Chapter 9
Braking system

Contents

Degrees of difficulty

Easy, suitable for novice with little experience 

Fairly easy, suitable for beginner with some experience 

Fairly difficult, suitable for competent DIY mechanic 

Difficult, suitable for experienced DIY mechanic 

Very difficult, suitable for expert DIY or professional 

Specifications

General

Brake fluid type	See Chapter 1
Minimum brake pad thickness	See Chapter 1
Brake disc minimum permissible thickness	Cast into disc
Parallelism	0.013 mm (0.0005 inch) maximum
Runout	0.102 mm (0.004 inch) maximum

Torque wrench settings

	Nm	lbf ft
Brake servo mounting nuts	10	7
Caliper bolts (front and rear)	31 to 40	23 to 29
Caliper bracket bolts		
Front bracket	102 to 128	75 to 94
Rear bracket	55 to 62	40 to 45
Master cylinder-to-brake servo nuts	22 to 28	16 to 20
Wheel nuts	See Chapter 1 Specifications	

1 General information

All models covered by this manual are equipped with hydraulically operated front and rear disc brake systems. Both front and rear brakes are self adjusting.

Hydraulic system

The hydraulic system is divided into two separate circuits. The master cylinder has separate reservoirs for the two circuits, and, in the event of a leak or failure in one hydraulic circuit, the other circuit will remain operative. All models are equipped with an Anti-lock Braking System (ABS).

Brake servo

A hydraulic brake servo system is used on all models covered by this manual. This system uses hydraulic pressure from an engine-driven pump on models equipped with a power hydraulic system, and an electric pump on models without the power hydraulic system.

Handbrake

The handbrake lever operates the rear brakes through cable actuation. It's activated by a lever mounted in the centre console. The handbrake assembly uses a pair of brake shoes located inside the rear hub/brake disc.

Brake pad wear warning system

The brake pad wear warning system turns on a red light in the instrument cluster when the brake pads have worn down to the point at which they must be replaced. Do NOT ignore this reminder. If you don't renew the pads shortly after the brake pad wear warning light comes on, the brake discs will be damaged.

The wear sensors are attached to the brake pads. Once the pads wear down to the point at which they're flush with the sensor, the disc grinds away the side of the sensor facing the disc, the wire inside the sensor is broken, the circuit is opened and the red light on the instrument panel comes on.

Always check the sensor(s) when replacing the pads. If you change the pads before the warning light comes on, the sensor(s) may still be good; once the light has come on, renew the sensor.

Service

After completing any operation involving dismantling of any part of the brake system, always test drive the vehicle to check for proper braking performance before resuming normal driving. When testing the brakes, perform the tests on a clean, dry, flat surface. Conditions other than these can lead to inaccurate test results.

Test the brakes at various speeds with both light and heavy pedal pressure. The vehicle should stop evenly without pulling to one side or the other. Avoid locking the brakes, because this slides the tyres and diminishes braking efficiency and control of the vehicle.

Tyres, vehicle load and wheel alignment are factors which also affect braking performance.

2 Anti-lock Brake system (ABS) - general information

The Anti-lock Brake System is designed to maintain vehicle steerability, directional stability and optimum deceleration under severe braking conditions on most road surfaces. It does so by monitoring the rotational speed of each wheel and controlling the brake line pressure to each wheel during braking. This prevents the wheels from locking up.

The ABS system has three main units - the wheel speed sensors, the electronic control unit and the modulator (hydraulic control unit). The sensors - one at each wheel - send a variable voltage signal to the electronic control unit, which monitors these signals, compares them to its program and determines whether a wheel is about to lock up. When a wheel is about to lock up, the control unit signals the hydraulic unit to reduce hydraulic pressure (or not increase it further) at that wheel's brake caliper. Pressure modulation is handled by three electrically-operated solenoid valves - one for each front wheel and one for the rear wheels - inside the modulator.

If a problem develops within the system, an "ABS" warning light will glow on the dashboard. Sometimes, a visual inspection of the ABS system can help you locate the problem. Carefully inspect the ABS wiring harness. Pay particularly close attention to the harness and connections near each wheel. Look for signs of chafing and other damage caused by incorrectly routed wires. If a wheel sensor harness is damaged, the sensor should be replaced (the harness and sensor are integral).

Warning: Do NOT try to repair an ABS wiring harness. The ABS system is sensitive to even the smallest changes in resistance. Repairing the harness could alter resistance values and cause the system to malfunction. If the ABS wiring harness is damaged in any way, it must be replaced.

Caution: Make sure the ignition is turned off before unplugging or reattaching any electrical connections.

Diagnosis and repair

If a dashboard warning light comes on and stays on while the vehicle is in operation, the ABS system requires attention. Although special electronic ABS diagnostic testing tools are necessary to properly diagnose the system, you can perform a few preliminary checks before taking the vehicle to a dealer service department or other qualified repair workshop.

a) Check the brake fluid level in the master cylinder reservoir.
b) Verify that all ABS system electrical connectors in the engine compartment are plugged in.
c) Check the fuses.
d) Follow the wiring harness to each front wheel and to the differential sensor and verify that all connections are secure and that the wiring is undamaged.

If the above preliminary checks do not rectify the problem, the vehicle should be diagnosed by a dealer service department. Due to the complex nature of this system, all actual repair work must be done by a dealer service department or other qualified repair workshop.

3 Disc brake pads - renewal

Warning: Disc brake pads must be replaced on both front wheels or both rear wheels at the same time - never renew the pads on only one wheel. Also, the dust created by the brake system may contain asbestos, which is harmful to your health. Never blow it out with compressed air and don't inhale any of it. An approved filtering mask should be worn when working on the brakes. Do not, under any circumstances, use petroleum-based solvents to clean brake parts. Use brake system cleaner only!

Note: *The following procedure applies to both the front and rear brake pads*.

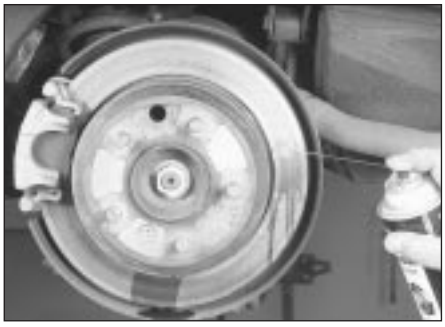
1 Remove the cap from the brake fluid reservoir and siphon off about two-thirds of the fluid from the reservoir. Failing to do this could result in fluid overflowing when the caliper pistons are pressed into their bores.

