

Chapter 15

Brakes

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Specifications

Type:

- Front Four piston, fixed caliper with ventilated disc
- Rear Single piston, sliding caliper incorporating drum type handbrake with ventilated disc

Operation:

- Footbrake Hydraulic dual circuit with optional ABS
- Handbrake Mechanical on rear wheels

Brake fluid type Dot 3

Master cylinder type Tandem

Front brakes:

- Brake disc thickness —
- Standard 22.0 mm
- Minimum 20.0 mm
- Runout limit 0.07 mm

Rear brakes:

- Brake disc thickness —
- Standard 18.0 mm
- Minimum 16.0 mm
- Runout limit 0.15 mm

- Handbrake drum diameter —
- Standard 210.0 mm
- Maximum 211.0 mm

Handbrake:

- Lever travel 6 – 8 notches at 200 N pull
- Shoe thickness —
- Standard 4.0 mm
- Minimum 1.0 mm

Disc pad lining thickness:

- Standard —
- Front 11.5 mm
- Rear 10.0 mm
- Minimum 1.0 mm

Brake pedal:

- Height 197.0 – 207.0 mm
- Freeplay 3 – 6 mm

Brake booster pushrod clearance 0.02 mm

TORQUE WRENCH SETTINGS

ABS:

- Front and rear sensor retaining bolts 8 Nm
- Harness retaining bolts 8 Nm
- Connector bracket 12 Nm

Early model ABS modulator —

- Bracket to modulator nuts 5 Nm
- Bracket to body bolts 19 Nm

Late model ABS —

- Accumulator 54 Nm
- Oil pressure sensor 81 Nm

Bellcrank housing bolts 13 Nm

Brake booster:

- Retaining nuts 14 Nm
- Pushrod clevis retaining nut 25 Nm

Front brakes:

- Brake pipe to caliper union nut 15 Nm
- Caliper retaining bolts 123 Nm
- Bleeder valve 11 Nm

Load sensing proportioning valve:

- Adjuster locknut 13 Nm
- Retaining nuts 13 Nm
- Bracket retaining bolts 29 Nm

Master cylinder:

- Retaining nuts —
- Without ABS 13 Nm
- With ABS 15 Nm
- Reservoir retaining screw 2 Nm
- Stop bolt 10 Nm

Rear brakes:

- Anchor plate bolts 103 Nm
- Guide pin bolts 88 Nm
- Dust boot plate bolts 8 Nm
- Brake hose union bolt 30 Nm
- Bleeder valve 11 Nm

Description

The brakes are applied by hydraulic pressure in two independent circuits by means of a tandem master cylinder. The system utilises disc brakes on the front and rear wheels. For safety reasons, the front and rear brakes are operated by separate circuits. Should a malfunction occur in one circuit, the remaining circuit is capable of stopping the vehicle safely.

The front brake calipers are the fixed type and have four pistons which force the brake pads against the brake disc. Elastic deformation of each piston seal takes place when the brakes are applied which retracts the piston to maintain clearance between the pads and the disc when the brakes are released. As pad wear takes place, the caliper piston is allowed to slide outward through the seal to take up a new position in the bore of the

caliper housing. The caliper is constructed in two half sections and is held together by four bolts. It is not advisable to separate the two sections.

The rear brake calipers are the single piston floating type, which slide on guide pins that are bolted to the anchor plate. Elastic deformation of the piston seal takes place when the brakes are applied which retracts the piston to maintain clearance between the pads and the disc when the brakes are released. As pad wear takes place, the caliper piston is allowed to slide outward through the seal to take up a new position in the bore of the caliper housing. The cable operated, drum type handbrake mechanism is mounted to each side of the rear axle housing and the brake drum is incorporated in the brake disc.

Some vehicles are equipped with an antilock braking system (ABS) to prevent the wheels locking in an emergency braking situation. Two types of ABS are used. Early systems have a conventional master cylinder and vacuum booster, while late models have a unified assembly and do not require vacuum assistance.

On all models except those with a unified ABS, a vacuum brake booster is installed between the brake pedal and the master cylinder to reduce pedal effort during brake application. The valve and rod assembly of the booster and the brake pedal pushrod are on the same axis and, in the case of a failure, will act as a single pushrod without vacuum assistance. Vacuum to the brake booster is supplied by the engine.

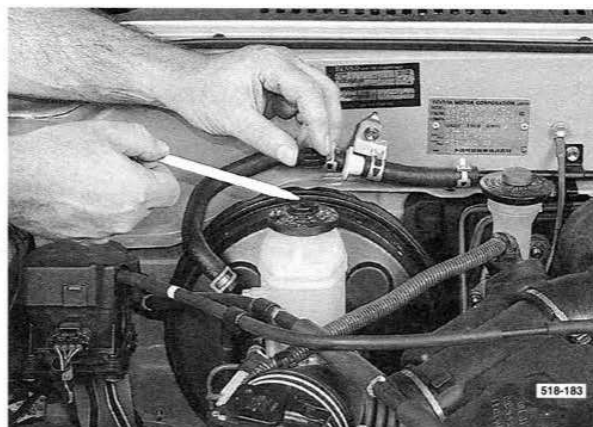
On the unified ABS, a pump is used to maintain a high residual pressure in certain parts of the system at all times. It will be noted, that the pump will run for a short period to recharge this pressure when the vehicle is started. Do not, under any circumstances loosen the red brake pipe fittings or pressure switch on this unit without reducing the residual pressure as described under the removal procedure.

A load sensing proportioning valve is incorporated in the brake hydraulic system to prevent premature locking of the rear brakes. The valve is mounted to the vehicle underbody and connected to the rear axle by a tension spring.

Routine Maintenance

TO CHECK BRAKE FLUID

The brake fluid should be checked regularly ensuring that the level is between the Min and Max marks on the side of the reser-



Ensure that the breather hole on the cap is not blocked or obstructed.

voir. If the level is low, clean any dirt from around the cap. Remove the cap and top up the reservoir with the specified type of brake fluid. Ensure that the breather hole on the top of the cap is free of accumulated dirt.



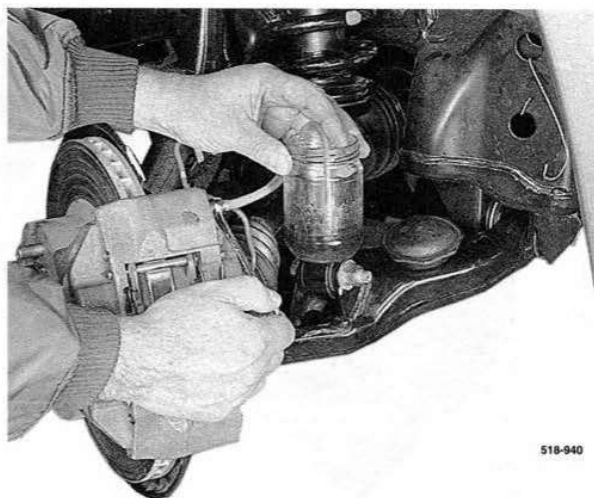
If the brake fluid level is quite low, check the condition of the brake pads, as described later in this chapter. It is normal for the brake fluid level to drop slightly as the brake pads wear.

Also, check for any signs of brake fluid leakage from the brake calipers, pipes and fittings. Repair any leaks referring to the appropriate headings in this chapter.

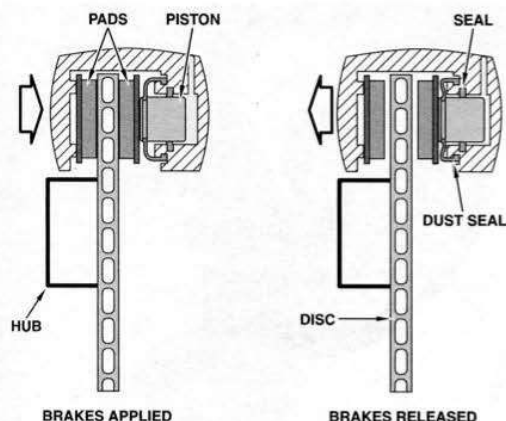
TO RENEW BRAKE FLUID

The brake fluid should be renewed at intervals specified in Routine Maintenance (chapter 2). There are four points in the system where bleeder valves are installed, one on each caliper.

- 1 Raise the front and rear of the vehicle and support on chassis stands. Refer to General Information (chapter 1) for the correct vehicle jacking points. Remove the wheels.
- 2 Withdraw as much old fluid as possible from the master cylinder, using a syringe or similar.



Renewing the brake fluid.



Single acting piston type disc brake system.

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- 3 Fill the fluid reservoir with clean brake fluid and maintain at least one third full throughout the entire operation.



On late models with a unified ABS do not allow the reservoir to completely empty, as specialist equipment is needed to bleed the system once the reservoir is empty.

- 4 If fitted, remove the dust cap and attach a transparent hose to the bleeder valve on the left rear caliper. Immerse the other end of the hose in a small amount of brake fluid contained in a clean glass jar held higher than the bleeder valve.



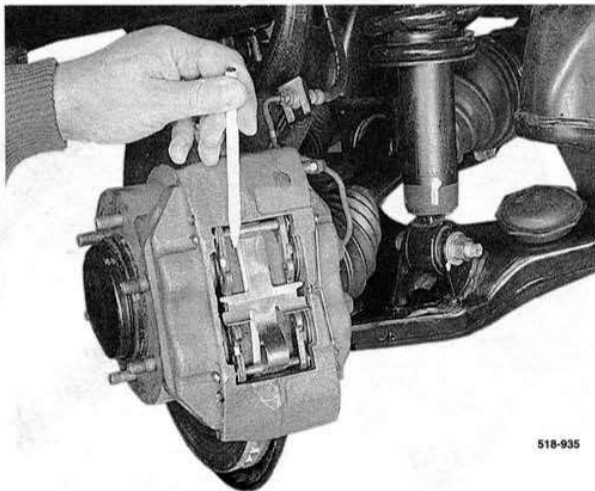
If desired, a one person bleeding kit may be used. These kits usually consist of a transparent tube with a one way ball valve. With a one person bleeding kit, it is not necessary to close the bleeder valve after each set of pedal strokes, however follow the kit manufacturers instructions.

- 5 Unscrew the bleeder valve one complete turn.
- 6 Have an assistant depress the brake pedal slowly to the full extent of its travel. Close the bleeder valve and allow the brake pedal to return without assistance.
- 7 Repeat steps 5 and 6 until a constant stream of new brake fluid, without any air bubbles, is being discharged into the glass jar. Hold the pedal down and tighten the bleeder valve. Tighten the bleeder valve to the specified torque. If removed, install the dust cap.



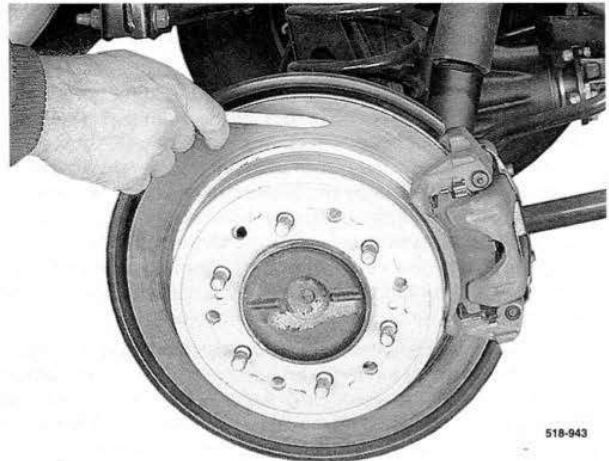
Do not allow the fluid level in the reservoir to fall below the one third full level at any time during the operation or air will enter the system and the procedure will have to be repeated. Always use new brake fluid for topping up the reservoir.

- 8 Perform the bleeding operation, in the same manner, on the remaining bleeder valves in the system. Always work from the longest brake line in the system to the shortest. This means, start with the left rear brake, then the right rear brake, left front and finally the right front brake.
- 9 On late models with unified ABS, ensure that the ignition is Off and depress the brake pedal at least 40 times to reduce



518-935

Check the brake pad thickness.



518-943

Check the brake disc for scoring.

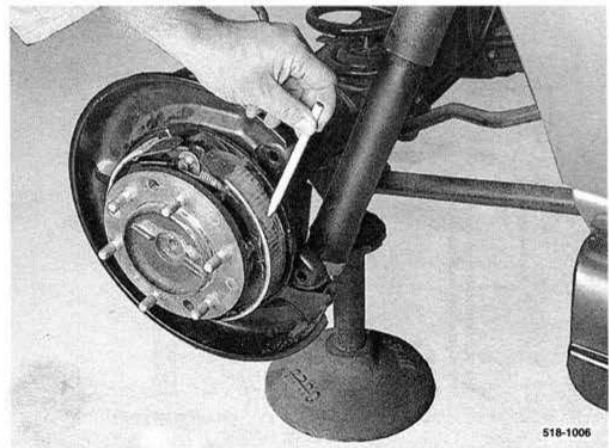
the residual pressure. Pressure is reduced when the brake pedal travel is short and the action is heavy.

