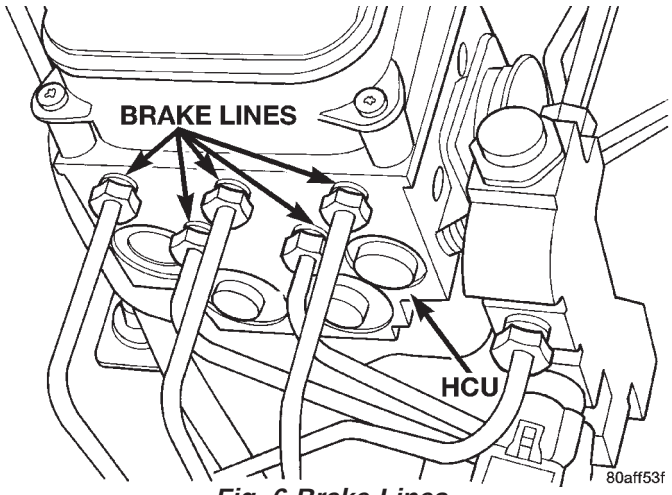


Fig. 6 Brake Lines

INSTALLATION

(1) Install the assembly into the mounting bracket.

(2) Install the mounting bolts and tighten to 12 N·m (102 in. lbs.).

(3) Connect the CAB harnesses.

(4) Connect the brake lines to the HCU. Tighten brake line fittings to 19-23 N·m (170-200 in. lbs.).

(5) Connect battery.

(6) Bleed brake system.

FRONT WHEEL SPEED SENSOR – 2WD

REMOVAL

(1) Raise vehicle and support vehicle front end.

(2) Remove wheel and tire assembly.

(3) Disconnect the ABS wheel speed sensor wire from under the hood. Remove sensor wire from the frame and steering knuckle.

(4) Remove brake caliper.

(5) Remove rotor.

(6) Remove bolts attaching sensor to steering knuckle and remove the sensor (Fig. 7).

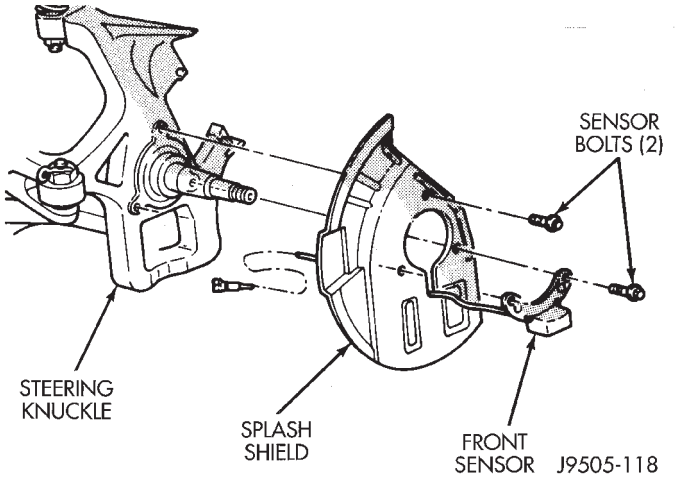


Fig. 7 Front Speed Sensor Mounting – 2WD

INSTALLATION

(1) Position sensor in knuckle.

(2) Install and tighten sensor bolts to 23 N·m (17 ft. lbs.). **Use original or replacement sensor bolts only. The bolts are special and must not be substituted.**

(3) Install sensor wire to the steering knuckle and frame. Connect the wheel speed sensor wire under the hood.

(4) Check sensor wire routing. Be sure wire is clear of all chassis components and is not twisted or kinked at any spot.

(5) Install rotor and brake caliper.

(6) Install wheel and tire assembly.

(7) Remove support and lower the vehicle.

(8) Apply brakes several times to seat brake shoes and caliper piston. Do not move vehicle until firm brake pedal is obtained.

(9) Verify sensor operation with scan tool.

FRONT WHEEL SPEED SENSOR – 4WD

REMOVAL

(1) Raise and support vehicle.

(2) Remove wheel and tire assembly.

(3) Disconnect the ABS wheel speed sensor wire from under the hood. Remove sensor wire from the frame and steering knuckle.

(4) Remove brake caliper.

(5) Remove rotor on models with 5 wheel studs. On models with 8 studs remove rotor hub bearing assembly and separate the rotor from the hub bearing.

(6) Remove bolt attaching sensor to the hub bearing (Fig. 8).

(7) Remove sensor and wire.

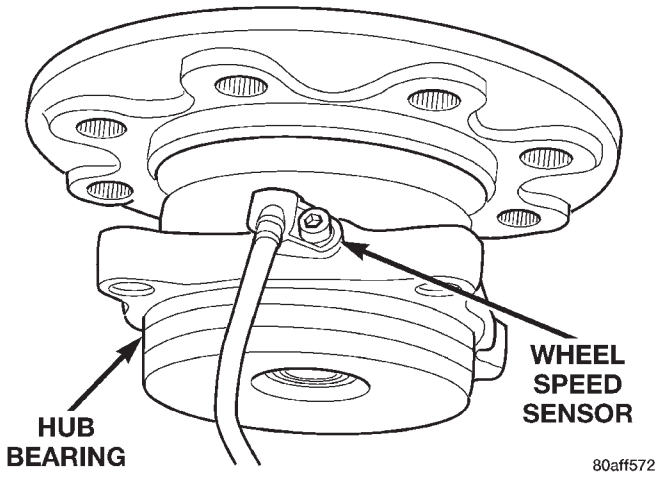


Fig. 8 Wheel Speed Sensor

INSTALLATION

(1) Install the sensor in the hub bearing and tighten the bolt to 14 N·m (11 ft. lbs.). **Use original or replacement sensor bolts only. The bolts are special and must not be substituted.**

REMOVAL AND INSTALLATION (Continued)

(2) Install the rotor on models with 5 wheel studs. On models with 8 studs install the rotor on the hub bearing and install the assembly on the knuckle.