2 Loosen the wheel nuts, raise the front of the vehicle and support it securely on axle stands.

3 Remove the front wheels. Work on one brake assembly at a time, using the assembled brake for reference if necessary.

4 Inspect the brake disc (see Section 5).

5 Follow the accompanying photos, beginning with **illustration 3.5a**, for the pad removal procedure. Be sure to stay in order and read the caption under each illustration.



3.5a Before starting, wash down the caliper and disc with brake cleaner

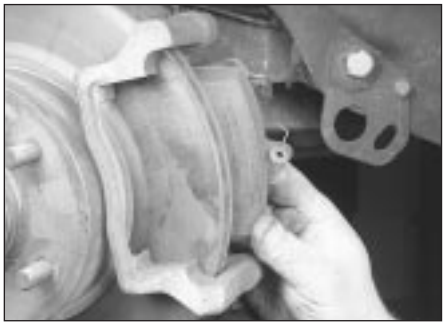
3.5b Attach a hose to the bleed screw, open the bleed screw slightly and depress the piston into the caliper. Tighten the bleed screw when the piston bottoms

3.5c Remove the caliper mounting bolts (upper bolt arrowed); use another spanner to hold the flats of the caliper guide pins while you back out the caliper bolts

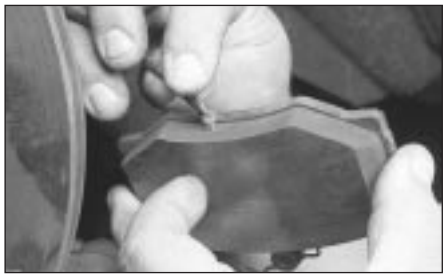
3.5d Remove the caliper . . .

3.5e . . . and suspend it out of the way with a piece of wire

3.5f Remove the outer brake pad



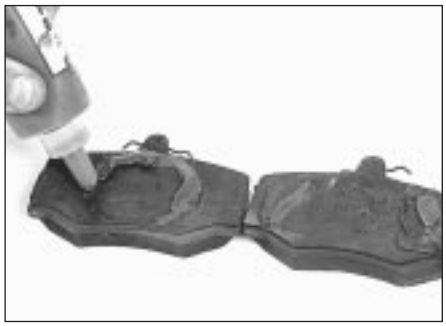
3.5g Remove the inner brake pad



3.5h Pull out the wear sensor, trace the sensor lead back to its plug, detach the lead from the suspension, and discard it

3.5i Remove the caliper guide pins and boots (lower pin and boot shown) . . .

3.5j . . . clean them off, inspect the pin and boot for damage, renew as necessary, then lubricate the pins with brake grease and refit them in the caliper bracket



3.5k Apply anti-squeal compound to the new brake pads

6 Be sure to buy new pads with wear sensors. Pattern pads may not have wear sensors; refitting pads without wear sensors will cause the dash warning light to come on.
7 To refit the new pads, reverse the removal procedure. When refitting the caliper, be sure to tighten the mounting bolts to the torque listed in this Chapter's Specifications.
8 After the job is completed, depress the brake pedal a few times to bring the pads into contact with the discs. The pedal should be at normal height above the floorpan and firm. Check the brake fluid level and add enough to top it up (see Chapter 1). Inspect carefully for leaks and check the operation of the brakes before placing the vehicle into normal service.
9 Tighten the wheel nuts to the specified torque.

4 Disc brake caliper - removal, overhaul and refitting

Warning: Dust created by the brake system may contain asbestos, which is harmful to your health. Never blow it out with compressed air and don't inhale any of it. An approved filtering mask should be worn when working on the brakes. Do not, under any circumstances, use petroleum-based solvents to clean brake parts. Use brake system cleaner only!

Note 1: *The following procedure applies to both front and rear calipers.*
Note 2: *If an overhaul is indicated, explore all options before beginning the job. New and factory rebuilt calipers are available on an exchange basis, which makes this job quite easy. If you decide to rebuild the calipers, make sure a rebuild kit is available before proceeding. Always rebuild the calipers in pairs - never rebuild just one of them.*

3.5l Insert the new wear sensor into the inner pad as shown . . .

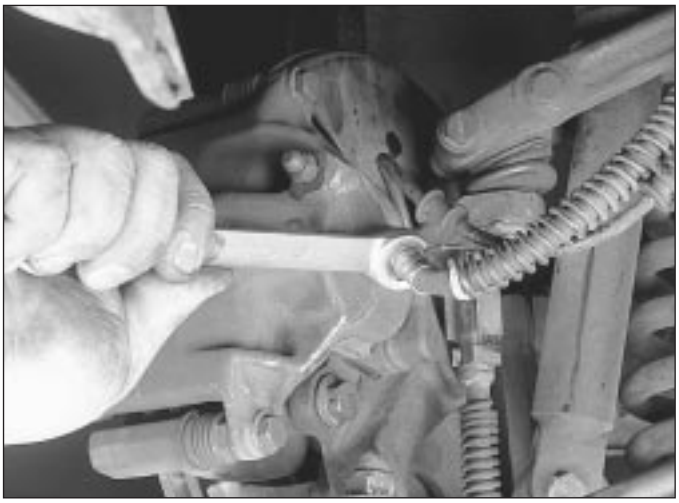
3.5m . . . then refit the inner pad onto the caliper bracket

3.5n Refit the outer pad

3.5o Refit the caliper, then tighten the mounting bolts to the specified torque

Removal

1 Loosen the wheel nuts, raise the front or rear of the vehicle and place it securely on axle stands. Remove the wheel.
2 If you're just removing the caliper for access to other components, it isn't



4.2 Use a flare-nut spanner to protect the brake hose fitting when unscrewing it from the caliper

4.5 With the caliper padded to catch the piston, use compressed air to force the piston out of its bore - make sure your fingers are not between the piston and the caliper

necessary to detach the brake line. If you're removing the caliper for overhaul, detach the hose from the metal line at the frame bracket (see Section 8), then disconnect the brake line from the caliper with a flare-nut spanner to protect the fitting **(see illustration)**. Plug the metal line to keep contaminants out of the brake system and to prevent losing brake fluid.