- 10 Top up the reservoir with the specified brake fluid to the MAX level and install the reservoir cap.
- 11 If the brake pedal is spongy or travels to the floor, air has entered the system. Repeat the bleeding procedure ensuring that all the air is removed from the brake hydraulic system.

TO CHECK FRONT AND REAR BRAKES

The brakes should be examined at the intervals specified in the Routine Maintenance (chapter 2) or whenever the condition of the brakes is suspect.

- 1 Raise the front and rear of the vehicle and support on chassis stands. Refer to General Information (chapter 1) for the correct vehicle jacking points. Remove the wheels.
- 2 Check the brake pad lining thickness through the inspection hole in the caliper body. If the lining thickness is less than 1 mm, renew the pads as described later in this chapter.
- 3 Check the machined faces on the brake disc for scoring, cracks, wear and signs of overheating. If the disc is scored, refer it to a brake specialist for machining. If it is excessively worn, it must be renewed.



518-1006

Check the handbrake shoe linings for wear and contamination.

- 4 Remove the rear calipers and brake discs as described later in this chapter. Check the handbrake shoes for signs of wear and oil contamination. Check that the handbrake shoe contact surfaces on the disc have no hot spots or scoring. Repair or renew components as necessary.

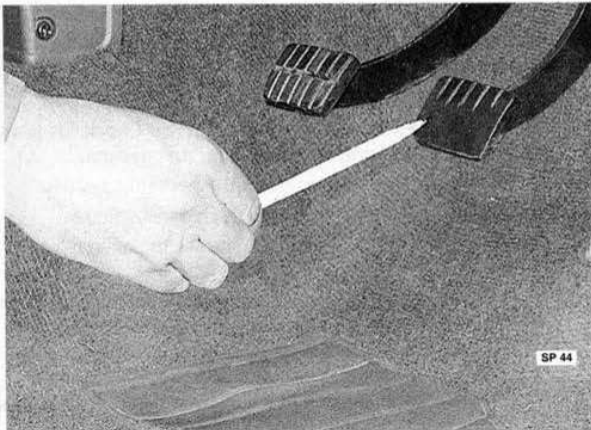
TO CHECK HYDRAULIC COMPONENTS

Periodically, all hydraulic pipes, hoses and unions should be checked for cracks or splits, chafing, leaks and corrosion. Any component which is damaged or suspect should be renewed immediately.

The ideal time for examining the hydraulic components is when the wheels are removed for brake pad checking.

PEDAL PAD

The brake pedal pad should be regularly inspected for splitting and other signs of wear. The pedal pad should be renewed if split or if the tread is worn.



Worn or split pedal pads should be renewed.

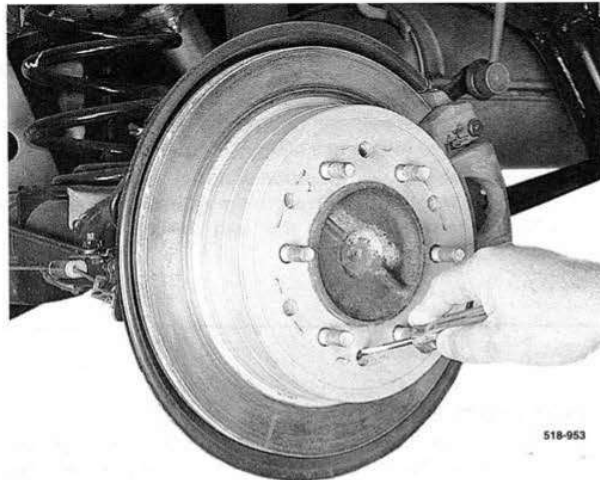
TO ADJUST HANDBRAKE

- 1 Raise the rear of the vehicle and support on chassis stands placed under the rear axle assembly. Refer to General Information (chapter 1) for the correct vehicle jacking points. Remove the rear wheels.
- 2 Working inside the vehicle, adjust the driver seat to its rear-most position. Release the Velcro fastener and lower the cover from the handbrake lever. Loosen, but do not remove the adjusting nut. Ensure that the handbrake lever is fully released.
- 3 Secure the brake disc to the hub using at least three wheel nuts, with the tapered face outward. Tighten the nuts securely.
- 4 Remove the caliper retaining bolts and suspend the caliper from the vehicle body, using wire or similar. If necessary, refer to the heading To Remove and Install Rear Disc.



Alternatively, insert a flat bladed screwdriver through the inspection hole, between the disc pads and the brake disc and carefully push the pads away from the disc, until there is no contact between the pads and the disc.

- 5 Prise the rubber plug from the disc and align the hole with the adjuster screw at the bottom.



Adjusting the handbrake shoes.

- 6 Using a flat bladed screwdriver, turn the adjuster screw upwards, in increments until the disc will not rotate. Turn the adjuster in the opposite direction 8 notches, ensuring that the disc rotates without binding. Repeat the procedure for the other wheel.
- 7 Adjust the bellcrank as follows:
 - a Remove the return spring from the bellcrank lever and loosen the locknut on the bellcrank adjusting screw.
 - b Lightly pull the bellcrank adjusting screw towards the centre of the vehicle to remove all freeplay from the bellcrank assembly.
 - c While holding the lever in this position, screw the adjusting screw in until it just contacts the backing plate and then loosen it one turn. Tighten the locknut and install the return spring.
- 8 Working inside the vehicle, adjust the handbrake cable adjusting nut until the brakes drag firmly with the handbrake lever applied 6 – 8 notches.



Turn the adjusting screw until it touches the backing plate, then back off one turn.

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- 9 Release the handbrake lever and check that the rear brakes do not drag.
- 10 Install the rubber plugs to the discs and if removed, install the brake calipers.
- 11 Install the rear wheels and tighten the retaining nuts to the specified torque in a diagonal sequence.
- 12 Check the handbrake operation with the vehicle parked on an incline. If satisfactory handbrake adjustment cannot be achieved, remove the rear disc and check the handbrake shoes and levers.

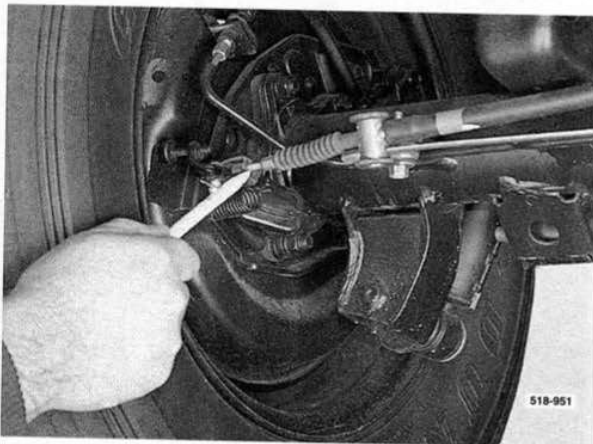
Trouble Shooting

BRAKE PEDAL HARD

- 1 Brake booster inoperative – all models except those with unified ABS: Check that the vacuum hose is not restricted, leaking or disconnected. Check the operation of the brake booster as described later and renew as necessary.
- 2 Incorrect brake pads installed: Check and replace with the recommended type.
- 3 Seized caliper pistons or guide pins: Check and overhaul the calipers.
- 4 Restricted brake line from the master cylinder: Check the brake lines and remove the restriction or renew the line.
- 5 Seized pedal pivot: Rectify or renew the pivot shaft and bushes.
- 6 Faulty ABS assembly – unified ABS models: Refer the vehicle to an authorised dealer.

BRAKE DRAG

- 1 Seized caliper pistons or caliper guide pins: Check and overhaul the calipers.
- 2 Incorrectly adjusted handbrake shoes: Check the handbrake shoe adjustment.
- 3 Seized handbrake cables: Free up or renew the cable(s).
- 4 Incorrectly adjusted handbrake cable: Adjust the handbrake cable.
- 5 Blocked or restricted master cylinder ports, brake lines or hoses: Check and clean the master cylinder, the fluid reservoir and the brake lines.



Check the handbrake cable for fraying. A frayed handbrake cable can cause rear brake drag.

- 6 Defective brake booster: Check the operation of the brake booster as described later and renew as necessary.
- 7 Seized pedal pivot: Rectify or renew the pivot shaft and bushes.
- 8 Incorrectly adjusted brake booster pushrod: Check and adjust the pushrod as necessary.



To check brake drag, raise the vehicle and spin the wheels, one at a time, to check for binding. If the wheels are not binding, have an assistant apply and release the brakes. Check if the brakes release immediately.

A blocked master cylinder port will cause binding on the two wheels fed by that particular circuit from the master cylinder. Open the bleeder valve on the suspect brake assembly to check if pressure build up is the cause of the binding.

A seized handbrake cable will usually cause binding on a rear wheel. To check this condition, disconnect the handbrake cable and check if the wheel will then turn freely.

LOW SPONGY BRAKE PEDAL

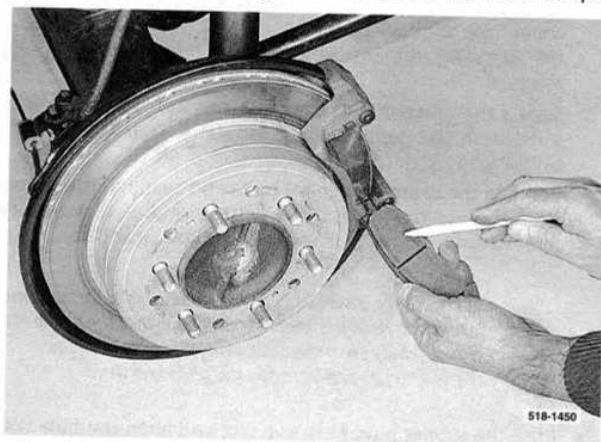
- 1 Insufficient fluid in the hydraulic system: Check for leaks, replenish the fluid and bleed the hydraulic system.
- 2 Air in the hydraulic system: Bleed the hydraulic system.
- 3 Faulty master cylinder: Overhaul the master cylinder.
- 4 Incorrect or worn brake pads: Renew the brake pads.



A spongy brake pedal in most cases is caused by air in the hydraulic system. For air to enter the system one or more of the sealing rubbers or pipes allow air to be sucked in and is usually indicated by fluid leakage. Always rectify the cause of the trouble before bleeding the brake system.

BRAKES LOCK ON APPLICATION

- 1 Gummy brake pads due to oil or fluid contamination: Rectify the source of the fluid leak and renew the brake pads.
- 2 Distorted brake disc: Machine or renew the faulty disc.
- 3 Incorrect brake pads installed: Check and renew the pads as a set, with the correct type.
- 4 Faulty or incorrectly adjusted load sensing proportioning valve: Check for damage or looseness of the valve components.



Check the rear brake pads for wear and contamination.

nents and refer the vehicle to an authorised dealer if the problem remains.

TIP If this condition arises, remove all the wheels and check the friction material for oil contamination and excessive wear. A distorted brake disc will be indicated by pulsating brake pedal when the brakes are lightly applied.

BRAKE PEDAL PULSATES

- 1 Distorted brake disc: Check and machine or renew the brake disc as necessary.
- 2 Loose or worn front or rear hub bearings: Renew the hub bearings as necessary.

i On vehicles with ABS, some pulsation of the brake pedal is normal during heavy braking.
Check and if necessary, renew the hubs and/or bearings as outlined in the relevant suspension chapter. Brake discs that are distorted must be machined. This job is best entrusted to a brake specialist who will also be able to determine if a new brake disc needs to be installed.

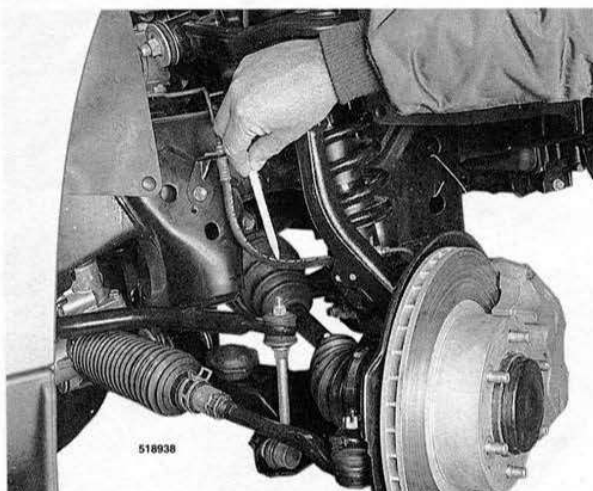
BRAKE FADE

- 1 Brake pads saturated with hydraulic fluid: Rectify the leak and renew the brake pads as a complete set.
- 2 Incorrect brake pads installed: Check and install the correct pads in sets.
- 3 Brakes overheating: Refer to the Brakes Overheating heading.

TIP In most cases brake fade is caused by overuse of the footbrake, which in turn causes a build up of heat at the friction material and discs. Once this excessive build up of heat is allowed to dissipate, the brakes should again function normally.

BRAKES OVERHEATING

- 1 Brakes dragging: Refer to the Brake Drag heading.
- 2 Incorrect or worn brake pads: Renew the brake pads as a set.
- 3 Overuse of the footbrake: Revise driving habits.



