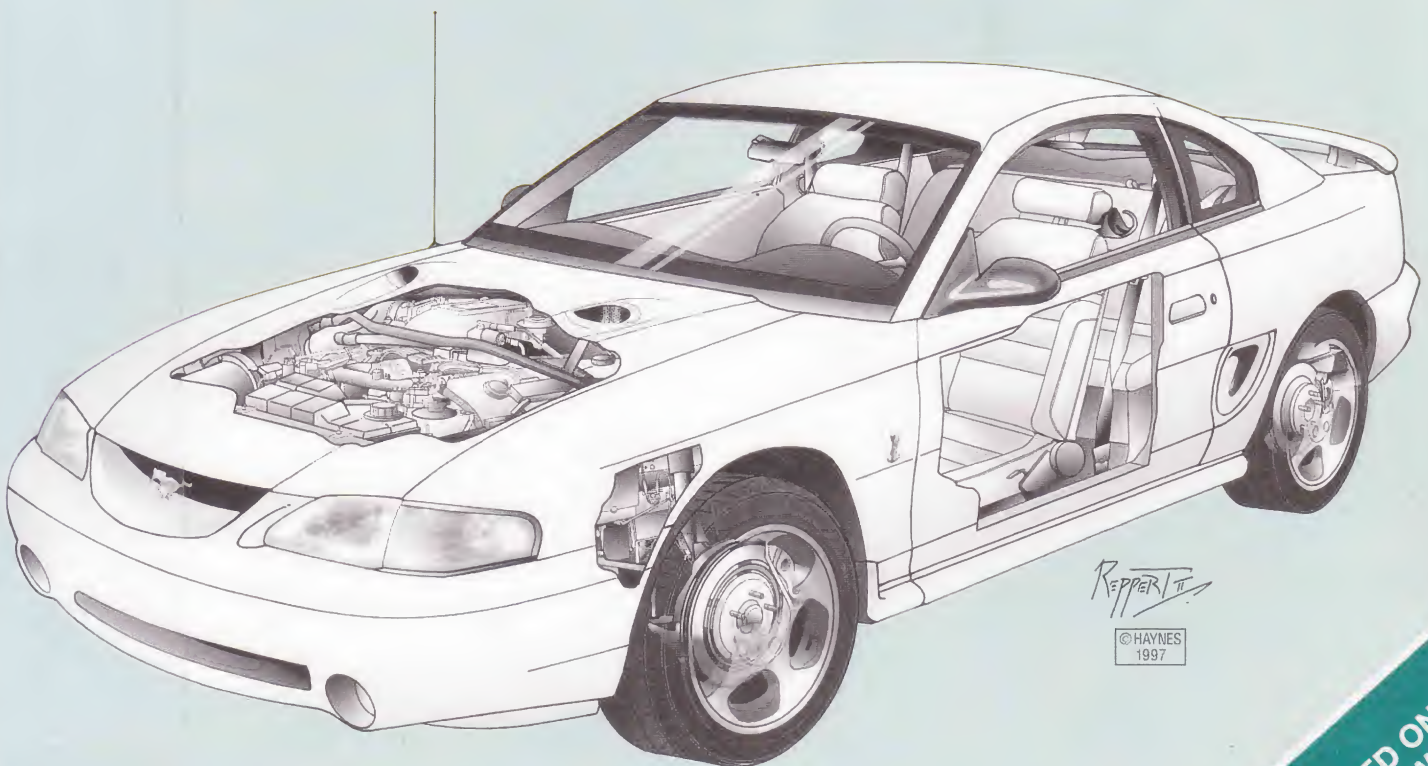
# FORD MUSTANG

## 1994 thru 1997 □ All models

36051

Haynes

# Automotive Repair Manual




PRINTED ON RECYCLED PAPER

EVERY MANUAL BASED ON A COMPLETE TEARDOWN AND REBUILD

It should be noted that many fasteners, especially Grades 0 through 2, have no distinguishing marks on them. When such is the case, the only way to determine whether it is standard or metric is to measure the thread pitch or compare it to a known fastener of the same size.