3 Refer to illustration 3.5c and unbolt the front or rear caliper.

Overhaul

4 Before you remove the piston, place a wood block between the piston and caliper to prevent damage as it is removed.

5 To remove the piston from the caliper, apply compressed air to the brake fluid hose connection on the caliper body **(see illustration)**. Use only enough pressure to ease the piston out of its bore. Remove the dust boot.

Warning: Be careful not to place your fingers between the piston and the caliper as the piston may come out with some force. Be sure to wear eye protection when using compressed air.

6 Inspect the mating surfaces of the piston and caliper bore wall. If there is any scoring, rust, pitting or bright areas, renew the complete caliper unit with a new one.

7 If these components are in good condition, remove the piston seal from the caliper bore using a wooden or plastic tool **(see illustration)**. Metal tools may damage the cylinder bore.

8 Remove the caliper guide pins and the rubber dust boots from the caliper bracket.

9 Wash all the components in brake system cleaner.

10 Using the correct rebuild kit for your vehicle, reassemble the caliper as follows.

11 Submerge the new rubber seal in clean brake fluid and refit it in the lower groove in the caliper bore, making sure it isn't twisted.

12 Coat the piston with clean brake fluid and stretch the new dust boot over the bottom of the piston. Hold the piston over the caliper bore and insert the rubber flange of the dust boot into the upper groove in the bore. Start with the side farthest from you and work your way around toward the front until it is completely seated. Push the piston into the caliper bore until it is bottomed in the bore, then seat the top of the dust boot in the groove in the piston.

13 Lubricate the sliding surfaces of the guide pins with silicone-based grease (usually supplied in the kit), then refit the new dust boots and pins into the caliper bracket.

Refitting

14 Refit the caliper by reversing the removal procedure (see Section 3).

15 If the brake hose was disconnected from the caliper, bleed the brake system (see Section 9).

4.7 Remove the piston seal from the caliper bore using a wooden or plastic tool (metal tools may damage the cylinder bore)

5 **Brake disc** - inspection, removal and refitting

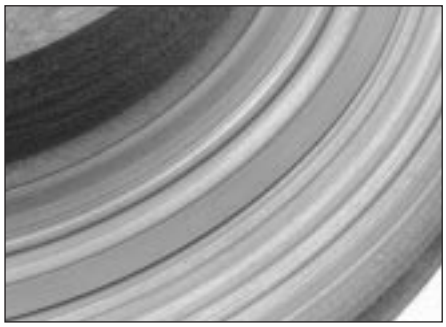
Note: *The following procedure applies to both the front and rear brake discs.*

Inspection

1 Loosen the wheel nuts, raise the vehicle and support it securely on axle stands. Remove the wheel and refit three nuts to hold the disc in place. If the rear brake disc is being worked on, release the handbrake.

2 Remove the brake caliper as outlined in Section 4. It is not necessary to disconnect the brake hose. After removing the caliper, suspend it out of the way with a piece of wire.

3 Visually inspect the disc surface for scoring or damage. Light scratches and shallow grooves are normal after use and may not always be detrimental to brake operation, but deep scoring - over 0.015 inch - requires disc removal and refinishing by an automotive machine shop. Be sure to check both sides of the disc **(see illustration)**. If pulsating has



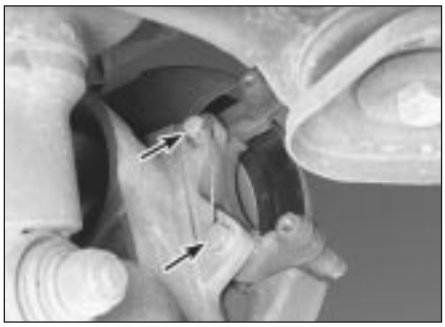
5.3 The brake pads on this vehicle were obviously neglected, as they wore down to the rivets and cut deep grooves into the disc - this disc must be replaced

5.4a To check disc runout, mount a dial indicator as shown and rotate the disc

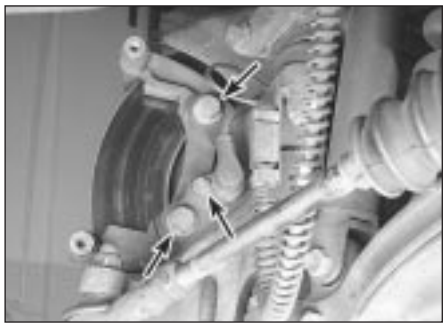
5.4b Using a swirling motion, remove the glaze from the disc surface with sandpaper or emery cloth

5.5a The disc thickness can be checked with a micrometer

5.5b Compare your measurement with the minimum thickness stamped into the disc



5.6a Before you can remove the caliper mounting bracket bolts (arrowed) and the bracket, you'll have to cut the safety wire between them with a pair of diagonal cutters (rear bracket shown)



5.6b On front caliper brackets, remove the ABS wheel speed sensor bolt (centre arrow) and pull out the sensor before removing the bracket bolts (upper and lower arrows) and bracket

been noticed during application of the brakes, suspect disc runout.

4 To check disc runout, place a dial indicator at a point about 1/2-inch from the outer edge of the disc **(see illustration)**. Set the indicator to zero and turn the disc. The indicator reading should not exceed the specified allowable runout limit. If it does, the disc should be refinished by an automotive machine workshop. **Note:** *It is recommended that the discs be resurfaced regardless of the dial indicator reading, as this will impart a smooth finish and ensure a perfectly flat surface, eliminating any brake pedal pulsation or other undesirable symptoms related to questionable discs. At the very least, if you elect not to have the discs resurfaced, remove the glazing from the surface with emery cloth or sandpaper using a swirling motion* **(see illustration).**

5 It is absolutely critical that the disc not be machined to a thickness under the specified minimum allowable thickness. The disc thickness can be checked with a micrometer **(see illustration)**. Then compare your measurement to the minimum wear (or discard) thickness stamped into the hub of the disc after the disc is removed **(see illustration)**.