Check the brake hoses for swelling and deterioration.

BRAKE FAILURE

- 1 Faulty master cylinder: Overhaul or renew the master cylinder.
- 2 Loss of brake fluid due to a leaking caliper: Overhaul or renew the caliper assembly and bleed the hydraulic system.
- 3 Loss of brake fluid due to a fractured hose, pipe or faulty union: Renew the faulty components as necessary and bleed the hydraulic system.
- 4 Air in the hydraulic system: Locate the source of the air leak and rectify. Bleed the hydraulic system.
- 5 Water in the hydraulic fluid: Drain, flush, refill and bleed the hydraulic system.

i To locate the source of a brake fluid leak, refill the master cylinder reservoir with brake fluid and have an assistant pump the brake pedal. Check for obvious signs of external leakage prior to dismantling and overhauling the brake system.

BRAKE NOISE

- 1 Brakes squeal on application: Glazed friction material. Remove and inspect the brake pads and deglaze the friction material with emery paper.
- 2 Grinding noise on application: Friction material worn away. Inspect the friction material on the brake pads. Renew the brake pads as necessary and machine or renew the brake disc.

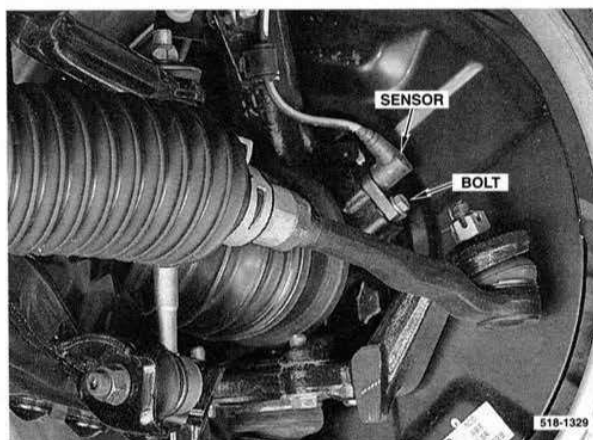
i It is normal for brakes to emit an occasional squeal due to conditions such as moisture, dirt, salt and temperature variances.

In most cases excessive brake squeal is caused by the friction material on the brake pads becoming glazed. Unsuitable friction material or the omission of anti-squeal shims or anti-rattle springs may also cause brake noise. If the brake pads require renewal always renew the brake pads as a complete set.

If badly scored, the brake disc should be machined or renewed to restore full braking efficiency.

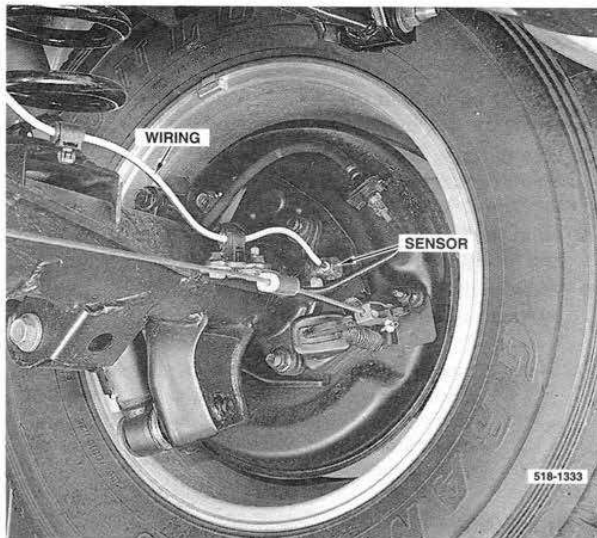
ABS WARNING LAMP STAYS ON

The ABS warning lamp, when illuminated for longer than 3 seconds after starting the engine, indicates a fault within the antilock braking (ABS) system. While specialised equipment is required to diagnose faults within this system, the following



Location of the front ABS sensor.

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Location of the rear ABS sensor.

procedures outline basic checks that can assist in locating a fault prior to referring the vehicle to an authorised dealer.

- 1 Front and rear hub bearings damaged or worn: Check the hub bearings as described in the relevant suspension chapter and renew hub and/or bearings if necessary.
- 2 Damaged ABS wheel sensor or pulse ring: Check the wheel sensors and pulse rings for any signs of damage and renew components as necessary.
- 3 Faulty wiring between the module and the ABS warning lamp: Check the wiring, referring to the wiring diagrams in Body Electrical (chapter 16).
- 4 Damaged or corroded wiring connectors: Disconnect and check each wheel sensor connector and the ABS modulator wiring connector for corrosion or backed out terminals. Repair or renew components as necessary.
- 5 Faulty ABS modulator: Refer the vehicle to an authorised dealer who has the necessary equipment to check the ABS modulator.

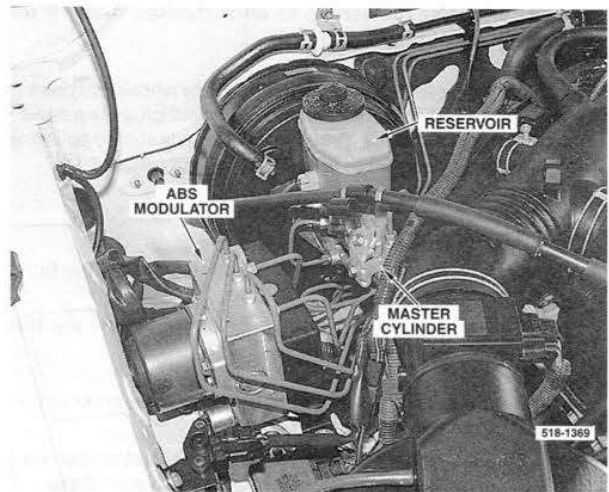
Master Cylinder

TO REMOVE AND INSTALL

Models Without Unified ABS

On models with early ABS, the modulator is located separately from the master cylinder on the right hand side wheel arch panel. A conventional vacuum brake booster is used.

- 1 Install a cover to the driver side mudguard to prevent damage to the vehicle paintwork.
- 2 Remove the master cylinder reservoir cap and, using a syringe, withdraw the brake fluid from the reservoir into a container. Discard the brake fluid.
- 3 Remove the bolt retaining the throttle and cruise control cable bracket and place the bracket with the cables still attached clear of the work area.
- 4 Disconnect the wiring from the warning switch on the master cylinder.



Master cylinder installed. Models with early ABS.

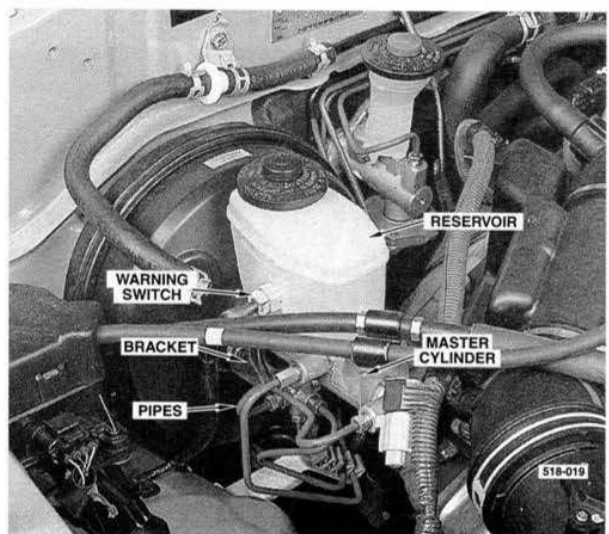
- 5 Disconnect the brake pipes from the outlets on the master cylinder and seal all the pipes to prevent the entry of dirt.
- 6 Remove the nuts retaining the master cylinder to the brake booster and remove the pipe bracket and the master cylinder assembly. Discard the gasket.

i Care should be exercised when removing or installing the master cylinder assembly to ensure that the brake fluid is not spilt on the vehicle paintwork. Brake fluid, if spilt, should be immediately washed away with water and allowed to dry naturally.

Do not depress the brake pedal, or disturb the pushrod after the master cylinder has been removed, as damage to the brake booster could result.

Installation is a reversal of the removal procedure with attention to the following points:

- 1 Place a new gasket on the brake booster studs. Loosely install the master cylinder and the bracket to the brake booster.



Master cylinder installed. Models without ABS.

- 2 Loosely install the brake pipes and tighten the master cylinder retaining nuts to the specified torque.
- 3 Connect the wiring to the warning switch.
- 4 Tighten the brake pipe union nuts and bleed the brakes as described later in this chapter.

Models With Unified ABS

The master cylinder assembly on late models with unified ABS contains the booster pump motor and the accumulator in one unit. A conventional vacuum brake booster is not used.

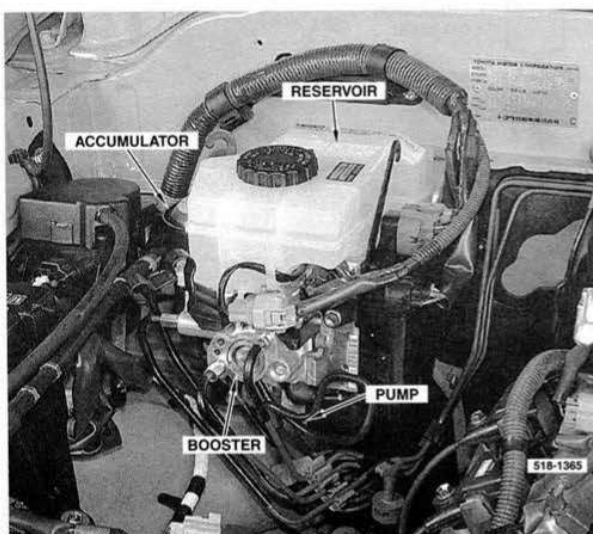
- 1 Turn the ignition Off and pump the brake pedal at least 40 times to release the residual pressure from the brake system.

i While the master cylinder is removed, do not turn the ignition On.

- 2 Install a cover to the driver side mudguard to prevent damage to the vehicle paintwork.
- 3 Remove the master cylinder reservoir cap and, using a syringe, withdraw the brake fluid from the reservoir into a container. Discard the brake fluid.
- 4 Disconnect the wiring connectors from the master cylinder reservoir and from the booster module.
- 5 Disconnect the brake pipes from the outlets on the master cylinder and seal all the pipes to prevent the entry of dirt.

i The pipes must not be distorted while disconnecting them from the master cylinder, as the high pressure in the system after installation could cause the pipes to split.

- 6 Working under the steering column, remove the lower dash panel as follows:
 - a Remove the screws retaining the bonnet and fuel filler door remote handles. Push the handles toward the front of the vehicle, to release the hooks, and manoeuvre the handles from the lower dash panel.
 - b Remove the bolt and screw retaining the lower dash panel.
 - c Partially remove the panel, disconnect the wiring connectors and withdraw the panel from the dashboard.



Late model (unified) ABS master cylinder and components.

- 7 Release the air duct from the fittings, by pulling the ends of the duct firmly downward. Withdraw the duct from under the dashboard.
- 8 Remove the retaining clip and withdraw the heater duct.
- 9 Release the return spring from the brake pedal. Remove the clip retaining the clevis pin and withdraw the wave washer. Remove the pin from the clevis.
- 10 While an assistant supports the master cylinder in the engine compartment, remove the nuts retaining the master cylinder to the firewall under the dashboard. Discard the gasket.
- 11 Withdraw the master cylinder assembly from the vehicle. Installation is a reversal of the removal procedure with attention to the following points:

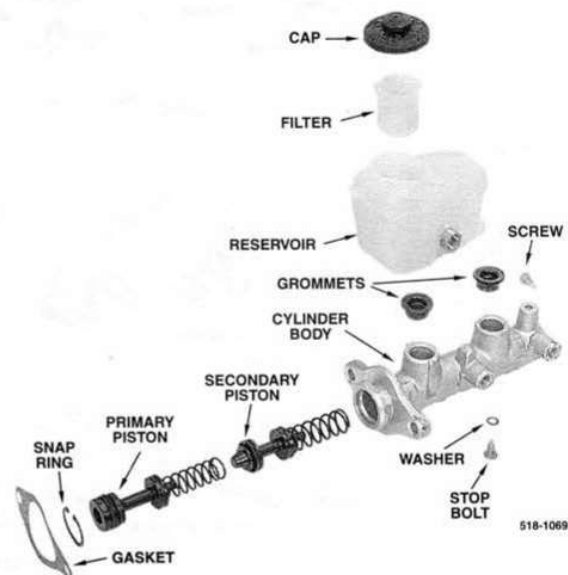
- 1 Install a new gasket to the master cylinder, install the master cylinder and tighten the retaining nuts to the specified torque.
- 2 Connect the clevis to the brake pedal, and secure the clevis pin with the clip.
- 3 Connect the return spring and install the lower dashboard panel and associated components.
- 4 Bleed the hydraulic system as described later in this chapter.

TO DISMANTLE

Models Without Unified ABS

If the master cylinder is worn or leaking it is often more economically viable to install a new or exchange cylinder rather than overhauling the original assembly. Check the price difference before proceeding.

