BRAKES

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SERVICE BRAKE COMPONENTS

WHEEL BRAKE UNITS

Front disc brakes and rear drum brakes are used on all models. The front disc brakes consist of single piston calipers and ventilated rotors.

Drum type rear brakes are used on all models. Brake size is 254 x 44 mm (10.0 x 1.75 in.). The assemblies are dual shoe, internal expanding units with a single wheel cylinder. A self adjusting mechanism is used for all applications.

The parking brakes are operated by a hand lever assembly. The lever assembly is connected to the rear brake trailing shoes by cables. Parking brake adjustment is controlled by a cable tensioner attached to the front cable.

VACUUM/HYDRAULIC COMPONENTS

A vacuum operated, 200 mm (7.8 in.), dual diaphragm power brake booster is used on all models. A center feed, dual reservoir master cylinder and a combination proportioning valve and pressure differential switch are used on all models. The proportioning valve is a fixed rate type.

BRAKE WARNING LIGHTS

All models are equipped with two brake warning lights. A red light is used for the service brake system. An amber light is used for the antilock system.

The red light alerts the driver if a pressure differential exists between the front and rear hydraulic systems. The red light also alerts the driver when the parking brakes are applied. The light is located in the instrument cluster.

The amber antilock warning light is also located in the instrument cluster. The light illuminates only when an antilock system fault occurs.

BRAKELINING MATERIAL

Factory installed front and rear brakelining on Grand Cherokee models, is made from organic materials combined with metallic particles. The brakelining material does not contain asbestos.

ANTILOCK BRAKE SYSTEM (ABS)

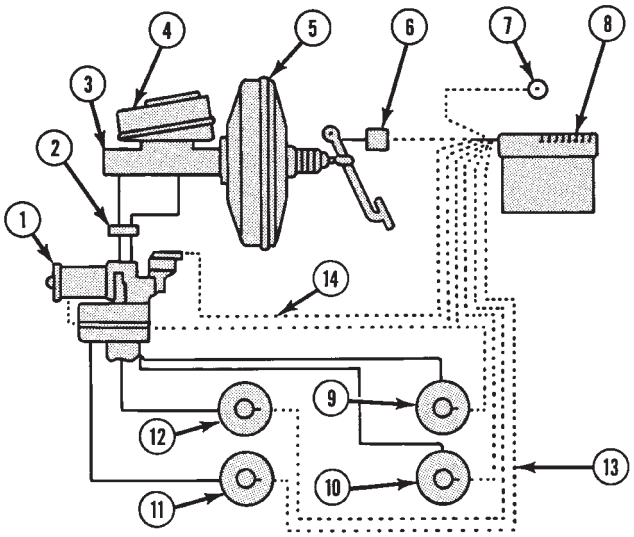
An antilock brake system (ABS) is standard equipment on Jeep Grand Cherokee models. The antilock system is an electronically operated all wheel brake control system. The system is designed to retard wheel lockup during periods of high wheel slip when braking.

The antilock electronic control system is separate from other electrical circuits in the vehicle. A specially programmed electronic control unit (ECU) is used to operate the system components.

Antilock system components consist of:

- electronic control unit (ECU)
- wheel speed sensors and axle shaft tone rings

- hydraulic control unit (HCU)
- tandem master cylinder with central valves
- vacuum power brake booster
- pedal travel sensor
- acceleration switch
- main relay and pump motor relay
- antilock warning light
- pump motor sensor



1. HCU
2. COMBINATION VALVE
3. MASTER CYLINDER
4. FLUID RESERVOIR
5. VACUUM POWER BOOSTER
6. PEDAL TRAVEL SENSOR
7. ACCELERATION SENSOR
8. ECU
9. RIGHT REAR WHEEL
10. LEFT REAR WHEEL
11. LEFT FRONT WHEEL
12. RIGHT FRONT WHEEL
13. WHEEL SPEED SENSOR WIRES
14. HCU HARNESS WIRES

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Fig. 1 AntiLock Brake System Basic Layout

BRAKE FLUID/LUBRICANTS/CLEANING SOLVENTS

Recommended brake fluid is Mopar brake fluid or equivalent, meeting SAE J1703 and DOT 3 standards.

Use Mopar multi-mileage grease to lubricate drum brake pivot pins and rear brakeshoe contact points on the support plates. Use GE 661 or Dow 111 silicone grease, or multi-mileage grease on caliper bushings and slide pins.

Use fresh brake fluid or Mopar brake cleaner to clean or flush brake system components. These are the only cleaning materials recommended.

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. If system contamination is suspected, check the fluid for dirt, discoloration, or separation into distinct layers. Drain and flush the system with new brake fluid if contamination is suspected.

BRAKE SAFETY PRECAUTIONS

WARNING: ALTHOUGH FACTORY INSTALLED BRAKELINING ON GRAND CHEROKEE MODELS IS MADE FROM ASBESTOS FREE MATERIALS, SOME AFTER MARKET BRAKELINING MAY CONTAIN ASBESTOS. THIS SHOULD BE TAKEN INTO ACCOUNT WHEN SERVICING A VEHICLE WITH PRIOR BRAKE SERVICE. WEAR A RESPIRATOR WHEN CLEANING BRAKE COMPONENTS AS ASBESTOS FIBERS CAN BE A HEALTH HAZARD. NEVER CLEAN WHEEL BRAKE COMPONENTS WITH COMPRESSED AIR. USE A VACUUM CLEANER SPECIFICALLY DESIGNED FOR REMOVING BRAKE DUST. IF A VACUUM CLEANER IS NOT AVAILABLE, CLEAN THE PARTS WITH WATER DAMPENED SHOP RAGS. DO NOT CREATE DUST BY SANDING BRAKELINING. DISPOSE OF ALL DUST AND DIRT SUSPECTED OF CONTAINING ASBESTOS FIBERS IN SEALED BAGS OR CONTAINERS. FOLLOW ALL RECOMMENDED SAFETY PRACTICES PRESCRIBED BY THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) AND THE ENVIRONMENTAL PROTECTION AGENCY (EPA), FOR HANDLING AND DISPOSAL OF PRODUCTS CONTAINING ASBESTOS.

ANTILOCK BRAKE SYSTEM DIAGNOSIS

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DIAGNOSIS PROCEDURE

Antilock system diagnosis involves three basic steps. First is observation of the warning light display. Second is a visual examination for low fluid level, leaks, or obvious damage to system components or wires. The third step involves using the DRB II scan tool to identify a faulty component.

The visual examination requires a check of reservoir fluid level and all system components. Things to look for are leaks, loose connections, or obvious component damage.

The final diagnosis step involves using the DRB II scan tool to determine the specific circuit or component at fault. The tester is connected to the ABS diagnostic connector in the passenger compartment.

The ABS diagnostic connector is inside the vehicle. It is located at the forward end of the console, just above the accelerator pedal and under the carpet. Access to the connector only requires that the carpeting be moved aside.

Refer to the DRB II scan tool manual for test procedures. Also refer to the ABS Fault Diagnosis charts at the end of this section for additional diagnosis information.

Initial faults should be cleared and the vehicle road tested to reset any faults that remain in the system. Faults can be cleared with the scan tool.

REAR SPEED SENSOR AIR GAP

The front wheel sensors are fixed and cannot be adjusted. Only the rear sensor air gap is adjustable. Air gap must be set with a brass feeler gauge.

Correct air gap is important to proper signal generation. An air gap that is too large may cause complete loss of sensor input. Or, a gap that is too small could produce a false input signal, or damaging contact between the sensor and tone ring.

WHEEL/TIRE SIZE AND INPUT SIGNALS

Antilock system operation is dependant on accurate signals from the wheel speed sensors. Ideally, the vehicle wheels and tires should all be the same size and type. However, the Jeep ABS system is designed to function with a compact spare tire installed.

OPERATING SOUND LEVELS

The hydraulic control unit pump and solenoid valves may produce some sound as they cycle on and off. This is a normal condition and should not be mistaken for faulty operation. Under most conditions, pump and solenoid valve operating sounds should not be audible.

VEHICLE RESPONSE IN ANTILOCK MODE

During antilock braking, the hydraulic control unit solenoid valves cycle rapidly in response to antilock electronic control unit inputs.

The driver will experience a slight pulsing sensation within the vehicle as the solenoids decrease, hold, or increase pressure as needed. Brake pedal pulsing will also be noted and is a normal condition when the solenoids are cycling.

The pulsing sensation occurs as the solenoids cycle during antilock mode braking. A slight pulse in the brake pedal may also be noted during the dynamic self check part of system initialization.

STEERING RESPONSE

A modest amount of steering input is required during extremely high deceleration braking, or when braking on differing traction surfaces. An example of differing traction surfaces would be when the left side wheels are on ice and the right side wheels are on dry pavement.

LOSS OF SENSOR INPUT

Sensor malfunctions will most likely be due to loose connections, damaged sensor wires, incorrect rear sensor air gap, or a malfunctioning sensor. Additional causes of sensor faults would be sensor and tone ring misalignment or damage.

ABS WARNING LIGHT DISPLAY

ABS LIGHT ILLUMINATES AT STARTUP

The amber antilock light illuminates at startup as part of the system self check feature. The light illuminates for 2-3 seconds then goes off as part of the normal self check routine.

ABS LIGHT REMAINS ON AFTER STARTUP

An ABS system fault is indicated when the light remains on after startup. Diagnosis with the DRB II scan tool will be necessary to determine which ABS component has malfunctioned.

ABS LIGHT ILLUMINATES DURING BRAKE STOP

A system fault such as loss of speed sensor signal or solenoid failure, will cause the amber warning light to illuminate. The most effective procedure here is to check for obvious damage first. Then check the electronic components with the DRB II scan tool.

BRAKE WARNING LIGHT OPERATION

The red brake warning light and the amber ABS light operate independently. If the red light remains on after startup or illuminates during a brake stop, refer to the standard brake system diagnosis section.

ANTILOCK CONTROL UNIT (ECU) DIAGNOSIS

The antilock, electronic control unit (ECU) controls all phases of antilock system operation. It also differentiates between normal and antilock mode braking.

The ECU monitors and processes the signals generated from all of the system sensors at all times.

The ECU program includes a self check routine that tests each of the system components. The self check occurs during both phases of the initialization program. A failure of the self check program will cause the immediate illumination of the amber warning light. The light will also illuminate if a solenoid or other system component fails during the dynamic phase of initialization.

If a system malfunction should occur, do not immediately replace the ECU. A blown system fuse, bad chassis ground, or loss of feed voltage will each cause a system malfunction similar to an ECU failure. Never replace the ECU unless diagnosis with the DRB II scan tool indicates this is necessary.

HYDRAULIC CONTROL UNIT (HCU) DIAGNOSIS

The HCU pump and motor and solenoid valve body are services only as an assembly. The HCU assembly should not be replaced unless a fault has actually been confirmed. Verify fault conditions with the DRB II scan tool before proceeding with repair.

ABS FAULT DIAGNOSIS CHART

The diagnosis chart describes potential antilock system fault conditions. The most probable cause for each fault condition is also provided. The causes of a fault condition are listed in order of probability starting with the most likely cause of a fault.

Use the chart as a guide to repair after initial diagnosis with the DRB II scan tool.

POTENTIAL ABS FAULT CONDITIONS AND CAUSES

ABS CONDITION	PROBABLE CAUSE
WHEEL SENSOR FAULT	1. Sensor disconnected. 2. Incorrect sensor air gap (usually too large). 3. Damaged sensor wire. 4. Damaged sensor or tone ring. 5. Sensor and/or tone ring loose or misaligned.
HCU SOLENOID VALVE FAULT	1. Bad ECU. 2. HCU wire harness short, open loose connection, or wire damage. 3. System circuit breakers (in PDC) faulty. 4. Relay fault.
PUMP MOTOR FAULT	1. Fuse or wire harness problem. 2. Relay malfunction. 3. Pump motor sensor malfunction. 4. Pedal travel sensor fault (short, open, mismatched). 5. Pump motor malfunction.
MAIN RELAY FAULT	1. Short or open in relay. 2. Short or open in relay wiring. 3. Inadequate feed voltage (less than 9 volts).
ABS LIGHT ON BUT NO FAULT CODE SET	1. ABS fuse blown. 2. Inadequate feed voltage to ECU (less than 9 volts). 3. ECU ground wire damage or loose connection. 4. Main relay inoperative.
INADEQUATE FEED VOLTAGE (NOT ENOUGH VOLTAGE TO OPERATE SYSTEM)	1. Battery discharged or low on charge. 2. Battery cables loose or corroded (at terminals). 3. Loose, corroded system ground. 4. Loose harness connections or corroded connections.
DECREASING BRAKE PEDAL HEIGHT (MOVES CLOSER TO FLOOR)	Noticeable decrease during ABS stops is due to: (a) Fluid leak. (b) Air in system. (c) Pedal travel sensor cap and booster are mismatched. (d) Pedal travel sensor or pump malfunction.
INCREASING BRAKE PEDAL HEIGHT, PUMP RUNS CONTINUOUSLY DURING ABS STOP (PEDAL FARTHER FROM FLOOR)	1. Pump motor wire harness problem (short, open, ground, loose, damaged). 2. Pedal travel sensor fault.
ACCELERATION SWITCH FAULT	1. Switch wires loose, damaged. 2. Switch malfunction. 3. Switch mounted upside down.

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SERVICE BRAKE COMPONENT DIAGNOSIS

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GENERAL INFORMATION

The diagnosis information in this section covers the vehicle service brake components which include:

- disc brake calipers
- disc brakeshoes
- drum brake wheel cylinders
- drum brakeshoes and brake drums
- drum brake support plates
- parking brake mechanism
- master cylinder/combination valve
- vacuum power brake booster
- brake pedal and brakelight switch
- brake warning light

DIAGNOSIS PROCEDURES

Service brake component diagnosis involves determining if the problem is related to a mechanical, hydraulic or vacuum operated part. A preliminary check, road testing and component inspection are needed to determine a problem cause.

Road testing will either verify proper brake operation or confirm the existence of a problem. Component inspection will, in most cases, identify the actual part causing a problem.

The first diagnosis step is the preliminary check. This involves inspecting fluid level, parking brake action, wheel and tire condition, checking for obvious leaks or component damage and testing brake pedal response. A road test will confirm or deny the existence of a problem. The final diagnosis procedure involves road test analysis and a visual inspection of brake components.

PRELIMINARY BRAKE CHECK

(1) If amber antilock light is illuminated, refer to Antilock Brake System Diagnosis. However, if red warning light is illuminated, or if neither warning light is illuminated, continue with diagnosis outlined in this section.

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

(3) 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.

(4) Inspect brake fluid level and condition.

(a) Fluid level should be at the MAX level indicator mark on master cylinder reservoir.

(b) Check fluid condition. Fluid should be reasonably clear and free of foreign material. **Note that brake fluid tends to darken over time. This is normal and should not be mistaken for contamination. If fluid is reasonably clear and free of foreign material, it is OK.**

(c) Remember that fluid level in front disc brake reservoir will decrease slightly as normal brakelining wear occurs. However, if fluid level is abnormally low, look for leaks at calipers, wheel cylinders, brakelines and master cylinder.

(d) If fluid is highly discolored, or appears to contain foreign material, drain out a sample with a clean suction gun. Pour sample in a glass container and note condition.

(e) If fluid separates into layers, or obviously contains oil or substance other than brake fluid, system seals and cups will have to be replaced and hydraulic system flushed.

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

(6) 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.

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

ROAD TESTING

(1) If amber warning light is illuminated, problem is with antilock system component. Refer to Antilock Brake System Diagnosis.

(2) If red warning light is illuminated, or if neither warning light is illuminated, make several stops and note pedal action and brake response.

(3) Check brake pedal response with transmission in Neutral and engine running. Pedal should remain

firm under steady foot pressure. If pedal falls away, problem is either in vacuum booster or master cylinder.

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

(5) Inspect suspect brake components and refer to problem diagnosis information for causes of various brake conditions.

COMPONENT INSPECTION

Fluid leak points and dragging brake units can usually be located without removing any components. The area around a leak point will be wet with fluid. The components at a dragging brake unit (wheel, tire, rotor) will be quite warm or hot to the touch.

Other brake problem conditions will require component removal for proper inspection. Raise the vehicle and remove the necessary wheels for better visual access.

DIAGNOSING BRAKE PROBLEMS

BRAKE WARNING LIGHT OPERATION

The red brake warning light will illuminate when the parking brakes are applied, when there is a leak in the front or rear wheel brake hydraulic circuit, and as part of the bulb check procedure at startup. A low fluid level and excessively worn brakelining can also trigger the warning light. If the light comes on, first verify that the parking brakes are fully released. Then check pedal action and fluid level. If a problem is confirmed, inspect the wheel brake hydraulic system.

The amber antilock warning light illuminates only when an ABS component has malfunctioned. Refer to the Antilock Brake Diagnosis section for more detailed diagnosis information.

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 brakeline, fitting, hose, wheel cylinder, or caliper. Internal leakage in the master cylinder caused by worn or damaged piston cups, may also be the problem cause.

If leakage is severe, fluid will be evident at or around the leaking component. However internal leakage in the master cylinder will not be physically evident. Refer to the cylinder test procedure in this section.

LOW PEDAL

If a low pedal is experienced and the amber antilock warning light is **not** on, worn lining and worn rotors or drums are the most likely cause. If the pedal remains low and the antilock light is on, the problem is with an antilock component. Refer to Antilock Brake System Diagnosis.

If the red warning light is on, a system leak is the most likely cause. A leak at a front caliper, rear wheel cylinder, brakeline, or brake hose will activate the differential pressure switch in the combination valve. The switch will shuttle forward or rearward depending on where the leak is. Switch movement in either direction will complete the electrical circuit to the red warning light causing the light to illuminate.

SPONGY PEDAL

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

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. Test the booster and valve as described in this section.

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

Brake drag also has a direct effect on fuel economy. If undetected, minor brake drag can be misdiagnosed as an engine or transmission/torque converter problem.

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.

Some common causes of brake drag are:

- loose or damaged wheel bearing
- seized or sticking caliper or wheel cylinder piston
- caliper binding on bushings or slide surfaces
- loose caliper mounting bracket
- distorted brake drum or shoes
- rear brakeshoes binding on worn/damaged support plates

- misassembled components.
- misadjusted brakelight switch
- binding brake pedal
- master cylinder internal fault

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

An improperly mounted or adjusted brakelight switch can prevent full brake pedal return. The result will be the same as if the cylinder compensator ports are blocked. In this case, the brakes would be partially applied all the time causing drag.

BRAKE FADE

Brake fade is a product of overheating caused by brake drag. However, brake overheating and subsequent 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 roads. Refer to the Brake Drag information in this section for causes.

PEDAL PULSATION

Pedal pulsation is caused by components that are loose, or beyond tolerance limits. However, light pedal pulsation will occur during periods of high wheel slip (antilock) braking. This is a normal condition and is a result of HCU pump operation.

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

BRAKE PULL

A front pull condition could be the result of contaminated lining in one caliper, seized caliper piston, binding caliper, loose caliper, loose or corroded slide pins, improper brakeshoes, or a 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 the dragging brake unit.

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

When diagnosing a change in pull condition, 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

Rear grab (or pull) is usually caused by 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 lightly applied for a mile or two. However, if the lining is both wet and dirty, disassembly and cleaning will be necessary.

BRAKE FLUID CONTAMINATION

There are two basic causes of brake fluid contamination. The first involves allowing dirt, debris, or other liquid materials to enter the cylinder reservoirs when the cover is off. The second involves topping off, or filling the cylinder reservoirs with a non-recommended fluid.

Brake fluid contaminated with only dirt, or debris usually retains a normal appearance. Generally, the foreign material will remain suspended in the fluid and be visible. The fluid and foreign material can be removed from the reservoir with a suction gun but only if the brakes have not been applied. If the brakes are applied after contamination, system flushing will be required. The master cylinder will also have to be flushed or replaced if the contaminants cannot be removed. Foreign material lodged in the reservoir compensator/return ports can cause brake drag by restricting fluid return after brake application.

Brake fluid contaminated by a non-recommended fluid, generally appears highly discolored, milky, oily looking, or foamy. In some cases, it may even appear as if the fluid contains sludge. **However, remember that brake fluid will darken in time and occasionally be cloudy in appearance. These are normal conditions and should not be mistaken for contamination.**

If some type of oil has been added to the system, the fluid will separate into distinct layers. To verify this, drain off a sample with a clean suction gun. Then pour the sample into a glass container and observe fluid action. If the fluid separates into distinct layers, it is definitely contaminated.

The only real correction for contamination by non-recommended fluid is to flush the entire hydraulic system and replace all the seals and cups.

BRAKE NOISE

Squeak/Squeal

The factory installed brakelining in Grand Cherokee models is made from asbestos free materials. These materials have different operating characteristics than previous lining material. Under certain conditions, asbestos free lining may generate some squeak, groan or chirp noise. This noise is considered normal and does not indicate a problem. The only time inspection is necessary, is when noise becomes constant or when grinding, scraping noises occur.

Constant 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 can also cause squeak/squeal.

Loud brake squeak, squeal, scraping, or grinding sounds are a sign of severely worn brake lining. If the lining has worn completely through 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.

Thump/Clunk

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 brakeshoes can also produce a thump noise.

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.

BRAKELINING CONTAMINATION

Brakelining contamination is a product of leaking calipers or wheel cylinders, driving through deep water puddles, or lining that has become covered with grease and grit during repair.

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 little or no tread left can produce a grab-like condition as the tire loses and recovers traction.

Flat-spotted tires can cause vibration and wheel tramp and generate shudder during brake operation.

A tire with internal damage such as a severe bruise or ply separation can cause pull and vibration.

POWER BRAKE BOOSTER CHECK VALVE TEST

(1) Disconnect vacuum hose from check valve.

(2) Remove check valve and valve seal from booster (Fig. 1).

(3) Hand operated vacuum pump can be used for test (Fig. 2).

(4) Apply 15-20 inches vacuum at large end of check valve (Fig. 1).

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

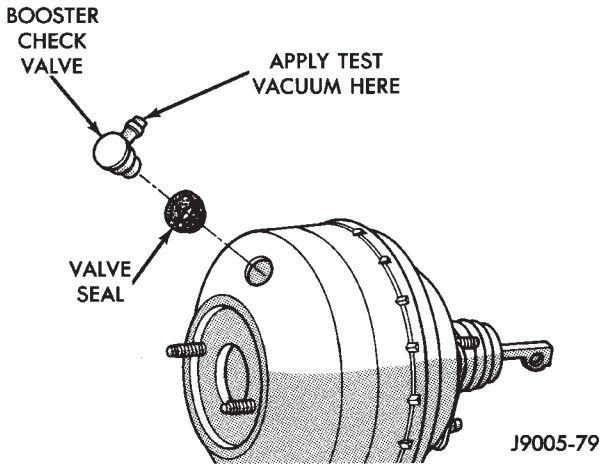

Fig. 1 Vacuum Check Valve And Seal Location

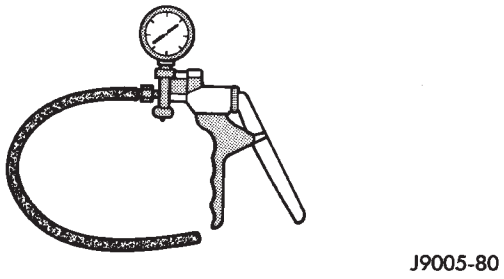

Fig. 2 Typical Hand Operated Vacuum Pump

POWER BRAKE BOOSTER VACUUM TEST

(1) Connect a vacuum gauge to the booster check valve with a short length of hose and a T-fitting (Fig. 3).

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

(3) Clamp hose shut between vacuum source and check valve (Fig. 3).

(4) Stop engine and observe vacuum gauge.

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

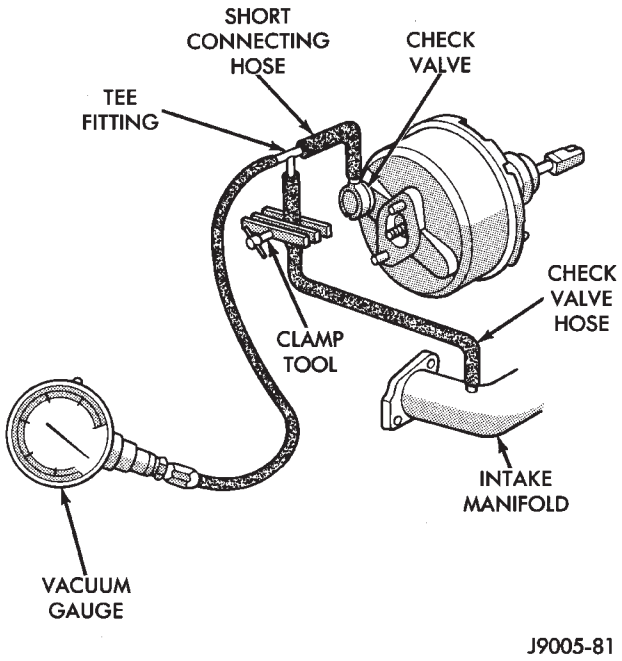

Fig. 3 Booster Vacuum Test Connections

BRAKE ADJUSTMENTS-FLUID LEVEL-BRAKE BLEEDING

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RECOMMENDED BRAKE FLUID

Recommended brake fluid for the Jeep ABS system is Mopar DOT 3 brake fluid. If Mopar fluid is not readily available, a top quality fluid meeting SAE J1703 and DOT 3 standards can be used.

Brake fluid used in the ABS system must meet the SAE and DOT quality standards and be exceptionally clean.

Never use substandard fluid, fluid not meeting the SAE and DOT standards, reclaimed fluid, or fluid from open containers.

CORRECT BRAKE FLUID LEVEL

Correct brake fluid level is marked on the driver side of the master cylinder reservoir (Fig. 1).

Preferred fluid level is to the MAX indicator mark. Acceptable fluid level is between the MAX and MIN marks.

If fluid level is at or below the MIN mark, the brake hydraulic system should be checked for leaks.

CAUTION: Clean the reservoir caps and exterior thoroughly before checking fluid level. Do not allow any dirt or foreign material to enter the reservoir while checking fluid level. Such materials can interfere with solenoid valve operation causing an ABS malfunction.

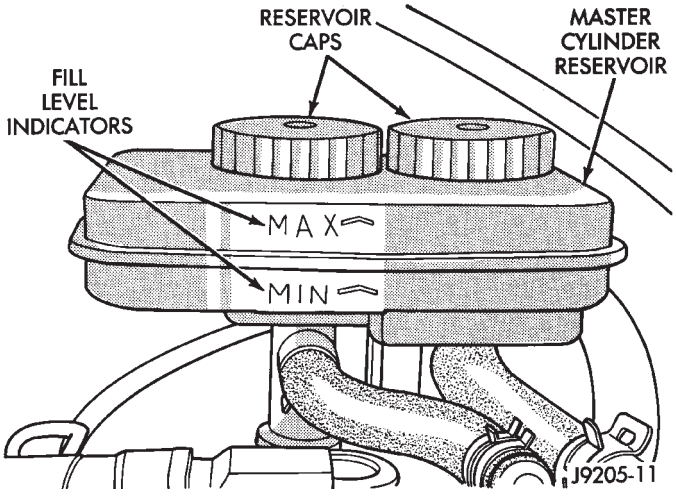


Fig. 1 Master Cylinder Reservoir Fluid Level Indicators

IMPORTANCE OF CLEAN BRAKE FLUID

The antilock system brake fluid must be kept clean and free of any type of contamination. Foreign material in the fluid, or non-recommended fluids will cause system malfunctions.