Removal

6 Cut the safety wire from the caliper bracket mounting bolts **(see illustration)**. On front caliper brackets, remove the ABS wheel speed sensor **(see illustration)**, then remove the caliper bracket bolts and remove the bracket.

7 Remove the disc retaining screw **(see illustration)** and remove the disc from the hub. If the disc sticks, give it a few sharp raps with a hammer **(see illustration)**. If the disc is stuck to the hub, spray a generous amount of penetrant onto the area between the hub and the disc and allow the penetrant a few minutes to loosen the rust between the two components. If a rear disc still sticks, insert a thin, flat-bladed screwdriver or brake adjusting tool through the hub flange, rotate the star wheel on the handbrake adjusting screw and contract the handbrake shoes **(see illustration)**.

5.7a Using an impact driver, if necessary, remove the disc retaining screw, then remove the disc from the hub

5.7b If the disc is stuck to the hub, give it a few sharp raps with a hammer

5.7c If a rear disc is stuck to the hub, insert a suitable tool through the hub flange and retract the handbrake shoes

6.4 Trace the electrical lead back from the reservoir cap and disconnect the low fluid level sensor

6.5 Loosen the hydraulic brake line fittings with a flare-nut spanner to protect the corners of the nuts

Refitting

8 Place the disc on the hub and refit the disc retaining screw. Tighten the screw securely.
9 Refit the caliper mounting bracket, using a new safety wire on the mounting bolts.
10 Refit the brake pads and caliper (see Section 3). Tighten all fasteners to the torque listed in this Chapter's Specifications.
11 Refit the wheel and wheel nuts, then lower the vehicle to the ground. Tighten the wheel nuts to the specified torque (see Chapter 1 Specifications). Depress the brake pedal a few times to bring the brake pads into contact with the disc.
12 Adjust the handbrake shoes, if necessary.
13 Check the operation of the brakes carefully, if possible before driving the vehicle on public roads.

6 **Master cylinder** - removal, overhaul and refitting

Note: *Although master cylinder parts and rebuild kits are available for most models, we recommend replacing the master cylinder with a new or remanufactured unit, if possible.*

Removal

1 The master cylinder is connected to the brake servo, which is attached to the pedal box, in front of the bulkhead on the driver's side of the engine compartment.
2 Remove as much fluid as you can from the reservoir with a syringe.
3 Place rags under the line fittings and prepare caps or plastic bags to cover the ends of the lines once they are disconnected. ***Caution: Brake fluid will damage paint. Cover all body parts and be careful not to spill fluid during this procedure.***
4 Disconnect the electrical connector for the low fluid level warning light **(see illustration)**.
5 Loosen the brake line fittings at the master cylinder **(see illustration)**. Use a flare-nut spanner to prevent rounding off the nuts. Pull the brake lines away from the master cylinder slightly and plug the ends to prevent contamination.
6 Remove the nuts attaching the master cylinder to the servo **(see illustration)**. Pull the master cylinder off the studs and lift it out of the engine compartment. Again, be careful not to spill fluid as this is done.

Overhaul

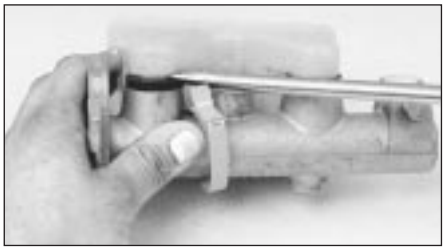
7 Follow the accompanying photo sequence, beginning with **illustration 6.7a**. Stay in order, don't skip steps, read each caption and study the photo carefully.
8 Once you have dismantled the master cylinder, clean everything thoroughly, blow the parts dry with compressed air and carefully inspect the secondary piston and the bore of the master cylinder with a bright light. If the secondary piston or the master cylinder bore is damaged or worn, renew the master cylinder with a new or rebuilt unit.

Bench bleeding procedure

9 Before refitting a new or rebuilt master cylinder it should be bench bled. Because it

6.6 Remove the two master cylinder mounting nuts

6.7a Knock out the roll pin that secures the reservoir to the master cylinder



6.7b Carefully pry off the reservoir by inserting a screwdriver between the reservoir and each grommet; this takes firm pressure, so don't slip and damage the reservoir or the master cylinder

6.7c Remove the grommets, noting the position of each one

6.7d Pry off the end cap

6.7e Locate the stopper pin (arrowed) inside the forward grommet hole . . .

6.7f . . . insert a punch into the pocket of the primary piston, place the master cylinder vertically as shown, push down on the master cylinder to depress the pistons and pull out the stopper pin with a magnet

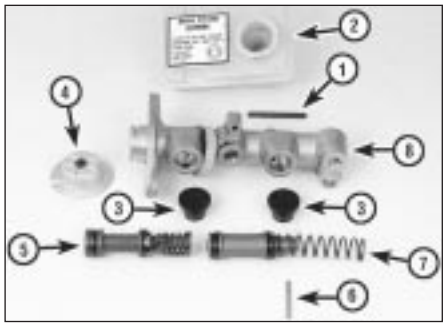
6.7g Remove the primary piston

6.7h Remove the secondary piston

6.7i If the secondary piston is stuck, rap the master cylinder on a wood block to dislodge it

6.7j Remove the seals and cups from the pistons - be very careful not to scratch the piston surface - then wash the secondary piston with clean brake fluid and inspect it; if the secondary piston is damaged, you must renew the master cylinder with a new or rebuilt unit (a new primary piston is included with the rebuild kit)

6.7k Refit the new O-ring seals and cups as shown; make sure the cups on the primary piston (the one on the left) face forward as shown (toward the spring), and the cups on the secondary piston (the one on the right) face out, away from the piston (the one on the left faces toward the primary piston, the one on the right faces toward the spring)



6.7l The master cylinder assembly

1 Roll pin
2 Reservoir
3 Grommets
4 End plate
5 Primary piston
6 Secondary piston stopper pin
7 Secondary piston

6.7m Apply some clean brake fluid to the secondary piston and refit it with the slot oriented with the stopper pin hole, so that the stopper pin will go through the slot

6.7n Apply a coat of clean brake fluid to the primary piston and refit it into the bore

6.7o Using the same technique as in illustration 6.7f, depress the pistons and refit the stopper pin

6.7p Refit the end plate as shown, with the bend in the plate flange aligned with the groove in the master cylinder flange

6.7q Using a hammer and punch, stake the end plate as shown (there's a dimple in the side of the plate for this purpose)

6.7r Refit the grommets

will be necessary to apply pressure to the master cylinder piston and, at the same time, control flow from the brake line outlets, it is recommended that the master cylinder be mounted in a vice. Use caution not to clamp the vice too tightly, or the master cylinder body might crack.