- 1 With the master cylinder removed, as previously described drain the remaining fluid from the reservoir.
- 2 Remove the reservoir retaining screw from the side of the master cylinder.
- 3 Ease the reservoir from the master cylinder and remove the rubber sealing grommets.
- 4 While depressing the piston, remove the stop bolt from the master cylinder. Discard the washer.



Brake master cylinder components. Models without ABS. Models with early ABS are similar.

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- 5 Depress the piston and remove the snap ring from the groove at the rear of the master cylinder.
- 6 Withdraw the primary piston from the cylinder bore.



Ensure that the piston is straight when withdrawn from the bore. Removing the piston in an angle may damage the cylinder bore.

- 7 Tap the cylinder body gently on a soft block of wood to dislodge the secondary piston assembly and the secondary spring. Do not remove the spring from the secondary piston.
- 8 If the piston seals only are to be renewed, note the installed position of each seal on both pistons. Using a blunt probe, remove and discard the seals. If a major repair kit is to be used, discard the piston assemblies and seals.

Models With Unified ABS

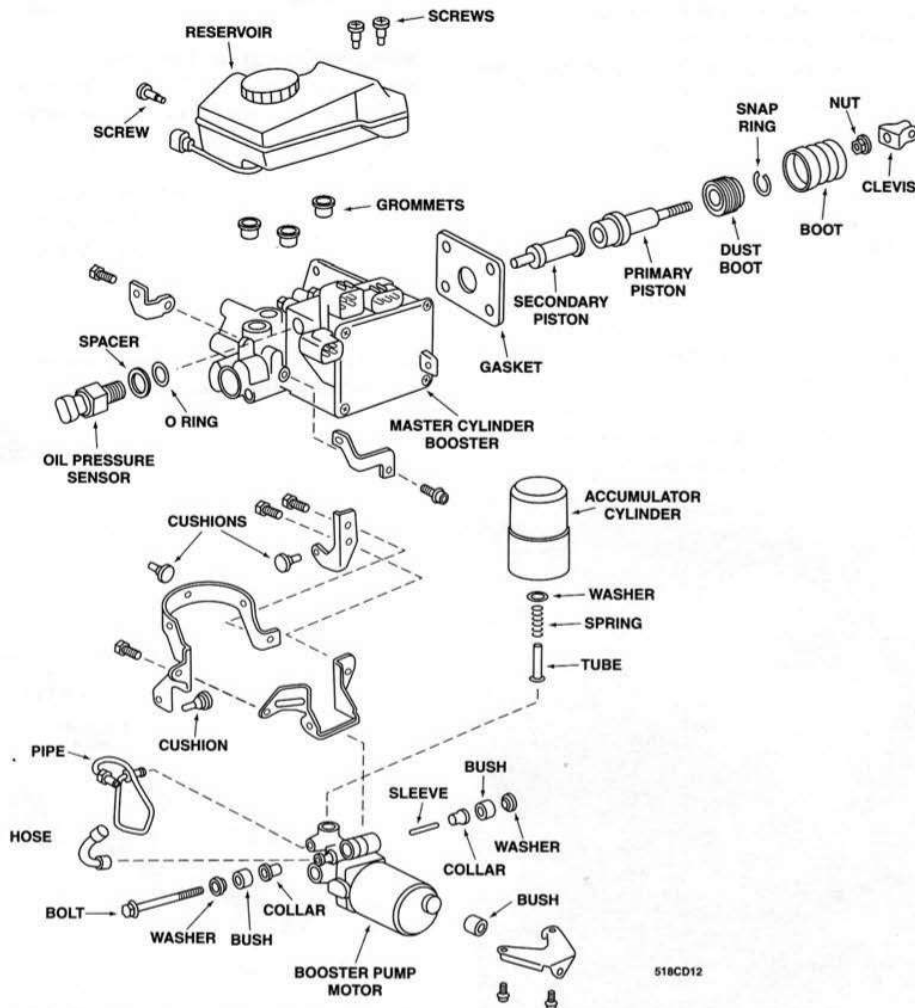
Due to the complex design of this unit, it is highly recommended that a new or exchange assembly is installed, rather than overhauling the original.

- 1 With the master cylinder removed, as previously described drain the remaining fluid from the reservoir.



Do not attempt to dismantle this unit, if the brake pedal was not depressed more than 40 times with the ignition Off. High residual brake pressure will remain in the unit and releasing this fluid could cause injury or blindness.

- 2 Disconnect the fluid level warning switch wiring connector. Remove the bolt retaining the clamp and withdraw the clamp. Remove the reservoir retaining screws from the rear and the side of the master cylinder reservoir.
- 3 Ease the reservoir from the master cylinder and remove the rubber sealing grommets.
- 4 Mark the installed position of the clevis lock nut in relation to the piston pushrod, and remove the clevis and the lock nut. Withdraw the dust boot.
- 5 Remove the retaining bolts and withdraw the support brackets.
- 6 Using a suitable pipe spanner, loosen the ABS modulator pipe flare nuts and withdraw the pipe.
- 7 Remove the booster pump motor as follows:
 - a Release the hose clips and remove the modulator hose from the fittings on the master cylinder and on the booster pump motor.



Unified ABS unit dismantled.

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- b Remove the screws retaining the wiring harness, release the connectors and withdraw the harness from the pump motor.
- c Measure and note the distance between the accumulator cylinder and the large support bracket. Mark the installed position of the brackets and remove the bolts retaining the accumulator brackets. Withdraw the small and large brackets from the booster assembly.
- d Remove the bolt retaining the large booster pump motor bracket and withdraw the bracket. Noting their installed position, collect the dished washers, the bushes and the collars. Withdraw the sleeve from the booster pump motor body.
- e Remove the bolts and withdraw the small pump motor bracket and the bush. Separate the booster pump motor from the booster assembly.
- 8 Using a 30 mm deep socket, remove the oil pressure sensor and the spacer washer. Discard the O ring.
- 9 While depressing the piston, remove the snap ring retaining the piston assembly in the bore of the master cylinder.



Use a screwdriver or similar to remove the snap ring from the groove.

- 10 Tap the cylinder body gently on a soft block of wood to dislodge the primary and secondary pistons assembly from the cylinder bore. Noting their installed position and direction, withdraw the pistons from the master cylinder bore.



Ensure that the pistons are held straight while withdrawing them from the cylinder, as the pistons and/or cylinder could be damaged if they are removed at an angle.

- 11 If necessary on unified ABS models, place the booster pump motor in a vice fitted with soft jaws and using a suitably size oil filter wrench, remove the accumulator from the pump motor. Discard the O ring and remove the spring and the tube from the pump motor.

TO CLEAN AND INSPECT

- 1 Wash all the external components thoroughly in clean methylated spirits. Do not use petrol, kerosene or other cleaning solvents. Wash all the internal components thoroughly in clean brake fluid.
- 2 Check the master cylinder bore for wear, corrosion or pitting.



Do not hone the master cylinder bore. If the bore is pitted or worn, renew the master cylinder as an assembly or consult a brake specialist. Resleeving of the master cylinder may be possible.

- 3 Ensure that all the inlet and compensating ports between the reservoir and the cylinder bore are free of any obstruction.
- 4 Discard all used rubber parts.
- 5 Check the primary and secondary pistons for scores or scratches. Renew if necessary.
- 6 On models with unified ABS, pay particular attention to the rubber cushions on the large accumulator bracket. Renew the cushions if worn or distorted.
- 7 On models with unified ABS, check the operation of the booster pump motor by applying battery power to the wiring connector terminals on the pump body. The pump should operate.

TO ASSEMBLE



Use a genuine major repair kit which contains preassembled pistons and springs. This will ensure a thorough overhaul and long service from the unit.

Always use all the parts supplied in the repair kit.

Assembly is a reversal of the dismantling procedure with attention to the following points:

- 1 Apply rubber grease or clean brake fluid to all rubber components prior to installation.
- 2 Install the seals to the pistons in the position noted previously.
- 3 Lubricate the master cylinder bore with clean brake fluid and install the piston assemblies to the cylinder bore in the positions noted on removal.
- 4 Depress the pistons into the cylinder bore and install the snap ring. On models without ABS, install the stop bolt using a new washer.



When installing the stop bolt, push the pistons into the cylinder, using a blunt instrument.

- 5 Lubricate the reservoir grommets with rubber grease or clean brake fluid and install the grommets to the master cylinder.
- 6 Push the reservoir into the grommets and install the retaining screw(s). Tighten the screw(s) to the specified torque.
- 7 On models with unified ABS, proceed as follows:
 - a If removed, install the accumulator tube and spring to the booster pump motor in the position noted during removal. Place a new O ring on the motor and install accumulator. Tighten to the specified torque.
 - b Install the sleeve, the collars, the cushions and the dished washers to the pump motor body, prior to installing the large pump motor bracket.
 - c Install the oil pressure sensor using a new O ring. Tighten the sensor to the specified torque.
 - d Loosely install the large booster pump bracket around the accumulator cylinder. Ensure that the clearance between the cylinder and the bracket is as noted during removal, and that the marks on the bracket are aligned prior to tightening the retaining bolts.
- 8 Install the master cylinder to the vehicle as previously described.
- 9 Bleed the brake hydraulic system, as described later in the chapter.

Front Disc Brakes

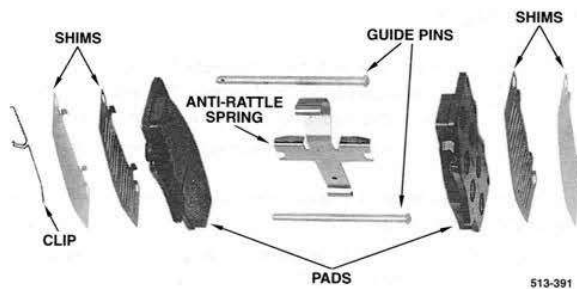


To Check Disc Runout — Dial gauge
To Check Disc Thickness — Micrometer

TO RENEW BRAKE PADS

- 1 Raise the front of the vehicle and support on chassis stands. Refer to General Information (chapter 1) for the correct vehicle jacking points. Remove the front wheels.

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**Front brake pad components.**

- 2 Drain approximately two thirds of the brake fluid from the master cylinder reservoir using a syringe. Discard this fluid.



The fluid is drained from the reservoir to prevent overflow when the caliper pistons are pushed back into the bores to facilitate pad renewal.

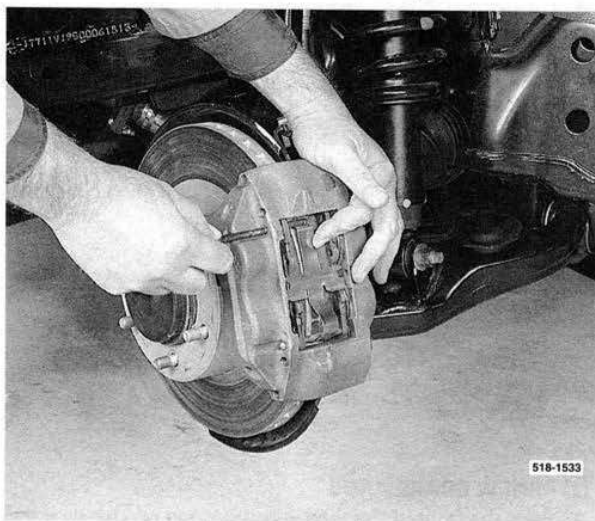
Complete work on one caliper at a time and renew brake pads as sets of four.

- 3 Remove the guide pin retaining clip and withdraw the guide pins and the anti-rattle spring from the brake caliper. Note the position of the anti-rattle spring.
- 4 Note the installed position and remove one brake pad and shims from the caliper.



Doing one brake pad at a time will prevent the other caliper pistons being forced from the bores.

- 5 Using two pieces of timber, slowly push the pistons fully back into the caliper. If leaks are evident or the dust boots are deteriorated, it is recommended that the caliper be overhauled.
- 6 Sparingly apply high melting point disc brake grease to both sides of the inner shims and install the inner and outer shims to the pad. Install the pad to the caliper.
- 7 Repeat steps 5 and 6 on the other brake pad.



Removing the guide pin from the front caliper. Note the installed position of the anti-rattle spring.

- 8 Install the anti-rattle spring. Ensure that the shims and anti-rattle springs are not corroded or damaged. Renew components as necessary.
- 9 Install the guide pins and the retaining clip.
- 10 Pump the brake pedal to bring the pads to their original position alongside the disc and top up the brake master cylinder reservoir with the recommended brake fluid.
- 11 Install the front wheels, and tighten the wheel nuts to the specified torque, in a diagonal sequence.
- 12 Road test the vehicle and check for correct brake operation.



To extend the service life of the new disc pads, find an area clear of traffic and perform ten moderate brake applications from about 70 km/h to 40 km/h every 500 metres.