Clean the reservoir and caps thoroughly before checking level or adding fluid. Cap open lines and hoses during service to prevent dirt entry.

Dirt or foreign material entering the ABS hydraulic system through the reservoir opening will circulate within the system. Dirt or foreign material in the system can lead to component malfunction. Always clean the reservoir exterior before checking fluid level or adding fluid. Use clean, fresh fluid only to top off, or refill the system.

CHECKING BRAKE FLUID FOR CONTAMINATION

Oil in the fluid will cause brake system rubber seals to soften and swell. The seals may also become porous and begin to deteriorate.

If fluid contamination is suspected, drain off a sample from the master cylinder. A suction gun or similar device can be used for this purpose.

Empty the drained fluid into a glass container. Contaminants in the fluid will cause the fluid to separate into distinct layers. If contamination has occurred, the system rubber seals, hoses and cups must be replaced and the system thoroughly flushed with clean brake fluid.

BRAKE BLEEDING

A different bleeding method is required for the antilock brake system (ABS). It is basically a three step process consisting of: A conventional manual brake bleed. A second bleed using the DRB II scan tool to run the pump. And a repeat of the conventional manual bleed procedure. Procedure is as follows:

(1) Clean master cylinder reservoir caps and reservoir exterior. Dirt, foreign material on the caps and reservoir must not be allowed to enter reservoir.

(2) Fill reservoir with Mopar brake fluid, or equivalent quality fluid meeting SAE 1703 and DOT 3 standards.

(3) Recommended bleeding sequence is:

- master cylinder

- HCU valve body (at fluid lines)
- right rear wheel
- left rear wheel
- right front wheel
- left front wheel.

(4) Attach bleed hose to caliper or wheel cylinder bleed fitting. Immerse end of bleed hose in glass container partially filled with brake fluid. Be sure hose end is submerged in fluid (Fig. 2).

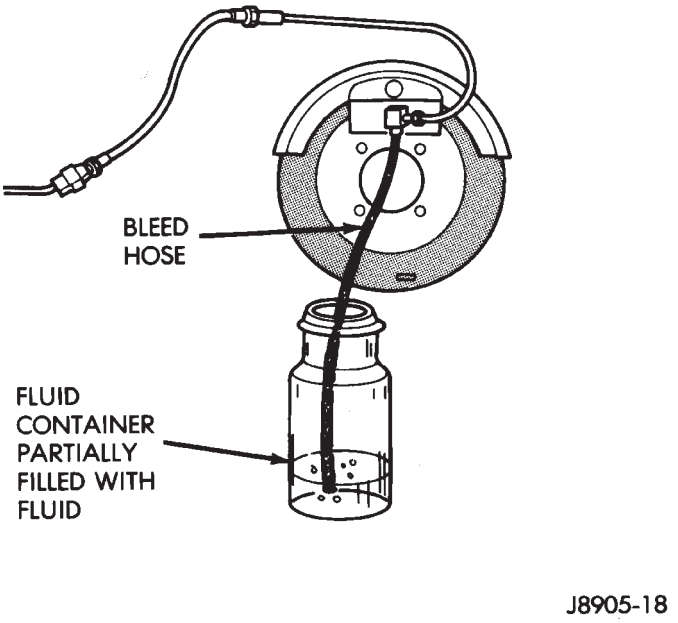


Fig. 2 Bleed Hose Immersed In Glass Container

(5) Bleed each wheel brake unit as follows:

(a) Have helper apply and hold brake pedal.

(b) Open bleed screw 1/2 turn. Close bleed screw when brake pedal contacts floorpan. **Do not pump brake pedal at any time while bleeding. This compresses air into small bubbles which are distributed throughout system. Additional bleeding operations will then be necessary to remove all trapped air from the system.**

(c) Repeat bleeding operation 5-7 more times at each rear wheel brake unit.

(d) Continue bleeding until fluid entering glass container is free of air bubbles. Check reservoir fluid level frequently and add fluid if necessary.

(e) Repeat bleeding procedures at front wheels.

CAUTION: Do not allow the master cylinder reservoir to run dry while bleeding the brakes. Running dry will allow air to re-enter the system making a second bleeding operation necessary.

(6) Perform "Bleed Brake" procedure with DRB II scan tool. Procedure is described in DRB II scan tool software information and diagnostic manual.

(a) Connect scan tool to diagnostic connector. Connector is under instrument panel near steering column.

(b) Run "Bleed Brake" procedure as described in scan tool manual.

(7) Repeat conventional bleeding procedure outlined in steps (1) through (5) and steps (8) and (9).

(8) Top off master cylinder fluid level if necessary.

(9) Verify proper brake operation.

REAR DRUM BRAKESHOE ADJUSTMENT

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.

The only tool needed for adjustment is a standard drum brake gauge (Fig. 3).

Adjustment is performed with the brakeshoes installed on the support plate. Procedure is as follows:

ADJUSTMENT PROCEDURE

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

(2) Verify that left/right adjuster levers and cables are properly connected.

(3) Insert brake gauge in the drum. Expand gauge until gauge inner legs contact braking surface of drum. Then lock gauge in position (Fig. 3).

(4) Adjust brakeshoes to gauge as follows:

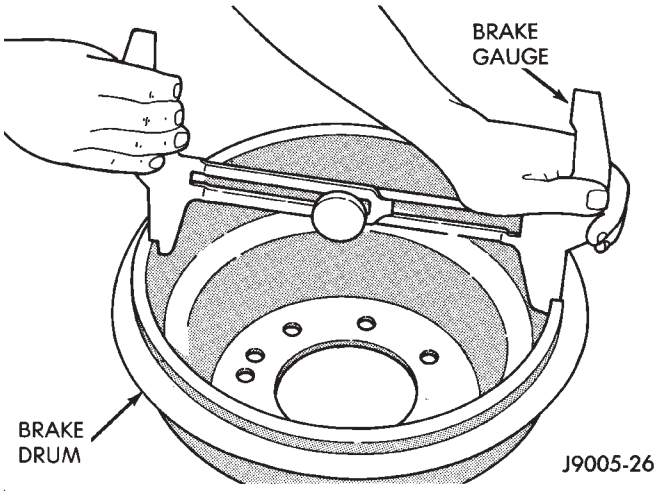


Fig. 3 Adjusting Brake Gauge To Brake Drum

(a) Reverse gauge and place it on brakeshoes. Position gauge legs at brakeshoe centers as shown (Fig. 4).

(b) Hold shoe adjuster star wheel away from adjuster lever.

(c) Turn adjuster star wheel by hand to expand or retract shoes until they fit gauge. Continue adjustment until gauge legs are light drag-fit on brakeshoes.

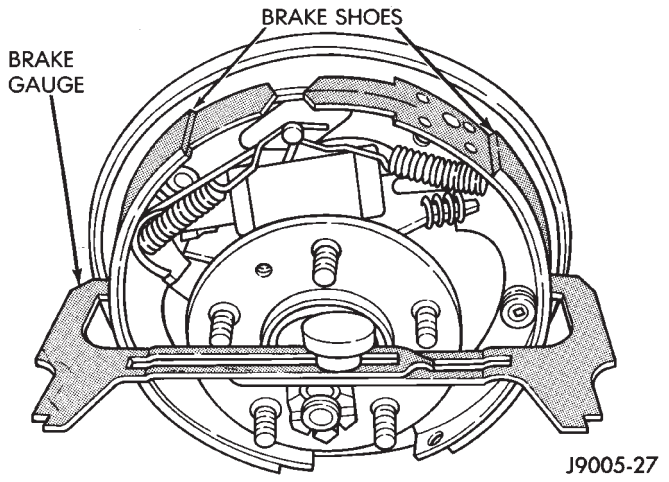


Fig. 4 Adjusting Brakeshoes To Brake Gauge

(5) Repeat adjustment at opposite brakeshoe assembly.

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

(7) Make final adjustment as follows: Drive vehicle and make one forward stop followed by one reverse stop. Repeat procedure 8-10 times to actuate self adjuster components and equalize adjustment. Bring vehicle to complete standstill at each stop. Incomplete, rolling stops will not activate the adjuster mechanism.

PARKING BRAKE CABLE ADJUSTMENT

A cable tensioner is used to control parking brake front cable adjustment. The tensioner requires a different method of adjustment than previous models. Perform adjustment only as described in the following procedure to avoid incorrect/ineffective adjustment.

ADJUSTMENT PROCEDURE

(1) Check and adjust rear drum brakeshoes if necessary. Refer to procedure in this section.

(2) Fully apply parking brakes.

(3) Raise vehicle on hoist.

(4) Mark position of adjusting nut on threaded end of cable tensioner (Fig. 5). Use chalk or grease pencil to mark position of nut.

(5) Tighten adjusting nut approximately 13 mm (1/2 in.) farther down threaded end of cable tensioner.

CAUTION: Replace the cable tensioner if there are not enough threads left for proper adjustment. Do not attempt to modify and reuse the tensioner. This practice will result in ineffective parking brake operation. The tensioner should be replaced.

(6) Lower vehicle until wheels are about 15 cm (6 in.) off shop floor.

(7) Release parking brake lever and verify that rear wheels rotate freely without drag.

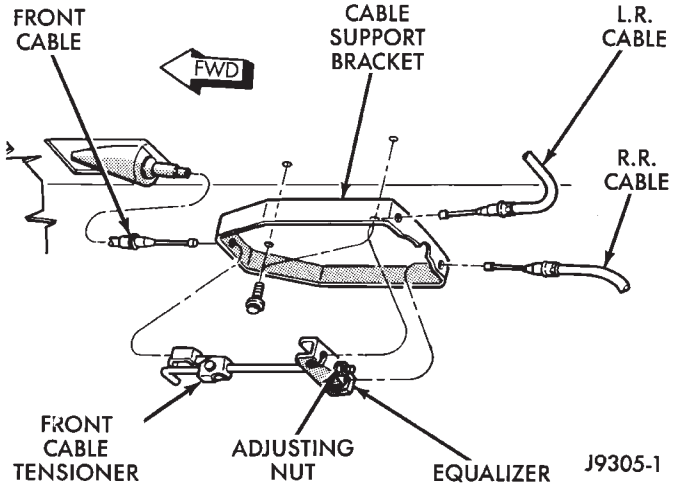


Fig. 5 Parking Brake Adjustment Components

(8) Lower vehicle completely.

REAR WHEEL SPEED SENSOR AIR GAP ADJUSTMENT

Only rear sensor air gap is adjustable. The front sensors are fixed and cannot be adjusted.

A rear sensor air gap adjustment is only needed when reinstalling an original sensor. Replacement sensors have an air gap spacer attached to the sensor pickup face. The spacer establishes correct air gap when pressed against the tone ring during installation. As the tone ring rotates, it peels the spacer off the sensor to create the required air gap.

Preferred rear sensor air gap is 1.1 mm (0.043 in.). Acceptable air gap range is 0.92 to 1.275 mm (0.036 to 0.050 in.).

Front sensor air gap is not adjustable. The front sensors are fixed in position and cannot be adjusted. Front sensor air gap can only be checked. Air gap should be 0.40 to 1.3 mm (0.0157 to 0.051 in.). If front sensor air gap is incorrect, the sensor is either loose, or damaged.

BRAKELIGHT SWITCH ADJUSTMENT

A plunger-type brakelight switch is used on Grand Cherokee models (Fig. 6). The switch plunger is actuated directly by the brake pedal.

The switch internal contacts are open when the brake pedal is in the released position. Brake application moves the pedal away from the switch allowing the plunger to extend. As the plunger extends, the switch internal contacts close completing the circuit to the brakelights.

A retainer clip is used to secure the switch to a bracket on the pedal support. The clip has tangs that seat in the threads of the switch plunger barrel.

BRAKELIGHT SWITCH ADJUSTMENT PROCEDURE

(1) Check switch adjustment as follows:

(a) Move brake pedal forward by hand and note operation of switch plunger.

(b) Plunger should be fully extended when pedal free play is taken up and brake application begins.

(c) Clearance of approximately 1.5 to 3 mm (1/16 to 1/8 in.) should exist between plunger and pedal at this point.

(2) If switch-to-pedal clearance is OK and brakelights operate correctly, adjustment is not required.

(3) If switch plunger does not fully extend and clearance between pedal and switch barrel is insufficient, adjust switch position as described in step (4).

(4) Grasp brake pedal and pull it rearward as far as possible. Switch plunger barrel will "ratchet" rearward in retaining clip to correct position.

(5) Verify brakelight switch operation and proper clearance between switch plunger and brake pedal.

CAUTION: Be very sure the brake pedal returns to a fully released position after adjustment. The switch can interfere with full pedal return if too far forward. The result will be brake drag caused by partial brake application.

WHEEL NUT TIGHTENING

The wheel attaching nuts must be tightened properly to ensure efficient brake operation. Overtightening the nuts or tightening them in the wrong sequence can cause distortion of the brake rotors and drums.

Impact wrenches are not recommended for tightening wheel nuts. A torque wrench is preferred for tightening purposes.

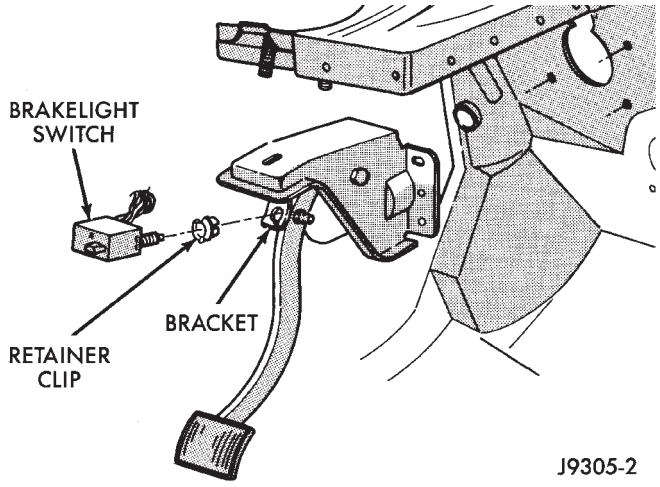


Fig. 6 Brakelight Switch Mounting

The correct tightening sequence is important in avoiding rotor and drum distortion. The correct sequence is in a diagonal crossing pattern (Fig. 7).

Seat the wheel and install the wheel nuts finger tight. Tighten the nuts in the sequence to half the required torque. Then repeat the tightening sequence to final specified torque.

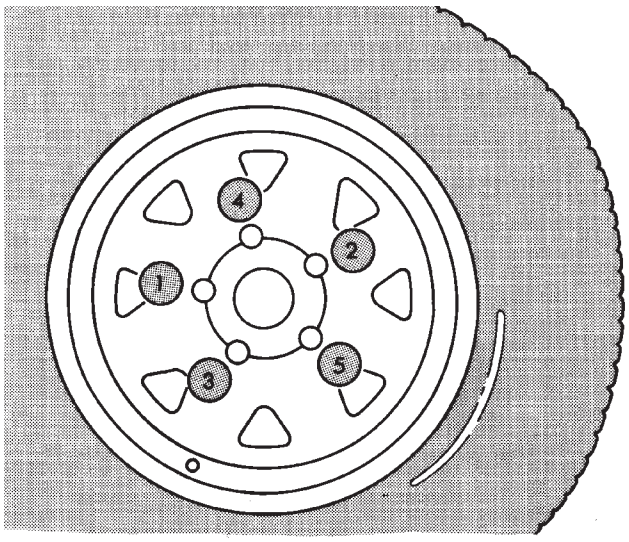


Fig. 7 Wheel Nut Tightening Sequence

ANTILOCK BRAKE OPERATION

INDEX

SYSTEM DESCRIPTION

The Grand Cherokee antilock brake system (ABS) is an electronically operated, all wheel brake control system. Major components are located underhood on the driver side of the vehicle (Fig. 1). Components include the:

- master cylinder/reservoir assembly
- vacuum power brake booster and pedal travel sensor

  hydraulic control unit (HCU)
- combination valve
- ABS electrical harnesses

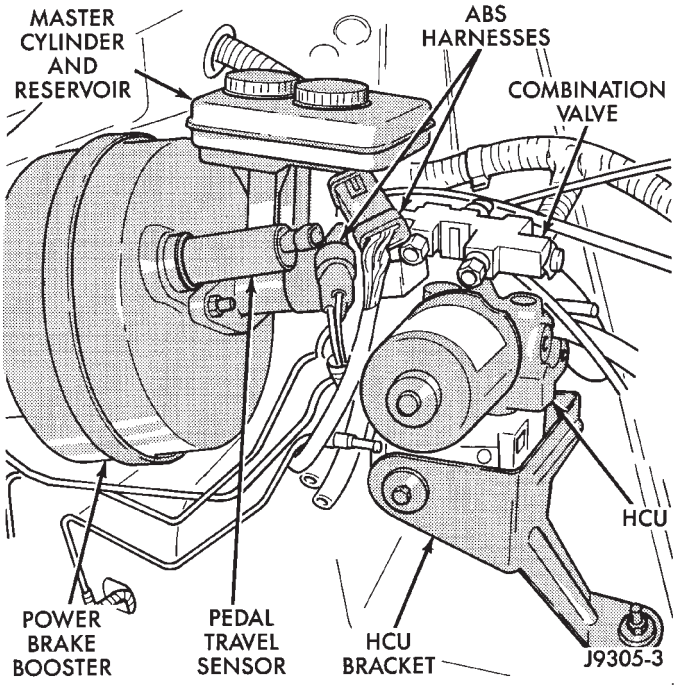


Fig. 1 Antilock System Underhood Components

- interconnecting brakelines

The antilock hydraulic system is a three channel design. The front wheel brakes are controlled individually and the rear wheel brakes in tandem (Fig. 2).

The antilock system is designed to retard wheel lockup during periods of high wheel slip when braking. Retarding wheel lockup is accomplished by modulating fluid pressure to the wheel brake units.

The ABS electronic control system is separate from other electrical circuits in the vehicle. A specially programmed electronic control unit (ECU) is used to operate the system components.

Electronic control system components include:

- electronic control unit (ECU)
- wheel speed sensors and axle shaft tone rings
- hydraulic control unit (HCU)
- tandem master cylinder with central valves
- vacuum power brake booster
- pedal travel sensor
- acceleration switch
- main relay and pump motor relay
- ABS warning light
- pump motor sensor

HYDRAULIC CONTROL UNIT (HCU)

The hydraulic control unit (HCU) consists of a valve body and pump/motor assembly (Figs. 1 and 2).

The valve body contains the electrically operated solenoid valves. It is the solenoid valves that modulate brake fluid apply pressure during antilock braking. The valves are operated by the antilock electronic control unit (ECU).

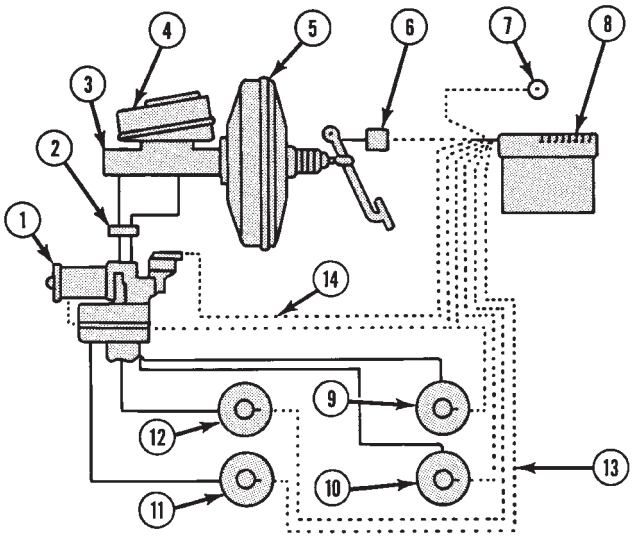
The HCU provides three channel pressure control to the front and rear brakes. One channel controls the rear wheel brakes in tandem. The two remaining channels control the front wheel brakes individually.

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.

The pump/motor assembly provides the extra volume of fluid needed during antilock braking. The pump is connected to the master cylinder reservoir by supply and return hoses.

The pump is operated by an integral electric motor. The DC type motor is controlled by the ECU.

The pump mechanism consists of two opposing pistons operated by an eccentric cam. One piston supplies the primary hydraulic circuit. The opposite piston supplies the secondary hydraulic circuit. In op-



1. HCU
2. COMBINATION VALVE
3. MASTER CYLINDER
4. FLUID RESERVOIR
5. VACUUM POWER BOOSTER
6. PEDAL TRAVEL SENSOR
7. ACCELERATION SENSOR
8. ECU
9. RIGHT REAR WHEEL
10. LEFT REAR WHEEL
11. LEFT FRONT WHEEL
12. RIGHT FRONT WHEEL
13. WHEEL SPEED SENSOR WIRES
14. HCU HARNESS WIRES

Fig. 2 AntiLock System Basic Layout

eration, one piston draws fluid from the master cylinder reservoir. The opposing piston then pumps fluid to the valve body solenoids. The pump cam is operated by the electric motor.

MASTER CYLINDER

A new style tandem master cylinder is used with the ABS system (Fig. 3). It is a center feed design. The primary and secondary pistons each contain a central valve which is a unique feature. The valves are used in place of the conventional piston and seal assemblies. The valves close and open the cylinder pressure chambers during brake application and release.

The only repairable components on the ABS master cylinder are the reservoir, reservoir grommets and the connecting hoses. The cylinder itself cannot be disassembled and is serviced only as an assembly.

POWER BRAKE BOOSTER

A dual diaphragm, vacuum operated power brake booster is used with the ABS master cylinder (Fig. 3). The engine intake manifold serves as the vacuum source for booster operation.

The booster is mounted on the engine compartment side of the dash panel. The master cylinder is mounted on attaching studs at the front of the booster. The master cylinder central valves are directly actuated by the booster push rod.

The pedal travel sensor is mounted in the forward face of the booster shell. The sensor plunger is actuated by the booster diaphragm plate.

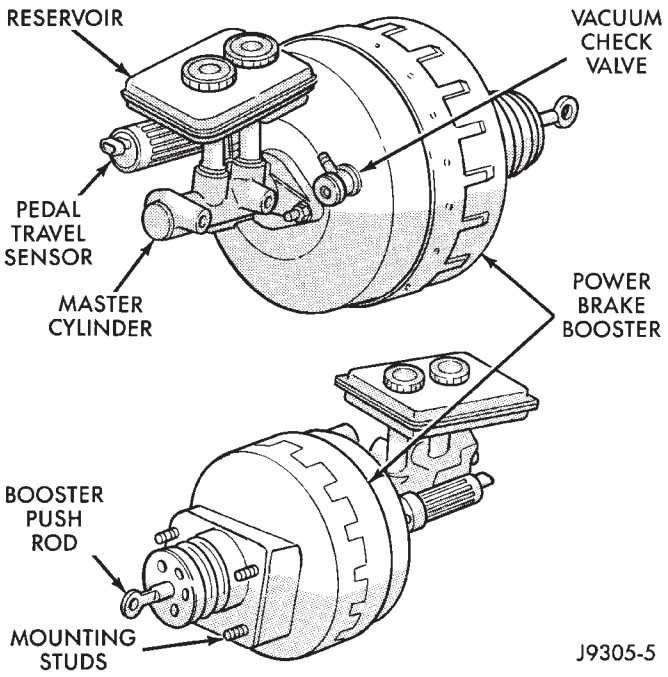


Fig. 3 Antilock Power Brake Booster And Master Cylinder

PEDAL TRAVEL SENSOR

The pedal travel sensor signals brake pedal position to the antilock ECU. The sensor signal is based on changes in electrical resistance. The resistance changes occur in steps generated by changes in brake pedal position. A resistance signal generated by changing brake pedal position, will cause the ECU to run the antilock pump when necessary.

The sensor is a plunger type, electrical switch mounted in the forward housing of the power brake booster (Fig. 4). The sensor plunger is actuated by movement of the booster diaphragm plate.

The tip on the sensor plunger is color coded. The tip must be matched to the color dot on the face of the brake booster front shell (Fig. 4).

WHEEL SPEED SENSORS

A sensor is used at each wheel. The sensors convert wheel speed into an electrical signal. This signal is transmitted to the antilock electronic control unit (ECU).

A gear type tone ring serves as the trigger mechanism for each sensor. The tone rings are mounted at the outboard ends of the front and rear axle shafts.

Different sensors are used at the front and rear wheels (Fig. 5). The front/rear sensors have the same electrical values but are not interchangeable.

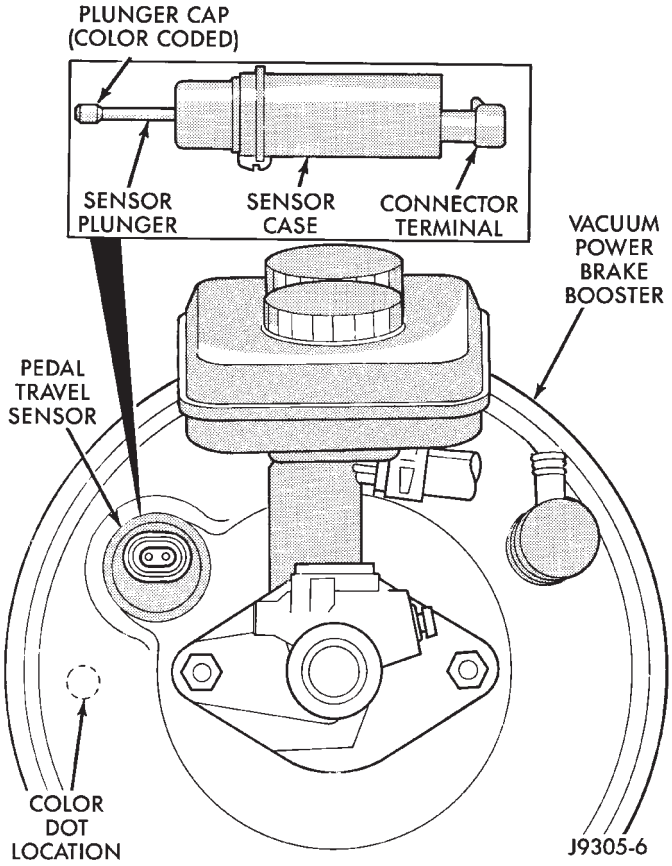


Fig. 4 Pedal Travel Sensor Location

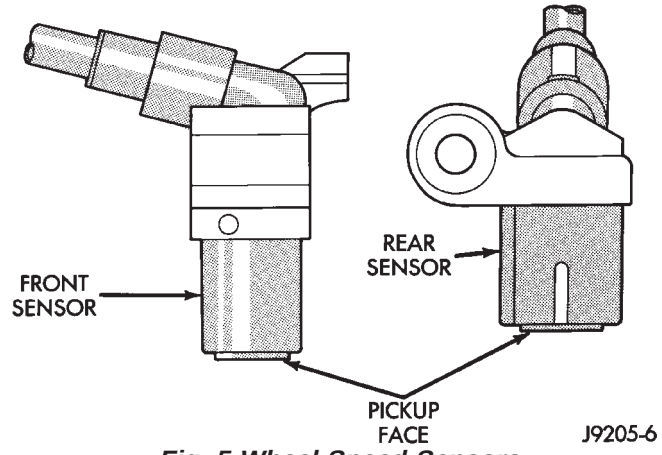


Fig. 5 Wheel Speed Sensors

ELECTRONIC CONTROL UNIT (ECU)

A separate electronic control unit (ECU) monitors, operates and controls the antilock system (Fig. 6). The ECU contains dual microprocessors. The logic block in each microprocessor receives identical sensor signals. These signals are processed and compared simultaneously (Fig. 7).