10 Insert threaded plugs into the brake line outlet holes and snug them down so that there will be no air leakage past them, but not so tight that they cannot be easily loosened.

11 Fill the reservoir with brake fluid of the recommended type (see *Recommended lubricants and fluids* in Chapter 1).

12 Remove one plug and push the piston assembly into the master cylinder bore to expel the air from the master cylinder. A large Phillips screwdriver can be used to push on the piston assembly.

13 To prevent air from being drawn back into the master cylinder, the plug must be replaced and tightened before releasing the pressure on the piston assembly.

14 Repeat the procedure until only brake fluid is expelled from the brake line outlet hole. When only brake fluid is expelled, repeat the procedure with the other outlet hole and plug. Be sure to keep the master cylinder reservoir filled with brake fluid to prevent the introduction of air into the system.

15 Since high pressure is not involved in the bench bleeding procedure, an alternative to the removal and renewal of the plugs with each stroke of the piston assembly is available. Before pushing in on the piston assembly, remove the plug as described in Step 12. Before releasing the piston, however, instead of replacing the plug, simply put your finger tightly over the hole to keep air from

6.7s Align the reservoir pipes with the grommets as shown . . .

6.7t . . . and squeeze the reservoir and master cylinder together; make sure the reservoir is fully seated

6.7u Refit the reservoir roll pin . . .

6.7v . . . and tap it into place

7.5 Use a flare-nut spanner to loosen the fittings, then pull the lines back from the brake servo and plug them to prevent contamination

7.6 Pry off the two rubber caps from the pedal box

7.7 To detach the brake servo from the pedal box, remove these four nuts (arrowed) (lower right nut not visible in this photo)

being drawn back into the master cylinder. Wait several seconds for brake fluid to be drawn from the reservoir into the piston bore, then depress the piston again, removing your finger as brake fluid is expelled. Be sure to put your finger back over the hole each time before releasing the piston, and when the bleeding procedure is complete for that outlet, renew the plug and snug it up before going on to the other port.

Refitting

16 Refit the master cylinder over the studs on the brake servo and tighten the mounting nuts only finger tight at this time.

17 Thread the brake line fittings into the master cylinder. Since the master cylinder is still a bit loose, it can be moved slightly to allow the fitting threads to start easily. Do not strip the threads as the fittings are tightened.

18 Tighten the brake fittings securely and the mounting nuts to the torque listed in this Chapter's Specifications.

19 Fill the master cylinder reservoir with fluid, then bleed the master cylinder and the brake system (see Section 9).

20 To bleed the master cylinder on the vehicle, have an assistant pump the brake pedal several times and then hold the pedal to the floor. Loosen the fitting nut to allow air and fluid to escape, then tighten the nut. Repeat this procedure on both fittings until the fluid is clear of air bubbles. Test the operation of the brake system carefully before placing the vehicle into service.

7 Brake servo - general information, removal and refitting

General information

1 A hydraulic brake servo system assists braking when the brake pedal is depressed. The booster unit, located between the brake pedal box and the master cylinder, is operated by hydraulic pressure generated by an engine-driven pump (on early models) or by an electric pump (on later models). When the engine is running, the pump supplies hydraulic pressure to an accumulator. The accumulator stores and regulates the pressure to the hydraulic brake servo. When you depress the brake pedal, the pressure in the booster helps actuate the master cylinder, reducing pedal effort.

2 The hydraulic brake servo isn't rebuildable; if it fails, it must be replaced. Basic operation can be checked (see Chapter 1, Section 15), but in-depth testing of the system requires special tools, so diagnosis is beyond the scope of the home mechanic. If the system fails, take it to a dealer service department or other qualified repair workshop for repairs. However, if the unit must be replaced, you can do it yourself as follows.

Removal and refitting

3 With the engine off, discharge the hydraulic accumulator by depressing the brake pedal several times until it feels hard to depress.

4 Remove the master cylinder (see Section 6).

5 Clean the area around the return and supply tube nuts, then disconnect them with a flare-nut spanner **(see illustration)**. Plug the lines to prevent dirt from entering the system.

Caution: Even a particle of dirt can damage the servo system, so be extremely careful to prevent dirt from entering the system while the lines are disconnected.

6 To disconnect the brake servo pushrod from the brake pedal, remove the access plugs from both sides of the pedal box **(see illustration)**, remove the clevis pin retaining clip and drive out the clevis pin.

7 Remove the four mounting nuts and remove the brake servo **(see illustration)**.

8 Refitting is the reverse of removal. Tighten the hydraulic line fittings securely.

9 When you're done, adjust the brake light switch (see Section 13).

8 Brake hoses and lines - inspection and renewal

Inspection

1 About every six months, with the vehicle raised and placed securely on axle stands, the flexible hoses which connect the steel brake lines with the front and rear brake assemblies should be inspected for cracks, chafing of the outer cover, leaks, blisters and other damage. These are important and vulnerable parts of the brake system and inspection should be complete. A light and mirror will prove helpful for a thorough check. If a hose exhibits any of the above conditions, renew it with a new one.

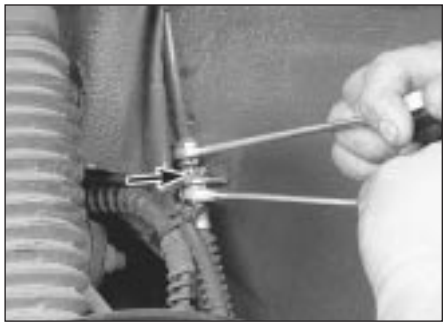
Flexible hose renewal

2 Clean all dirt away from the ends of the hose.

3 To disconnect the hose at the frame end, use a second spanner on the hex-shaped fitting on the end of the flexible hose and loosen the nut on the metal brake line **(see illustrations)**. If the nut is stuck, soak it with penetrating oil. After the hose is disconnected from the metal line, remove the nut right above the bracket and detach the hose from the bracket.