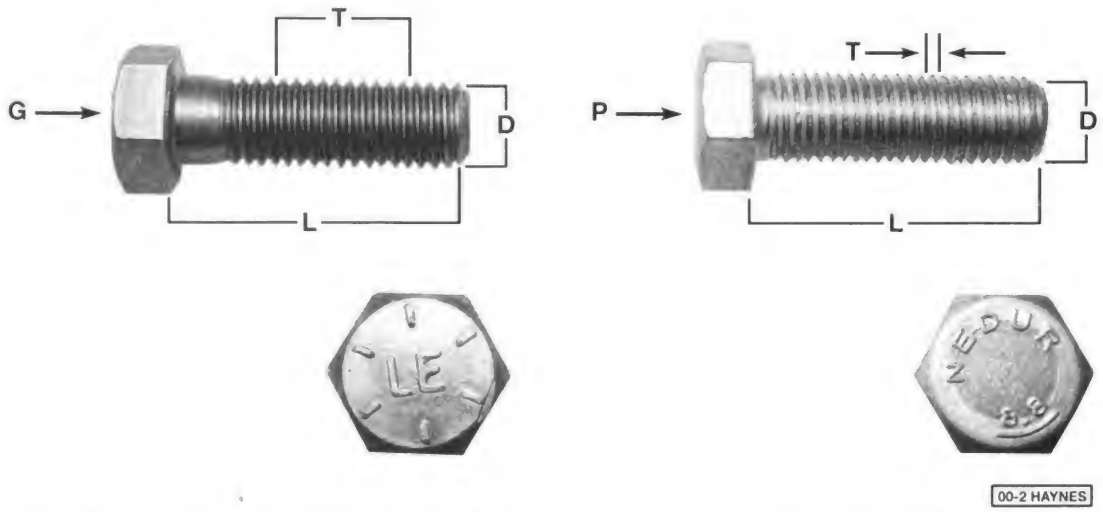
Standard fasteners are often referred to as SAE, as opposed to metric. However, it should be noted that SAE technically refers to a non-metric fine thread fastener only. Coarse thread non-metric fasteners are referred to as USS sizes.

Since fasteners of the same size (both standard and metric) may have different strength ratings, be sure to reinstall any bolts, studs or nuts removed from your vehicle in their original locations. Also, when replacing a fastener with a new one, make sure that the new one has a strength rating equal to or greater than the original.

## Tightening sequences and procedures

Most threaded fasteners should be tightened to a specific torque value (torque is the twisting force applied to a threaded component such as a nut or bolt). Overtightening the fastener can weaken it and cause it to break, while undertightening can cause it to eventually come loose. Bolts, screws and studs, depending on the material they are made of and their thread diameters, have specific torque values, many of which are noted in the Specifications at the beginning of each Chapter. Be sure to follow the torque recommendations closely. For fasteners not assigned a specific torque, a general torque value chart is presented here as a guide. These torque values are for dry (unlubricated) fasteners threaded into steel or cast iron (not aluminum). As was previously mentioned, the size and grade of a fastener determine the amount of torque that can safely be applied to it. The figures listed

| Metric thread sizes | Ft-lbs | Nm |
|---|---|---|
| M-6 | 6 to 9 | 9 to 12 |
| M-8 | 14 to 21 | 19 to 28 |
| M-10 | 28 to 40 | 38 to 54 |
| M-12 | 50 to 71 | 68 to 96 |
| M-14 | 80 to 140 | 109 to 154 |
| **Pipe thread sizes** | | |
| 1/8 | 5 to 8 | 7 to 10 |
| 1/4 | 12 to 18 | 17 to 24 |
| 3/8 | 22 to 33 | 30 to 44 |
| 1/2 | 25 to 35 | 34 to 47 |
| **U.S. thread sizes** | | |
| 1/4 - 20 | 6 to 9 | 9 to 12 |
| 5/16 - 18 | 12 to 18 | 17 to 24 |
| 5/16 - 24 | 14 to 20 | 19 to 27 |
| 3/8 - 16 | 22 to 32 | 30 to 43 |
| 3/8 - 24 | 27 to 38 | 37 to 51 |
| 7/16 - 14 | 40 to 55 | 55 to 74 |
| 7/16 - 20 | 40 to 60 | 55 to 81 |
| 1/2 - 13 | 55 to 80 | 75 to 108 |




**Standard (SAE and USS) bolt dimensions/grade marks**

*G Grade marks (bolt strength)*
*L Length (in inches)*
*T Thread pitch (number of threads per inch)*
*D Nominal diameter (in inches)*

**Metric bolt dimensions/grade marks**

*P Property class (bolt strength)*
*L Length (in millimeters)*
*T Thread pitch (distance between threads in millimeters)*
*D Diameter*