The ECU is located in the engine compartment. It is mounted on the driver side inner fender panel.

The 6-way antilock diagnostic connector is inside the vehicle. It is located at the forward end of the console just above the accelerator pedal and under the carpeting. Access to the connector only requires that the carpet be moved aside.

The voltage source for the ECU is through the ignition switch in the On and Run positions.

The antilock ECU is separate from the other vehicle electronic control units. It contains a self check program that illuminates the amber warning light when a system fault is detected. Faults are stored in a diagnostic program memory and are accessible with the DRB II 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.

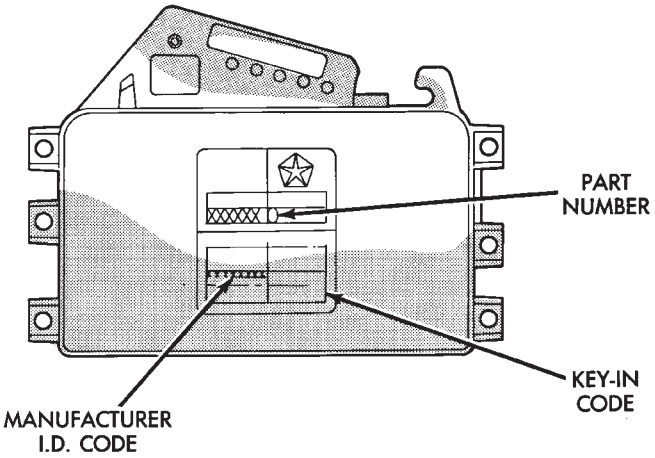


Fig. 6 Anti-Lock ECU

ACCELERATION SWITCH

An acceleration switch (Fig. 8), provides an additional vehicle deceleration reference during 4-wheel drive operation. The switch is monitored by the antilock ECU at all times.

The switch reference signal is utilized by the ECU when all wheels are decelerating at the same speed. Equal wheel speeds occur during braking in undifferentiated 4-wheel ranges.

SYSTEM RELAYS

The ABS system has two relays, which are the main and motor pump relays. The motor pump relay

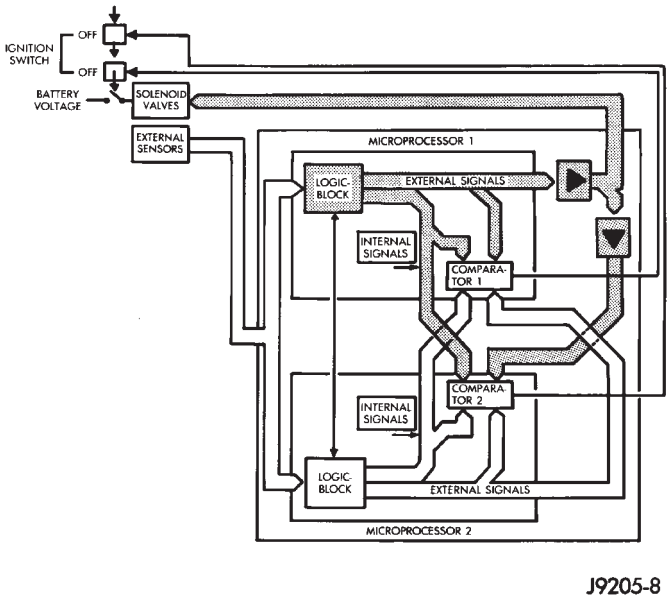


Fig. 7 ECU Dual Microprocessor Schematic

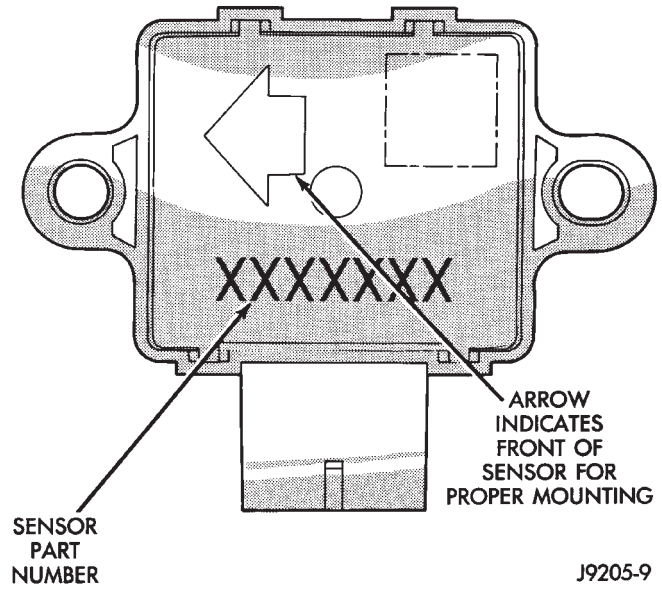


Fig. 8 Acceleration Switch

is used for the motor pump only. The main relay is used for the solenoid valves and remaining system components. The main relay is connected to the ECU at the power control relay terminal.

The pump motor relay starts/stops the pump motor when signaled by the ECU. The start/stop signal to the ECU is generated by the pedal travel sensor.

IGNITION SWITCH

The antilock ECU and warning light are in standby mode with the ignition switch in Off or Accessory position. No operating voltage is supplied to the system components.

A 12 volt power feed is supplied to the ECU, relays, solenoid valves, and warning light when the ignition switch is in the ON, Start and Run positions. Refer to the ABS system schematic at the end of this section for details.

SYSTEM WARNING LIGHTS

Two warning lights are used. The standard brake system light is red. The antilock system light is amber. Both lights are in the instrument cluster. The amber ABS light is in circuit with the ECU and operates independently of the red brake light.

The amber light indicates antilock system condition. It is in circuit with the valve body solenoids and main relay. The light illuminates (flashes) at start-up for the self check. The light goes out when the self check program determines system operation is normal.

If an ABS fault occurs either during the start-up self check, or during normal operation, the amber light remains on until the fault is corrected.

COMBINATION VALVE

A combination valve is used with the ABS system (Fig. 1). The valve contains a front/rear brake pressure switch and proportioning valve. The valve is connected between the master cylinder and hydraulic control unit (HCU).

ANTILOCK SYSTEM OPERATION

SYSTEM POWER-UP AND INITIALIZATION

The antilock system is in standby mode with the ignition switch in Off or Accessory position. The antilock electrical components are not operational.

Turning the ignition switch to On or Run position allows battery voltage to flow through the switch to the ECU ignition terminal.

The ABS system is activated when battery voltage is supplied to the ECU. The ECU performs a system initialization procedure at this point. Initialization consists of a static and dynamic self check of system electrical components.

The static check occurs immediately after the ignition switch is turned to the On position. The dynamic check occurs when vehicle road speed reaches approximately 10 kph (6 mph). During the dynamic check, the ECU briefly cycles the pump to verify operation. The HCU solenoids are checked continuously.

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

ABS OPERATION IN NORMAL BRAKING MODE

The ECU monitors wheel speed sensor inputs continuously while the vehicle is in motion. However, the ECU will not activate any ABS components as long as sensor inputs and the acceleration switch 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.

ABS OPERATION IN ANTILOCK BRAKING MODE

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 ECU 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 zero (or lockup) during braking. Periods of high wheel slip occur when brake stops involve high pedal pressure and rate of vehicle deceleration.

The antilock system retards 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 ECU 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 (Fig. 9). A speed sensor input signal indicating high slip conditions activates the ECU antilock program.

Two solenoid valves are used in each antilock control channel (Fig. 10). 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.

HCU SOLENOID VALVE OPERATION

Normal Braking

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.

Antilock Pressure Modulation

Solenoid valve pressure modulation occurs in three stages which are: pressure increase, pressure hold, and pressure decrease. The valves are all contained in the valve body portion of the HCU.

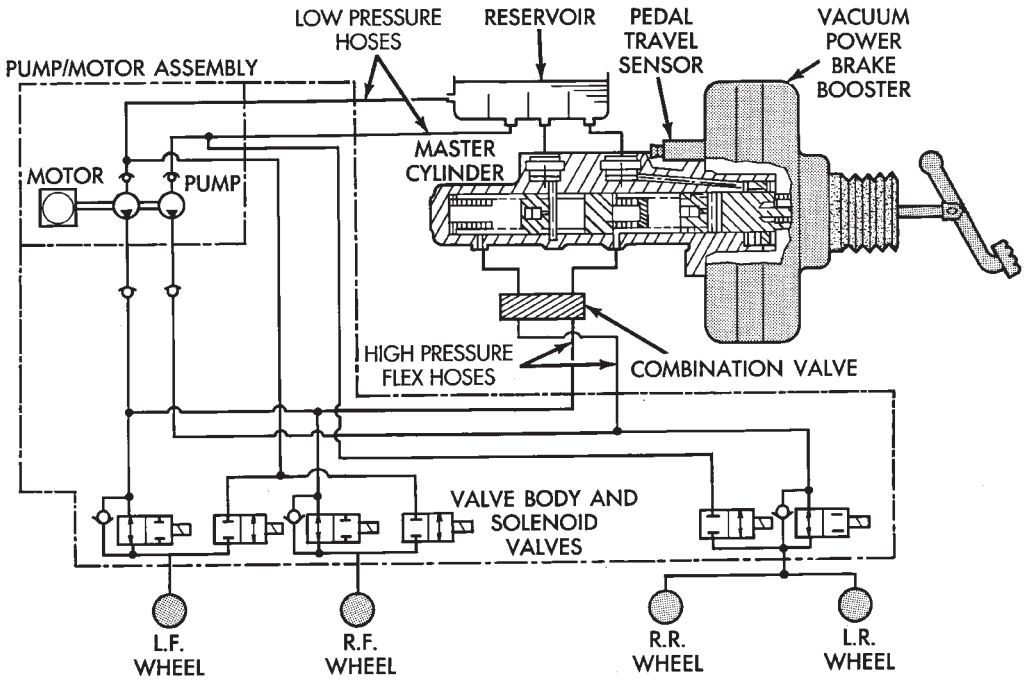


Fig. 9 Three-Channel ABS Hydraulic Control Circuit

Pressure Decrease

The outlet valve is opened and the inlet valve is closed during the pressure decrease cycle (Fig. 10).

A pressure decrease cycle is initiated when speed sensor signals indicate high wheel slip at one or more wheels. At this point, the ECU opens the outlet valve. Opening the outlet valve also opens the hydraulic return circuit to the master cylinder reservoir. Fluid pressure is allowed to bleed off (decrease) as needed to prevent wheel lock.

Once the period of high wheel slip has ended, the ECU 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 (Fig. 11). Fluid apply pressure in the control channel is maintained at a constant rate. The ECU 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 (Fig. 12). The pressure increase cycle is used to counteract unequal wheel speeds. This cycle controls reapplication of fluid apply pressure after a pressure decrease cycle.

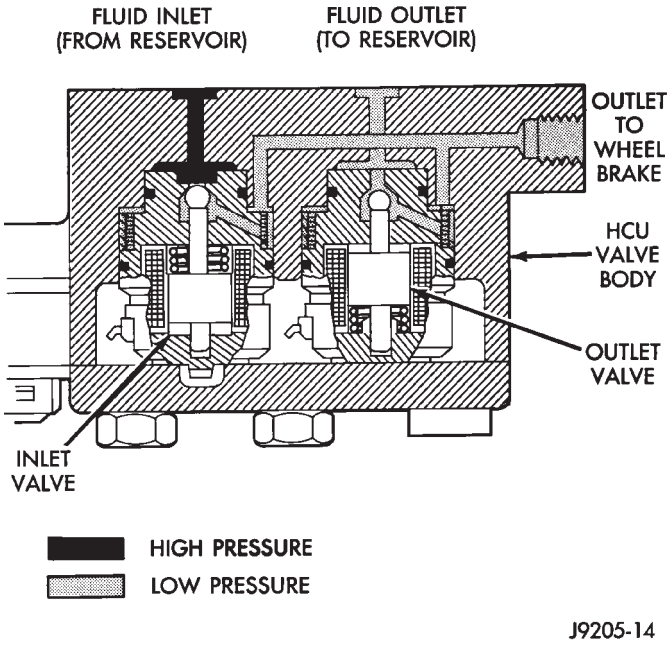


Fig. 10 Solenoid Valves In Pressure Decrease Cycle

HCU PUMP AND PEDAL TRAVEL SENSOR OPERATION

The HCU pump has two functions during antilock braking. First, the pump supplies the extra volume of fluid needed. And second, the pump maintains brake pedal height. The fluid source for the pump is the master cylinder reservoir. The reservoir and HCU are interconnected by hoses.

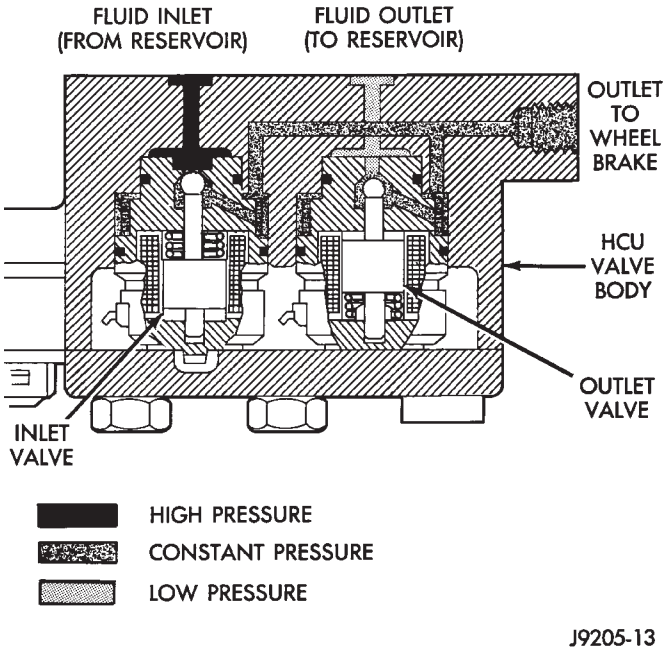


Fig. 11 Solenoid Valves In Pressure Hold Cycle

The pump motor is activated by the ECU. However, the signal to run the pump actually comes from the pedal travel sensor.

The pedal travel sensor is mounted in the forward face of the brake booster (Fig. 13). The sensor plunger is actuated by movement of the booster diaphragm plate. The sensor has a total of seven pedal positions, six of which are monitored. The six pedal positions monitored range from full release to full apply. Each pedal position (toward full apply), generates an increasing degree of electrical resistance in the sensor.

The ECU continuously monitors electrical resistance at the pedal travel sensor. The ECU activates the pump whenever sensor electrical resistance increases during ABS mode braking.

At the start of antilock braking, pedal height will decrease as the volume of fluid in the master cylinder is used up. When pedal height drops a predetermined amount, the pedal travel sensor will signal the ECU to run the pump. At this point, the pump is activated to supply the extra fluid volume and restore pedal height at the same time.

The pump does not run continuously. It cycles on/off according to signals from the travel sensor and ECU. The pump is connected directly to the master cylinder reservoir by hoses. During antilock braking, the additional volume of fluid needed is drawn from the reservoir by the pump.

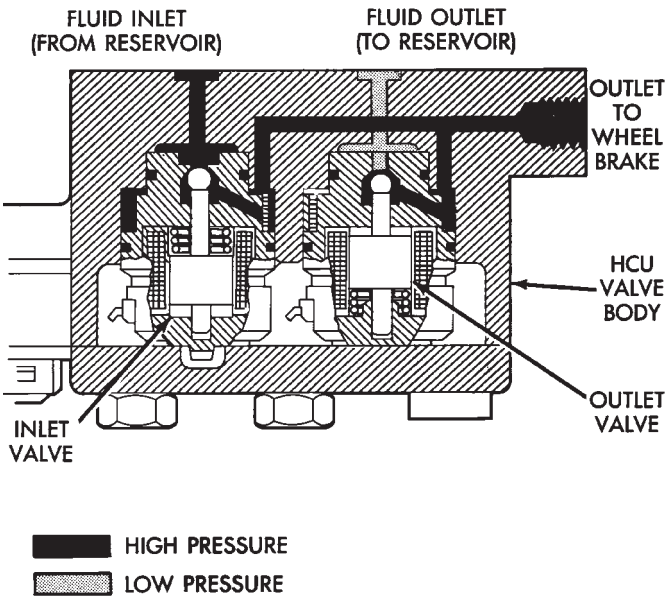


Fig. 12 Solenoid Valves In Pressure Increase Cycle

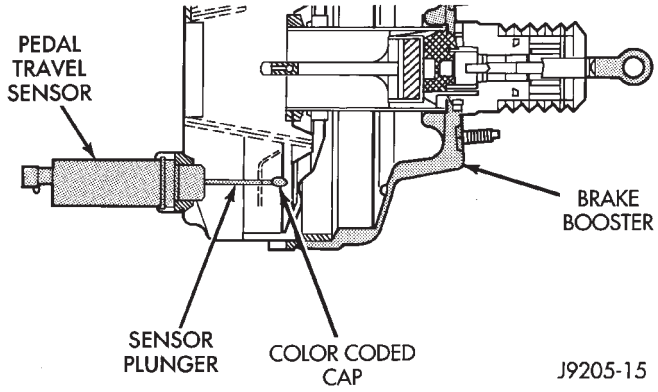


Fig. 13 Pedal Travel Sensor Actuation

WHEEL SPEED SENSOR OPERATION

Wheel speed input signals are generated by a sensor and tone ring at each wheel. The sensors, which are connected directly to the ECU, are mounted on brackets attached to the front steering knuckles and rear brake support plates.

The sensor triggering devices are the tone rings which are similar in appearance to gears. The tone rings are located on the outboard end of each front/rear axle shaft. The speed sensors generate a signal whenever a tone ring tooth rotates past the sensor pickup face.

The wheel speed sensors provide the input signal to the ECU. If input signals indicate ABS mode braking, the ECU causes the HCU solenoids to decrease, hold, or increase fluid apply pressure as needed.

The HCU solenoid valves are activated only when wheel speed input signals indicate that a wheel is approaching a high slip, or lockup condition. At this point, the ECU will cycle the appropriate wheel control channel solenoid valves to prevent slip or lockup.

The wheel sensors provide speed signals whenever the vehicle wheels are rotating. The ECU examines these signals for degree of deceleration and wheel slip. If signals indicate normal braking, the solenoid valves are not activated. However, when incoming signals indicate the approach of wheel slip, or lockup, the ECU cycles the solenoid valves as needed.

ACCELERATION SWITCH OPERATION

The ECU monitors the acceleration switch at all times. The switch assembly contains three mercury switches that monitor vehicle ride height and deceleration rates (G-force). Sudden, rapid changes in vehicle and wheel deceleration rate, triggers the switch sending a signal to the ECU. The switch assembly provides three deceleration rates; two for forward braking and one for rearward braking.

ECU OPERATION

The antilock ECU controls all phases of antilock operation. It monitors and processes input signals from all of the system sensors.

It is the ECU that activates the solenoid valves to modulate apply pressure during antilock braking. The ECU program is able to determine which wheel control channel requires modulation and which fluid pressure modulation cycle to use.

The ECU cycles the solenoid valves through the pressure decrease, hold and increase phases to retard and prevent wheel lock during periods of high wheel slip.

Solenoid valve operation is selective. The solenoid valves may not be cycled simultaneously, nor are they all cycled in the same pressure modulation phase at the same time. The ECU cycles the valves in each control channel as needed. For example, sensor inputs may indicate that only the left front wheel requires modulation during a period of high slip.

MASTER CYLINDER—HCU—COMBINATION VALVE—BRAKELINES

INDEX

SERVICE INFORMATION

The master cylinder, antilock hydraulic control unit (HCU) and combination valve are not serviceable components. If a cylinder, HCU, or valve malfunction should occur, replace the faulty part as an assembly.

The brakelines can be serviced separately when needed. Mopar preformed brakeline is recommended for repair purposes. Brakeline repair is not recommended except as a temporary, emergency-type repair. Refer to the brakeline information in this section for details.

MASTER CYLINDER RESERVOIR FLUID LEVEL

Correct fluid level is to the MAX level indicator on the reservoir (Fig. 1).

The only fluid recommended for the ABS system is Mopar brake fluid, or an equivalent quality fluid meeting standards SAE J1703 and DOT 3. Do not use any other fluid in the ABS system.

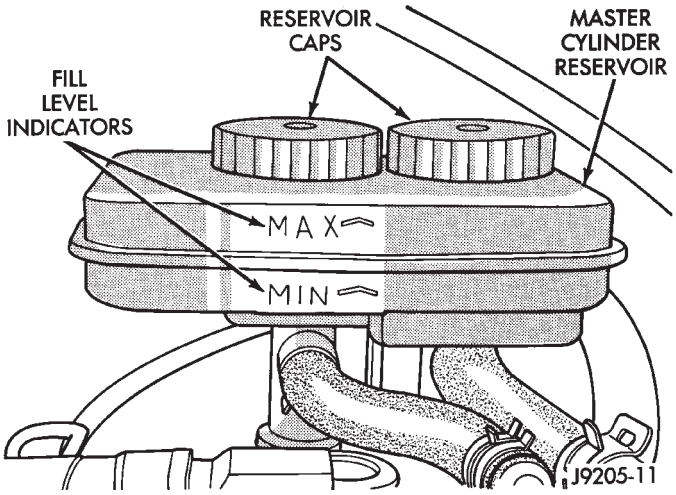


Fig. 1 Reservoir Fluid Level Indicators

MASTER CYLINDER REMOVAL

(1) Disconnect battery negative cable.

(2) Remove windshield washer reservoir.

(3) Pump brake pedal to exhaust all vacuum from power brake booster.

CAUTION: It is very important that all vacuum be exhausted from the booster. Failure to do so could result in damage to the master cylinder-to-booster seal when the cylinder is removed.

(4) Disconnect antilock harness connectors and move wire harnesses aside for working clearance.

(5) Remove clamps that secure reservoir hoses to HCU pipes.

(6) Position small drain container under master cylinder reservoir hoses.

(7) Disconnect reservoir hoses (Fig. 2) from HCU pipes and allow fluid to drain into container. Discard drained fluid.

(8) Disconnect and remove combination valve. Refer to procedure in this section.

(9) Disconnect brakelines at master cylinder.

(10) Remove nuts attaching master cylinder to booster mounting studs (Fig. 3).

(11) Remove master cylinder. Pull cylinder forward and off studs and work it out of engine compartment.

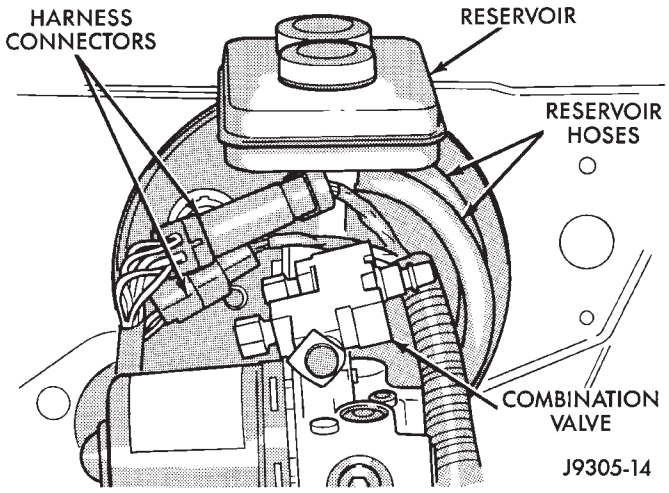


Fig. 2 Harness, Reservoir Hose And Valve Position

MASTER CYLINDER INSTALLATION

(1) If new master cylinder is being installed, bleed cylinder on bench before installing it in vehicle.

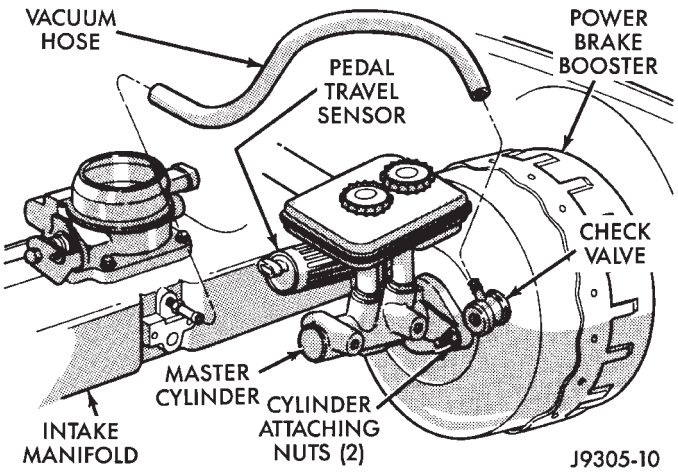


Fig. 3 Master Cylinder Mounting

CAUTION: The seal between the master cylinder and brake booster can be damaged if the cylinder is improperly installed. A vacuum leak may develop if the seal is damaged during installation. To avoid seal damage, install the master cylinder only as described in the following step.

(2) Install master cylinder as follows:

(a) Have helper press brake pedal until booster push rod is visible in opening at front of booster. Then have helper hold brake pedal in position.

(b) Guide master cylinder onto booster mounting studs and onto booster push rod. **Be sure booster push rod is properly aligned and seated in master cylinder.**

(c) Have helper slowly release brake pedal as master cylinder is seated on booster mounting studs. Keep booster push rod centered in master cylinder while seating cylinder.

(d) Install and tighten master cylinder mounting nuts to 25 N●m (220 in. lbs.) torque.

(3) Connect brakelines to master cylinder. Tighten line fittings to 15 N●m (132 in. lbs.) torque.

(4) Connect reservoir hoses to HCU pipes. Be sure hose clamps are securely in place.

(5) Verify that master cylinder and booster are properly attached before proceeding.

(6) Install and connect combination valve.

(7) Connect antilock harnesses (Fig. 2).

(8) Fill master cylinder reservoir and bleed brakes. Refer to bleeding procedures in section dealing with brake bleeding and adjustments.

(9) Install windshield washer reservoir and air cleaner.

(10) Connect battery negative cable.

HCU REMOVAL

(1) Disconnect battery negative cable.

(2) Disconnect pedal travel sensor wire connector (Fig. 4).

(3) Remove air cleaner and hoses (Fig. 5).

(4) Remove windshield washer reservoir (Fig. 5).

(5) Position small drain container under master cylinder reservoir hoses.

(6) Disconnect ABS harnesses (Figs. 5 and 6).