TO OVERHAUL CALIPER

- 1 Raise the front of the vehicle and support on chassis stands. Refer to General Information (chapter 1) for the correct vehicle jacking points. Remove the front wheels.
- 2 Unscrew the union connecting the brake pipe to the caliper body, disconnect the brake pipe and seal to prevent the loss of fluid and the entry of dirt.
- 3 Noting the installed position of components, remove the brake pads and shims from the caliper.
- 4 Remove the retaining bolts and lift the caliper assembly from the steering knuckle.
- 5 Using a small screwdriver, prise the retaining rings and the dust boots from the caliper.
- 6 Position a piece of wood, the approximate thickness of a brake pad against the outer pad locating lugs of the caliper and using low air pressure applied to the brake hose aperture in the caliper, remove the piston from the caliper.

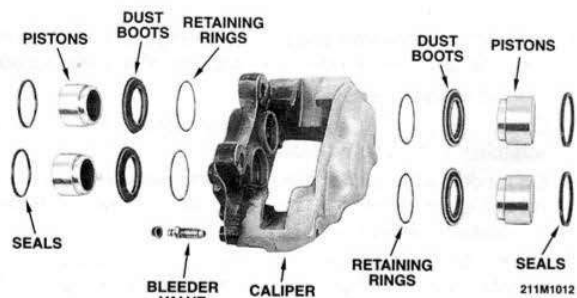


On models without unified ABS, if the pistons cannot be dislodged or compressed air is not available, connect the brake hose and slowly depress the brake pedal until the pistons are forced from the caliper. If removing the pistons in this way, only have one caliper removed from the disc at a time.

- 7 Using a thin, blunt probe, preferably made from wood or plastic, remove and discard each piston seal from the groove in the caliper bore.



Using a tooth pick or similar to remove the O ring will prevent scratching grooves in the caliper bore. Avoid separating the two halves of the caliper, as the factory matching is hard to replicate.



Front brake caliper components.

- 8 Remove the cap and the bleeder valve from the caliper body and check that the valve and the port are clear.
- 9 Inspect all caliper components for wear and corrosion. Pay particular attention to the pistons and caliper bores. Renew worn or corroded components as necessary.



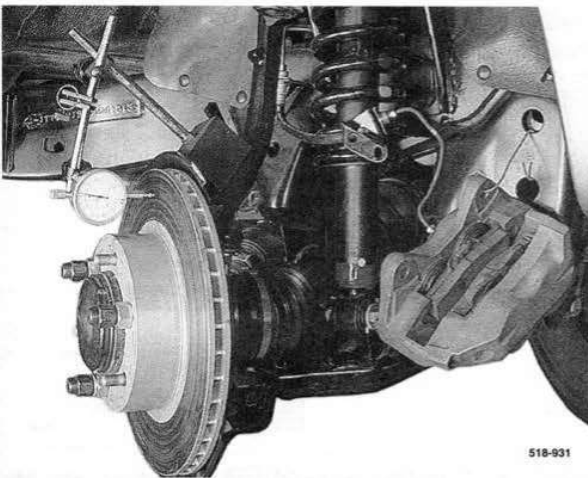
When overhauling a caliper, it is recommended that a genuine repair kit containing the rubber parts and, if supplied, the special grease is used. Use rubber grease if the repair kit does not contain the special grease.

- 10 Lubricate a new piston seal with the special grease. Insert the seal into the groove in the caliper bore ensuring that the seal is correctly seated and not twisted.
- 11 Coat the outside of the piston and the inside of the new dust cover with rubber grease and install the small outer end of the dust cover over the inner end of the piston.
- 12 Insert the inner end of the dust cover into the groove in the outer end of the caliper bore.
- 13 Using a hammer handle, gently push the piston into the cylinder bore until the dust seal groove in the piston is just above the top of the caliper bore. Do not tilt or use force to install the pistons.
- 14 Install the retaining ring to the dust boot. Repeat the above procedure on the remaining three pistons.
- 15 Lift the caliper assembly over the brake disc and install the retaining bolts. Tighten the bolts to the specified torque.
- 16 Install the brake pipe to the caliper and tighten the union securely.
- 17 Install the brake pads, the shims and the anti-rattle spring to the caliper in the position noted during removal.
- 18 Bleed the brakes as described later in this chapter.

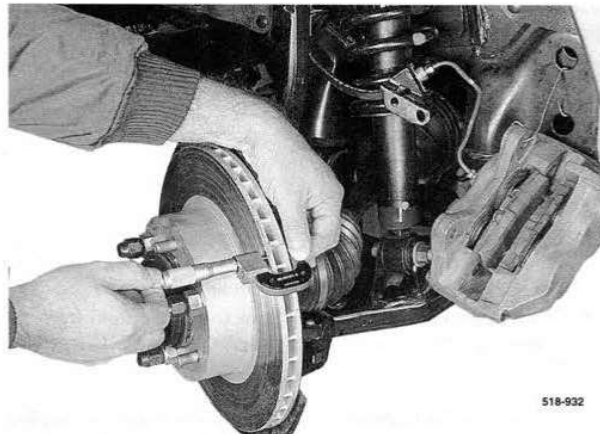
BRAKE DISC

To Check

- 1 Raise the front of the vehicle and support on chassis stands. Refer to General Information (chapter 1) for the correct vehicle jacking points. Remove the front wheels.
- 2 Secure the brake disc to the hub, using at least three wheel nuts, with suitable spacers between them and the disc. Tighten the nuts securely.



Checking the brake disc runout using a dial gauge.



Checking the front disc thickness using a micrometer.

- 3 Remove the brake pads as described under To Renew, to allow the disc to turn easily.
- 4 Mount a dial gauge to a suspension component and position the plunger against the machined face of the disc approximately 10 mm from the outer edge of the disc.
- 5 Rotate the disc and measure the runout.
- 6 If the runout exceeds Specifications, check the front hub bearing freeplay as described in Front Axle and Suspension (chapter 13). If the end float of the front hub bearing is within Specifications, machine or renew the brake disc.
- 7 Using a micrometer, check the thickness of the machined faces of the disc at several points. Renew the disc if the thickness is less than specified at any point.

To Remove and Install

- 1 Raise the front of the vehicle and support on chassis stands. Refer to General Information (chapter 1) for the correct vehicle jacking and points. Remove the front wheels.
- 2 Remove the caliper retaining bolts and lift the caliper assembly from the steering knuckle. Suspend the caliper assembly from the suspension using wire or similar ensuring, that the weight of the caliper is not taken by the brake hose.
- 3 If the disc is to be reused, suitably mark the location of the disc in relation to the hub to aid assembly and withdraw the brake disc from the front hub.
- 4 Inspect the machined faces on the sides of the disc for scores, cracks, wear and signs of overheating. If the disc is badly scored it must be machined.



Disc machining is best entrusted to a brake specialist who can advise on disc serviceability.

Installation is a reversal of the removal procedure with attention to the following points:

- 1 Ensure that the mating faces of the disc and the hub are clean and free from burrs and that the marks made on removal are aligned.
- 2 Inspect the brake pads and renew as required.
- 3 Install the brake caliper and tighten the retaining bolts to the specified torque.
- 4 Pump the brake pedal several times to bring the pads to their original position alongside the disc.

Rear Disc Brakes and Handbrake



To Check Disc Runout — Dial gauge
To Check Disc Thickness — Micrometer

TO RENEW BRAKE PADS

- 1 Raise the rear of the vehicle and support on chassis stands. Refer to General Information (chapter 1) for the positions of the jacking points. Remove the rear wheels.
- 2 Drain approximately two thirds of the brake fluid from the master cylinder reservoir using a syringe or ladle. Discard this fluid.



The fluid is drained from the reservoir to prevent overflow when the caliper piston is pushed back into the bore to facilitate pad renewal.

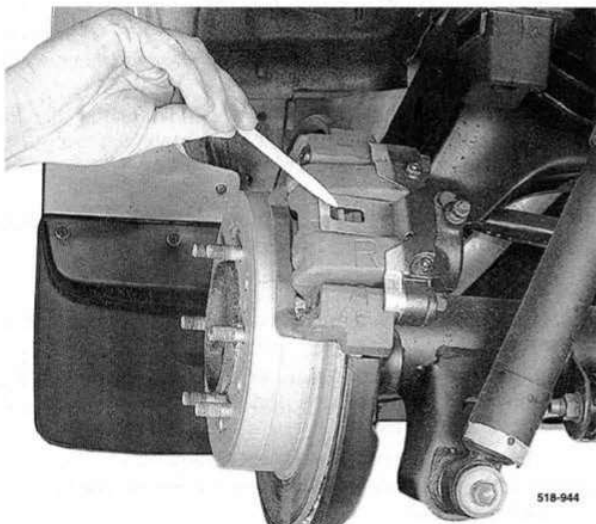
Complete work on one caliper at a time and renew brake pads as sets of four.

- 3 Remove the guide pin bolts from the caliper and remove the caliper, to expose the pads, shims and retainers in the anchor plate. Support the caliper using wire or cord.
- 4 Noting their installed positions, remove the brake pads, and separate the retainers and shims from the brake pads. Also remove the brake pad wear indicator plates.
- 5 Check the shims and retainers for wear and damage. If necessary, renew the unserviceable components.
- 6 Push the piston squarely by hand into the caliper bore and check for fluid leaks.

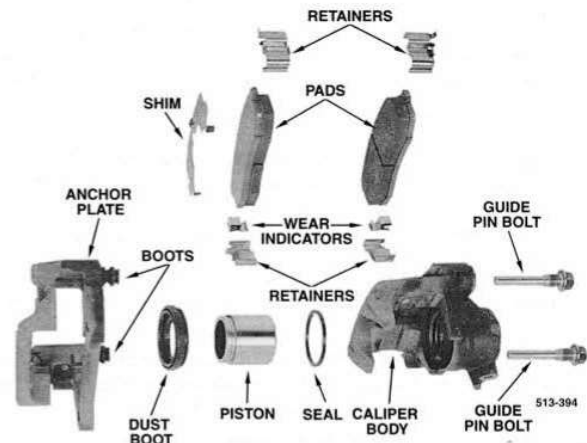


If the piston cannot be pushed into the caliper bore by hand, use a G clamp or fabricate a tool as illustrated. Install the friction surface of the old brake pad towards the piston when using the fabricated tool, as this will prevent damage to the piston.

If excessive force is required to move the piston, if leaks are present or the dust seals have deteriorated, the caliper must be overhauled.



Checking the rear brake pad thickness through the caliper inspection hole.



Rear brake caliper components.

- 7 Install the shims and the wear indicator plates to the pads and install the retainers to the anchor plate in the positions noted on removal.
- 8 Ensure that the caliper guide pin bolts slide freely in the anchor plate. If not, clean the anchor plate and sparingly apply high melting point grease to the bolts.
- 9 Install the caliper, over the brake pads and tighten the guide pin bolts to the specified torque.
- 10 Pump the brake pedal to bring the pads to their original position alongside the disc and top up the brake master cylinder reservoir with the recommended brake fluid.
- 11 Install the rear wheels, and tighten the wheel nuts to the specified torque, in a diagonal sequence.
- 12 Road test the vehicle and check for correct brake operation.



To extend the service life of the new disc pads, find an area clear of traffic and perform ten moderate brake applications from about 70 km/h to 40 km/h every 500 metres.

TO OVERHAUL CALIPER

Overhauling the rear brake caliper is similar to overhauling the front brake caliper, which is described under the Front Disc Brakes heading.

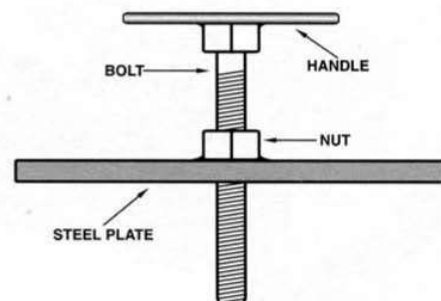


Illustration of a tool that can be fabricated to push the piston into the caliper bore.

BRAKE DISC

To Check

Checking the disc runout and the thickness is similar to the front brake disc. The procedure is described under the Front Disc Brakes heading.

To Remove and Install

- 1 Raise the rear of the vehicle and support on chassis stands. Refer to General Information (chapter 1) for the positions of the jacking points.
- 2 Remove the brake caliper anchor plate retaining bolts and withdraw the brake caliper and anchor plate as an assembly.
- 3 Suspend the caliper assembly from the vehicle body using wire or similar ensuring, that the weight of the caliper is not taken by the brake hose.
- 4 Mark the location of the disc in relation to the axle hub to aid assembly and withdraw the brake disc from the rear axle flange. Discard the gasket.