# Troubleshooting

## Contents

# Chapter 1
# Tune-up and routine maintenance

## Contents

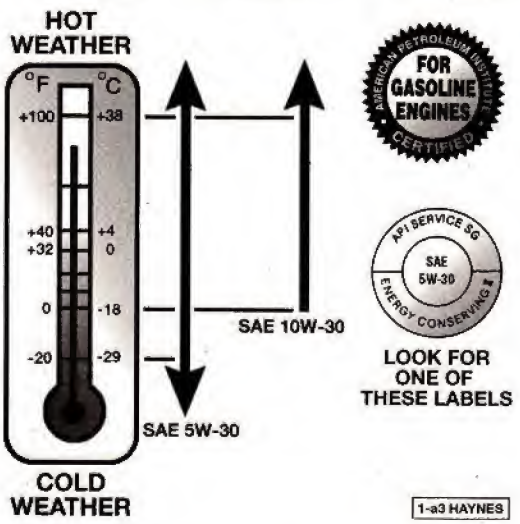


## Specifications

### Recommended lubricants and fluids

| | |
|---|---|
| Engine oil | |
| Type | API grade SG or SG/CC multigrade and fuel efficient oil |
| Viscosity | See accompanying chart |
| Fuel | |
| All except Cobra | unleaded gasoline, 87 octane or higher |
| Cobra | unleaded gasoline, 91 octane or higher |
| Engine coolant | 50/50 mixture of ethylene glycol based antifreeze and water |
| Brake fluid | DOT 3 heavy duty brake fluid |
| Power steering fluid | MERCON automatic transmission fluid |
| Automatic transmission fluid | MERCON automatic transmission fluid |
| Manual transmission fluid | MERCON automatic transmission fluid |
| Chassis grease | SAE NLGI no. 2 chassis grease |
| Differential lubricant | SAE 80W-90 GL-5 gear lubricant* |

** Trak-Lok axles add 4 oz. of friction modifier (Ford part no. C8AZ-19B546-A) when oil is changed.*




**Recommended engine oil viscosity**

4.22 The windshield washer reservoir is located at the left front corner of the engine compartment next to the battery

5.2 Use a tire tread depth indicator to monitor tire wear - they are available at auto parts stores and service stations and cost very little

## 5 Tire and tire pressure checks (every 250 miles or weekly)

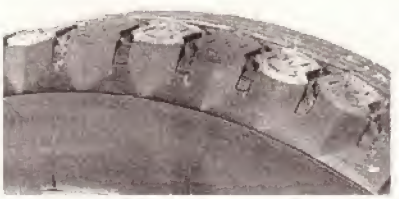
*Refer to illustrations 5.2, 5.3, 5.4a, 5.4b and 5.8*

1 Periodic inspection of the tires may spare you the inconvenience of being stranded with a flat tire. It can also provide you with vital information regarding possible problems in the steering and suspension systems before major damage occurs.

2 The original tires on this vehicle are equipped with 1/2-inch side bands that will appear when tread depth reaches 1/16-inch, but they don't appear until the tires are worn out. Tread wear can be monitored with a simple, inexpensive device known as a tread depth indicator **(see illustration)**.

3 Note any abnormal tread wear **(see illustration)**. Tread pattern irregularities such as cupping, flat spots and more wear on one side than the other are indications of front end alignment and/or balance problems. If any of these conditions are noted, take the vehicle to a tire shop or service station to correct the problem.

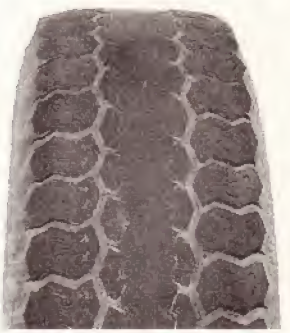
UNDERINFLATION



CUPPING

Cupping may be caused by:

- Underinflation and/or mechanical irregularities such as out-of-balance condition of wheel and/or tire, and bent or damaged wheel.
- Loose or worn steering tie-rod or steering idler arm.
- Loose, damaged or worn front suspension parts.

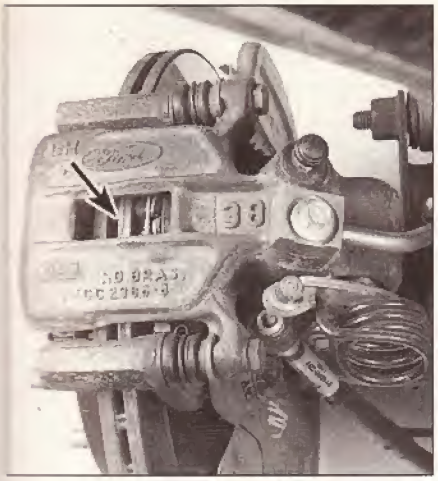


OVERINFLATION

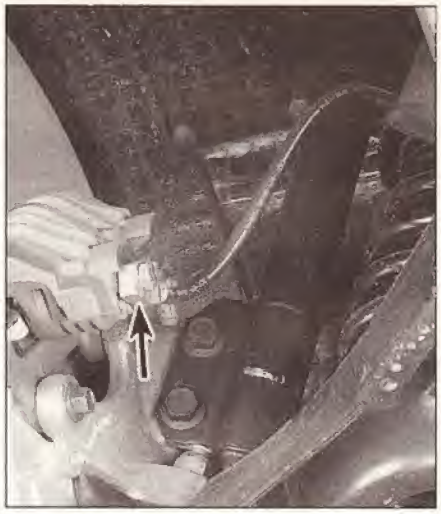
INCORRECT TOE-IN OR EXTREME CAMBER

FEATHERING DUE TO MISALIGNMENT

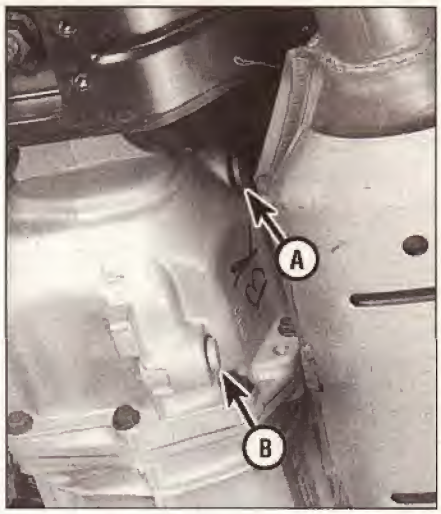
5.3 This chart will help you determine the condition of the tires, the probable cause(s) of abnormal wear and the corrective action necessary