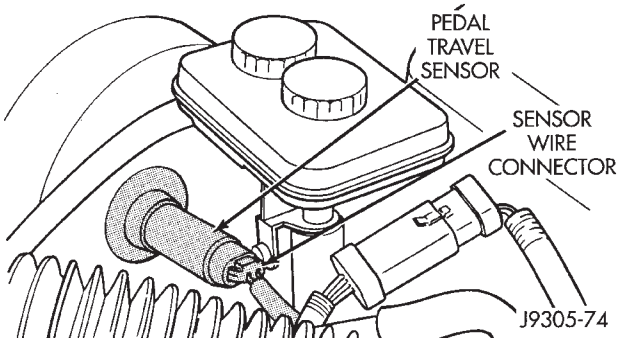


Fig. 4 Pedal Travel Senor Connector Location

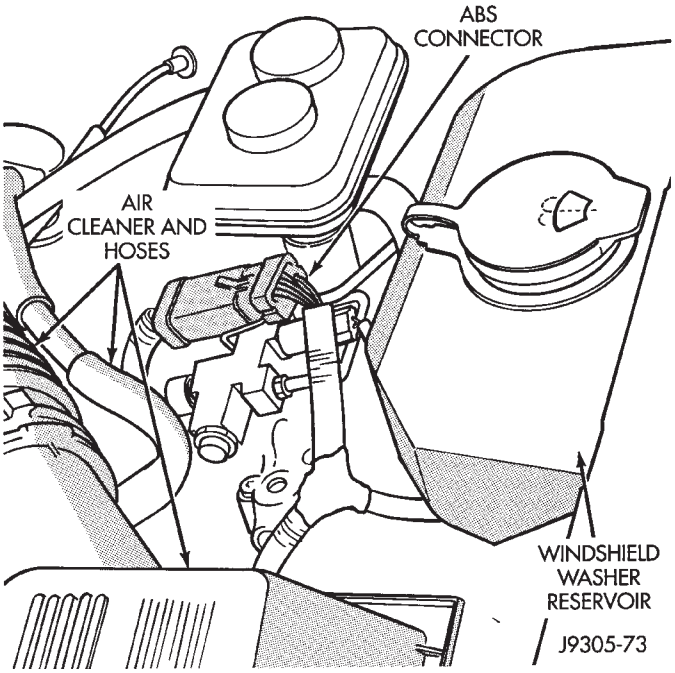


Fig. 5 Components To Be Removed/Disconnected For HCU Access

(7) Remove combination valve. Refer to procedure in this section.

(8) Move harness wires, hoses, lines aside for access to HCU bracket nuts (Fig. 7).

(9) Remove nuts attaching HCU bracket to inner fender panel (Fig. 7).

(10) Mark or tag HCU hydraulic lines for assembly reference.

(11) Disconnect hydraulic lines and hoses at HCU.

(12) Remove HCU. Lift HCU up and off mounting bracket studs. Then work it past brakelines and master cylinder to remove it.

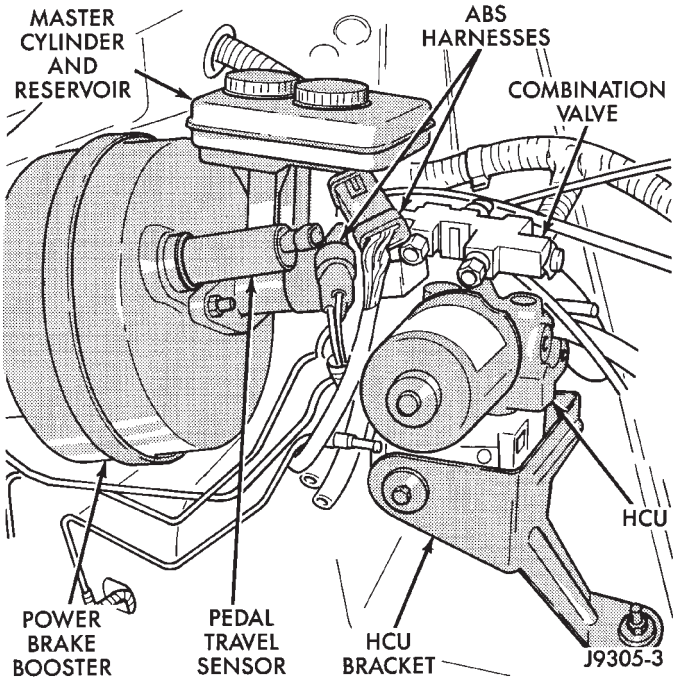


Fig. 6 HCU Location

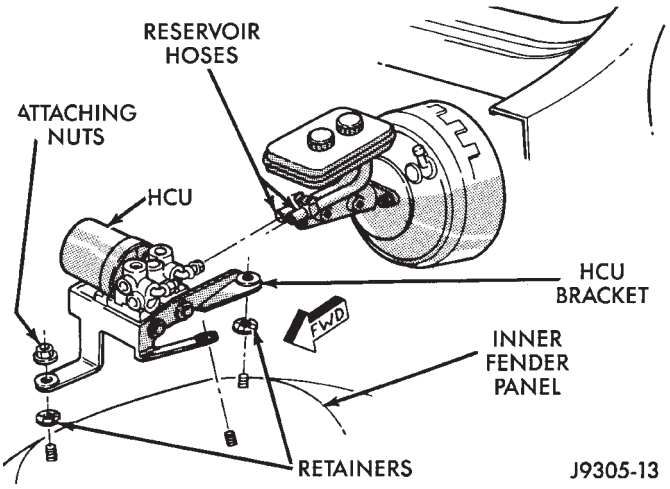


Fig. 7 HCU Bracket Attachment

HCU INSTALLATION

(1) Connect master cylinder reservoir hoses to HCU pipes.

(2) Position HCU assembly on mounting bracket and install attaching nuts. Tighten nuts to 12 N●m (102 in. lbs.) torque.

(3) Connect hydraulic lines and hoses to HCU (Fig. 8). Fitting nuts and bosses on valve body ports are color coded. Be sure lines are properly connected. Tighten line fittings to 12 N●m (106 in. lbs.) torque.

(4) Install and connect combination valve. Tighten brakeline fittings at valve to 21 N●m (185 in. lbs.) torque

(5) Connect harness wires to HCU (Fig. 9).

(6) Check routing of HCU lines/hoses. Be sure lines are not kinked and are clear of engine components.

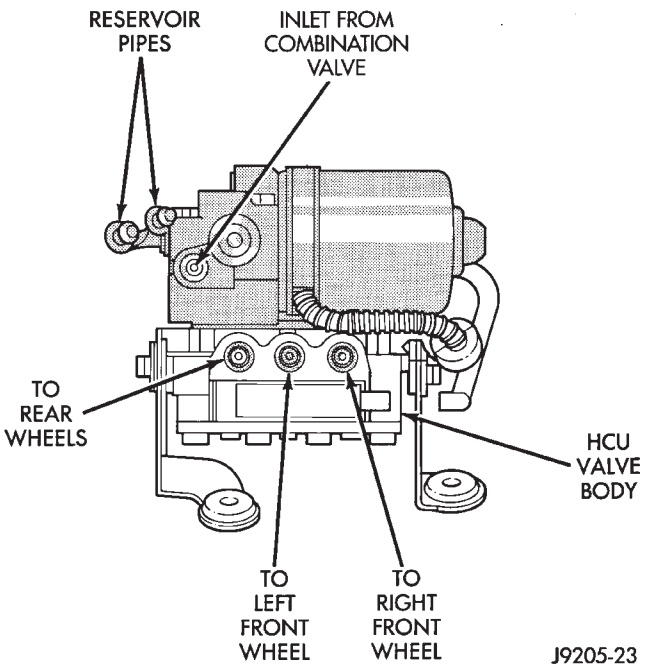


Fig. 8 HCU Hydraulic Line Connections

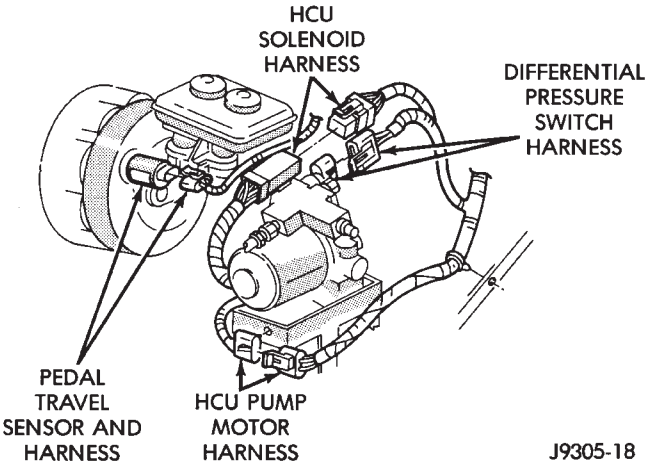


Fig. 9 HCU Harness Connectors

(7) Connect battery negative cable.

(8) Fill master cylinder reservoir with fresh Mopar DOT 3 brake fluid or equivalent.

(9) Bleed brake system. Refer to brake bleeding and adjustments section for procedure.

(10) Install air cleaner and hoses.

(11) Install windshield washer fluid reservoir.

(12) Check brake pedal action before moving vehicle. Bleed brakes again if pedal is not firm (feels soft/spongy).

COMBINATION VALVE REMOVAL

(1) Disconnect battery negative cable.

(2) Remove air induction tube for access to valve, if necessary.

(3) Unsnap wire harness from bracket at top of combination valve. Then disconnect wire connectors.

(4) Disconnect pedal travel sensor harness connector and move harness wires aside for working access if necessary.

(5) Disconnect pressure differential switch wires at terminal on valve (Fig. 10).

(6) Disconnect hydraulic lines at valve.

(7) Remove bolt attaching valve bracket to master cylinder and remove valve.

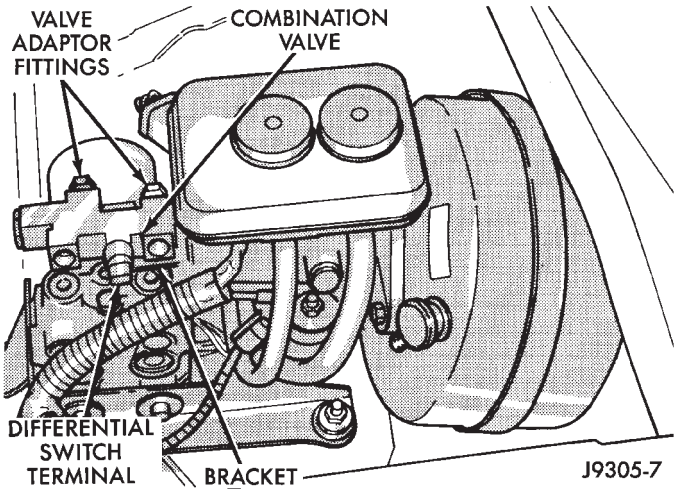


Fig. 10 Combination Valve Mounting

COMBINATION VALVE INSTALLATION

(1) If a replacement combination valve is being installed and it does not have primary and secondary brakeline adaptor fittings (Fig. 11), transfer original adapters to new valve. Tighten adapters to 25 N•m (220 in. lbs.) torque.

(2) Connect brakelines lines to combination valve but do not tighten fittings at this time. Start all line fittings by hand to avoid cross threading.

(3) Position valve mounting bracket on master cylinder and install bracket attaching bolt.

(4) Reconnect pressure differential switch and pedal travel sensor wires.

(5) Tighten brakeline fittings at valve to 21 N•m (185 in. lbs.) torque. Use backup wrench to prevent adapters from turning when tightening line fittings.

(6) Connect and snap harness wire connectors into bracket at top of valve.

(7) Bleed brake system. Refer to procedure in this section.

(8) Verify proper valve operation. If red warning light comes on, parking brakes may be still be applied, system may contain air, or a brakeline fitting is loose. Check and correct as needed.

BRAKELINES AND HOSES

Metal brakelines and rubber brake hoses should be inspected periodically and replaced if damaged.

Rubber brake hoses should be replaced if cut, cracked, swollen, or leaking. Rubber hoses must only be replaced. They are not repairable parts.

When installing new, or original brakelines and hoses, lubricate the fitting threads with brake fluid before connection.

BRAKELINE CHARTS

Brakeline charts are provided in illustration Figures 11 and 12. The illustrations show typical brakeline routing, hose connections and component position.

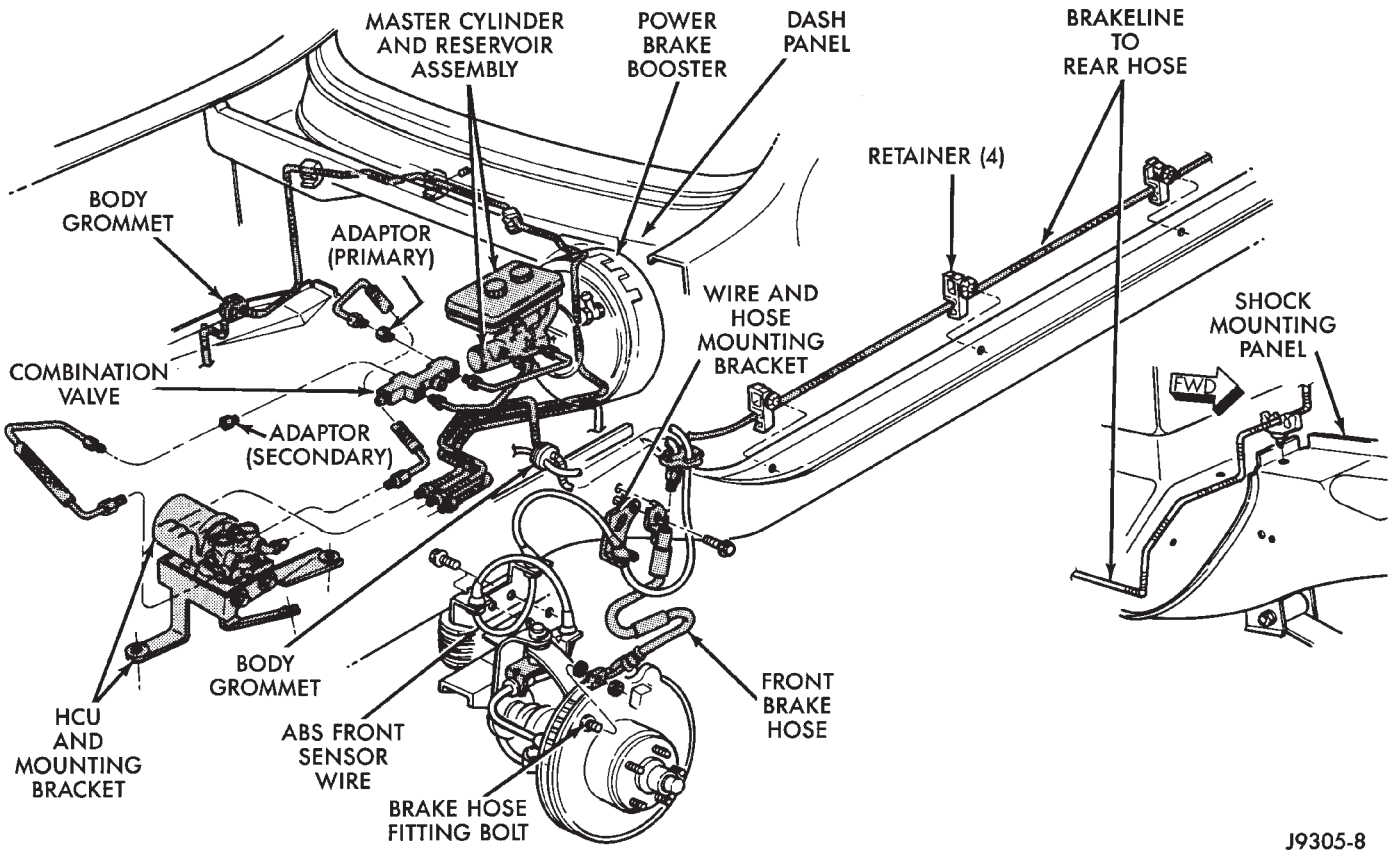


Fig. 11 Front Brakeline Routing And Connections

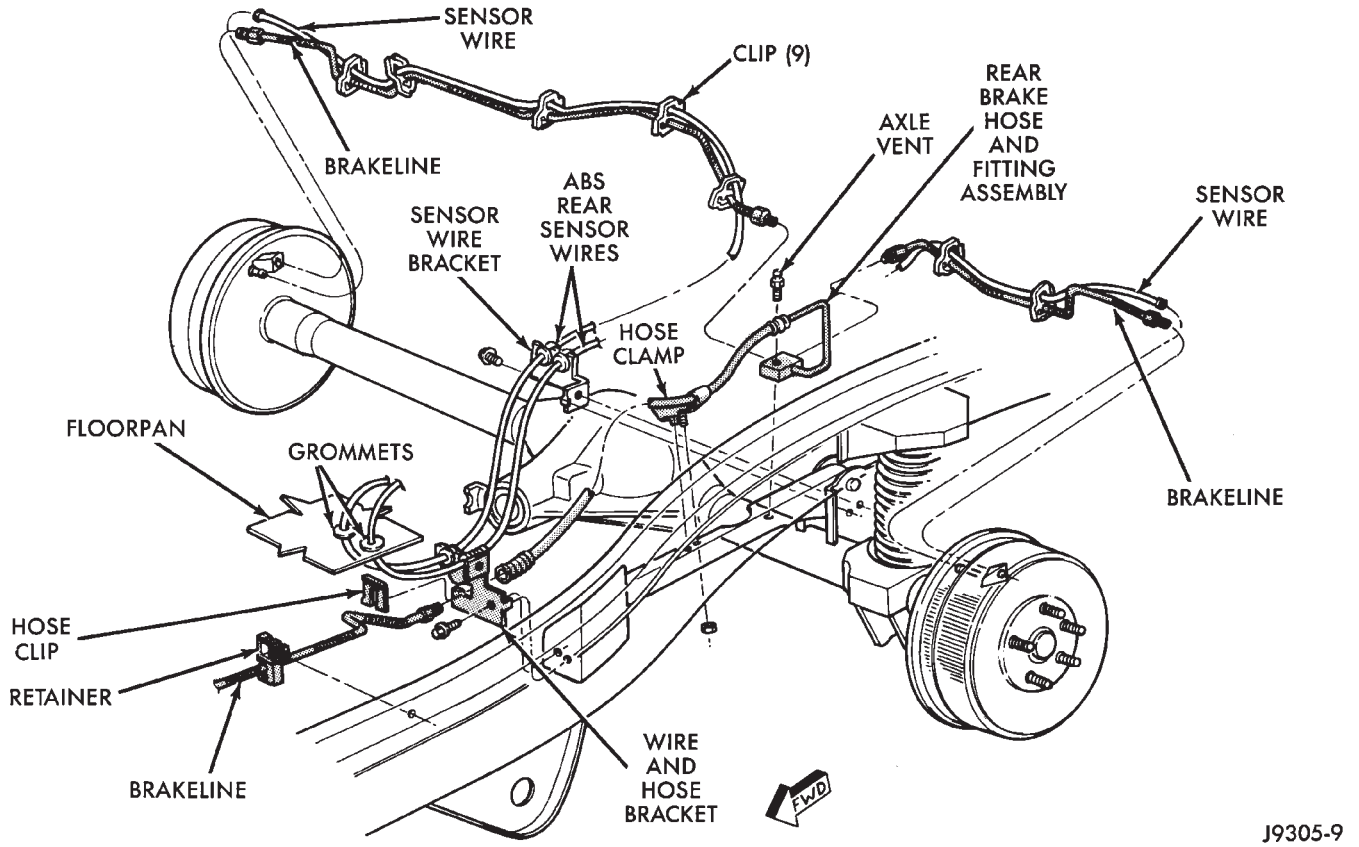


Fig. 12 Rear Brakeline Routing And Connections

POWER BRAKE BOOSTER SERVICE

INDEX

BOOSTER SERVICE INFORMATION

The only serviceable parts on the power brake booster are the check valve, vacuum hose and pedal travel sensor. The booster is not a serviceable component. Replace the booster as an assembly if diagnosis indicates a malfunction.

POWER BRAKE BOOSTER REMOVAL

(1) Pump brake pedal until all vacuum is exhausted from power brake booster.

CAUTION: It is very important that all vacuum be exhausted from the booster. Failure to do so could result in damage to the master cylinder-to-booster seal when the cylinder is removed.

(2) Disconnect battery negative cable.

(3) Disconnect harness wire connectors from pedal travel sensor and brake warning switch on combination valve.

(4) Remove air cleaner and hoses.

(5) Remove windshield washer reservoir.

(6) Position small drain pan under master cylinder reservoir hoses. Pan is needed to catch fluid when hoses are disconnected.

(7) Remove clamps that secure reservoir hoses to HCU pipes. Then remove hoses from pipes. Be sure to keep hoses over drain pan until fluid has stopped flowing.

(8) Remove nuts attaching master cylinder to booster mounting studs. Then remove master cylinder and combination valve as assembly. Slide cylinder forward and off booster mounting studs.

(9) Disconnect vacuum hose at booster check valve.

(10) Working inside vehicle, disconnect booster push rod from brake pedal. Slide retainer clip off pedal stud and slide push rod off stud.

(11) Remove nuts attaching booster to passenger compartment side of dash panel (Fig. 1).

(12) Slide booster forward out of dash panel. Tilt booster upward and remove it from engine compartment.

POWER BRAKE BOOSTER INSTALLATION

CAUTION: The pedal travel sensor and power brake booster must form a matched set. The cap on the sensor plunger and booster shell are color coded for identification, and to ensure they are used as matched sets. Be sure the color of the sensor cap and the color dot on the booster shell (Fig. 2) are the same before installation. A new pedal travel sensor is supplied with four different color caps. The caps are color coded to ease matching them with the color code dot on the booster shell.

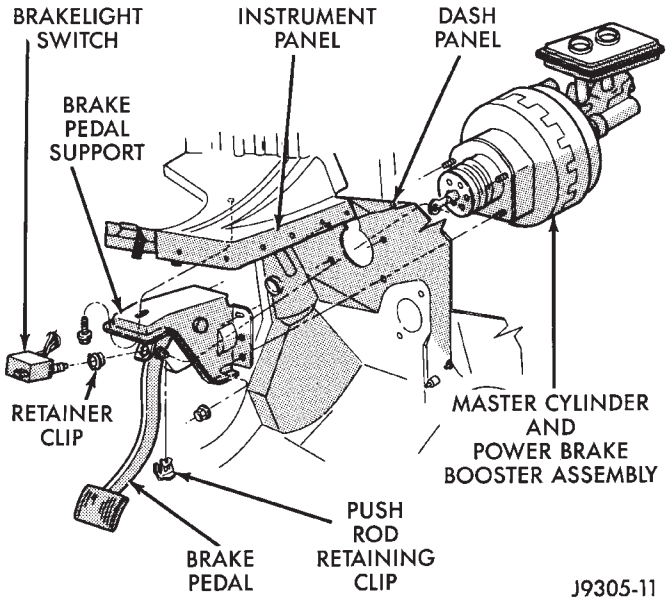


Fig. 1 Power Brake Booster Mounting

(1) If **original** booster and pedal travel sensor will be reinstalled, continue with installation procedure.

(2) If **new** booster is being installed, it will be necessary to inspect and match booster and pedal travel sensor as follows:

(a) If new booster is already equipped with pedal travel sensor, matching will not be necessary. Sensor and booster were prematched by supplier. Continue with booster installation procedure.

(b) If new booster is NOT equipped with a pedal travel sensor, it will be necessary to match and transfer original sensor to new booster. Compare color of sensor cap and color dot on booster shell (Fig. 2). If colors match, install sensor and continue with booster installation procedure. However, if colors **do not match**, select and install correct color cap on sensor plunger before installing sensor in booster.

(3) Install O-ring on pedal travel sensor.

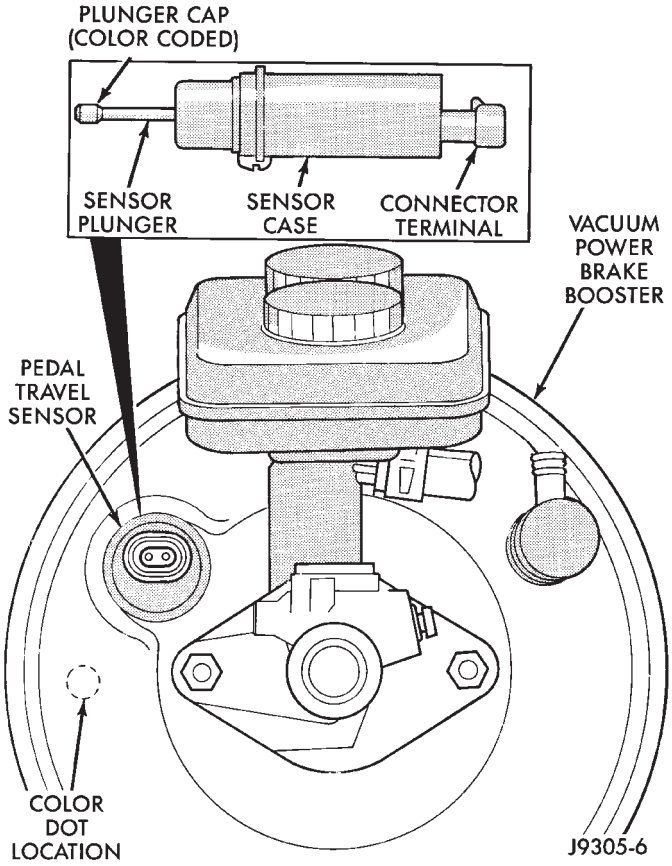


Fig. 2 Booster And Pedal Travel Sensor Color Code Locations

(4) Install sensor retaining ring on booster flange. Be sure retaining ring is firmly seated.

(5) Insert sensor into booster. Be sure sensor is fully seated and engaged in retaining ring.

(6) Position booster on dash panel. Align booster mounting studs with holes in panel and seat booster.

(7) In passenger compartment, install booster attaching nuts on mounting studs. Tighten attaching nuts to 41 N●m (30 ft. lbs.) torque.

(8) Connect booster push rod to brake pedal (Fig. 1).

(9) In engine compartment, install seal on master cylinder. Seal is slight interference fit to help hold it in place.

(10) Attach vacuum hose to booster check valve.

CAUTION: The seal between the master cylinder and brake booster can be damaged if the cylinder is improperly installed. A vacuum leak may develop if the seal is damaged during installation. To avoid seal damage, install the master cylinder only as described in the following step.

(11) Install master cylinder and combination valve assembly on booster as follows:

(a) Have helper press brake pedal until booster push rod is visible in opening at front of booster. Then have helper hold brake pedal in position.

(b) Guide master cylinder and valve assembly onto booster mounting studs and booster push rod. **Be sure booster push rod is properly aligned and seated in master cylinder.**

(c) Have helper slowly release brake pedal as master cylinder is seated on booster mounting studs. Keep booster push rod centered in master cylinder while seating cylinder.

(d) Install and tighten master cylinder mounting nuts to 25 N●m (220 in. lbs.) torque.

(12) Connect brakelines to master cylinder. Tighten line fittings to 15 N●m (132 in. lbs.) torque.

(13) Connect reservoir hoses to HCU pipes. Be sure hose clamps are securely attached and properly located.

(14) Connect pedal travel sensor and combination valve switch wires.

(15) Connect harness wire connectors and snap them into bracket at top of combination valve.

(16) Connect battery negative cable.

(17) Bleed brakes. Refer to brake bleeding and adjustments section for procedure.

(18) Install air cleaner and hoses.

(19) Install windshield washer reservoir.

ANTILOCK ELECTRONIC COMPONENT SERVICE

INDEX

SERVICE INFORMATION

The electronic control unit (ECU) and various sensors used in the antilock brake system are not repairable components. The ECU and the individual sensors are serviced as assemblies only.

The ECU and sensors should not be replaced unless actually faulty. Use the DRB II scan tool to confirm or deny a component malfunction before attempting repair.

PEDAL TRAVEL SENSOR SERVICE

CAUTION: The pedal travel sensor and power booster must form a matched set. The cap on the sensor plunger and booster shell are color coded for identification, and to ensure they are used as matched sets. Be sure the color of the sensor cap and the color dot on the booster shell are the same before installation. Refer to the Sensor Replacement information before installing a new or original sensor.

PEDAL TRAVEL SENSOR REMOVAL

(1) Turn ignition switch to OFF position.
(2) Disconnect battery negative cable.
(3) Pump brake pedal to exhaust all vacuum from booster.
(4) Disconnect wires at sensor.
(5) Unseat sensor retaining ring.
(6) Remove sensor from booster (Fig. 2).