4 To detach the flexible hose from the caliper, simply unscrew it.

5 Refitting is the reverse of the removal procedure. Make sure the brackets are in good condition and the locknuts are tightened securely.



8.3a To remove a front flexible brake hose from a metal brake line, use one spanner to hold the hose fitting just below the bracket (lower spanner), then break loose the nut on the metal line (upper spanner); to disconnect the flex hose from the bracket, remove the centre nut (arrowed) just above the bracket

8.3b The connection (arrowed) for the rear hose and line is located right above the mounting bracket for the front corner of the differential crossmember; remove the hose as described in the previous illustration

6 Carefully check to make sure the suspension and steering components do not make contact with the hoses. Have an assistant push on the vehicle and also turn the steering wheel from lock-to-lock during inspection.

7 Bleed the brake system (see Section 9).

Metal brake line renewal

8 When replacing brake lines, use the proper parts only. Do not use copper line for any brake system connections. Purchase steel brake lines from a dealer or motor factors..

9 Unless you're using factory renewal brake lines, you may need a tubing bender to bend the lines to the proper shape.

10 First, remove the line you intend to renew, lay it on a clean workbench and measure it carefully. Obtain a new line of the same length and bend it to match the pattern of the old line.

Warning: Do not crimp or damage the line. No bend should have a smaller radius than 9/16-inch. Make sure the protective coating on the new line is undamaged at the bends.

11 When refitting the new line, make sure it's well supported by the brackets, the routing matches the original and there's plenty of clearance between moving or hot components.

12 After refitting, check the master cylinder fluid level and add fluid as necessary. Bleed the brake system as outlined in Section 9 and test the brakes carefully before driving the vehicle. Be sure there are no leaks.

9 Brake hydraulic system - bleeding

Warning: Wear eye protection when bleeding the brake system. If the fluid comes in contact with your eyes, immediately rinse them with water and seek medical attention.

9.9 When bleeding the brakes, a hose is connected to the bleed screw at the caliper or wheel cylinder and then submerged in brake fluid - air will be seen as bubbles in the tube and container (all air must be expelled before moving to the next brake)

Note: *Bleeding the hydraulic system is necessary to remove any air which has entered the system during removal and refitting of a hose, line, caliper or master cylinder.*

1 It will probably be necessary to bleed the system at all four brakes if air has entered the system due to low fluid level or if the brake lines have been disconnected at the master cylinder.

2 If a brake line was disconnected at only one wheel, then only that caliper or wheel cylinder must be bled.

3 If a brake line is disconnected at a fitting located between the master cylinder and any of the brakes, that part of the system served by the disconnected line must be bled.

4 Bleed the right rear, the left rear, the right front and the left front caliper, in that order, when the entire system is involved.

5 Remove any residual vacuum from the servo and pressure in the anti-lock braking system (if equipped) by applying the brake about 30 times with the engine off.

6 Remove the master cylinder reservoir cover and fill the reservoir with brake fluid. Refit the cover. **Note:** *Check the fluid level often during the bleeding operation and add fluid as necessary to prevent the fluid level from falling low enough to allow air into the master cylinder.*

7 Have an assistant on hand, as well as a supply of new brake fluid, an empty clear plastic container, a length of 3/16-inch clear tubing to fit over the bleed screws and a spanner to open and close the bleed screws.

8 Beginning at the right rear wheel, loosen the bleed screw slightly, then tighten it to a point where it is snug but can still be loosened quickly and easily.

9 Place one end of the tubing over the bleed valve and submerge the other end in brake fluid in the container **(see illustration)**.

10 Have the assistant pump the brakes a few times to build pressure in the system, then hold the pedal firmly depressed.

11 While the pedal is held depressed, open the bleed screw just enough to allow fluid to flow from the caliper. Watch for air bubbles to exit the submerged end of the tube. When the fluid flow slows after a couple of seconds, close the screw and have your assistant release the pedal.

12 Repeat Steps 10 and 11 until no more air is seen leaving the tube, then tighten the bleed screw and proceed to the left rear wheel, the right front wheel and the left front wheel, in that order, and perform the same procedure. Be sure to check the fluid in the master cylinder reservoir frequently.

13 Never reuse old brake fluid. It contains contaminates and moisture which could damage the braking system.

14 Refill the master cylinder with fluid at the end of the operation.

15 Check the operation of the brakes. The pedal should feel solid when depressed, with no sponginess. If necessary, repeat the entire process.

Warning: Do not drive the car if in doubt about the effectiveness of the brake system.

10 Handbrake cable - adjustment

1 Slowly apply the handbrake and count the number of clicks at the lever. It should be fully applied within three to five clicks. If the lever is still not fully applied by the fifth click, adjust the handbrake cable as follows:

2 Raise the vehicle and place it securely on axle stands.

3 Loosen the locknut **(see illustration)** and tighten the cable adjuster until all slack has been removed. Tighten the locknut. Make sure the wheels turn freely with the handbrake lever released

4 Lower the vehicle and recheck the handbrake lever. It should now be properly adjusted. If it's now fully applied within three to five clicks, raise the vehicle again and readjust the cable at the adjuster.

5 Make sure the handbrake holds the vehicle on an incline.

10.3 To adjust the handbrake cable, loosen the locknut, then turn the adjuster to remove any slack in the cable; be sure to tighten the locknut when the cable is properly adjusted

11.2 To disconnect the forward end of the front cable from the handbrake lever, remove this cotter pin, washer and clevis pin

11.3 To disconnect the rear end of the front cable from the adjuster lever, remove this cotter pin, washer and clevis pin (arrowed)

11.5 To disconnect the intermediate cable, remove the cotter pins, washers and clevis pins (arrowed) from the adjuster lever and the yoke

11 Handbrake cable(s) - renewal

1 Raise the vehicle and place it securely on axle stands.

Front cable

2 Remove the cotter pin, washer and clevis pin from the forward end of the front cable **(see illustration)**. Disconnect the forward end of the front cable from the handbrake lever.
3 Follow the cable back to the adjuster lever and remove the cotter, washer and clevis pin **(see illustration)**. Remove the front cable.
4 Refitting is the reverse of removal.