18.6 You will find an inspection hole (arrow) like this in each caliper - placing a ruler across the hole should enable you to determine the thickness of remaining pad material for both inner and outer pads



18.11 Check along the brake hoses and at each fitting (arrow) for deterioration and cracks




19.2 The manual transmission fill plug (A) and drain plug (B) (arrows) are located on the side of the transmission case

cleaner only! Try to use non-asbestos replacement parts whenever possible.

**Note:** *For detailed photographs of the brake system,* refer to Chapter 9.

1 In addition to the specified intervals, the brakes should be inspected every time the wheels are removed or whenever a defect is suspected.

2 Any of the following symptoms could indicate a potential brake system defect: The vehicle pulls to one side when the brake pedal is depressed; the brakes make squealing or dragging noises when applied; brake pedal travel is excessive; the pedal pulsates; brake fluid leaks, usually onto the inside of the tire or wheel.

3 Loosen the wheel lug nuts.

4 Raise the vehicle and place it securely on jackstands.

5 Remove the wheels (see *Jacking and towing* at the front of this book, or your owner's manual, if necessary).

## Disc brakes

*Refer to illustrations 18.6 and 18.11*

6 There are two pads (an outer and an inner) in each caliper. The pads are visible through inspection holes in each caliper **(see illustration)**.

7 Check the pad thickness by looking at each end of the caliper and through the inspection hole in the caliper body. If the lining material is less than the thickness listed in this Chapter's Specifications, replace the pads. **Note:** *Keep in mind that the lining material is riveted or bonded to a metal backing plate and the metal portion is not included in this measurement.*

8 If it is difficult to determine the exact thickness of the remaining pad material by the above method, or if you are at all concerned about the condition of the pads, remove the caliper(s), then remove the pads from the calipers for further inspection (refer to Chapter 9).

9 Once the pads are removed from the calipers, clean them with brake cleaner and re-measure them with a ruler or a vernier caliper.

10 Measure the disc thickness with a micrometer to make sure that it still has service life remaining. If any disc is thinner than the specified minimum thickness, replace it (refer to Chapter 9). Even if the disc has service life remaining, check its condition. Look for scoring, gouging and burned spots. If these conditions exist, remove the disc and have it resurfaced (see Chapter 9).

11 Before installing the wheels, check all brake lines and hoses for damage, wear, deformation, cracks, corrosion, leakage, bends and twists, particularly in the vicinity of the rubber hoses at the calipers **(see illustration)**. Check the clamps for tightness and the connections for leakage. Make sure that all hoses and lines are clear of sharp edges, moving parts and the exhaust system. If any of the above conditions are noted, repair, reroute or replace the lines and/or fittings as necessary (see Chapter 9).

## Brake booster check

12 Sit in the driver's seat and perform the following sequence of tests.

13 With the engine stopped, depress the brake pedal several times - the travel distance should not change.

14 With the brake fully depressed, start the engine - the pedal should move down a little when the engine starts.

15 Depress the brake, stop the engine and hold the pedal in for about 30 seconds - the pedal should neither sink nor rise.

16 Restart the engine, run it for about a minute and turn it off. Then firmly depress the brake several times - the pedal travel should decrease with each application.

17 If your brakes do not operate as described above when the preceding tests are performed, the brake booster is either in need of repair or has failed. Refer to Chapter 9 for the removal procedure.

## Parking brake

18 The parking brake mechanisms on these vehicles are self adjusting and do not require regular scheduled maintenance. For more detailed information on the parking brake assembly see Chapter 9.

## 19 Manual transmission lubricant level check (every 15,000 miles or 12 months)

*Refer to illustration 19.2*

1 The manual transmission has a filler plug which must be removed to check the lubricant level. If the vehicle is raised to gain access to the plug, be sure to support it safely on jackstands - DO NOT crawl under a vehicle which is supported only by a jack! Be sure the vehicle is level or the check may be inaccurate.