PEDAL TRAVEL SENSOR REPLACEMENT INFORMATION

A new pedal travel sensor is supplied with four different color caps. The caps are color coded to ease matching them with the color code dot on the booster shell.

Compare the color of the new sensor cap and the color dot on the booster shell (Fig. 1). If the colors match, proceed with sensor installation. However, if the colors **do not match**, select and install the correct color cap on the sensor plunger before proceeding.

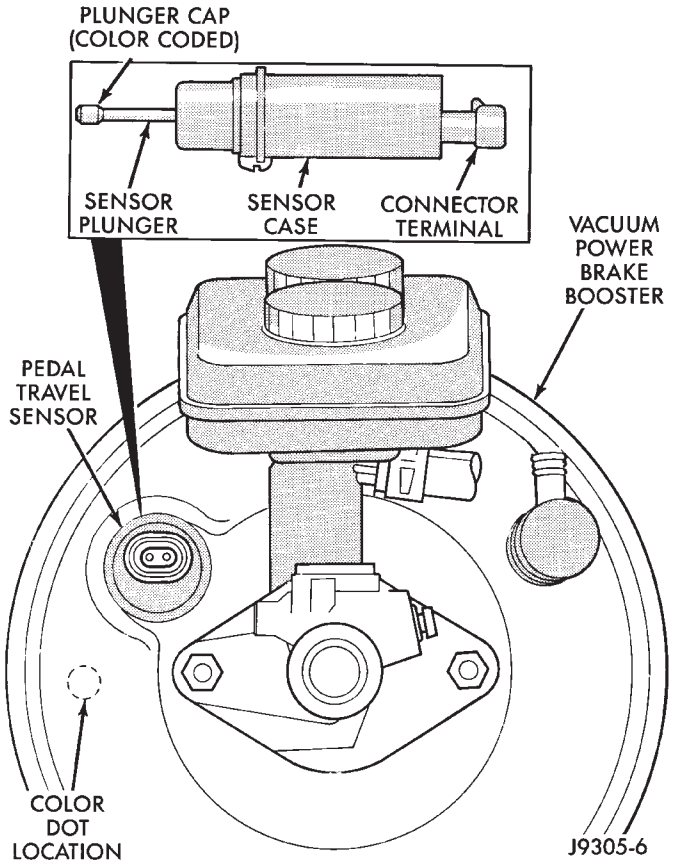


Fig. 1 Booster And Pedal Travel Sensor Color Code Locations

PEDAL TRAVEL SENSOR INSTALLATION

(1) Check color dot on face of power brake booster (Fig. 1). Then check color of cap on sensor plunger. If colors match, proceed with installation. If colors do not match, install correct color cap on end of plunger.
(2) Install O-ring on sensor.
(3) Install sensor retaining ring on booster flange.
(4) Insert sensor in retaining ring and booster.
(5) Verify that retaining ring is properly engaged in sensor and that sensor is seated in booster.
(6) Connect wires to sensor.
(7) Check sensor operation with DRB II scan tool.
(8) Connect battery negative cable.

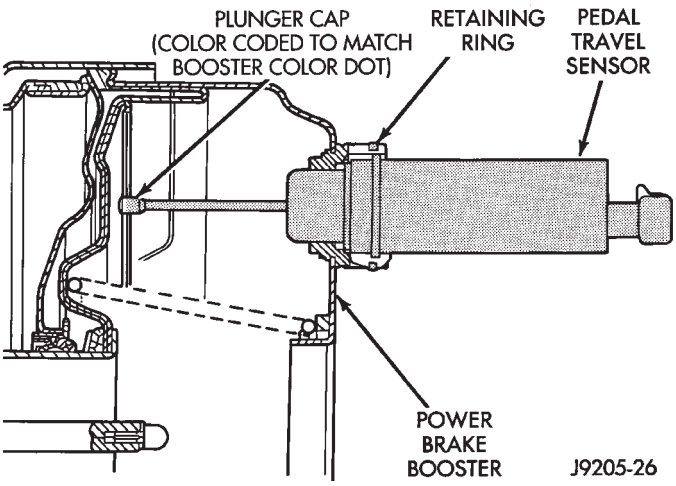


Fig. 2 Pedal Travel Sensor Mounting

AXLE SHAFT TONE WHEEL SERVICE

The axle shaft tone wheels are not serviceable. If a tone wheel becomes damaged, it will be necessary to replace the axle shaft.

The wheel brake components such as the calipers, brakeshoes, wheel cylinders, rotors and drums are all serviced the same as standard brake system components.

FRONT WHEEL SENSOR REMOVAL

(1) Turn ignition switch to OFF position.
(2) Disconnect battery negative cable.
(3) Raise vehicle.
(4) Remove wheel and tire.
(5) Remove bolt attaching front sensor to steering knuckle (Fig. 3).

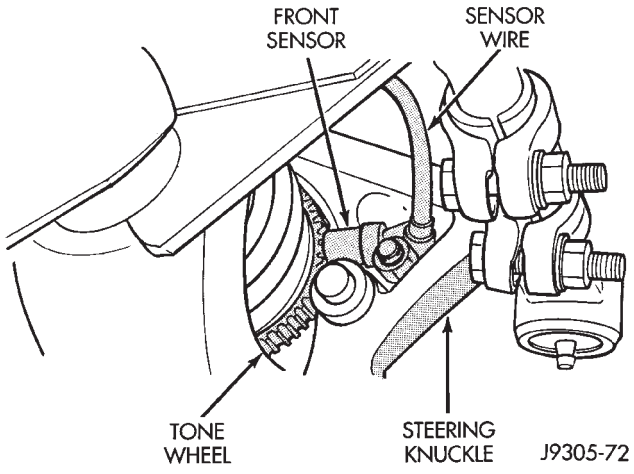


Fig. 3 Front Wheel Sensor Location

(6) Disengage sensor wire from brackets on steering knuckle and frame member (Figs. 4 and 5).
(7) Unseat grommet that secures sensor wire in fender panel (Fig. 5)
(8) In engine compartment, disconnect sensor wire connector at harness plug (Fig. 6).
(9) Remove sensor and wire assembly.

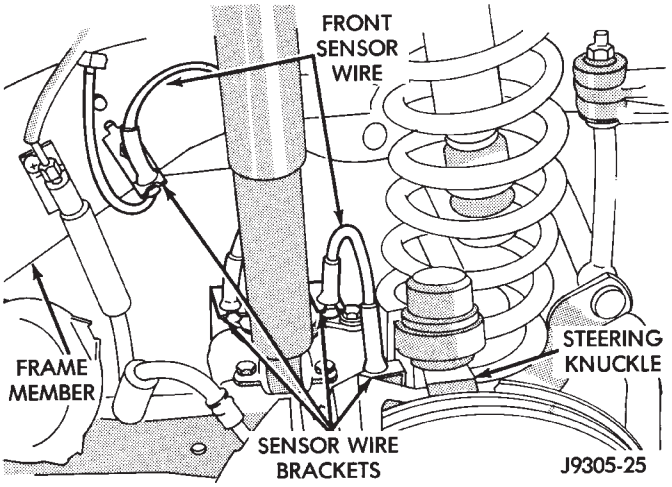


Fig. 4 Front Wheel Sensor Wire Routing

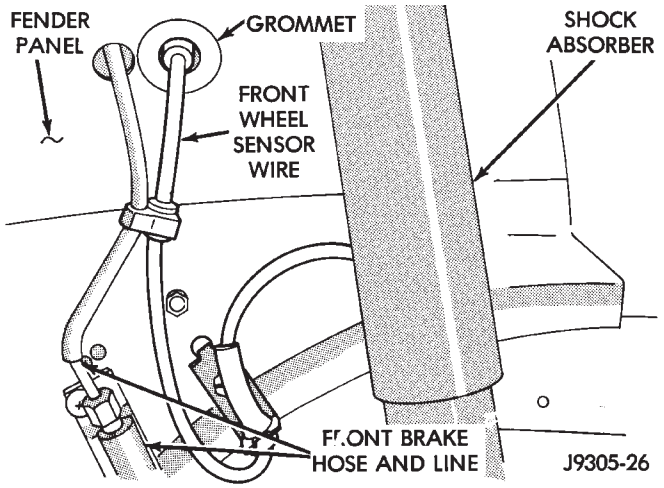


Fig. 5 Front Wheel Sensor Wire Grommet Location

FRONT WHEEL SENSOR INSTALLATION

(1) Apply Mopar Lock N' Seal or Loctite 242 to sensor attaching bolt. Use new sensor bolt if original bolt is worn or damaged.
(2) Position sensor on steering knuckle. Seat sensor locating tab in hole in knuckle and install sensor attaching bolt finger tight.
(3) Tighten sensor bolt to 14 N●m (11 ft. lbs.) torque.
(4) Route sensor wire from steering knuckle to fender panel (Figs. 4, 5, and 6).
(5) Engage grommets on sensor wire in brackets on body, chassis, frame, and steering knuckle (Figs. 4, 5 and 6).
(6) Check sensor wire routing. Be sure wire is clear of all chassis components and is not twisted or kinked at any spot.
(7) Seat sensor wire in body grommet and seat grommet in fender panel (Fig. 5).
(8) Connect sensor wire to harness in engine compartment.

(9) Connect battery negative cable.

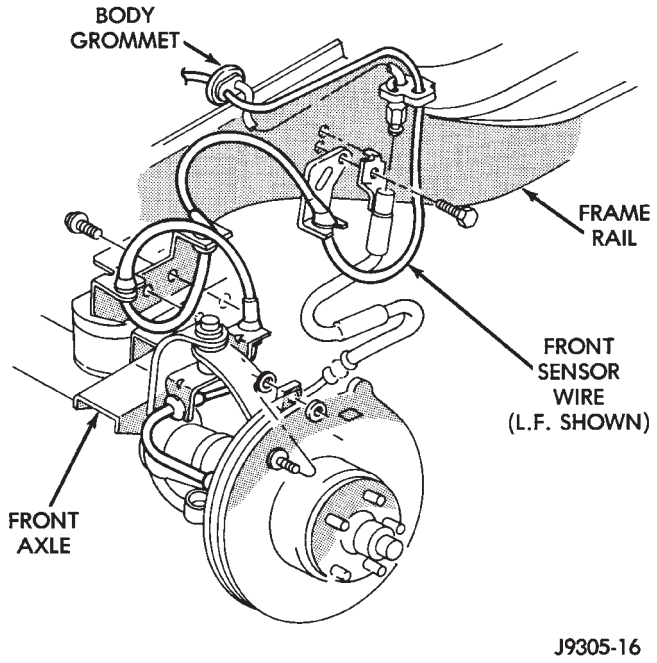


Fig. 6 Front Sensor Wire Routing (Left Front Shown)

REAR WHEEL SENSOR REMOVAL

(1) Turn ignition switch to OFF position.

(2) Disconnect battery negative cable.

(3) Raise and fold rear seat forward. Then move carpeting aside for access to rear sensor connectors.

(4) Disconnect rear sensor wires at harness connectors (Fig. 7).

(5) Push sensor wires and grommets through floorpan holes.

(6) Raise vehicle.

(7) Remove wheel and brake drum.

(8) Disengage sensor wire from axle and chassis brackets and from brakeline retainers (Fig. 8).

(9) Unseat sensor grommet from brake support plate.

(10) Remove bolt attaching sensor to support plate bracket (Fig. 9).

(11) Remove sensor and wire through opening in support plate.

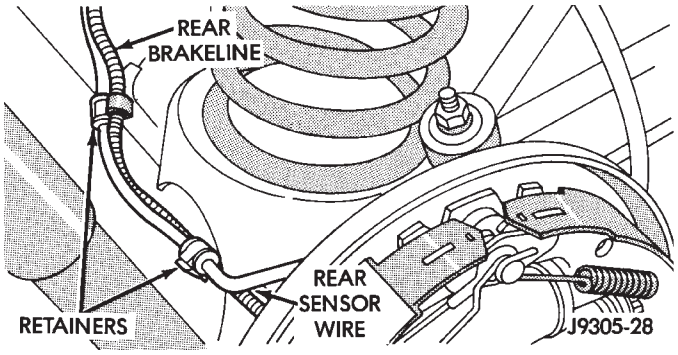


Fig. 8 Rear Wheel Sensor Wire Attachment

REAR WHEEL SENSOR INSTALLATION

(1) Insert sensor wire through support plate hole and seat sensor grommet in support plate.

(2) Apply Mopar Lock N' Seal or Loctite 242 to original sensor bolt. Use new bolt if original is worn or damaged.

(3) Install sensor bolt finger tight only at this time.

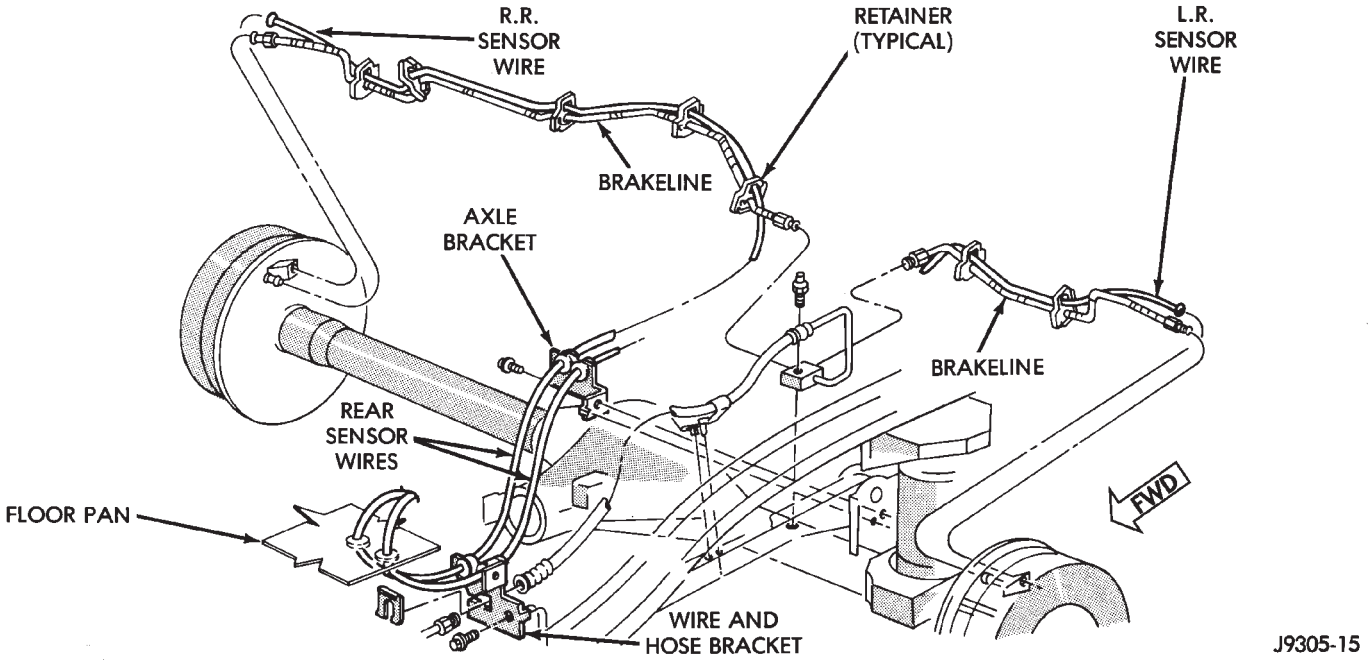


Fig. 7 Rear Wheel Sensor Wire Routing And Connections

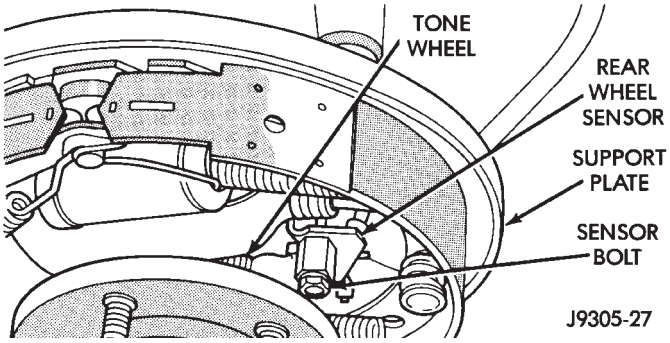


Fig. 9 Rear Wheel Sensor Mounting

(4) Set sensor air gap as follows:

(a) If **original sensor** is being installed, remove any remaining pieces of cardboard spacer from sensor pickup face. Then adjust air gap to preferred setting of 1.1 mm (0.043 in.) with brass feeler gauge (Fig. 10). Tighten sensor bolt to 14 N●m (124 in. lbs.) torque.

(b) If **new sensor** is being installed, push cardboard spacer on sensor face (Fig. 11) against tone ring. Then tighten sensor bolt to 8 N●m (71 in. lbs.) torque. Correct air gap will be established as tone ring rotates and peels spacer off sensor face.

(c) Verify sensor air gap adjustment. If adjustment changed after tightening bolt, readjust sensor air gap as needed.

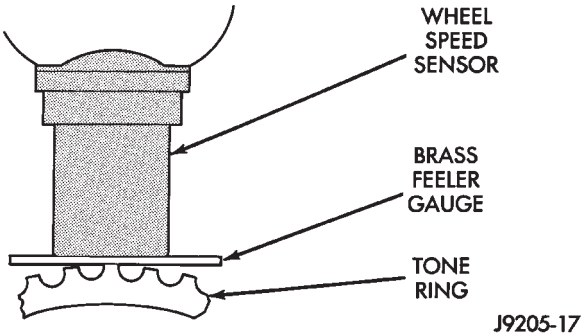


Fig. 10 Setting Air Gap On Original Rear Sensor

(5) Route sensor wires to rear seat area.

(6) Feed sensor wires through floorpan access hole and seat sensor grommets in floorpan.

(7) Secure sensor wire in brackets and in retainers on rear brakelines. Verify that sensor wire is secure and clear of rotating components.

(8) Install brake drum and wheel and lower vehicle.

(9) Fold rear seat and carpet forward for access to sensor wires and connectors.

(10) Connect sensor wires to harness connectors.

(11) Reposition carpet and fold rear seat down.

(12) Connect battery negative cable.

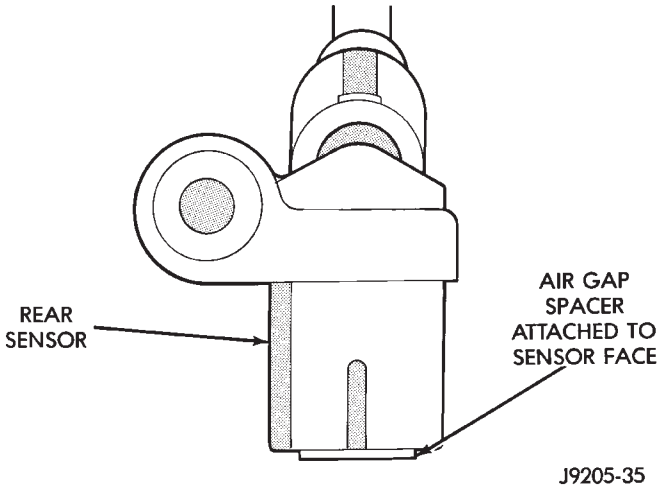


Fig. 11 New Rear Sensor With Air Gap Spacer

ACCELERATION SENSOR REMOVAL

(1) Turn ignition switch to OFF position.

(2) Disconnect battery negative cable.

(3) Tilt rear seat assembly forward for access to sensor.

(4) Disconnect sensor harness (Fig. 12).

(5) Remove screws attaching sensor to bracket.

(6) Remove sensor.

ACCELERATION SENSOR INSTALLATION

(1) Note position of locating arrow on sensor. Sensor must be positioned so arrow faces forward.

CAUTION: The sensor mercury switch will not function properly if the sensor is mispositioned. Verify that the sensor locating arrow is pointing to the front of the vehicle.

(2) Position sensor in mounting bracket (Fig. 12).

(3) Install and tighten sensor attaching screws to 2-4 N●m (17-32 in. lbs.) torque.

(4) Connect harness to sensor. Be sure harness connector is firmly seated.

(5) Move rear seat back to normal position.

(6) Connect battery negative cable.

ELECTRONIC CONTROL UNIT (ECU) SERVICE

The antilock system electronic control unit (ECU) should not be replaced unless actually faulty. Always check ECU operation with the DRB II scan tool to confirm or deny a malfunction.

ECU REMOVAL AND INSTALLATION

The antilock ECU is located in the engine compartment. It is attached to a bracket mounted on the driver side inner fender panel or apron (Fig. 13).

(1) Turn ignition switch to OFF position.

(2) Disconnect battery negative cable.

(3) Remove screws attaching ECU to fender panel bracket.

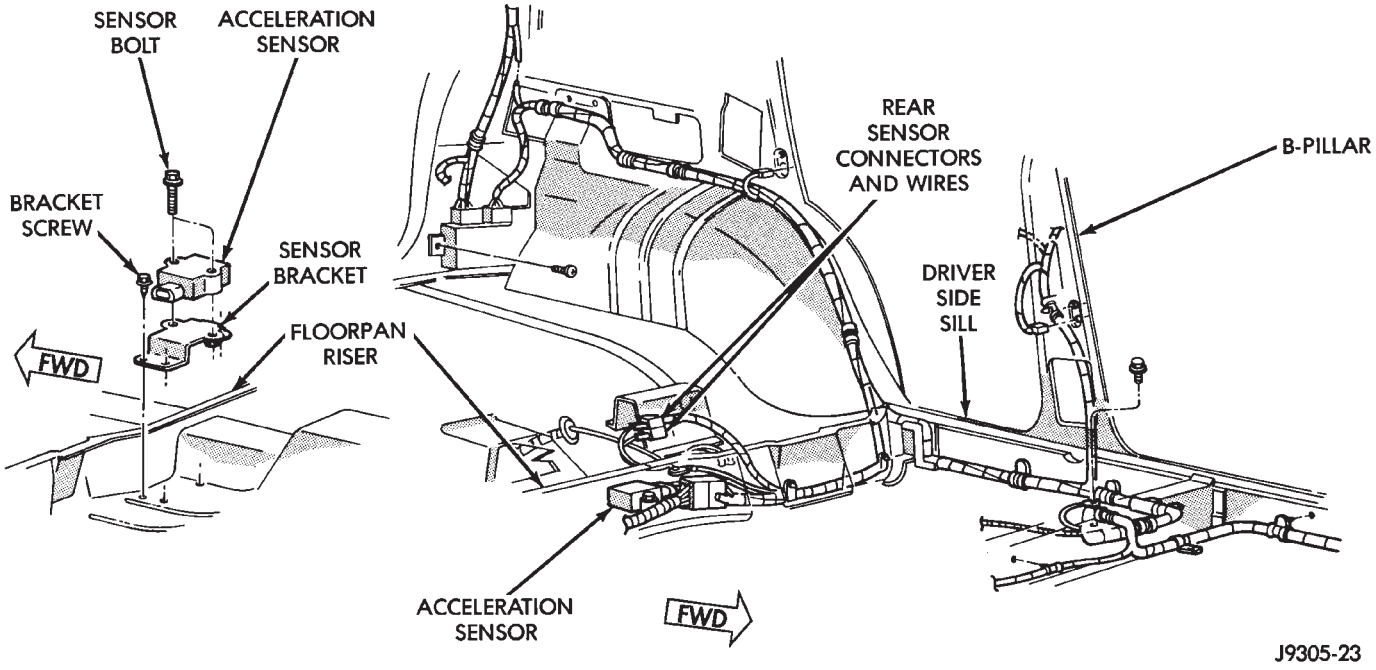


Fig. 12 Acceleration Sensor Mounting

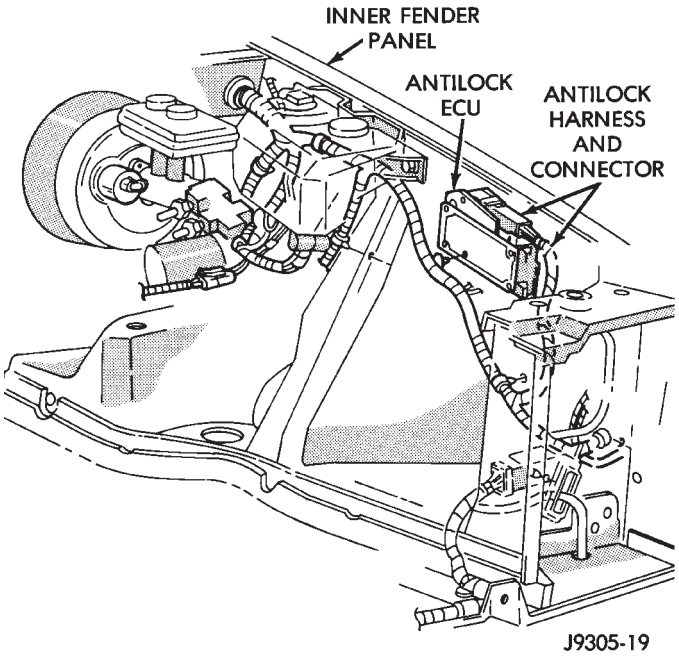


Fig. 13 Antilock ECU Location And Mounting

(4) Lift ECU out of engine compartment for access to harness connector.

(5) Release strap securing harness connector to ECU pin terminals (Fig. 14).

(6) Disconnect and separate harness connector from ECU as follows: Tilt harness connector upward to disengage it from ECU pin terminals. Then slide it out of retaining tangs in ECU.

(7) Obtain replacement ECU if necessary.

(8) Align and attach harness connector to ECU.

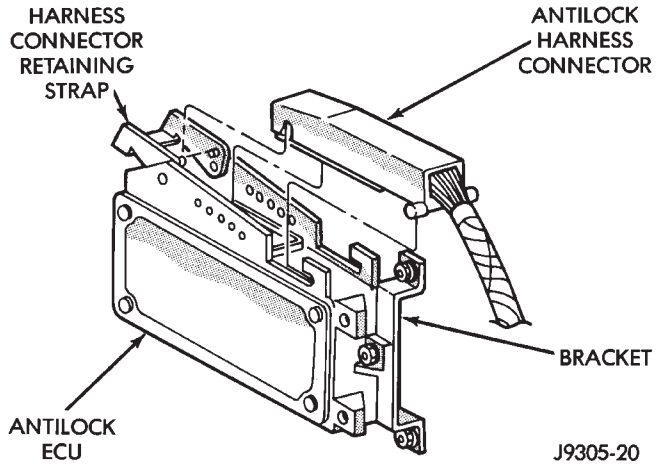


Fig. 14 ECU Harness Connector Attachment

Slide connector into engagement with tangs on ECU. Then tilt connector downward and into engagement with ECU pin terminals. Exercise care as pin terminals can be damaged if connector is forced into place.

(9) Position ECU on fender panel bracket and install attaching screws.

(10) Connect battery negative cable.

DISC BRAKE SERVICE

INDEX

DISC BRAKESHOE REMOVAL

(1) Raise vehicle and remove front wheels.

(2) If brakeshoes are severely worn, drain small amount of fluid from master cylinder front brake reservoir with suction gun.

(3) Bottom caliper piston with C-clamp. Position clamp screw on outboard brakeshoe and frame of clamp on rear of caliper.

Do not allow the clamp screw to bear directly on the outboard shoe retainer spring. Use a wood or metal spacer between the shoe and clamp screw if necessary. A typical method of bottoming piston with C-clamp is shown in Figure 1.