(3) Install sensor wire to the steering knuckle and frame. Connect the wheel speed sensor wire under the hood.

(4) Check sensor wire routing. Be sure wire is clear of all chassis components and is not twisted or kinked at any spot.

(5) Install brake caliper.

(6) Install wheel and tire assemblies.

(7) Remove support and lower the vehicle.

(8) Apply brakes several times to seat brake shoes and caliper piston. Do not move vehicle until firm brake pedal is obtained.

(9) Verify sensor operation with scan tool.

TONE WHEEL

The tone wheel for the front speed sensor is located in the rotor hub on 2-wheel drive models (Fig. 9). On 4-wheel drive models, the tone wheel is located in the hub/bearing housing.

The tone wheel is not a serviceable component. On 2-wheel drive models, the complete rotor and hub assembly will have to be replaced if the tone wheel is damaged. On 4-wheel drive models, the hub/bearing must be replaced, if the tone wheel is damaged.

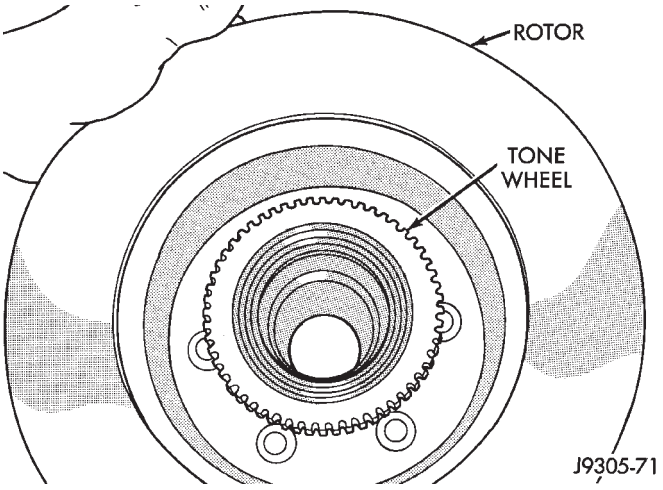


Fig. 9 Tone Wheel 2WD

REAR WHEEL SPEED SENSOR

REMOVAL

(1) Raise vehicle on hoist.

(2) Remove brake line mounting nut and remove the brake line from the sensor stud.

(3) Remove mounting stud from the sensor and shield (Fig. 10).

(4) Remove sensor and shield from differential housing.

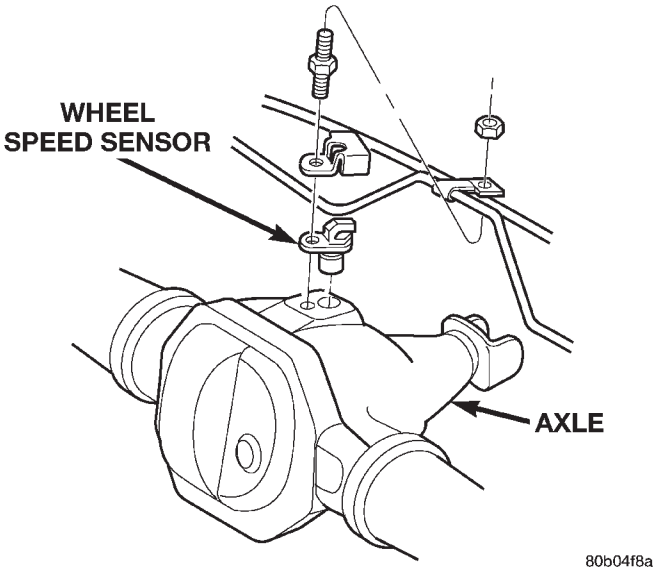


Fig. 10 Rear Speed Sensor Mounting

(5) Disconnect sensor wire harness and remove sensor.

INSTALLATION

(1) Connect harness to sensor. **Be sure seal is securely in place between sensor and wiring connector.**

(2) Install O-ring on sensor (if removed).

(3) Insert sensor in differential housing.

(4) Install sensor shield.

(5) Install the sensor mounting stud and tighten to 24 N·m (18 ft. lbs.).

(6) Install the brake line on the sensor stud and install the nut.

(7) Lower vehicle.

EXCITER RING

The exciter ring is mounted on the differential case. If the ring is damaged refer to Group 3 Differential and Driveline for service procedures.

SPECIFICATIONS

TORQUE CHART

DESCRIPTION	TORQUE
ABS Assembly	
Bracket Bolts	10-16 N·m (120-144 in. lbs.)
Mounting Nuts	12 N·m (102 in. lbs.)
CAB Screws	4-4.7 N·m (36-42 in. lbs.)
Brake Lines	19-23 N·m (170-200 in. lbs.)
Wheel Speed Sensor	
Ft. Bolts (2WD)	23 N·m (17 ft. lbs.)
Ft. Bolt (4WD)	14 N·m (11 ft. lbs.)
Rear Bolt	24 N·m (18 ft. lbs.)