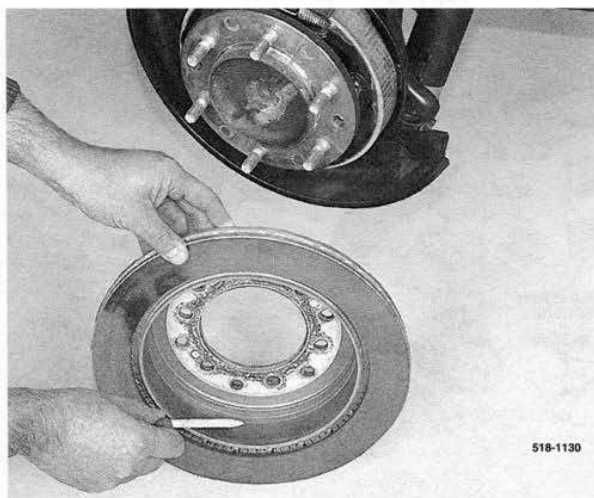
TIP If the disc cannot be withdrawn more than a small amount, the handbrake shoes may be holding it. Remove the plug from the disc, insert a thin screwdriver into the access hole and engage the teeth on the adjuster wheel. Rotate the wheel downwards to retract the handbrake shoes until the disc can be withdrawn.

- 5 Inspect the machined faces on the sides of the disc for scores, cracks, wear and signs of overheating. If the disc is badly scored it must be machined. Check the handbrake drum surface for scoring or excessive wear.

i Disc machining is best entrusted to a reliable brake specialist who can advise on disc serviceability.

Installation is a reversal of the removal procedure with attention to the following points:

- 1 Ensure that the mating faces of the disc and the flange are clean and free from burrs. Install a new gasket to the axle flange and install the brake disc ensuring that the marks made on removal are aligned.



Check the handbrake drum surface for scoring or excessive wear.

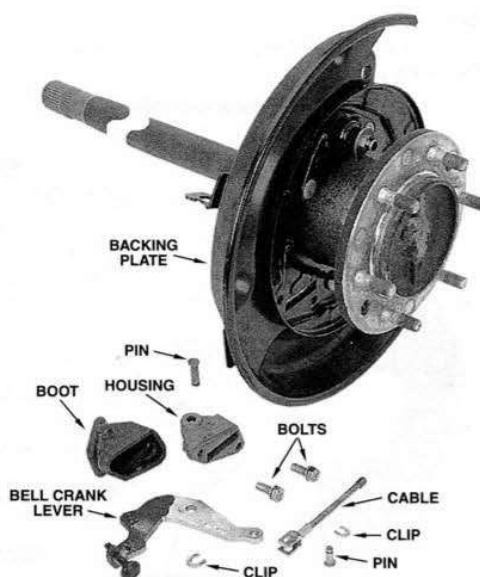
TIP If a new disc is installed, remove the protective coating from the disc using solvent.

- 2 Inspect the brake pads and renew as required.
- 3 Install the anchor plate and caliper and tighten the bolts to the specified torque.
- 4 Adjust the handbrake as described in Routine Maintenance, under the heading To Adjust Handbrake.

HANDBRAKE SHOES, BELL CRANK AND ADJUSTER

To Remove

- 1 Raise the rear of the vehicle and support on chassis stands placed under the rear suspension arms. Refer to General Information (chapter 1) for the correct vehicle jacking points. Remove the rear wheels.
- 2 Remove the rear disc assembly as previously described.
- 3 Check the linings for excessive wear, oil saturation or contamination. The shoes should be renewed, using the following procedure, if the linings are less than 1 mm thick, unevenly worn or contaminated with fluid or grease.
- 4 Mark the installed position of the brake shoes and the return springs.
- 5 Disconnect the return springs from the brake shoes.
- 6 Spread the top of the brake shoes and, noting their installed position, remove the strut and spring.
- 7 Release the cable return spring from the actuating lever and the inner rear shoe retainer spring seat, and withdraw the spring from the handbrake assembly.
- 8 Remove the hold down springs from each brake shoe by turning the retainers 90 degrees. Remove the retainer, the spring and the spring seat.
- 9 Release the tension spring and, noting its installed position, remove the adjuster from the brake shoes. Withdraw the rear brake shoe from the backing plate.



Handbrake bellcrank dismantled.

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- 10 Partially withdraw the front brake shoe from the backing plate. Disconnect the intermediate handbrake cable from the actuating lever and remove the front brake shoe from the backing plate.
- 11 If the brake shoes are to be renewed, remove the clip and shim and withdraw the actuating lever from the front brake shoe.
- 12 If necessary, remove and dismantle the handbrake bellcrank as follows:
 - a Working at the rear of the backing plate, remove the clip and pin and disconnect the handbrake cable from the bellcrank lever, using care not to misplace the retaining clip.
 - b Disconnect the return springs from the bellcrank lever.
 - c Remove the clip and pin retaining the intermediate handbrake cable to the bellcrank lever.
 - d Remove the retaining bolts and withdraw the bellcrank housing from the backing plate.
 - e Prise the rubber boot away from the housing, remove the clip and retaining pin and separate the lever from the housing. Remove the rubber boot.

To Inspect

- 1 Thoroughly clean all components in methylated spirits and examine for wear and damage.
- 2 Inspect the brake drum part of the rear disc for cracks, scoring and ovality. Machine or renew the drum as necessary.
- 3 Check the brake shoe contact surfaces on the brake backing plate for wear.
- 4 Check all springs for damage, fatigue and loss of tension. Renew any spring where its serviceability is suspect.
- 5 Dismantle the brake shoe adjuster and check that the threads of the screw and adjusting nut are not worn or damaged. Apply a film of high melting point grease to the threads and the sleeve, and install the adjusting screw fully into the adjusting nut, ensuring that it rotates smoothly.

To Assemble

Assembly is a reversal of the dismantling procedure with attention to the following points:

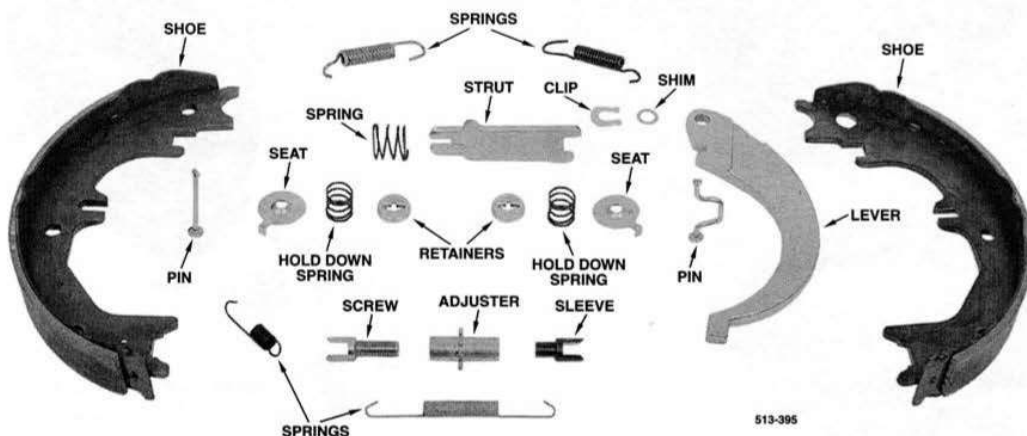
- 1 If dismantled, assemble the bellcrank as follows:

- a Apply rubber grease to the bellcrank boot and assemble the bellcrank assembly ensuring that a new clip is installed to the retaining pin.
- b Install the bellcrank assembly to the backing plate and tighten the bolts to the specified torque.
- c Connect the intermediate handbrake cable to the bellcrank lever using a new clip.
- 2 Sparingly lubricate the brake shoe to backing plate contact points with high melting point grease.
- 3 Install the actuating lever to the front brake shoe and install the shim and a new clip. Measure the clearance between the lever and the shoe at the pivot point. If the clearance exceeds 0.35 mm, remove the clip, install a shim of suitable thickness and install a new clip.



Shims are available in 0.3 mm, 0.6 mm and 0.9 mm thickness.

- 4 Connect the intermediate handbrake cable to the actuating lever.
- 5 Assemble the shoe hold down springs and seats on the backing plate. Install the adjuster and spring to the brake shoes.
- 6 Slide the shoes into position on the backing plate, while lifting the seats of the hold down springs, so the shoes will slide under the spring seats.
- 7 Spread the top of the brake shoes and install the strut and spring, in the position noted during removal and install the return springs.
- 8 Install the spring retaining the rear handbrake shoe to the bracket on the backing plate.
- 9 Install the brake disc ensuring that the marks made on removal are aligned. Adjust the handbrake as previously described under the Routine Maintenance heading.
- 10 Install the anchor plate and the brake caliper and tighten the bolts to the specified torque. Install the rear wheel.
- 11 If new handbrake shoes were installed, drive the vehicle at 50 km/h and apply the handbrake lever with a force of approximately 90 Newtons (10 kg). Drive the vehicle in this condition for approximately 400 metres. Repeat this procedure three times, allowing time for the brakes to cool, between applying the handbrake.



Handbrake shoes and components.

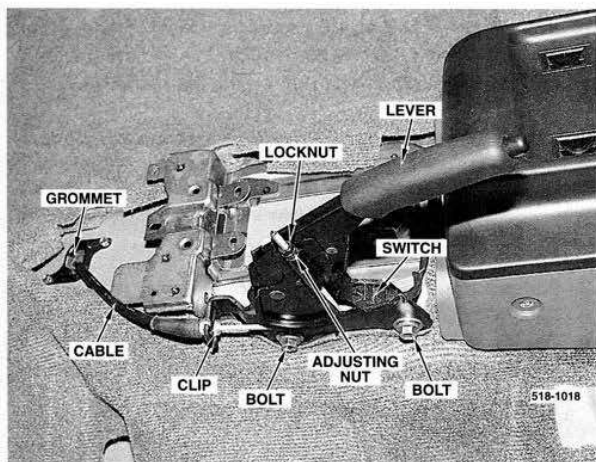
Handbrake Lever

TO REMOVE AND INSTALL

- 1 Remove the rear of the centre console from the vehicle, referring to Body (chapter 17), if necessary.
- 2 Remove the locknut and the adjusting nut from the handbrake cable.
- 3 Disconnect the wiring from the handbrake warning lamp switch.
- 4 Prise the clip retaining the outer handbrake cable to the bracket.
- 5 Remove the bolts retaining the handbrake lever to the floor panel.
- 6 Straighten the cable guide tab, raise the handbrake lever and at the same time manoeuvre the cable from the guide on the lever. Remove the lever assembly from the vehicle.

Installation is a reversal of the removal procedure with attention to the following points:

- 1 Apply multipurpose grease to the lever and ratchet mechanism.
- 2 Ensure that the cable is correctly located in the groove in the lever and bend the retainer.
- 3 Tighten the handbrake lever retaining bolts securely.
- 4 Adjust the handbrake cable as described previously under the Routine Maintenance heading.
- 5 Install the centre console referring to the Body (chapter 17), if necessary.



Handbrake lever installed showing components.

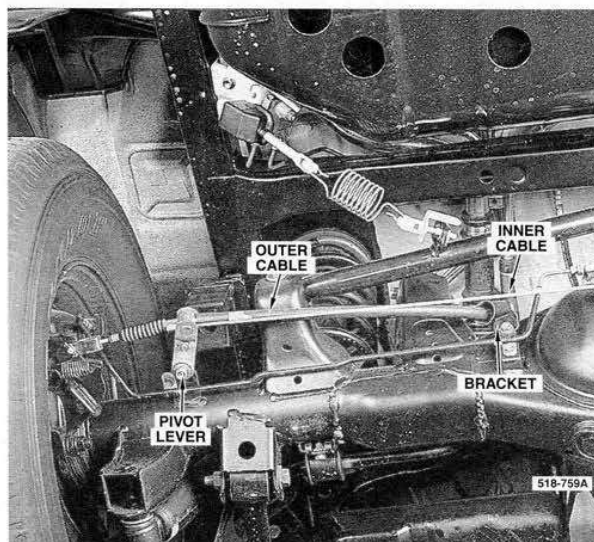
Handbrake Cables

To Remove and Install

- 1 Raise the front and rear of the vehicle and support it on chassis stands. Place the chassis stands at the rear under the rear axle. Refer to General Information (chapter 1) for the correct vehicle jacking points.



It is important that the chassis stands are placed under the rear axle to ensure correct adjustment of the handbrake cables.



Handbrake cable pivot lever installed.

- 2 Remove the rear of centre console and manoeuvre the console from the vehicle, referring to Body (chapter 17), if necessary.
- 3 Remove the adjusting and the lock nuts from the end of the handbrake cable. Carefully bend the locking tab away from the arm.
- 4 Raise the carpet from the floor and remove the bolts retaining the cable grommet to the floor. Withdraw the grommet from the handbrake cable.
- 5 Working under the vehicle, remove the bolt retaining the handbrake cable to the chassis, adjacent to the sub fuel tank.
- 6 Working at the rear of the backing plates, remove the handbrake cable clevis pin retaining clip and remove the clevis pin. Disconnect the handbrake cable from the bellcrank.
- 7 Remove the bolts retaining the handbrake inner cable mounting brackets from the rear axle housing and withdraw the brackets from the axle housing.
- 8 Remove the nut and bolt and withdraw the handbrake cable pivot lever from the rear axle housing. Remove the outer cable support bracket mounting bolt and withdraw the handbrake cable from the vehicle.