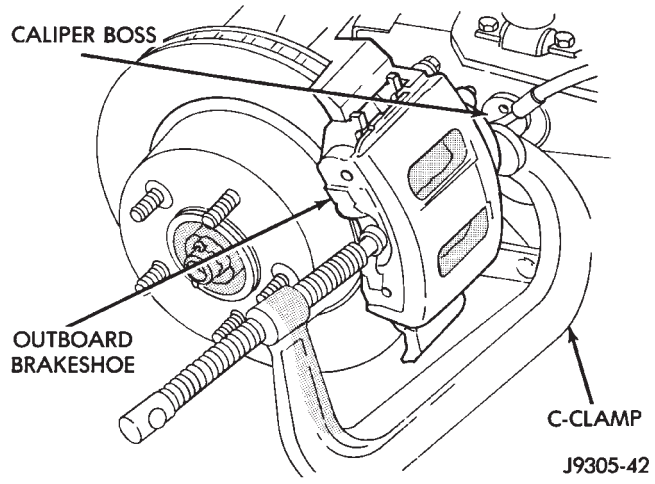


Fig. 1 Bottoming Caliper Piston With C-Clamp

(4) Remove caliper mounting bolts (Fig. 2).

(5) Tilt top of caliper outward. Use pry tool if necessary (Fig. 3).

(6) Lift caliper off steering knuckle (Fig. 4).

(7) **If original brakeshoes will be used, keep them in sets (left and right as they are not interchangeable.**

(8) Remove outboard shoe. Press one end of shoe inward to disengage shoe lug and rotate shoe upward until retainer spring clears caliper. Then press opposite end of shoe inward to disengage opposite shoe lug and rotate shoe up and out of caliper (Fig. 5).

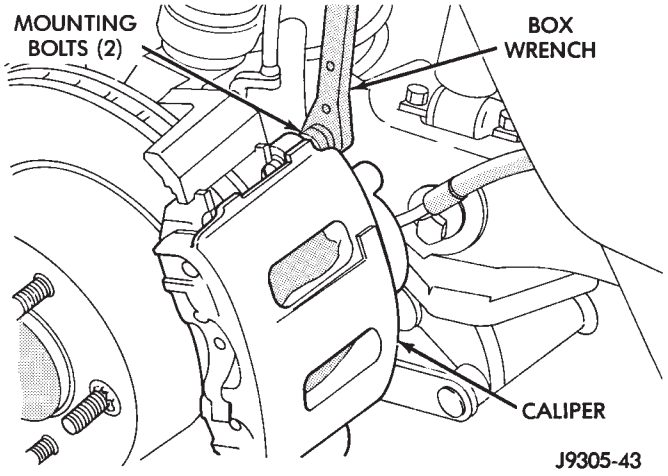


Fig. 2 Removing/Installing Caliper Mounting Bolts

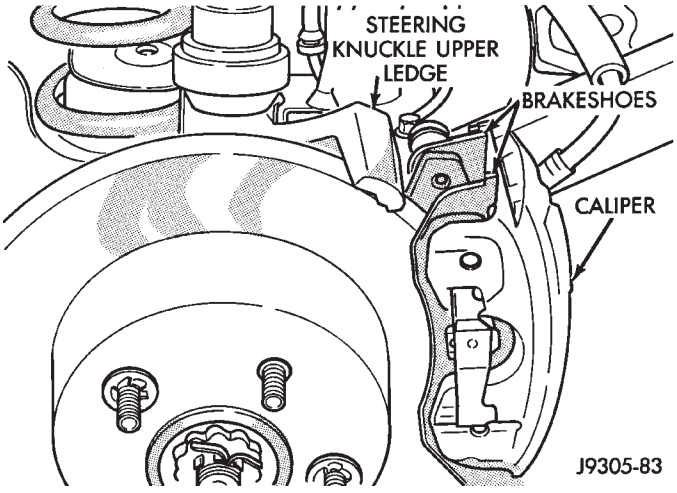


Fig. 3 Tilting Caliper Outward

(9) Remove inboard shoe. Grasp ends of shoe and tilt shoe outward to release springs from caliper piston (Fig. 6). Then remove shoe from caliper.

(10) Support caliper on box, mechanics stool, or similar device. **Do not allow brake hose to support caliper weight.**

(11) Wipe caliper off with shop rags or towels. **Do not use compressed air. Compressed air can unseat dust boot and force dirt into piston bore.**

(12) Inspect condition of caliper piston dust boot (Fig. 7). Overhaul caliper if there is evidence of leakage past piston and dust boot. Then inspect caliper bushings and boots (Fig. 7). Replace boots if torn or cut. If bushings or boots are damaged, replace them.

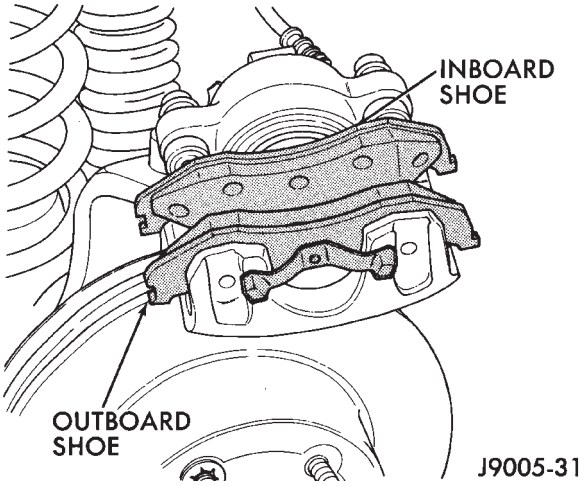


Fig. 4 Caliper Removal

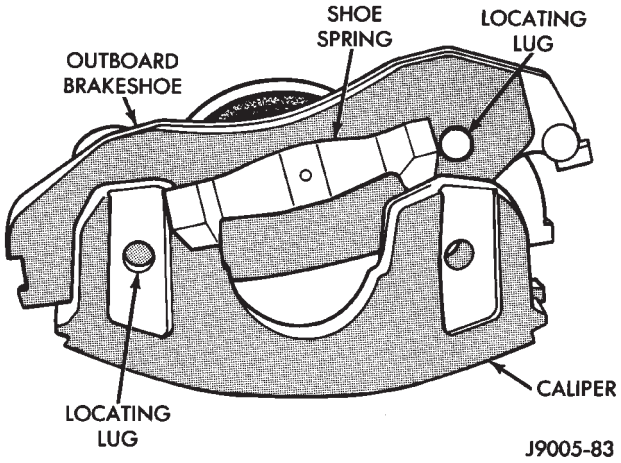


Fig. 5 Removing Outboard Brakeshoe

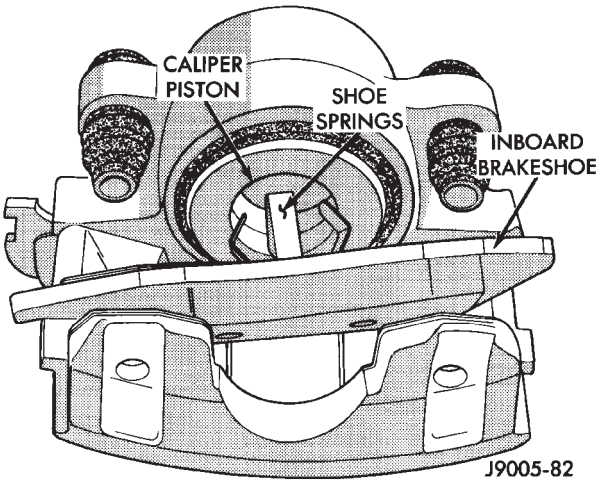


Fig. 6 Removing Inboard Brakeshoe

DISC BRAKESHOE INSTALLATION

(1) Lubricate caliper mounting bolts and bushings (Fig. 7) with GE 661 or Dow 111 silicone grease.

(2) **Keep new or original brakeshoes in sets. They are not interchangeable from side to side.**

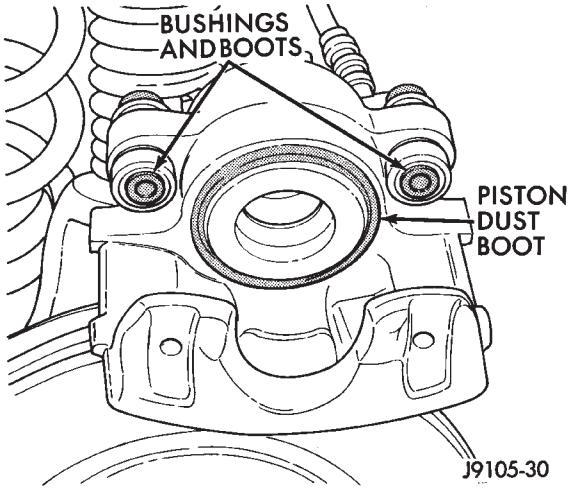


Fig. 7 Caliper Dust Boot And Bushing Locations

(3) Install inboard shoe in caliper (Fig. 8). Be sure shoe retaining springs are fully seated in caliper piston.

(4) Install outboard shoe in caliper (Fig. 9). Start one end of shoe in caliper and rotate shoe downward and into place until shoe locating lugs and shoe spring are seated in caliper.

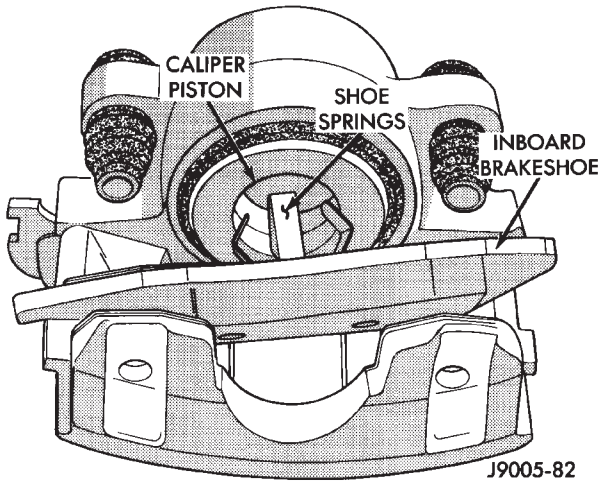


Fig. 8 Installing Inboard Brakeshoe

(5) Verify that locating lugs on outboard shoe are seated in caliper (Fig. 4).

(6) Install caliper. Position notches at lower end of brakeshoes on bottom mounting ledge of steering knuckle. Then rotate caliper onto rotor and seat tabs at upper ends of brakeshoes on top mounting ledge (Fig. 10).

(7) Check brakeshoe position on steering knuckle mounting ledges. Be sure notches at lower end of brakeshoes are securely seated on bottom mounting ledges. Then verify that tabs at upper ends of shoes are seated on top mounting ledge (Fig. 10).

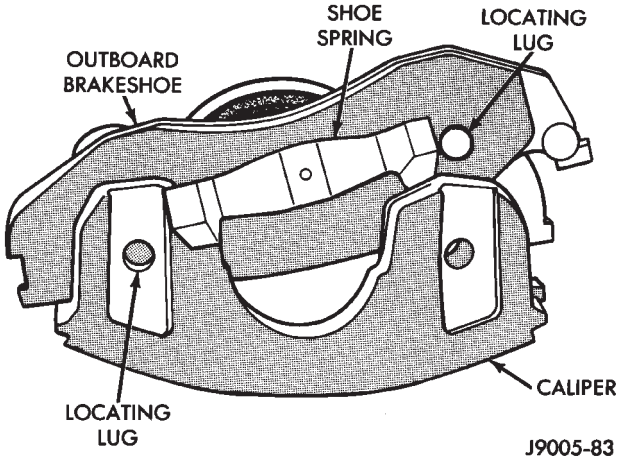


Fig. 9 Installing Outboard Brakeshoe

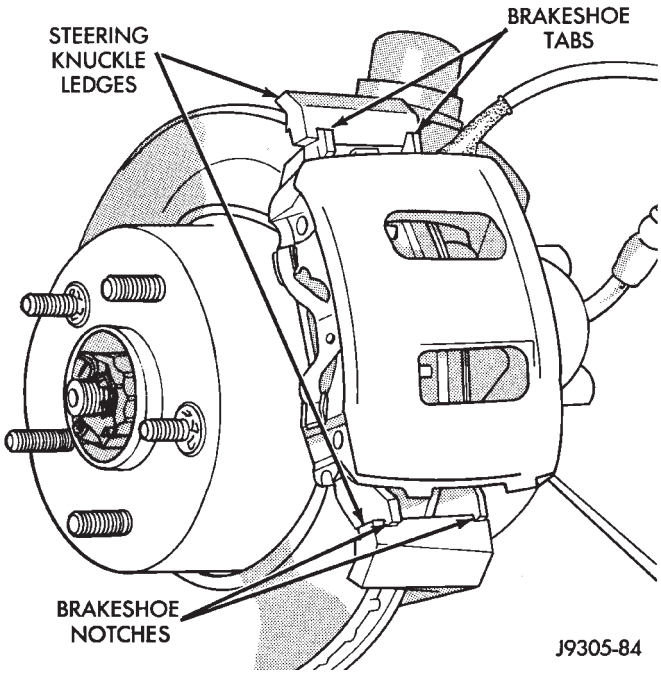


Fig. 10 Caliper And Brakeshoe Installation

CAUTION: Before securing the caliper, be sure the caliper brake hose is not twisted, kinked or touching any chassis components (Fig. 11).

(8) Lubricate and install caliper mounting bolts. Start bolts by hand then tighten bolts to 10-20 N●m (7-15 ft. lbs.) torque.

(9) Install wheels. Tighten lug nuts to 120 N●m (88 ft. lbs.) torque.

(10) Turn ignition On and run pump until it shuts off. Then pump brake pedal until shoes are seated and indicator lights go out.

(11) Top off brake fluid level if necessary. Use Mopar brake fluid or equivalent meeting SAE J1703 and DOT 3 standards only.

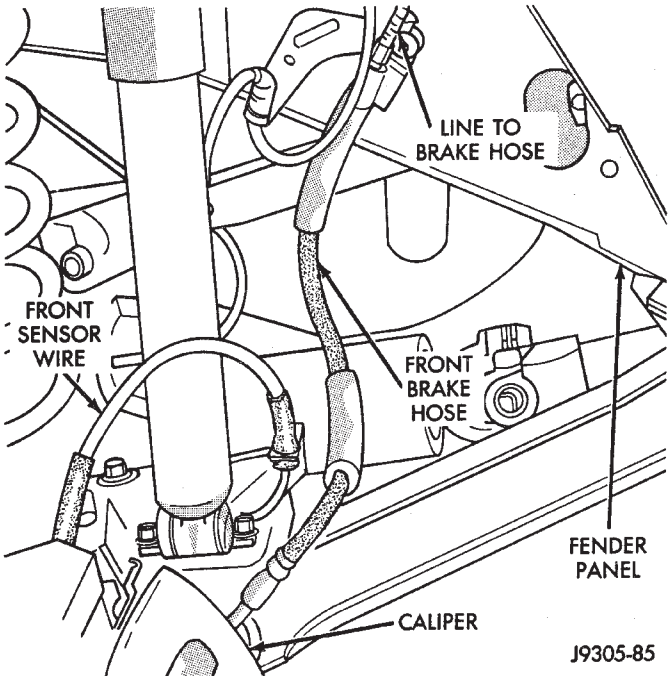


Fig. 11 Correct Front Brake Hose Routing (Driver Side Shown)

DISC BRAKE CALIPER OVERHAUL

CALIPER REMOVAL

(1) Raise vehicle and remove front wheels.

(2) Remove caliper mounting pins (Fig. 2).

(3) Rotate caliper rearward by hand or with pry tool (Fig. 3). Then rotate caliper and brakeshoes off mounting ledges.

(4) Remove caliper fitting bolt and disconnect front brakeline at caliper. Discard fitting bolt washers. They are not reusable and should be replaced.

(5) Remove caliper from vehicle.

CALIPER DISASSEMBLY

(1) Remove brakeshoes from caliper.

(2) Pad interior of caliper with minimum, one-inch thickness of shop towels or rags (Fig. 12). Towels are needed to protect caliper piston during removal.

(3) Remove caliper piston with one or two **short bursts** of low pressure compressed air. Direct air through fluid inlet port and ease piston out of bore (Fig. 13).

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. In addition, NEVER attempt to catch the piston as it leaves the bore. This could result in personal injury.

(4) Remove caliper piston dust boot (Fig. 14). Collapse boot with suitable tool and remove and discard boot.

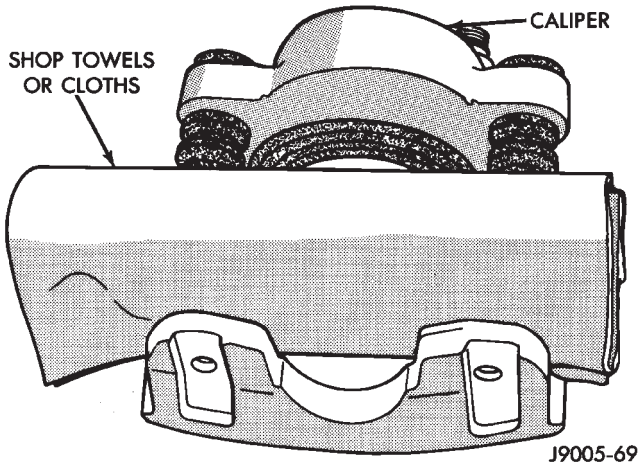


Fig. 12 Padding Caliper Interior To Protect Piston During Removal

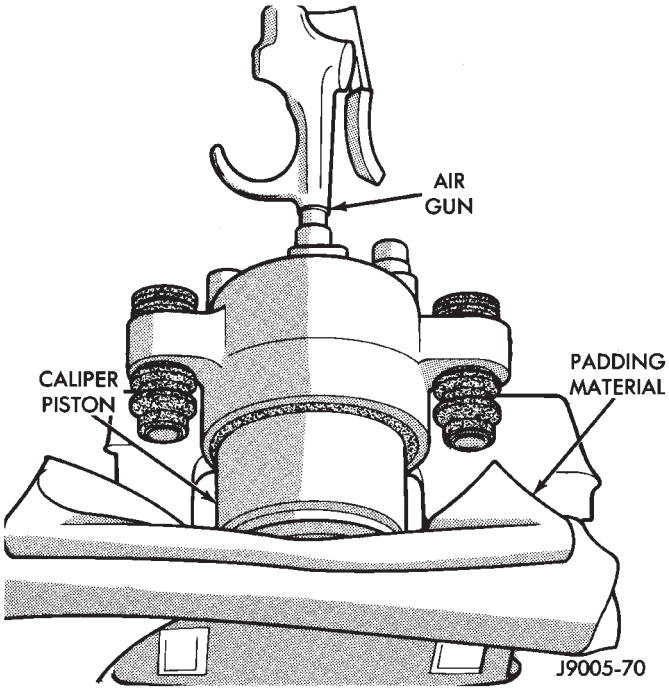


Fig. 13 Removing Caliper Piston

(5) Remove and discard caliper piston seal with pencil, toothpick, or plastic tool (Fig. 15). Do not use metal tools as they will scratch piston bore.

(6) Remove caliper slide bushings and boots (Fig. 16).

CALIPER CLEANING AND INSPECTION

Clean the caliper and piston with clean brake fluid or Mopar brake cleaning solvent only. Do not use gasoline, kerosene, thinner, or any similar type of solvent. These products may leave a residue that could damage the piston and seal.

Wipe the caliper and piston dry with lint free towels or use low pressure compressed air.

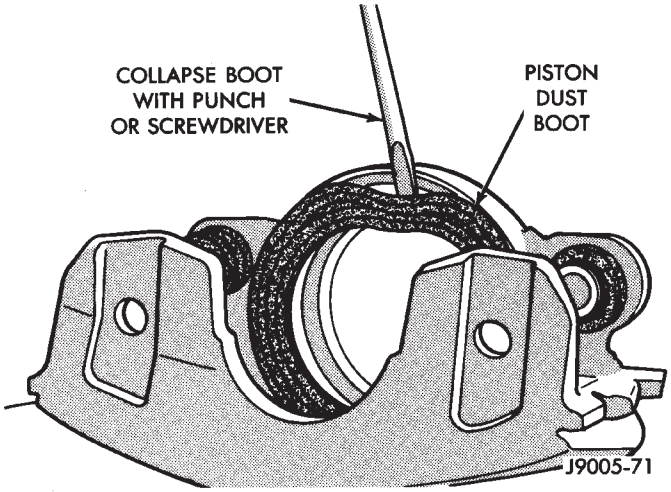


Fig. 14 Removing Caliper Piston Dust Boot

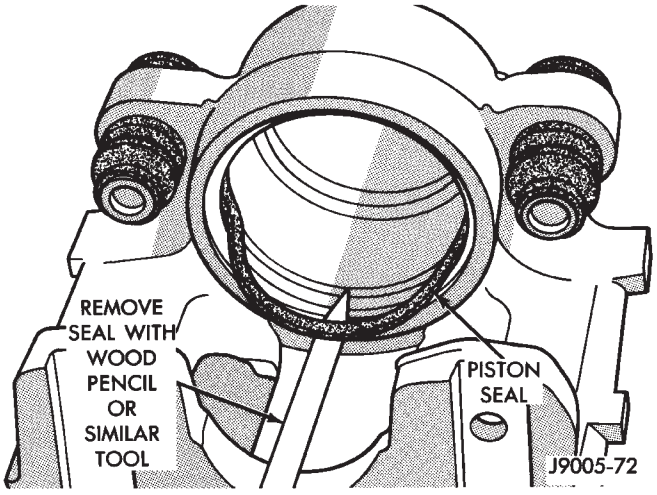


Fig. 15 Removing Caliper Piston Seal

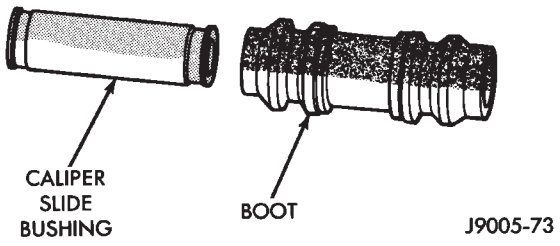


Fig. 16 Caliper Slide Bushing And Boot

Inspect the piston and piston bore. Replace the caliper if the bore is corroded, rusted, or scored. Do not hone the caliper piston bore. Replace the caliper if the bore is damaged.

Inspect the caliper piston. The piston is made from a phenolic resin (plastic material) and should be smooth and clean. Replace the piston if cracked, chipped, or scored. Do not attempt to restore a scored piston surface by sanding or polishing. The piston must be replaced if damaged.

CAUTION: Never interchange phenolic resin and steel caliper pistons. The seals, seal grooves, caliper bores and piston tolerances are different for resin and steel pistons. Do not intermix these components.

Inspect the caliper bushings and boots. Replace the boots if cut or torn. Clean and lubricate the bushings with GE 661 or Dow 111 silicone grease if necessary.

CALIPER ASSEMBLY

(1) Coat caliper piston bore, new piston seal and piston with clean, fresh brake fluid.

(2) Lubricate caliper slide bushings and interior of bushing boots with GE 661 or Dow 111 silicone grease.

(3) Install bushing boots in caliper first. Then insert bushing into boot and push bushing into place (Fig. 17).

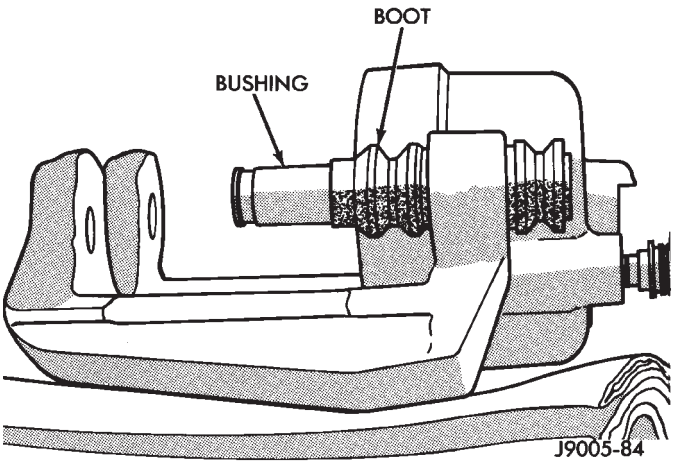


Fig. 17 Installing Slide Bushings And Boots

(4) Install new piston seal in caliper bore. Press seal into seal groove with finger (Fig. 18).

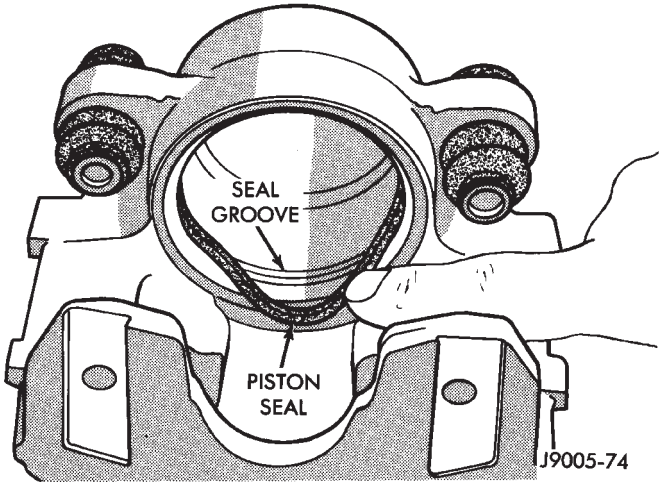


Fig. 18 Installing Piston Seal

(5) Install dust boot on caliper piston (Fig. 19). Slide boot over piston and seat boot in piston groove.

(6) Start caliper piston in bore by hand (Fig. 20). Use a turn and push motion to work piston into seal. Once piston is started in seal, press piston **only part way** into bore.

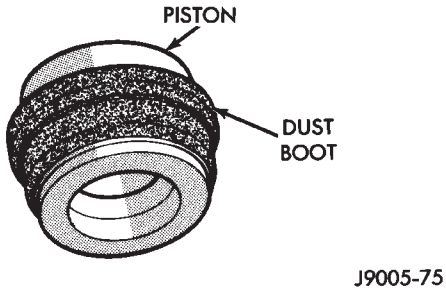


Fig. 19 Installing Dust Boot On Piston

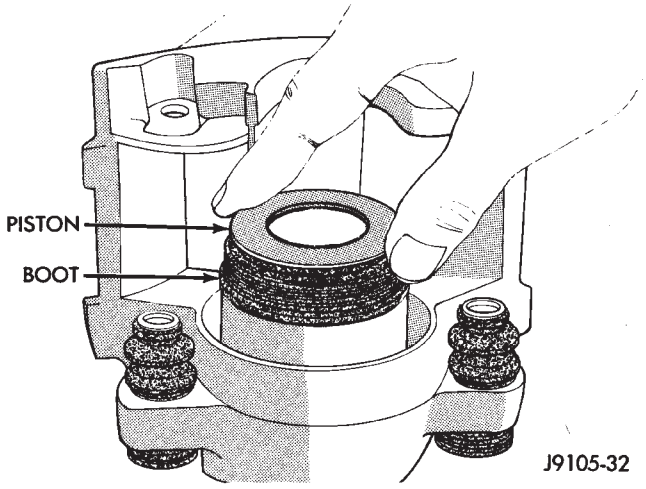


Fig. 20 Installing Caliper Piston

(7) Press caliper piston to bottom of bore.

(8) Seat dust boot in caliper with Installer Tool C-4842 and tool Driver Handle C-4171 (Fig. 21).

(9) Install caliper bleed screw if removed.

CALIPER INSTALLATION

(1) Install brakeshoes in caliper (Figs. 8, 9).