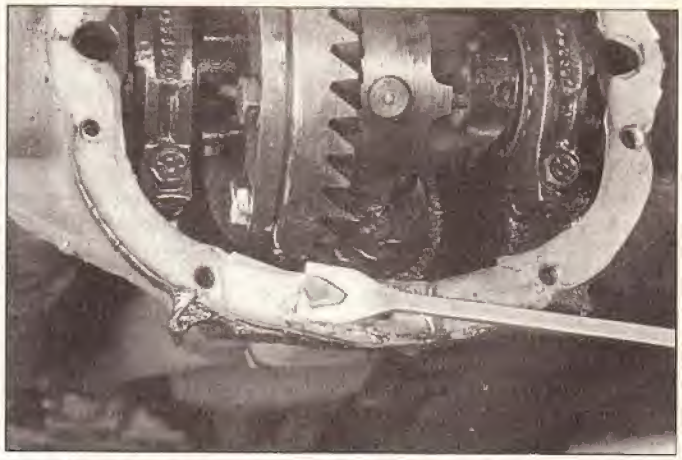
2 Using an open -end wrench, unscrew the plug from the transmission **(see illustration)** and use a finger to reach inside the housing to determine the lubricant level. The level should be at or near the bottom of the plug hole.

3 If it isn't, add the recommended lubricant through the plug hole with a pump or squeeze bottle.

4 Install and tighten the plug and check for leaks after the first few miles of driving.

1

32.4c Once the lubricant has drained, remove the cover



32.6 Carefully scrape off the old material to ensure a leak-free seal



remove the bolts on the lower half of the plate **(see illustration)**. Loosen the bolts on the upper half and use them to keep the cover loosely attached **(see illustration)**. Allow the oil to drain into the pan, then completely remove the cover **(see illustration)**.

5 Using a lint-free rag, clean the inside of the cover and the accessible areas of the differential housing. As this is done, check for chipped gears and metal particles in the lubricant, indicating that the differential should be more thoroughly inspected and/or repaired.

6 Thoroughly clean the gasket mating surfaces of the differential housing and the cover plate. Use a gasket scraper or putty knife to remove all traces of the old gasket **(see illustration)**.

7 Apply a thin layer of RTV sealant to the cover flange, then press a new gasket into position on the cover. Make sure the bolt holes align properly.

8 Place the cover on the differential housing and install the bolts. Tighten the bolts securely.

9 Use a hand pump, syringe or funnel to fill the differential housing with the specified lubricant until it's level with the bottom of the plug hole.

10 Install the filler plug and make sure it is secure.

32 Carefully set the manifold in place while the sealant is still wet. **Caution:** *Don't disturb the gaskets. The alignment studs will keep the manifold from moving fore-and-aft after it contacts the seals on the engine block. Make sure the end seals haven't been disturbed.*

33 Lightly oil the manifold bolts, install them and tighten to the torque listed in this Chapter's Specifications, following the recommended sequence **(see illustrations)**. Work up to the final torque in three steps. When all but the corner bolts have been installed hand-tight, remove the alignment studs and replace them with bolts before tightening any bolts to the final torque.

34 The remaining installation steps are the reverse of removal. Start the engine and check carefully for oil and coolant leaks at the intake manifold joints.

35 Recheck the mounting bolt torque.

## 8 Exhaust manifolds - removal and installation

### *Removal*

*Refer to illustrations 8.5, 8.11a and 8.11b*

1 Disconnect the negative battery cable from the battery.

2 Disconnect the oxygen sensor electrical connector and remove the spark plugs (Chapter 1).

3 Raise the vehicle and support it securely on jackstands.

4 Working under the vehicle, apply penetrating oil to the exhaust pipe-to-manifold studs and nuts (they're usually rusty).

5 Remove the nuts holding the exhaust crossover pipe to the exhaust manifold(s) **(see illustration)**. In extreme cases you may have to heat them with a propane or acetylene torch in order to loosen them.

#### Right (passenger's side) manifold

6 Remove the air cleaner duct assembly (Chapter 4).

7 Disconnect the ignition secondary wire from the coil and distributor.

8 Disconnect the EGR tube.

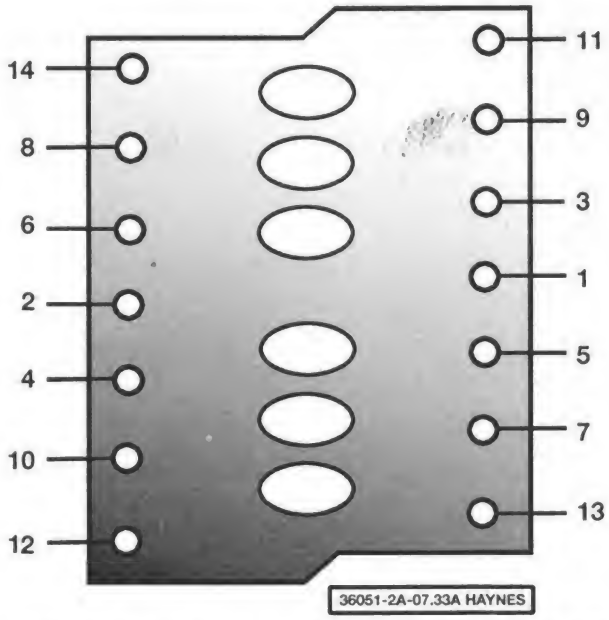
9 On vehicles with an automatic transmission, the automatic transmission dipstick and tube must be removed. Plug the hole to prevent dirt from entering the engine.