Installation is a reversal of the removal procedure with attention to the following points:

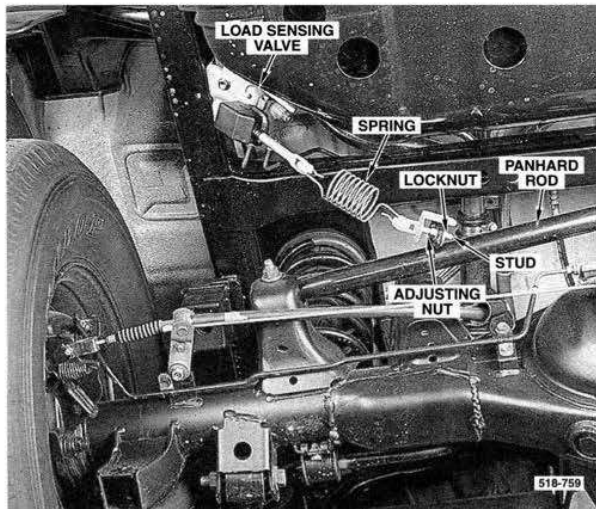
- 1 Install the cable and tighten the bracket retaining bolts securely. Install the clips to the bellcranks.
- 2 Adjust the handbrake, as previously described under Routine Maintenance in this chapter.

Load Sensing Proportioning Valve

TO REMOVE AND INSTALL

- 1 Raise the rear of the vehicle and support on chassis stands. Refer to General Information (chapter 1) for the positions of the jacking points.
- 2 Disconnect the brake pipes from the load sensing valve. Seal the ends of the pipes to prevent the loss of fluid and the entry of dirt.

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Load sensing proportioning valve installed.

- 3 Mark the installed position of the proportioning valve adjusting nut in relation to the bracket on the panhard rod. Suitably mark the adjusting nut in relation to the stud and, while holding the stud, remove the locknut. Place the proportioning valve spring clear of the work area.
- 4 Remove the retaining bolts and nuts and withdraw the load sensing valve from the vehicle.

Installation is a reversal of the removal procedure with attention to the following points:

- 1 Tighten the load sensing valve retaining bolts to the specified torque.
- 2 Guide the proportioning valve stud to the bracket on the panhard rod, ensuring, that the adjusting nut has not moved. Align the mark made on the bracket with the adjusting nut and tighten the locknut to the specified torque.
- 3 Bleed the brakes as described later in this chapter.
- 4 If a new or replacement load sensing valve is installed, have the valve adjusted by an authorised dealer or a brake specialist.

Bleeding the Brake System

TO BLEED

Bleeding the hydraulic system should only be necessary when some portion of the hydraulic system has been disconnected or fluid has been drained, allowing air to enter the system.

There are four points in the system where bleeder valves are installed, one on each caliper.



On late models with a unified ABS do not allow the reservoir to completely empty, as specialist equipment is needed to bleed the system once the reservoir is empty.

- 1 Fill the fluid reservoir with clean brake fluid and maintain at least one third full throughout the entire operation.
- 2 On models with unified ABS, proceed as follows:
 - a Turn the ignition Off and pump the brake pedal at least 40 times to release the residual pressure from the brake system.

- b Turn the ignition On and ensure that the pump stops operating after approximately 30 – 40 seconds.



If the pump does not stop, turn the ignition Off and repeat step a.

- c With the ignition On, pump the brake pedal at least 20 times.
- 3 Attach a transparent hose to the bleeder valve on the left rear caliper and immerse the other end of the hose in a small amount of clean brake fluid contained in a clean glass jar held higher than the bleeder valve.



If desired a one person bleeding kit may be used. These kits usually consist on a transparent tube with a one way ball valve.

With a one person bleeding kit, it is not necessary to close the bleeder valve after each set of pedal strokes; however follow the kit manufacturers instructions.

- 4 Unscrew the bleeder valve one complete turn.
- 5 On models without ABS, or early ABS have an assistant depress the brake pedal slowly to the full extent of its travel. Close the bleeder valve and allow the brake pedal to return without assistance.



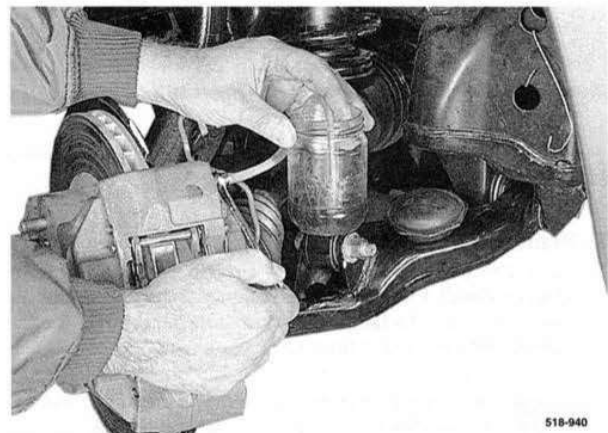
On models with unified ABS, have an assistant hold the brake pedal depressed, while bleeding the brakes. It is not necessary to pump the pedal, but the ignition must be switched On.

- 6 Repeat steps 3 and 4 until a constant stream of fluid, without any air bubbles, is being discharged into the glass jar. Hold the pedal down and tighten the bleeder valve.



Do not allow the fluid level in the reservoir to fall below the one third full level at any time during the operation or air will enter the system and the procedure will have to be repeated. Always use new brake fluid for topping up the reservoir.

- 7 Perform the bleeding procedure on the right rear, left front and right front calipers in that order.
- 8 Top up the reservoir with the specified brake fluid to the MAX level and install the reservoir cap.



Bleeding the brake system.

Brake Booster

The brake booster on models with unified ABS is part of the master cylinder assembly. All procedures under this heading regarding the brake booster only apply to models without unified ABS, as special equipment is required to test that system. Removal of the unified ABS unit is covered under the Master Cylinder heading.

TO CHECK OPERATION

- 1 With the engine switched Off, apply the footbrake several times to exhaust all vacuum from the system.

- 2 Firmly depress the brake pedal and start the engine.

If the brake booster is functioning satisfactorily, a distinct downward movement of the brake pedal should be noticed. Should the pedal fail to fall away when the engine has been started, the vacuum system can be considered inoperative.

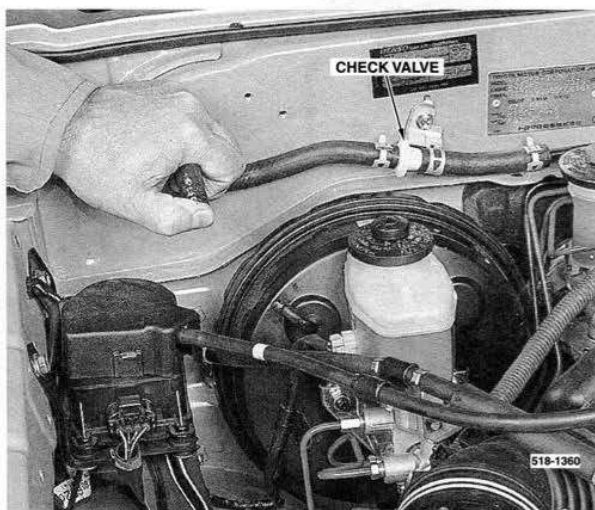
i If the pedal continues to fall away, there is a fault in the hydraulic system.

- 3 Ensure that the brake pedal is fully released, start the engine and run it at medium speed. Stop the engine. Let the vehicle stand for 1 – 2 minutes, press the brake pedal two or three times and check its operation. If there is no vacuum assistance, the vacuum system has developed a leak or the check valve is defective.

TIP Before removing the brake booster from the vehicle for inspection, disconnect the hose from the booster, start the engine and check that manifold vacuum is reaching the booster. Also test the check valve as described below.

TO TEST CHECK VALVE

- 1 Release the retaining clips and disconnect the hoses from the check valve. Remove the retaining bolt and withdraw the valve.
- 2 Check the valve for sticking. Suction on the manifold side should allow air to flow freely. Air blown into the valve from the manifold side should not be able to flow through the valve.



Checking for vacuum at the brake booster hose with the engine running.

- 3 Install the valve and check the operation of the brake booster as previously described.

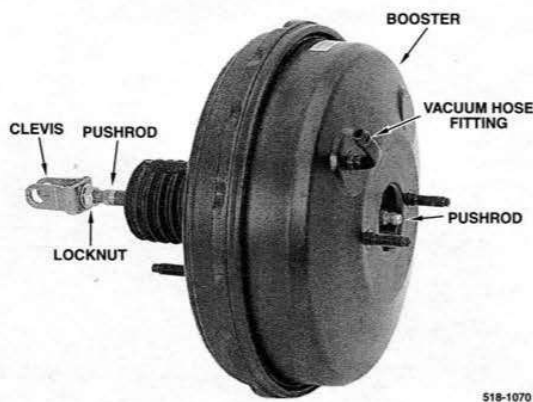
i Check that there are no air leaks at the hose connections and that the hose clips are tight. Also check that the hose is not bulged or collapsed due to deterioration.

TO REMOVE AND INSTALL

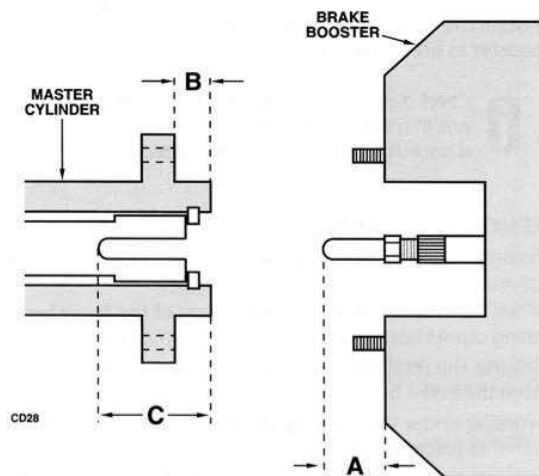
- 1 Remove the nuts retaining the master cylinder to the brake booster.
- 2 Move the master cylinder forward clear of the brake booster being careful not to damage any brake pipes or vehicle wiring.
- 3 Release the retaining clip and disconnect the vacuum hose from the brake booster fitting.
- 4 Working under the steering column, remove the lower dash panel as follows:
 - a Remove the screws retaining the bonnet and fuel filler door remote handles. Push the handles toward the front of the vehicle, to release the hooks, and manoeuvre the handles from the lower dash panel.
 - b Remove the bolt and screw retaining the lower dash panel.
 - c Partially remove the panel, disconnect the wiring connectors and withdraw the panel from the dashboard.
- 5 Release the air duct from the fittings, by pulling the ends of the duct firmly downward. Withdraw the duct from under the dashboard.
- 6 Disconnect the brake pedal return spring, remove the retaining clip and withdraw the clevis pin connecting the pushrod to the brake pedal. Ensure that the wave washer on the pin is not misplaced.
- 7 Remove the retaining nuts and remove the brake booster from the vehicle. Discard the gasket.

Installation is a reversal of the removal procedure with attention to the following points:

- 1 Prior to installation, check and if necessary, adjust the brake booster pushrod clearance as described under the following heading.
- 2 Install a new gasket, prior to installing the brake booster. Tighten the retaining nuts to the specified torque.
- 3 Check the brake pedal height and freeplay as described later in this chapter.
- 4 Ensure that the vacuum hose is securely connected and is free of leaks.



Brake booster removed showing components.



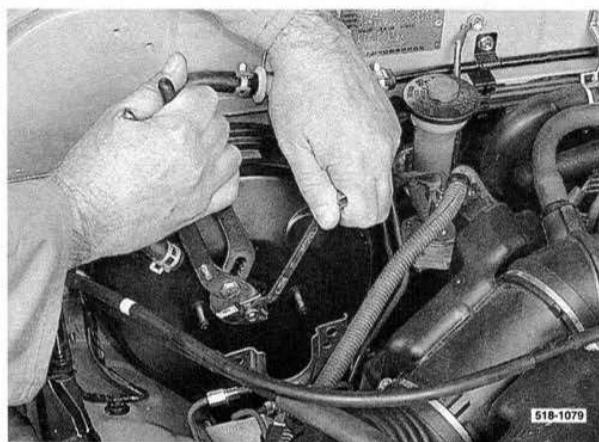
Measuring points for checking the master cylinder to brake booster pushrod clearance.

TO CHECK AND ADJUST PUSHROD CLEARANCE

- 1 Remove the master cylinder as previously described.
- 2 Ensure that the gasket is installed to the master cylinder and measure the distance from the mounting flange to the end of the master cylinder as shown in the illustration. Record this measurement as dimension B.
- 3 Using vernier calipers, measure the distance from the end of the master cylinder to the bottom of the hole in the piston. Record this measurement as dimension C.
- 4 Measure the protrusion of the pushrod from the master cylinder mounting surface on the front of the brake booster. Record this measurement as dimension A.
- 5 Apply the dimensions obtained to the following formula:
Pushrod clearance = $(C - B) - A$.
- 6 The pushrod clearance should be 0.02 mm.
- 7 If necessary, hold the knurled section of the pushrod with pliers and adjust the pushrod length until dimension A, when applied to the formula, will achieve the specified clearance.