(2) Connect brake hose fitting to caliper but do not tighten fitting bolt completely at this time. **Be sure to use new washers on fitting bolt to avoid leaks (Fig. 22).**

(3) Install caliper. Position mounting notches at lower end of brakeshoes on bottom mounting ledge (Fig. 10). Then rotate caliper over rotor and seat notches at upper end of shoes on mounting ledge (Fig. 10).

(4) Coat caliper mounting bolts with GE 661 or Dow 111 silicone grease. Then install and tighten pins to 10-20 N•m (7-15 ft. lbs.) torque.

(5) Position front brake hose clear of all chassis components and tighten caliper fitting bolt to 31 N•m (23 ft. lbs.) torque.

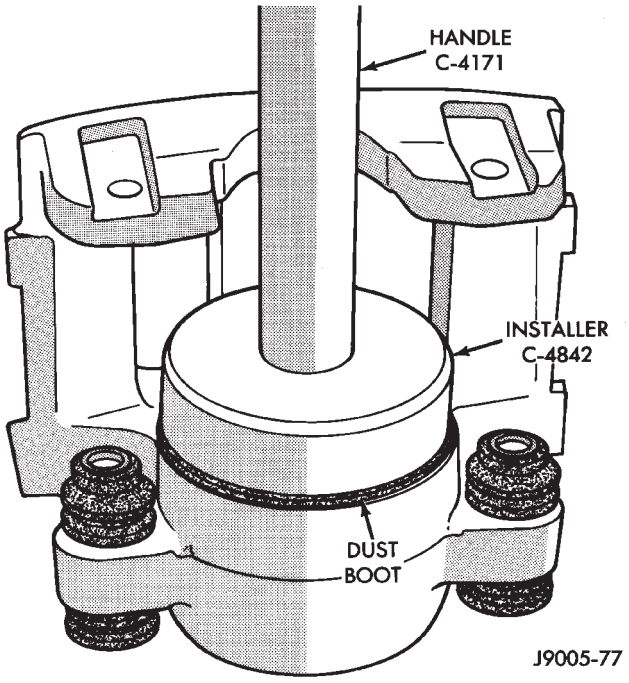


Fig. 21 Seating Dust Boot In Caliper

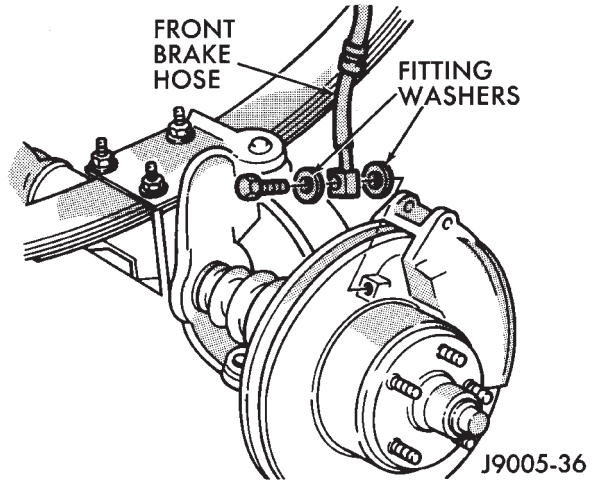


Fig. 22 Front Brake Hose And Fitting Components

(6) Install wheels. Tighten lug nuts to 120 N●m (88 ft. lbs.) torque.

(7) Bleed brake system. Refer to procedures in Service And Adjustments section.

DISC BRAKE ROTOR SERVICE

ROTOR REMOVAL

(1) Raise vehicle and remove wheel.

(2) Remove caliper.

(3) Remove retainers securing rotor to hub studs (Fig. 23).

(4) Remove rotor from hub (Fig. 23).

(5) If rotor shield requires service, remove front hub and bearing assembly.

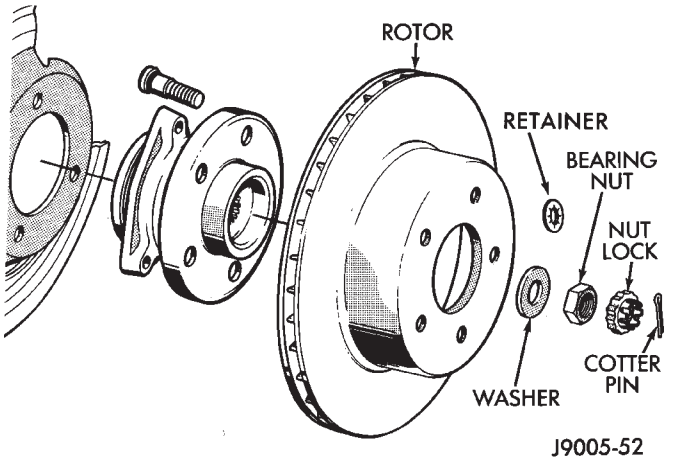


Fig. 23 Disc Brake Rotor Mounting

ROTOR INSTALLATION

(1) Install rotor on hub.

(2) Install caliper.

(3) Install new spring nuts on wheel studs.

(4) Install wheel and lower vehicle.

CHECKING ROTOR THICKNESS

Rotor minimum usable thickness is 22.7 mm (0.89 in.). Do not resurface a rotor if machining would cause thickness to fall below this limit.

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

CHECKING ROTOR THICKNESS VARIATION

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

Measure rotor thickness at four to six points around the rotor face. Position the micrometer approximately 3/4 inch from the rotor outer circumference for each measurement (Fig. 24).

Thickness should not **vary** by more than 0.013 mm (0.0005 in.) from point to point on the rotor. Refinish or replace the rotor if necessary.

CHECKING ROTOR LATERAL RUNOUT

Check rotor lateral runout whenever diagnosis indicates pedal pulsation and rapid, uneven brakelining wear.

On 4-wheel drive models, the rotor must be securely clamped to the hub to ensure an accurate runout measurement. Secure the rotor with the wheel nuts and 4 or 5 large diameter flat washers on each stud as shown (Fig. 25).

Use a dial indicator to check lateral runout (Fig. 26).

Maximum allowable rotor lateral runout is 0.13 mm (0.005 in.).

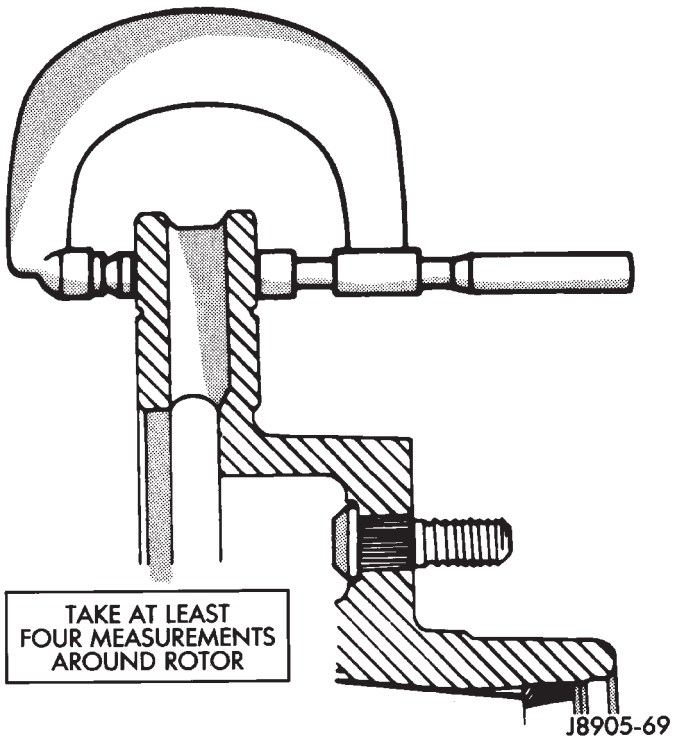


Fig. 24 Measuring Rotor Thickness Variation

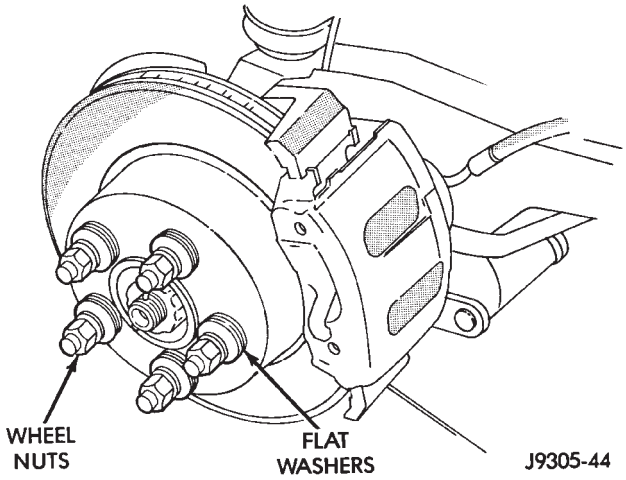


Fig. 25 Securing Rotor For Runout Check

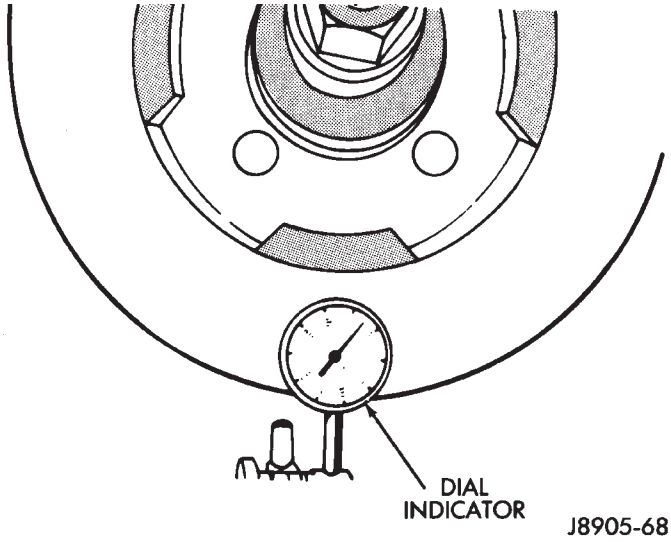


Fig. 26 Checking Rotor Lateral Runout

ROTOR REFINISHING

Rotor brake surfaces can be refinished by sanding and/or machining in a disc brake lathe. Machining can be performed on, or off the vehicle. Use either a standard lathe, or one of the newer style, portable lathes. The portable lathes machine the rotor while in place on the vehicle.

The disc brake lathe must be capable of machining both rotor surfaces simultaneously with dual cutter heads (Fig. 27). **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.

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 refinish a rotor if machining would cause the rotor to fall below minimum allowable thickness.

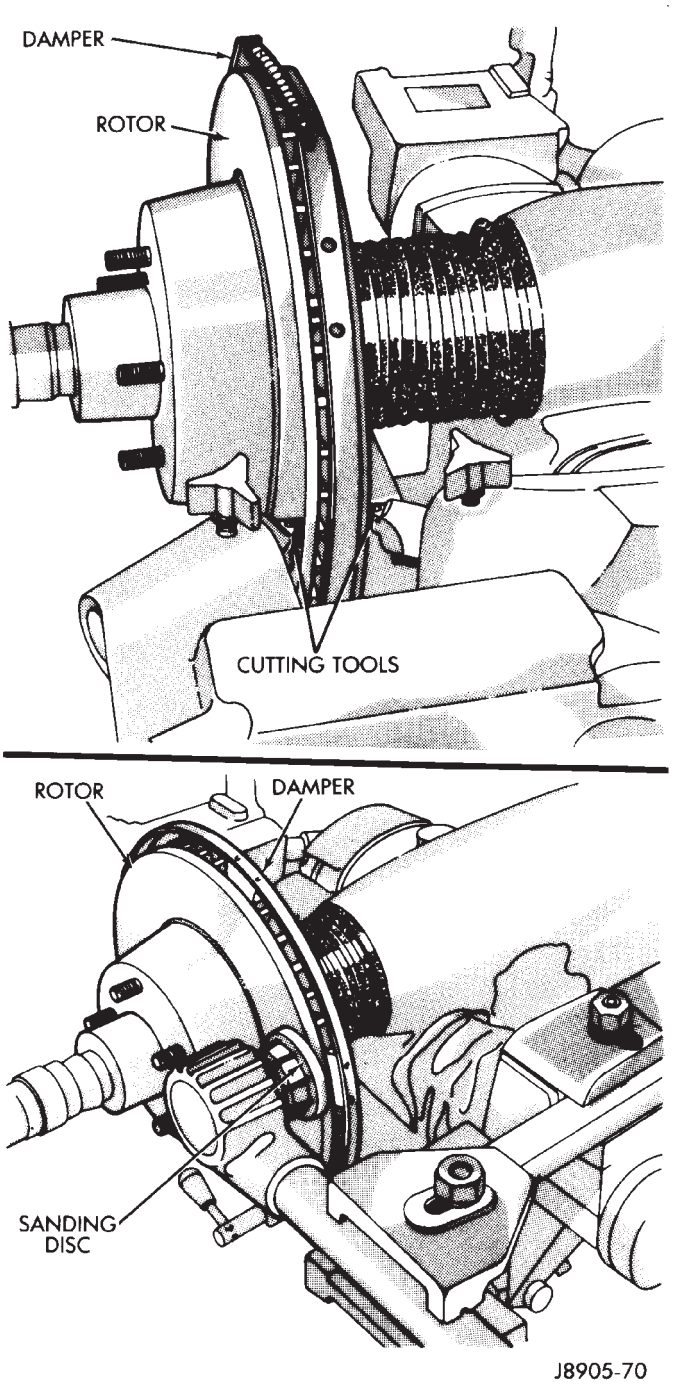


Fig. 27 Rotor Refinishing Equipment

The final finish on the rotor should be a non-directional, cross hatch pattern (Fig. 28). Use sanding discs to produce this finish.

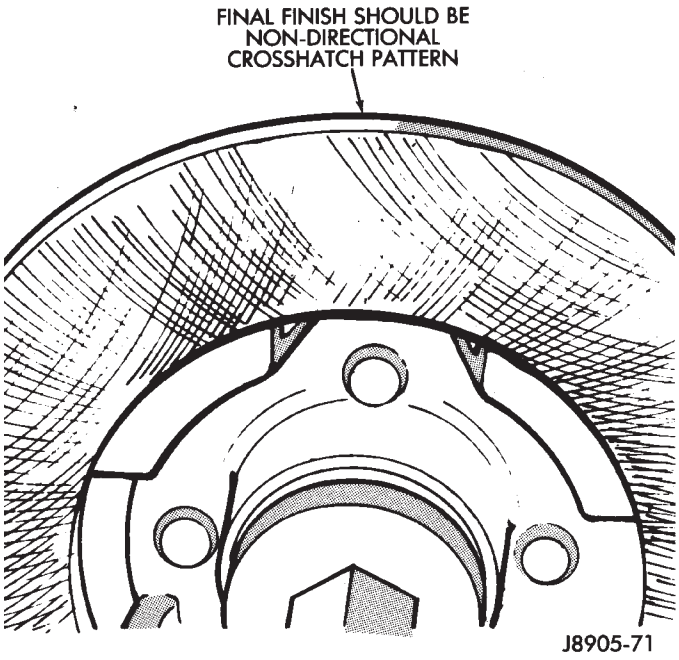


Fig. 28 Correct Final Surface Finish

DRUM BRAKE SERVICE

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DRUM BRAKESHOE REMOVAL (Fig. 1)

(1) Raise vehicle and remove rear wheels.

(2) Remove and discard spring nuts securing drums to wheel studs.

(3) Remove brake drums. If drums prove difficult to remove, retract brakeshoes. Remove access plug at the rear of backing plate and back off adjuster screw with brake tool and screwdriver.

(4) Remove U-clip and washer securing adjuster cable to parking brake lever.

(5) Remove primary and secondary return springs from anchor pin with brake spring tool.

(6) Remove holddown springs, retainers and pins.

(7) Install clamps on wheel cylinders to hold pistons in place.

(8) Remove adjuster lever, adjuster screw and spring.

(9) Remove adjuster cable and cable guide.

(10) Remove brakeshoes and parking brake strut.

(11) Disconnect cable from parking brake lever and remove lever.

DRUM BRAKESHOE INSTALLATION (Fig. 1)

(1) Clean and lubricate anchor pin with Mopar multi purpose grease.

(2) Clean and lubricate support plate shoe contact surfaces with Mopar multi purpose grease (Fig. 2).

(3) Lubricate adjuster cable guides, adjuster screw and pivot, parking brake lever and lever pivot pin with Mopar multi purpose grease.

(4) Attach parking brake lever to secondary brakeshoe with washer and new U-clip.

(5) Remove wheel cylinder clamps.

(6) Attach parking brake cable to lever.

(7) Install brakeshoes on support or backing plate. Secure shoes with new holddown springs, pins and retainers.

(8) Install parking brake strut and spring.

(9) Install guide plate and adjuster cable on anchor pin.

(10) Install primary and secondary return springs.

(11) Install adjuster cable guide on secondary shoe.

(12) Lubricate and assemble adjuster screw.

(13) Install adjuster screw, spring and lever and connect to adjuster cable.

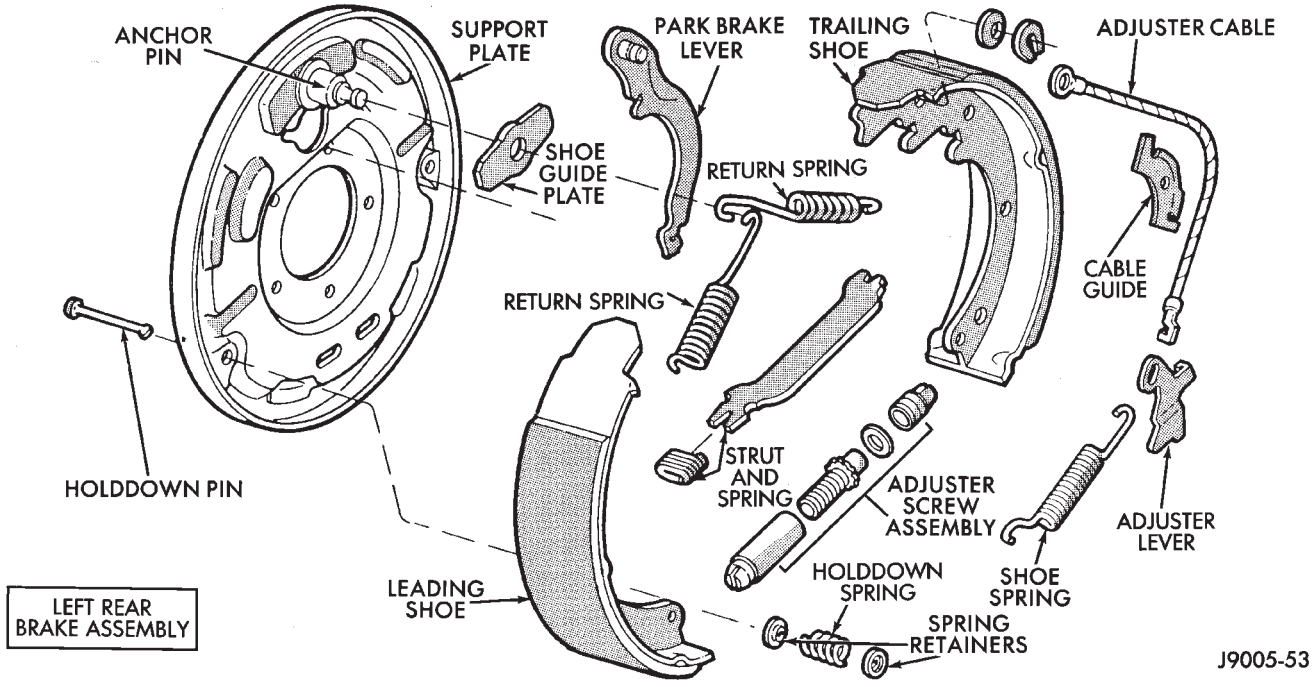

Fig. 1 Ten-Inch Drum Brake Components

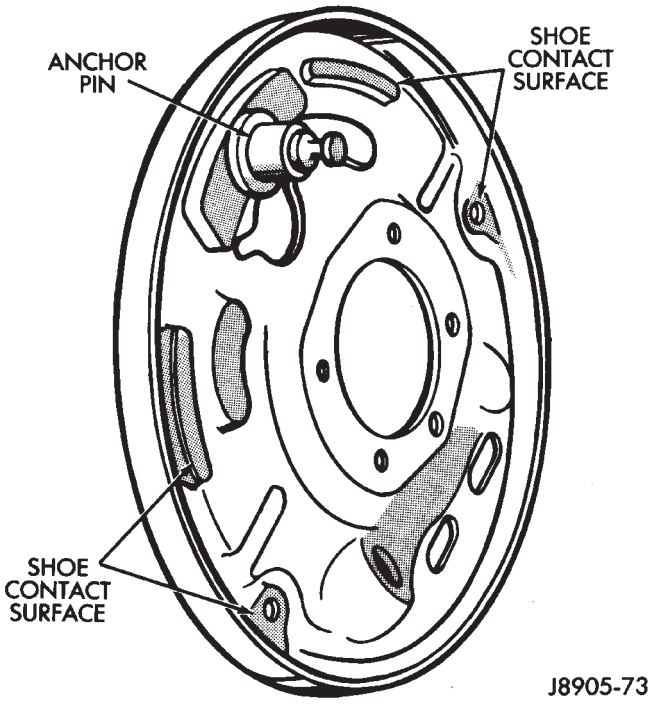

Fig. 2 Shoe Contact Surfaces

(14) Adjust shoes to drum with brake gauge and install brake drum.

(15) Install wheel and tire assembly. Tighten wheel lug nuts to 120 N●m (88 ft. lbs.) torque.

WHEEL CYLINDER REMOVAL

(1) Raise vehicle and remove wheel.

(2) Disconnect brakeline at wheel cylinder.

(3) Remove brakeshoes.

(4) Remove bolts attaching wheel cylinder to backing plate and remove cylinder.

WHEEL CYLINDER OVERHAUL (Fig. 3)

(1) Remove links.

(2) Remove dust boots.

(3) Remove cups and pistons.

(4) Remove spring and expander.

(5) Remove bleed screw.

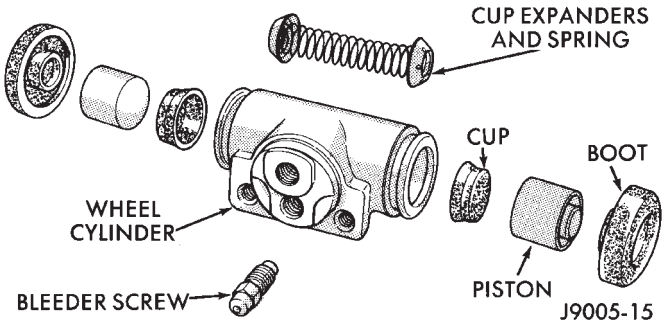

Fig. 3 Wheel Cylinder Components

(6) Clean cylinder, pistons and links with Mopar brake cleaner. Discard cups, boots and expander.

(7) Inspect cylinder bore and pistons. Light discoloration of bore is acceptable. However, replace cylinder if bore and pistons are scored, pitted, or corroded. **Do not hone cylinder bores or polish pistons. Replace cylinder as an assembly if bore is damaged.**

(8) Install bleed screw.

(9) Coat cylinder bore, pistons, cups and expander with brake fluid and reassemble cylinder components. Be sure piston cup lips face expander.

WHEEL CYLINDER INSTALLATION

(1) Start brakeline fitting in wheel cylinder by hand. Install fitting to depth of 2-3 threads. Be sure fitting is not cross threaded.

(2) Position wheel cylinder on backing plate (Fig. 4).

(3) Install and tighten cylinder mounting bolts to 10 N●m (90 in. lbs.) torque.

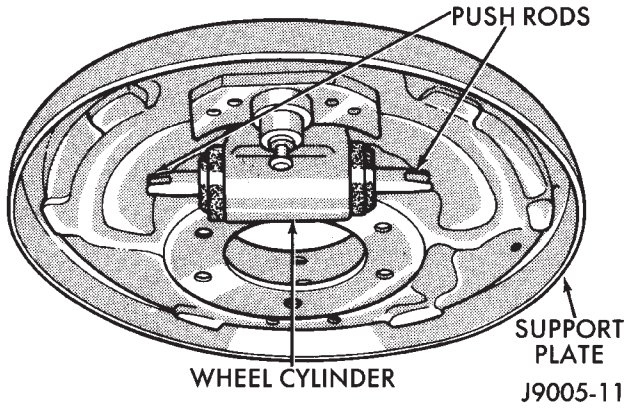

Fig. 4 Wheel Cylinder Mounting

(4) Tighten brakeline fitting to 132 in. lbs. (15 N●m).

(5) Install brakeshoes. Adjust shoes to drum with brake gauge.

(6) Install brake drums.

(7) Install wheel and tire assemblies. Tighten wheel lug nuts to 120 N●m (88 ft. lbs.) torque.

(8) Remove supports and lower vehicle.

(9) Fill master cylinder and bleed brakes.

BRAKE DRUM REFINISHING

Brake drums can be machined to restore the braking surface. Use a brake lathe to clean up light scoring and wear.

CAUTION: Never refinish a brake drum if machining will cause the drum to exceed maximum allowable brake surface diameter.

Brake drums that are warped, distorted, or severely tapered should be replaced. Do not refinish drums exhibiting these conditions. Brake drums that are heat checked or have hard spots should also be replaced.

Maximum allowable diameter for the drum braking surface is generally stamped or cast into the edge of the drum outer face (Fig. 5).

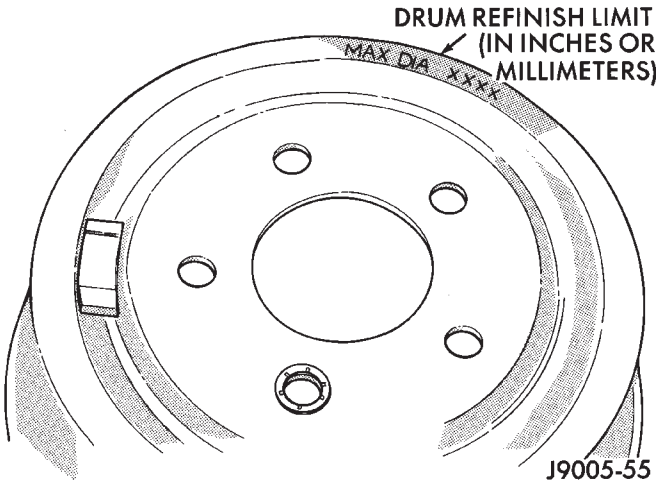

Fig. 5 Typical Location Of Brake Drum Refinish Limit

PARKING BRAKE SERVICE

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PARKING BRAKE LEVER REMOVAL—WITH FULL CONSOLE

(1) Release parking brakes.
(2) Disconnect battery negative cable.
(3) Remove screws at bottom of console storage bin (Fig. 1).