Intermediate cable

5 Remove the cotter pins, washers and clevis pin from both ends of the intermediate cable **(see illustration)**. Remove the cable.
6 Refitting is the reverse of removal.

Rear cables

7 Remove the cotter pin, washer and clevis pin from the intermediate cable-to-rear cable yoke **(see illustration)**.
8 Disconnect the rear end of each cable from the handbrake assembly **(see illustration)**., then pry the cable out of the carrier.
9 Refitting is the reverse of removal.

All cables

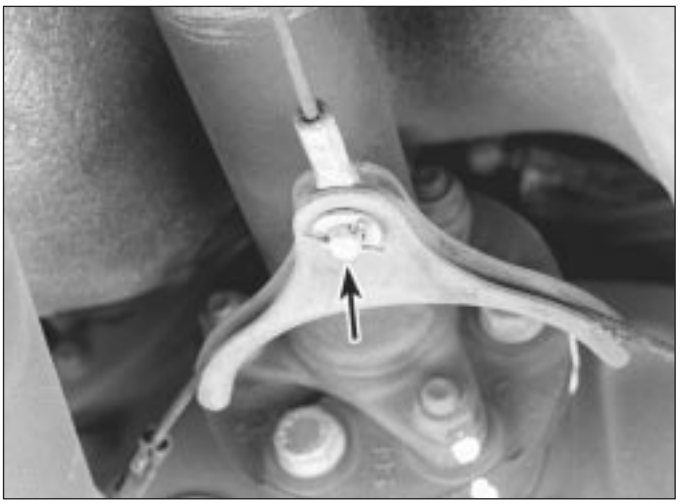
10 Be sure to adjust the handbrake cable when you're done (see Section 10). The rear wheels should turn freely with the handbrake lever released.
11 Remove the axle stands and lower the vehicle. Apply the handbrake lever, make sure it's fully applied within three to five clicks and that it holds the vehicle on an incline. If it doesn't, readjust it (see Section 10).

12 Handbrake shoes - check and renewal

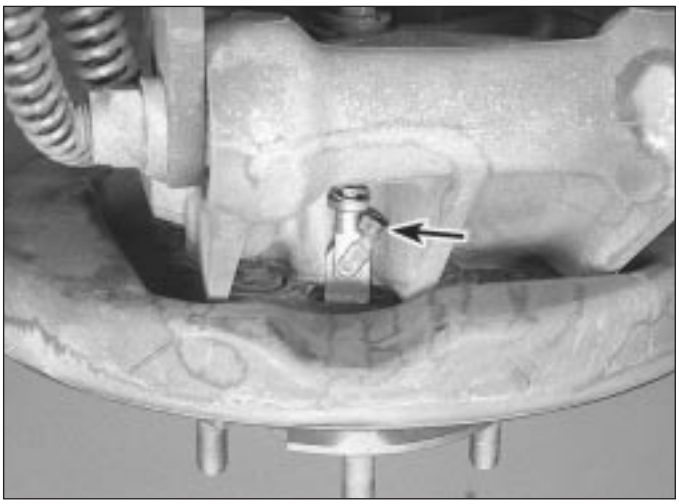
Warning: Dust created by the brake system may contain asbestos, which is harmful to your health. Never blow it out with compressed air and don't inhale any of it. An approved filtering mask should be worn when working on the brakes. Do not, under any circumstances, use petroleum-based solvents to clean brake parts. Use brake system cleaner only!

Check

1 The handbrake system should be checked regularly. With the car parked on a hill, apply the brake, place the transmission in Neutral and check that the handbrake alone will hold the car (be sure to stay in the car during this check). However, every 24 months (or



11.7 To disconnect the rear cables and yoke from the intermediate cable, remove this cotter pin, washer and clevis pin (arrowed)



11.8 The rear handbrake cable-to-handbrake shoe connection is hidden behind the lower part of the brake backing plate, on the underside of the carrier (this view is looking straight up from underneath the carrier). To disconnect either rear handbrake cable, swing this clip (arrowed) to the side and remove it - the rear cable is now disconnected

12.5a Wash down the handbrake assembly with brake cleaner before dismantling

12.5b Back off the star wheel on the adjuster, then disengage the adjuster mechanism from the handbrake shoes

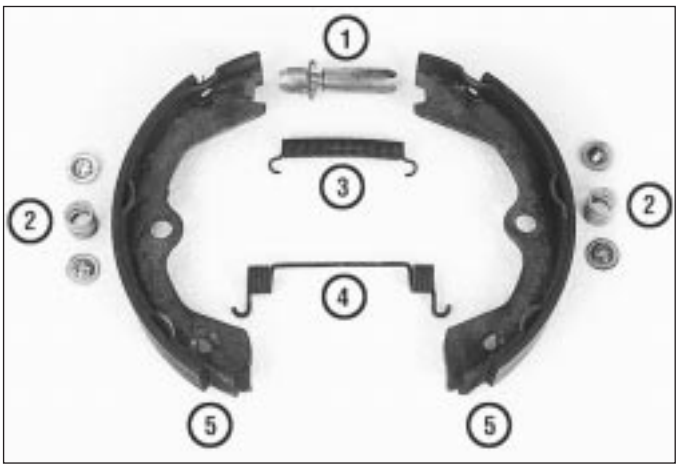
12.5c Remove the front hold-down spring, washers and pin; note that one washer goes below the spring and one above it

12.5d Remove the rear hold-down spring, washers and pin; put the parts in a plastic bag so you don't lose them

12.5e Push the shoes together and disengage the upper return spring from the rear shoe . . .

12.5f . . . and from the front shoe

12.5g Pull the shoes apart and remove them with the lower spring attached as shown, then disengage the lower return spring from both shoes



12.5h The handbrake shoe assembly

1 Adjuster
2 Hold down springs and washers
3 Upper return spring
4 Lower return spring
5 Handbrake shoes

whenever a fault is suspected), the assembly itself should be visually inspected.