#### Left (driver's side) manifold

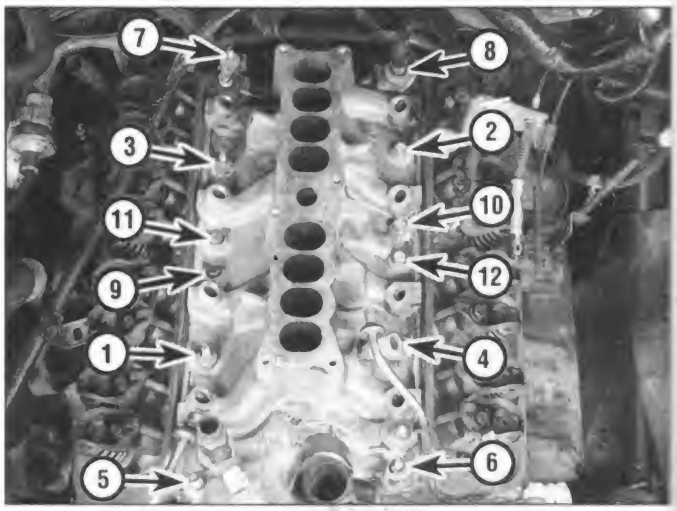
10 If it's in the way, remove the oil dipstick and tube.

#### Both manifolds

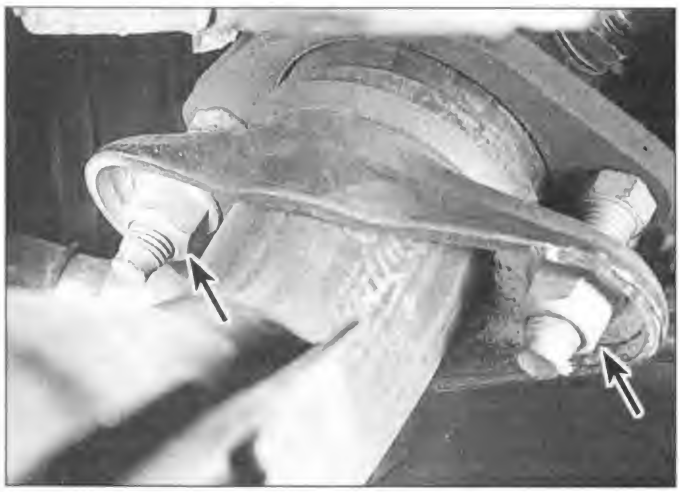
11 Bend back the locking tabs (if equipped). Remove the mounting bolts and separate the exhaust manifold(s) from the cylinder head **(see illustrations)**. Note the locations of the bolts and studs, and remove the old gaskets.



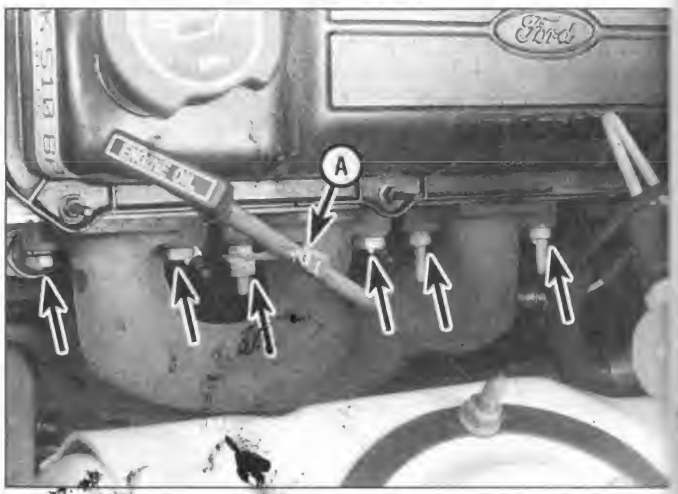

7.33a Intake manifold bolt tightening sequence - V6 engine



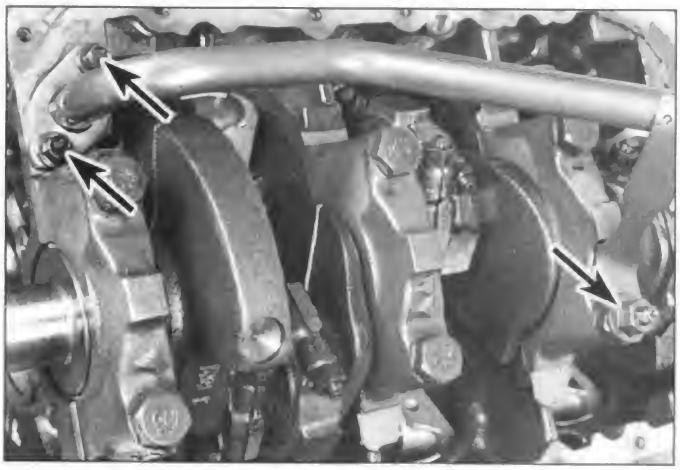

7.33b Intake manifold tightening sequence - 5.0L V8 engine



8.5 From below, remove the two exhaust pipe-to-manifold nuts (arrows)




8.11a Remove the exhaust manifold bolts and studs (V6 engine, right manifold)