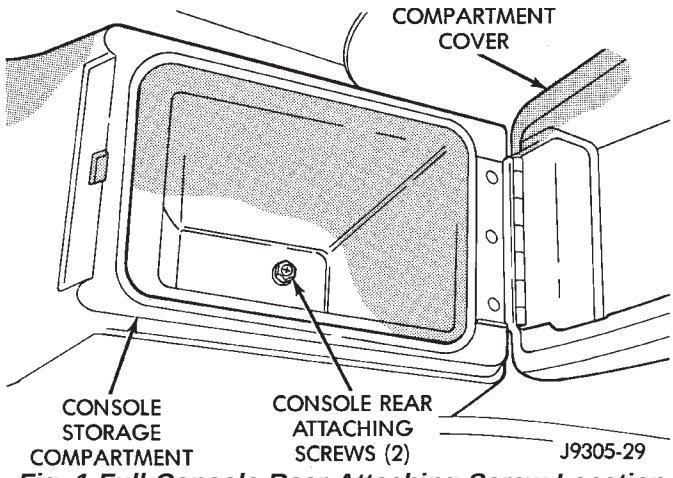

Fig. 1 Full Console Rear Attaching Screw Location

(4) On models with automatic transmission, remove handle from transmission shift lever. Grasp handle and pull up sharply to remove handle from lever.
(5) Unsnap and remove shift lever bezel (Fig. 2). Bezel has two retainer tabs on each side.
(6) Remove bulb from shift lever bezel.
(7) Remove screws attaching front of console. Screws are under shift lever bezel and are accessible once bezel has been removed.
(8) Remove bezel under parking brake lever.
(9) Move transmission and transfer case shift levers rearward.
(10) Raise front of console and remove bulb at rear of transfer case shift lever bezel.
(11) Remove console by lifting it upward and off shift levers.
(12) Disconnect and remove air bag module (Fig. 3).
(13) Disconnect parking brake switch wires.

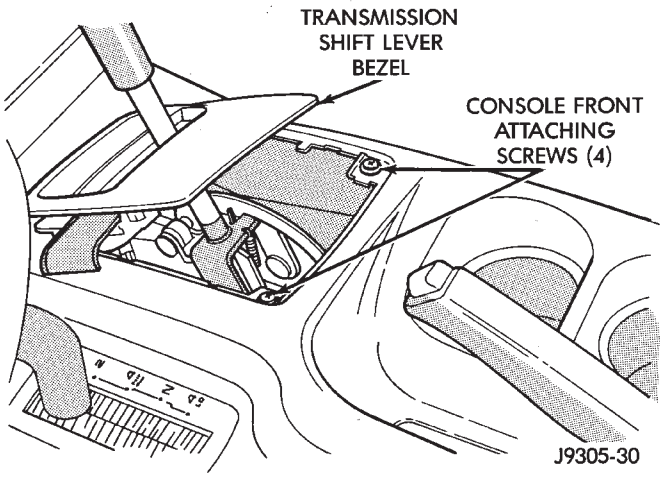

Fig. 2 Full Console Front Attaching Screw Location

(14) Remove parking brake lever attaching screws.
(15) Disengage front cable from parking brake lever and remove lever assembly.

PARKING BRAKE LEVER INSTALLATION—WITH FULL CONSOLE

(1) Attach front cable to parking brake lever.
(2) Install parking brake lever on floorpan.
(3) Connect parking brake switch wires to lever.
(4) Install air bag module and connect all wires to module.
(5) Install console over shift levers and on mounting brackets and floorpan.
(6) Install bulbs in shift lever bezels.
(7) Install console attaching screws.
(8) Install transmission shift lever bezel and install bezel under parking brake lever.
(9) Align and install shift handle on transmission shift lever.
(10) Adjust parking brake front cable if necessary.
(11) Lower vehicle.
(12) Connect battery negative cable.

PARKING BRAKE LEVER REMOVAL—WITH MINI CONSOLE

(1) Release parking brakes if applied.
(2) Disconnect battery negative cable.

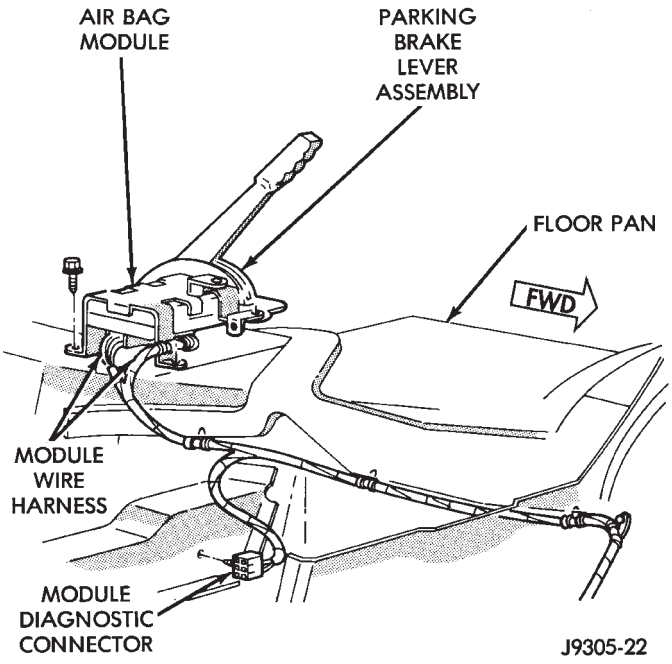

Fig. 3 Air Bag Module Mounting

(3) Raise vehicle on hoist.

(4) Remove front cable adjusting nut and disengage cable tensioner from equalizer. Then remove front cable from tensioner (Fig. 4).

(5) disengage front cable from insert and insert from floorpan (Fig. 4).

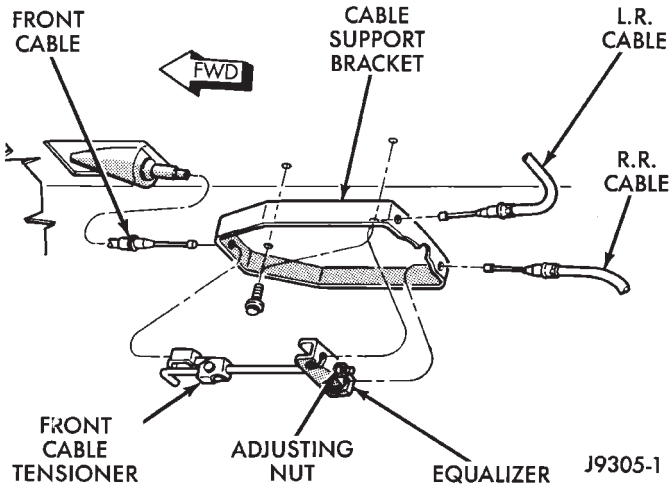

Fig. 4 Parking Brake Front Cable Attachment

(6) Lower vehicle.

(7) Unsnap and remove cup holder from parking brake lever cover (Fig. 5).

(8) Remove screws attaching lever cover to floor pan and remove cover (Fig. 5).

(9) Disconnect wires at parking brake switch and at air bag module (Figs. 3 and 5). Note that air bag module has two sets of wires connected to it.

(10) Remove screws attaching air bag module to floorpan and parking brake lever (Figs. 5 and 6). Then move module aside for access to lever.

(11) Remove screws attaching parking brake lever to bracket (Fig. 7) and lift lever upward for access to front cable.

(12) Disengage front cable from parking brake lever and remove lever assembly from vehicle.

PARKING BRAKE LEVER INSTALLATION—WITH MINI CONSOLE

(1) Connect front cable to lever assembly.

(2) Seat front cable in floor pan.

(3) Install lever assembly on mounting bracket (Fig. 5).

(4) Connect parking brake switch wire.

(5) Install air bag module (Fig. 3). Be sure all module wires harnesses are securely connected.

(6) Install parking lever cover.

(7) Install cup holder in cover.

(8) Raise vehicle.

(9) Assemble front cable, cable tensioner and equalizer.

(10) Adjust parking brake front cable. Refer to procedure in this section.

(11) Lower vehicle.

(12) Connect battery negative cable.

PARKING BRAKE FRONT CABLE REMOVAL

(1) Release parking brakes, if applied.

(2) Disconnect battery negative cable and raise vehicle on hoist.

(3) Remove front cable adjusting nut and disengage cable tensioner from equalizer. Then remove front cable from tensioner (Fig. 4).

(4) disengage front cable from insert and insert from floorpan (Fig. 4).

(5) Lower vehicle.

(6) On models with full console, remove console. Refer to parking brake lever removal procedure for full console.

(7) On models with mini console, unsnap and remove cup holder from parking brake lever cover (Fig. 5). Then remove screws attaching lever cover to floor pan and remove cover (Fig. 5).

(8) Disconnect wires at parking brake switch and at air bag module (Figs. 3 and 7). Note that air bag module has two sets of wires connected to it.

(9) Remove screws attaching air bag module to floorpan and parking brake lever. Then move module aside for access to lever.

(10) Remove screws attaching parking brake lever to bracket and lift lever upward for access to front cable.

(11) Disconnect front cable from parking brake lever and remove cable.

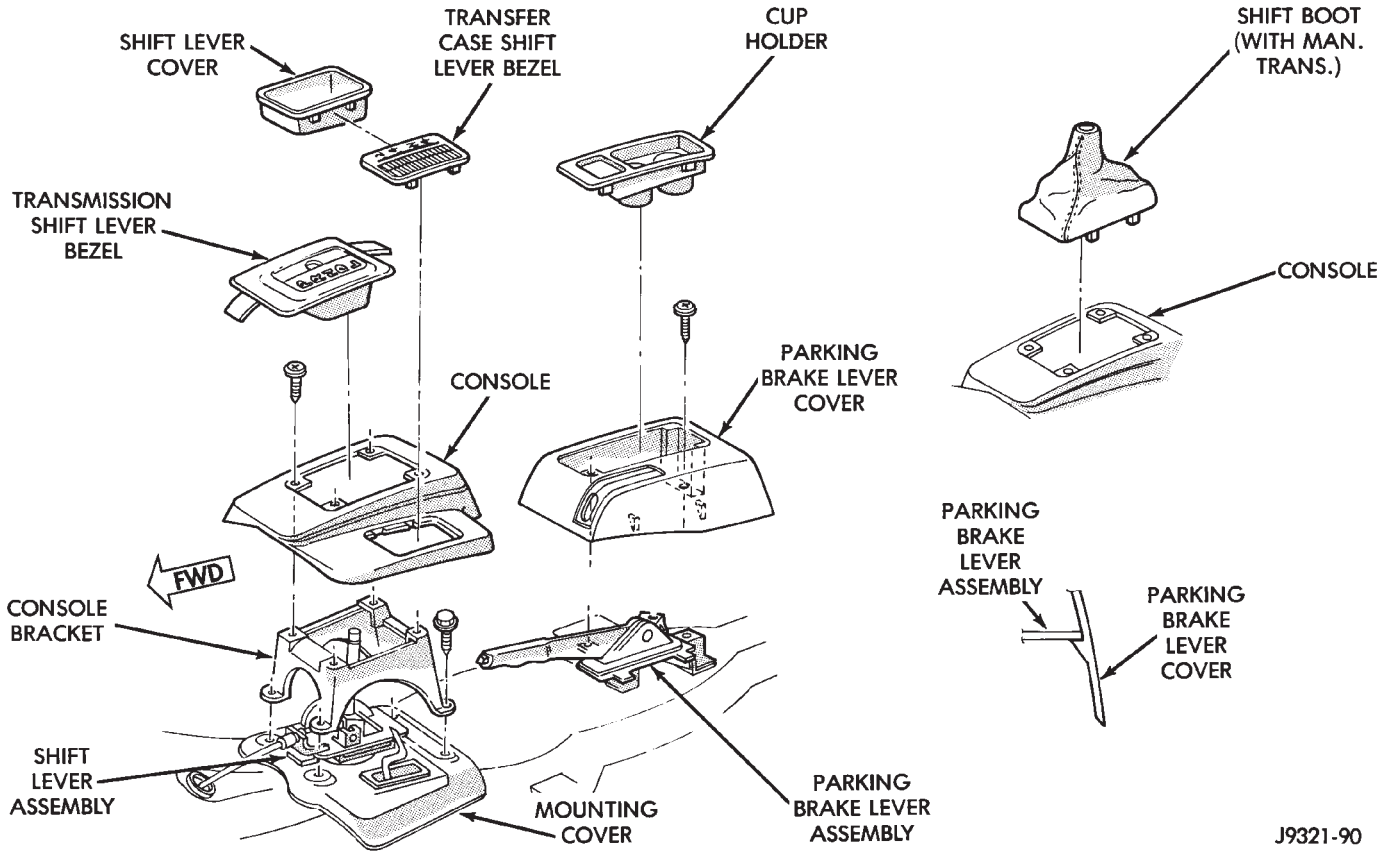

Fig. 5 Mini Console Components

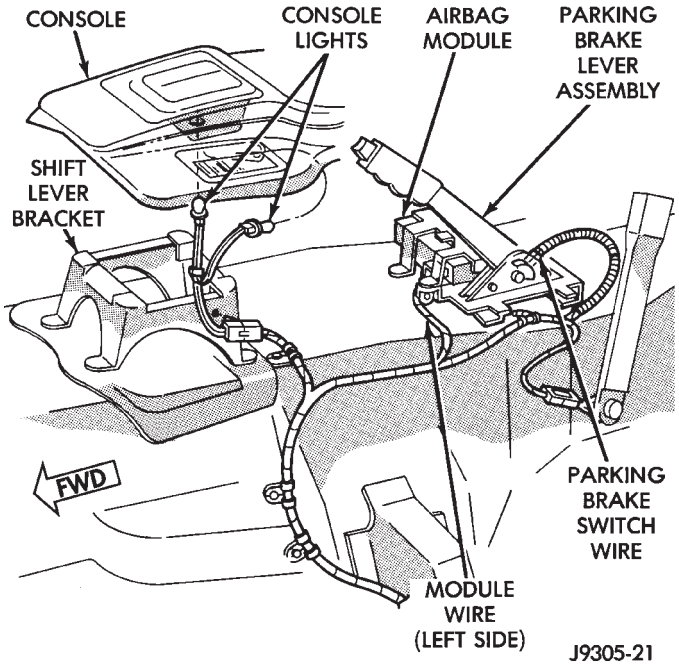

Fig. 6 Parking Brake Lever Mounting

PARKING BRAKE FRONT CABLE INSTALLATION

(1) Connect front cable to lever assembly.
(2) Seat front cable in floor pan.
(3) Install lever assembly on mounting bracket.
(4) Connect parking brake switch wire.
(5) Install air bag module. Be sure all module wires harnesses are securely connected.
(6) Install parking lever cover.
(7) Install cup holder in cover.
(8) Raise vehicle.
(9) Assemble front cable, cable tensioner and equalizer.
(10) Adjust parking brake front cable. Refer to procedure in this section.
(11) Lower vehicle.
(12) Disconnect battery negative cable.

PARKING BRAKE REAR CABLE REMOVAL

(1) Raise vehicle and loosen cable tensioner nut (Fig. 4) until rear cables are slack.
(2) Disengage necessary cable at equalizer and remove cable from body and chassis clips and retainers.
(3) Remove rear wheel and brake drum.
(4) Remove secondary brakeshoe.
(5) Disconnect cable from lever on secondary brakeshoe.
(6) Compress cable retainer with worm drive hose clamp and remove cable from brake support plate.

PARKING BRAKE REAR CABLE INSTALLATION

(1) Install new cable in brake support plate. Be sure cable retainer is fully seated.

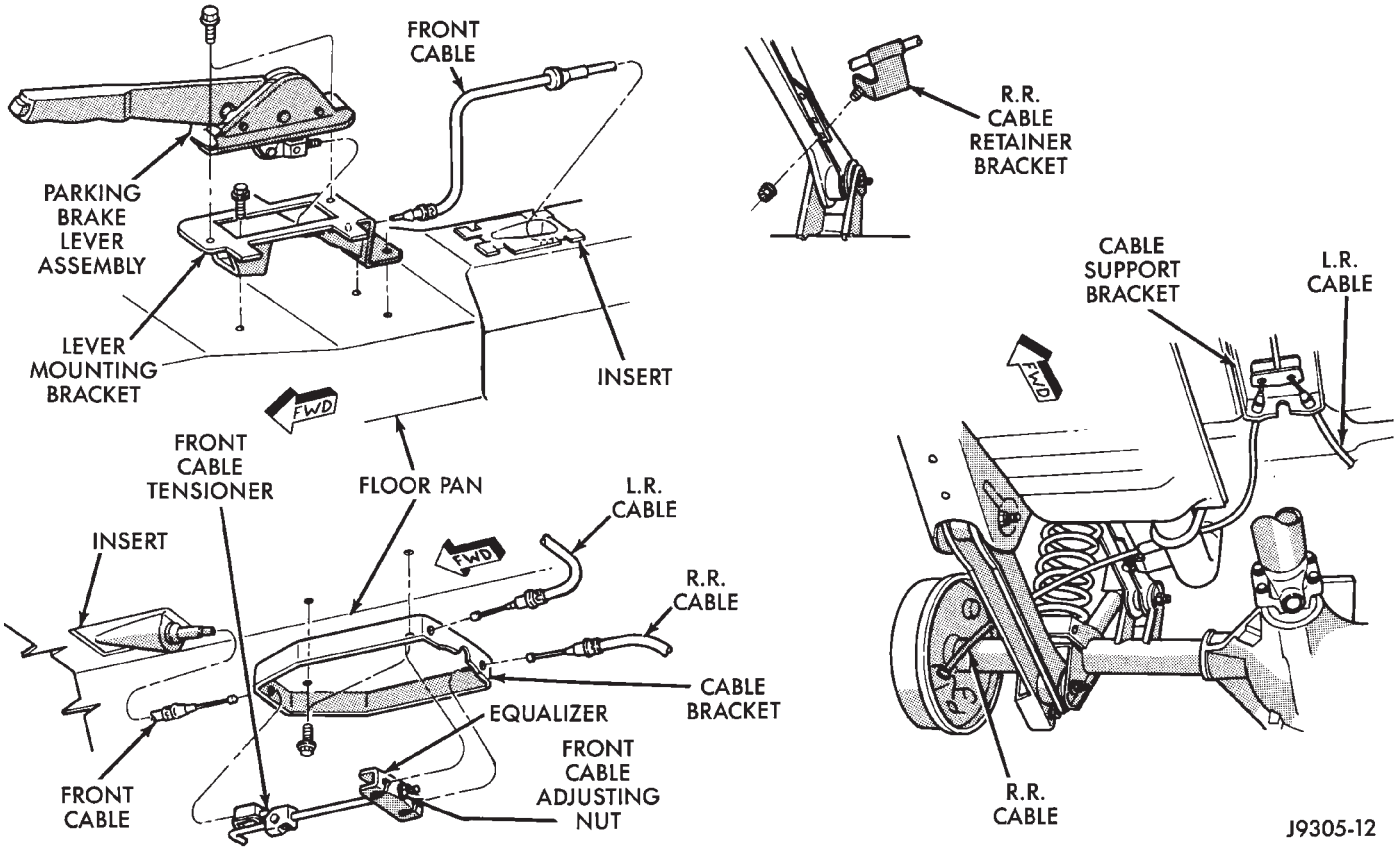

Fig. 7 Parking Brake Lever And Cable Components

(2) Attach cable to lever on secondary brakeshoe and reinstall brakeshoe on support plate.

(3) Adjust rear brakeshoes to brake drum with brake gauge.

(4) Install brake drum and wheel.

(5) Engage cable in equalizer and install nut on cable tensioner (Fig. 4).

(6) Check cable routing. Be sure cable is secured in body and chassis clips and retainers. Also be sure cable is not twisted, kinked or touching any rotating components.

(7) Adjust parking brake front cable as described in following procedure.

PARKING BRAKE FRONT CABLE ADJUSTMENT

(1) Check and adjust rear drum brakeshoes if necessary. Refer to procedure in this section.

(2) Fully apply parking brake.

(3) Raise vehicle on hoist.

(4) Mark position of adjusting nut on threaded end of cable tensioner (Fig. 4). Use chalk or grease pencil to mark position of nut.

(5) Tighten adjusting nut approximately 13 mm (1/2 in.) farther down threaded end of cable tensioner.

CAUTION: Replace the cable tensioner if there are not enough threads left for proper adjustment. Do not attempt to modify and reuse the tensioner. This practice will result in ineffective parking brake operation. The tensioner should be replaced.

(6) Lower vehicle until wheels are about 15 cm (6 in.) off shop floor.

(7) Release parking brake lever and verify that rear wheels rotate freely without drag.

(8) Lower vehicle completely.

BRAKE PEDAL AND SWITCH SERVICE

INDEX

GENERAL INFORMATION

A suspended-type brake pedal is used on all models (Fig. 1). The pedal pivots on a pin mounted in the pedal support bracket. The bracket is attached to the dash and instrument panels on all models.

A plunger-type, adjustable brakelight switch is used on all models. The switch is attached to a flange on the pedal support bracket.

BRAKE PEDAL SERVICE

The brake pedal is a serviceable component. The pedal, pivot pin, sleeve, pedal bushings and spacers/washers are all replaceable parts. The pedal bracket can also be replaced when necessary.

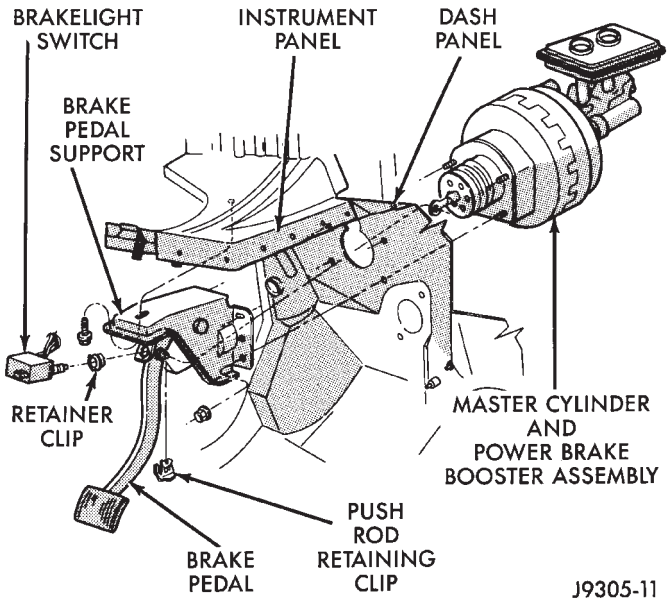

Fig. 1 Brake Pedal And Brakelight Switch Mounting

BRAKE PEDAL REMOVAL (Fig. 1)

(1) Remove lower trim panel and air conditioning duct if necessary.

(2) Remove steering column lower trim panel and bezel.

(3) Remove necessary dash panel-to-instrument panel brace rods.

(4) Remove retainer clip securing booster push rod to pedal.

(5) Remove nut securing pedal shaft in support bracket.

(6) Slide pedal shaft outward for clearance and remove brake pedal.

(7) Remove pedal bushings if they are to be replaced.

BRAKE PEDAL INSTALLATION (Fig. 1)

(1) Install new bushings in pedal. Lubricate bushings and pivot pin with Mopar multi mileage grease.

(2) Position pedal, sleeve and spacer(s) in bracket and install pivot pin.

(3) Install new nut on pivot pin. **Pivot pin nut is specially formed and should not be reused. Be sure to install new nut to secure pin.**

(4)) Tighten new pivot pin nut to 27 N●m (20 ft. lbs.) on models with manual transmission. Tighten nut to 35 N●m (26 ft. lbs.) on models with automatic transmission.

(5) Install booster push rod on pedal pin. Secure push rod with original, or new retainer clip if necessary.

(6) Install dash brace rod, if equipped.

(7) Install instrument panel trim and air conditioning duct if removed.

(8) Check and adjust brakelight switch if necessary. Refer to procedure in this section.

BRAKELIGHT SWITCH REMOVAL

The brakelight switch is mounted in the pedal support bracket and is operated by the pedal. The switch is secured in the bracket with a retainer (Fig. 1).

(1) Remove steering column cover and lower trim panel for switch access, if necessary.

(2) Disconnect switch wires.

(3) Thread switch out of retainer, or rock switch up/down and pull it rearward out of retainer.

(4) Inspect switch retainer. Replace retainer if worn, distorted, loose, or damaged.

BRAKELIGHT SWITCH INSTALLATION

(1) Insert replacement switch in retainer (Fig. 1). Thread switch into place or rock it up/down until switch plunger touches brake pedal.

(2) Connect brakelight switch wires.

(3) Check brakelight switch operation. Adjust switch position if necessary. Refer to procedures in this section.

(4) Install trim panels (if removed).

BRAKELIGHT SWITCH ADJUSTMENT

(1) Check switch adjustment. Move brake pedal forward by hand and note operation of switch plunger. Plunger should be fully extended when pedal free play is taken up and brake application begins. Clearance of approximately 1.5 to 3.0 mm (1/16 to 1/8 in.) should exist between plunger and pedal at this point.

(a) If switch-to-pedal clearance is OK and brakelights operate correctly, adjustment is not required.

(b) If switch plunger does not fully extend and clearance between pedal and switch barrel is insufficient, adjust switch position as described in step (2).

(2) Grasp brake pedal and pull it rearward as far as possible. Pedal should contact switch barrel, push it rearward in retaining clip and stop at correct position.

(3) Verify brakelight switch operation and proper clearance between switch and brake pedal.

CAUTION: Be very sure the brake pedal returns to a fully released position after adjustment. The switch can interfere with full pedal return if too far forward. The result will be brake drag caused by partial brake application.

SPECIFICATIONS

BRAKE TORQUE SPECIFICATIONS

Description	Torque
Acceleration Sensor Screws:	
at sensor	8-9 N•m (71-83 in. lbs.)
at bracket	1-2 N•m (13-18 in. lbs.)
Brake Booster Mounting Nuts	41 N•m (30 ft. lbs.)
Brakeline Fittings At:	
combination valve	18-24 N•m (160-210 in. lbs.)
front brake hose	15-18 N•m (130-160 in. lbs.)
HCU	14-16 N•m (125-140 in. lbs.)
master cylinder primary outlet	14-16 N•m (125-140 in. lbs.)
master cylinder secondary outlet	15-18 N•m (135-160 in. lbs.)
rear brakeline (to hose)	15-18 N•m (130-160 in. lbs.)
wheel cylinder	15-18 N•m (130-160 in. lbs.)
Brake Pedal Support Bolt	23-34 N•m (200-300 in. lbs.)
Brake Pedal Pivot Bolt/Nut	27-35 N•m (20-26 ft. lbs.)
Caliper Mounting Bolts	10-20 N•m (7-15 ft. lbs.)
Combination Valve Adaptor Fittings	23-27 N•m (200-240 in. lbs.)
ECU Mounting Screws	8-13 N•m (75-115 in. lbs.)

Description	Torque
Front Brake Hose Bracket Screw	4-6 N•m (34-50 in. lbs.)
Front Brake Hose Fitting Bolt	24-38 N•m (216-336 in. lbs.)
Front Wheel Sensor Bracket Bolt	4-6 N•m (34-50 in. lbs.)
HCU Bracket Attaching Nuts	10-13 N•m (92-112 in. lbs.)
Master Cylinder Attaching Nuts	13-25 N•m (115-220 in. lbs.)
Parking Brake Cable Retainer Nut	1-2 N•m (12-16 in. lbs.)
Parking Brake Lever Screws	10-14 N•m (85-125 in. lbs.)
Parking Lever Bracket Screws	10-14 N•m (85-125 in. lbs.)
Rear Axle Vent Fitting	11-18 N•m (100-160 in. lbs.)
Rear Brake Hose Bracket Screw	8-9 N•m (74-82 in. lbs.)
Rear Sensor Axle Bracket Bolt	8-9 N•m (74-82 in. lbs.)
Rear Sensor Bolt	12-14 N•m (10-11 ft. lbs.)
Support Plate Bolts/Nuts	43-61 N•m (32-45 ft. lbs.)
Wheel Cylinder Bolts	10 N•m (90 in. lbs.)
Wheel Lug Nuts	120 N•m (88 ft. lbs.)

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