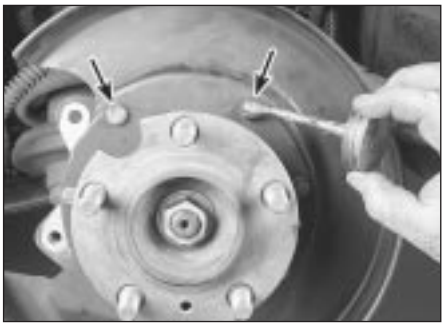
2 Loosen the wheel nuts, raise the rear of the vehicle and place it securely on axle stands. Remove the rear wheels.

3 Remove the rear brake calipers and discs (see Sections 3, 4 and 5). Support the caliper assemblies with a coat hanger or heavy wire and do not disconnect the brake line from the caliper.

4 With the disc removed, the handbrake components are visible and can be inspected for wear and damage. The linings should last the life of the vehicle. However, they can wear down if the handbrake system has been improperly adjusted. There is no minimum thickness specification for the handbrake shoes, but as a rule of thumb, if the shoe material is less 1/32-inch thick, you should renew them. Also check the springs and adjuster mechanism and inspect the drum for deep scratches and other damage.

Renewal

5 Loosen the wheel nuts, raise the rear of the vehicle and place it securely on axle stands. Remove the rear wheels. Remove the brake discs (see Section 5). Follow the accompanying photo sequence beginning with **illustration 12.5a**. Work on only one side



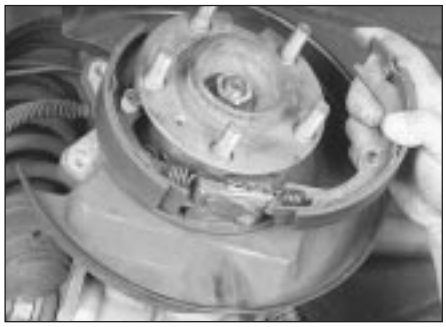
12.5i Lubricate the six friction points (two arrowed) on the backing plate with high-temperature brake grease

12.5j Place the front shoe in position, insert the pin through the backing plate and the shoe . . .

12.5k . . . and refit the hold-down spring and washers

12.5l Hook the lower return spring into its hole in the front shoe . . .

12.5m . . . hook the other end of the lower spring into the rear shoe . . .



12.5n . . . stretch the spring over the top of the handbrake lever box . . .

at a reference during reassembly.

6 Refitting is the reverse of removal.

7 After refitting the brake disc, adjust the handbrake shoes. Temporarily refit two nuts, turn the adjuster **(see illustration 5.7c)** and expand the shoes until the disc locks, then back off the adjuster until you can spin the disc without the shoes dragging.

8 Adjust the handbrake cable (Section 10).

9 Remove the axle stands and lower the vehicle. Tighten the wheel nuts to the specified torque (see Chapter 1 Specifications).

12.5o . . . place the rear shoe in position, insert the pin through the backing plate and the shoe and refit the rear washers and hold-down spring

12.5p Hook the upper return spring into the front shoe . . .

13 Brake light switch - check and renewal

1 The brake light switch activates the brake lights when the brake pedal is depressed. It's located at the top of the brake pedal, inside the pedal box.

2 If the brake lights don't come on when the brake pedal is depressed, check the fuses (the fuse for the left brake light is in the left fuse panel and the fuse for the right brake light is in the right panel).

3 If the fuses are okay, check the brake light bulbs (see Chapter 12).

4 If the fuses and bulbs are okay, either the switch isn't getting voltage (there's an open-circuit between the voltage source and the switch), voltage isn't reaching the brake light

12.5q . . . and into the rear shoe

12.5r Pull the shoes apart and refit the adjuster mechanism

bulbs (open-circuit between the switch and the bulbs), or the switch is defective.

5 To remove the switch, reach up under the dash and unplug the two electrical connectors - one for the brake lights and one for the cruise control system. Locate the two pairs of leads coming down the pedal box and trace them to their connectors on or near the steering column.

6 Remove the three switch-plate retaining bolts and remove the switch assembly **(see illustrations)**. Inspect the switch-plate rubber gasket for cracks or deterioration and renew it if it's damaged or worn.

7 Place the switch assembly on a workbench and connect an ohmmeter to the brake light switch terminals. With the switch plunger in its normal, extended position (brake pedal not applied), there should be no continuity (infinite resistance) **(see illustration)**; when the plunger is depressed (brake pedal applied), there should be continuity (zero resistance) **(see illustration)**. If the switch doesn't perform as described, renew it. If the switch works in an opposite fashion, i.e. continuity when the plunger is free, no continuity when the plunger is depressed, you've tested the cruise control switch! Switch the ohmmeter leads to the other connector and recheck.

8 To remove the switch from the plate, remove the two small nuts on the back of the plate **(see illustration)**.

9 Refit the switch assembly and the switch plate bolts but don't tighten the bolts yet.

10 Plug in the brake light and cruise control connectors.

11 The holes in the switch plate are slotted for adjustment. While an assistant presses the brake pedal, verify that the brake lights come on; with the pedal released, make sure the brake lights are off. If the lights don't come on when the pedal is depressed, or stay on when the pedal is released, adjust the switch by moving the plate until proper operation is achieved. Tighten the switch-plate bolts.

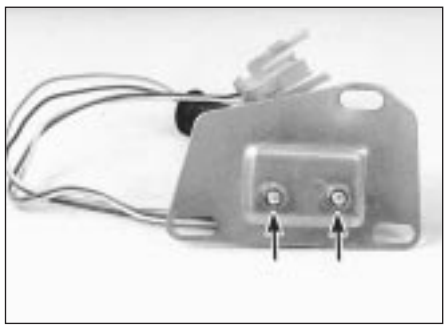
12 After tightening the switch-plate bolts, check the switch again to make sure it performs properly.

13.6a To remove the brake light switch, remove the three mounting plate screws (arrowed) . . .

13.6b . . . and carefully pry the switch plate away from the pedal box - be careful not to damage the gasket

13.7a To check the brake light switch, connect an ohmmeter to the switch terminals; with the switch plunger released, there should be no continuity (infinite resistance)

13.7b With the switch plunger depressed, there should be continuity (zero resistance)



13.8 If you're replacing the switch, remove these two nuts (arrowed) and transfer the retaining plate to the new switch