**15.11 To detach the V6 engine pickup tube, remove the nut and bolt (arrows)**

4 Clean and inspect the oil pump cavity. If the oil pump gear pocket in the timing chain cover is damaged or worn, replace the timing chain cover.

5 Remove all traces of gasket material from the oil pump cover, then check it for warpage with a straightedge and feeler gauges. If it's warped more than 0.0016-inch, replace it with a new one.

6 To remove the pressure relief valve, first detach the timing chain cover from the engine (Section 10). Drill a hole in the plug **(see illustration 10.14)**, then pry it out or remove it with a slide hammer and screw adapter. Remove the spring and valve from the bore.

7 Remove all metal chips from the bore and the valve, then check them carefully for wear, score marks and galling. If the bore is worn or damaged, a new timing chain cover will be required. The valve should fit in the bore with no noticeable side play or binding.

8 If the spring appears to be fatigued or collapsed, replace it with a new one. The tension can be measured and compared to this Chapter's Specifications to determine its condition.

9 Apply clean engine oil to the valve and install it in the bore, small end first. Insert the spring, then install a new plug. Carefully tap it in until it's 0.010-inch below the machined surface of the cover.

10 Intermediate shaft removal and installation is covered in Section 10.

11 The oil pump pickup is inside the oil pan. For access, remove the oil pan (see Section 14). Remove the pick-up tube nut and the two mounting bolts **(see illustration)**.

12 Installation is the reverse of removal. **Caution:** *Be sure to pack the oil pump with petroleum jelly before installing the cover (DO NOT use any lubricant other than petroleum jelly). It must fill all voids between the gears, cavity and cover. If this isn't done, the pump may fail to prime when the engine is started.* Install a new cover gasket and tighten the bolts to the torque listed in this Chapter's Specifications in a criss-cross pattern. Use a new pick-up tube gasket and tighten the mounting bolts securely.

### *V8 models*

*Refer to illustration 15.17*

13 Unbolt and lower the oil pan as described in Section 14.

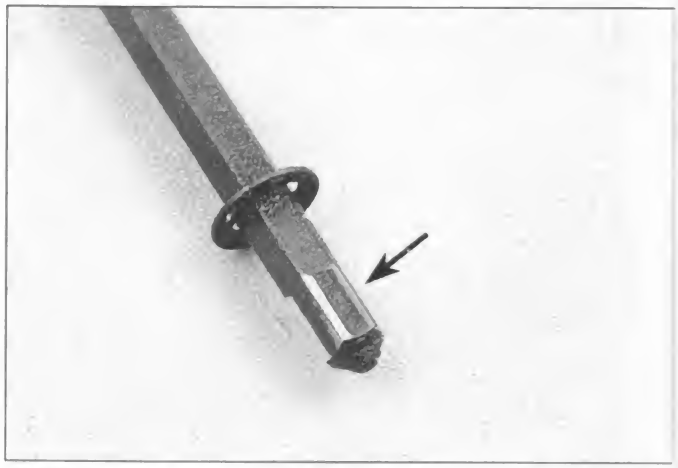
14 Remove the oil pick-up tube-to-main bearing cap nut.

15 Remove the oil pump mounting bolts.

16 Lower the oil pump assembly into the oil pan and remove the oil pan from the vehicle with the oil pump inside. If the pump is faulty, or you suspect that it's faulty, install a new one - do not attempt to repair the original.

17 The oil pump hex driveshaft will come out with the pump. Examine the distributor end of the hex for signs of wear **(see illustration)**. **Caution:** *If this shaft breaks, serious engine damage can result. If it looks worn, replace it.*

18 Prime the oil pump prior to installation. Pour clean oil into the pickup and turn the pump shaft by hand.



**15.17 There is serious wear on the distributor end (arrow) of this hex drive - it should be replaced**

19 If you separate the pump from the pick-up tube, use a new gasket and tighten the bolts securely when reattaching them.

20 Fit the oil pump driveshaft into the pump. It must seat all the way DO NOT try to force it. If it doesn't align, turn the pump slightly and try again.

21 Install the oil pump/pickup and drive with the oil pan as described in Section 14. Tighten the mounting nuts/bolts to the torque listed in this Chapter's Specifications.