While adjusting the pushrod, have an assistant slightly depress the brake pedal, until the pushrod just emerges from the booster.



Adjusting the brake booster pushrod.

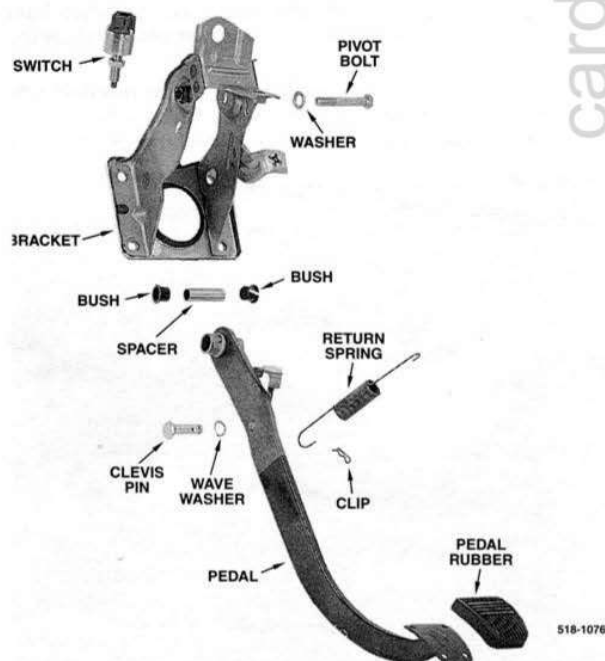
Brake Pedal

TO REMOVE AND INSTALL

- 1 Working under the steering column, remove the lower dash panel as follows:
 - a Remove the screws retaining the bonnet and fuel filler door remote handles. Push the handles toward the front of the vehicle, to release the hooks, and manoeuvre the handles from the lower dash panel.
 - b Remove the bolt and screw retaining the lower dash panel.
 - c Partially remove the panel, disconnect the wiring connectors and withdraw the panel from the dashboard.
- 2 Release the air duct from the fittings, by pulling the ends of the duct firmly downward. Withdraw the duct from under the dashboard.
- 3 Disconnect the brake pedal return spring, remove the retaining clip and withdraw the clevis pin connecting the pushrod to the brake pedal. Ensure that the wave washer on the pin is not misplaced.
- 4 Disconnect the wiring connector from the stop lamp switch.
- 5 Remove the retaining nuts and washers and manoeuvre the brake pedal assembly from the vehicle.
- 6 Remove the pivot bolt and washer from the bracket. Withdraw the pedal from the bracket and noting their installed positions, remove the bushes and the spacer.

Installation is a reversal of the removal procedure with attention to the following points:

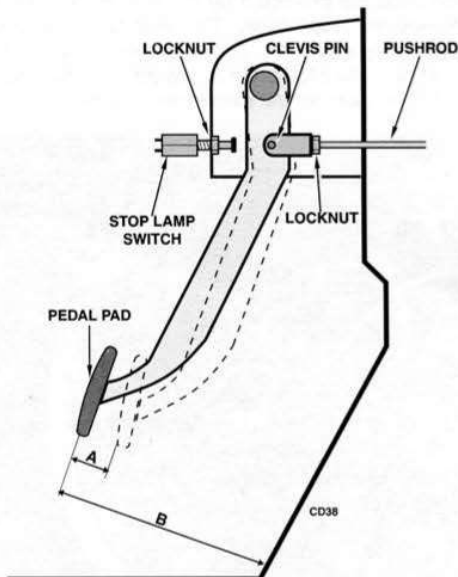
- 1 Sparingly apply multipurpose grease to the pedal bushes.
- 2 Install the spacer and bushes in the pedal and tighten the pivot bolt securely.
- 3 Install the air duct and the lower dashboard panel.



Brake pedal and associated components.

TO CHECK AND ADJUST PEDAL HEIGHT AND FREEPLAY

- 1 Working under the steering column, remove the lower dash panel as follows:
 - a Remove the screws retaining the bonnet and fuel filler door remote handles. Push the handles toward the front of the vehicle, to release the hooks, and manoeuvre the handles from the lower dash panel.
 - b Remove the bolt and screw retaining the lower dash panel.
 - c Partially remove the panel, disconnect the wiring connectors and withdraw the panel from the dashboard.
- 2 Release the air duct from the fittings, by pulling the ends of the duct firmly downward. Withdraw the duct from under the dashboard.
- 3 Disconnect the wiring from the stop lamp switch, loosen the locknut and unscrew the switch until it is clear of the pedal.
- 4 Measure the distance from the centre of the pedal pad to the asphalt sheet on the firewall as shown in the illustration. If the brake pedal height is not 197 – 207 mm, proceed as follows.
- 5 Loosen the locknut on the pushrod and, using a pair of pliers, rotate the pushrod to achieve the specified pedal height. Tighten the locknut.
- 6 Depress the brake pedal several times to exhaust all vacuum from the system and lightly press the brake pedal by hand until resistance is felt, indicating freeplay as shown in the illustration. If the brake pedal freeplay is not 3 – 6 mm, proceed as follows:
 - a Loosen the locknut on the pushrod and, using a pair of pliers, rotate the pushrod to achieve the specified freeplay. Tighten the locknut.
 - b Start the engine and check that the freeplay is correct.
- 7 Connect the wiring and check that the stop lamps illuminate only when the brake pedal is depressed and extinguishes when the pedal is released.



Brake pedal free play and height measuring and adjusting points.
 Dimension A is brake pedal freeplay.
 Dimension B is brake pedal height.

Antilock Braking System (ABS)**DESCRIPTION**

The early model ABS is a three channel design, where the front wheels are controlled independently and the rear wheels as a pair. Models with unified ABS utilize the four channel ABS which controls all wheels independently.

The ABS on early models consists of the master cylinder, which is similar to the master cylinder used on models without ABS, a separate modulator mounted onto the driver side inner mudguard and the ABS ECU. A conventional vacuum brake booster is used.

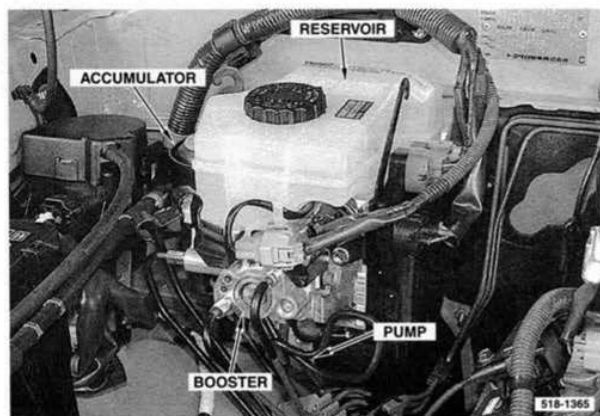
The ABS on late model vehicles consists of unified assembly, which houses the master cylinder, the booster pump motor and the accumulator. The ABS ECU is located below the steering column. No vacuum assistance is required.

On both early and late systems the front sensors are bolted to the steering knuckle, while the rear sensors are mounted on each end of the rear axle.

The slots in the pulse rings generate pulses in each wheel sensor which are transmitted to the ECU, which then calculates wheel speed and deceleration rates. The ECU signals the ABS modulator assembly to increase or decrease hydraulic pressure to each wheel individually, to maintain minimum wheel rotation without locking. Constant illumination of the dashboard warning lamp indicates a problem within the ABS system. Below are several minor checks that can assist in tracing some of the more common faults within the ABS system. If these checks fail to find the fault, refer the vehicle to an authorised dealer for repair.

ABS SYSTEM BASIC CHECKS

- 1 Switch the ignition On and check that the ABS warning lamp extinguishes after 3 seconds. If the light does not light up or extinguishes and the following test will not find a fault, the vehicle must be taken to a repairer equipped with the specialist equipment required to diagnose and repair the ABS system.
- 2 Raise the front and rear of the vehicle and support on chassis stands. Refer to General Information (chapter 1) for the correct vehicle jacking points.
- 3 Check the front and rear wheel bearings for excessive freeplay. Refer to relevant suspension chapter if necessary.
- 4 Inspect the front and rear ABS wheel sensors for any signs of damage or being loose. Where necessary, tighten or renew the ABS wheel sensors.



Late model with unified ABS master cylinder.

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Location of the ABS electronic control unit (ECU).

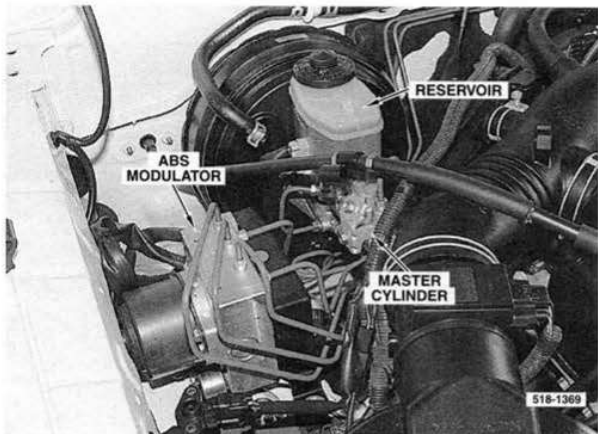


The wheel sensors can be damaged from objects picked up by the wheels. Shake each sensor to ensure it is not loose or cracked.

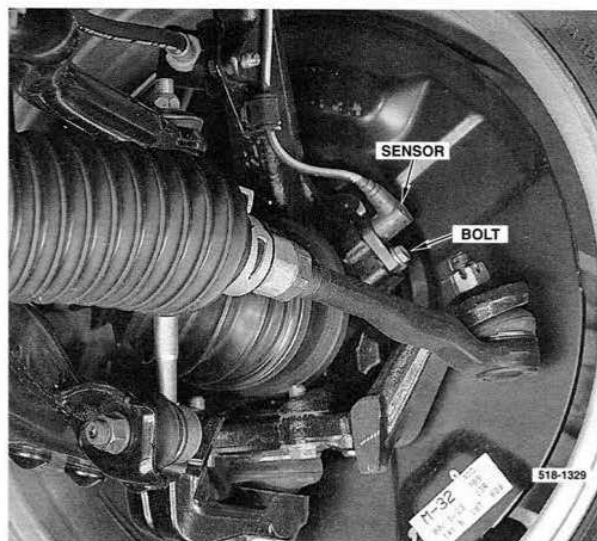
- 5 Check that the wheel sensor terminals are not corroded or backed out of the rear of the connector. Repair any damaged terminals or renew the wheel sensors where necessary.
- 6 Check that the ABS electronic control unit wiring connector is making good contact and the terminals are free of corrosion. Repair where necessary.
- 7 If no fault can be found, it is recommended that the vehicle be referred to an authorised dealer, who will have the specialised equipment to isolate the fault.

TO RENEW WHEEL SENSORS

- 1 Raise the front or rear of the vehicle and support on chassis stands. Refer to General Information (chapter 1) for the correct vehicle jacking points.
- 2 If removing the front sensor, proceed as follows:
 - a Remove the bolts retaining the wiring to the steering knuckle, to the upper control arm and to the vehicle body. Disconnect the wiring connector.
 - b Remove the bolt retaining the sensor and withdraw the sensor from the steering knuckle. Discard the O ring.



Early model with conventional master cylinder and separate ABS modulator.



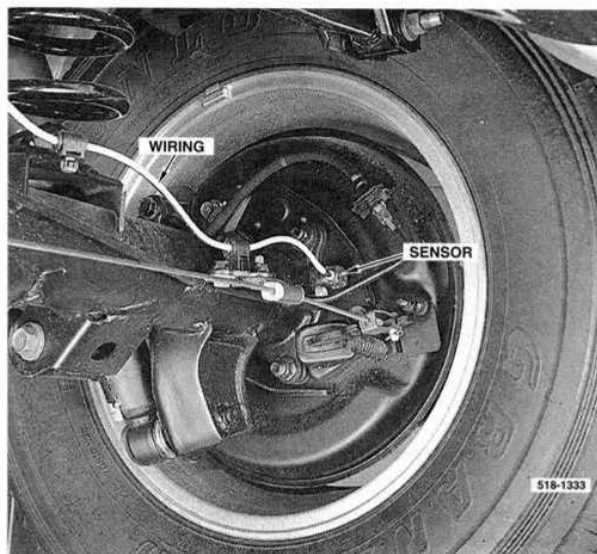
Front ABS sensor location.

- 3 If removing the rear sensor, proceed as follows:
 - a Release the retaining clips from the axle housing and from the upper control arm.
 - b Disconnect the wiring connector and remove the bolt retaining the sensor to the axle housing. Withdraw the sensor and discard the O ring.

Installation is a reversal of the removal procedure, ensuring that a new O ring is used and the retaining bolt(s) are tightened to the specified torque.

TO RENEW PULSE RINGS

The pulse rings are protected by the steering knuckle and the rear axle housing respectively. The removal of the pulse rings therefore is only necessary when renewing the front or rear wheel bearings. The method of renewing the wheel bearings is described in the appropriate suspension chapter.



Rear ABS sensor location.