22 The remainder of installation is the reverse of removal.

## 16 Crankshaft oil seals - replacement

### *Front seal - timing chain cover in place*

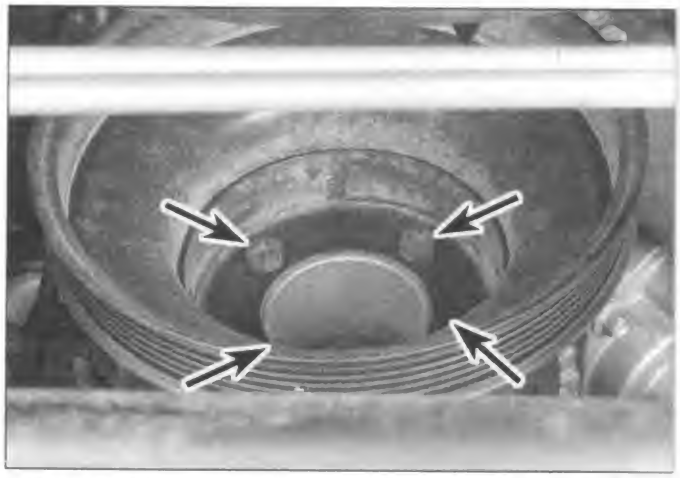
*Refer to illustrations 16.4, 16.5, 16.6, 16.8 and 16.10*

1 Disconnect the cable from the negative battery terminal.

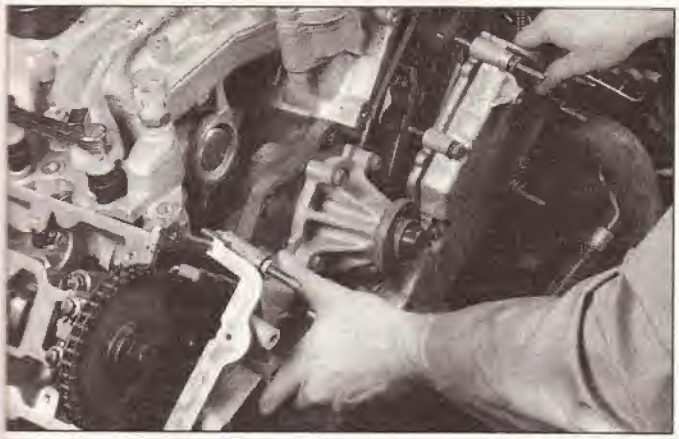
2 Remove the electric cooling fan/shroud assembly (see Chapter 3).

3 Remove the drivebelts (see Chapter 1).

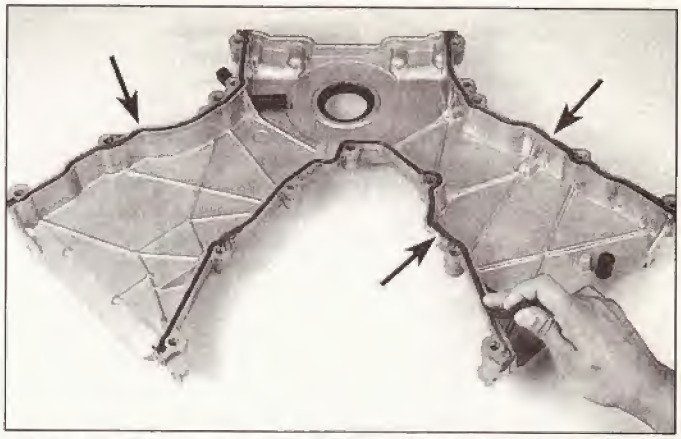
4 Mark the crankshaft pulley and vibration damper so they can be reassembled in the same relative position. This is important, since the damper and pulley are initially balanced as a unit. Unbolt and remove the pulley **(see illustration)**.



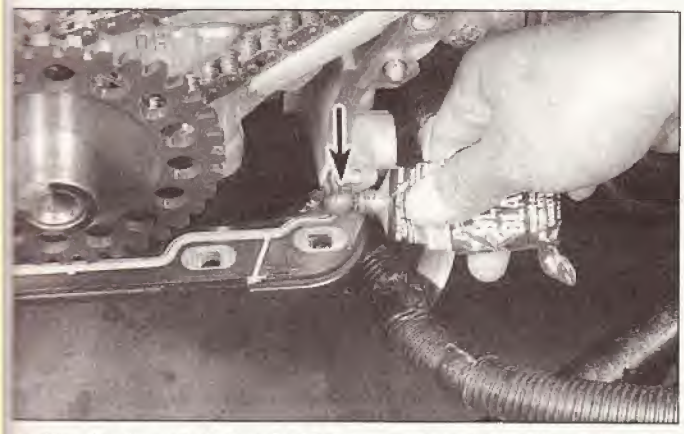
**16.4 Mark the pulley and vibration damper before removing the four bolts (arrows) - the large vibration damper bolt in the center (not seen here) is usually very tight, so use a six-point socket and a breaker bar to loosen it**



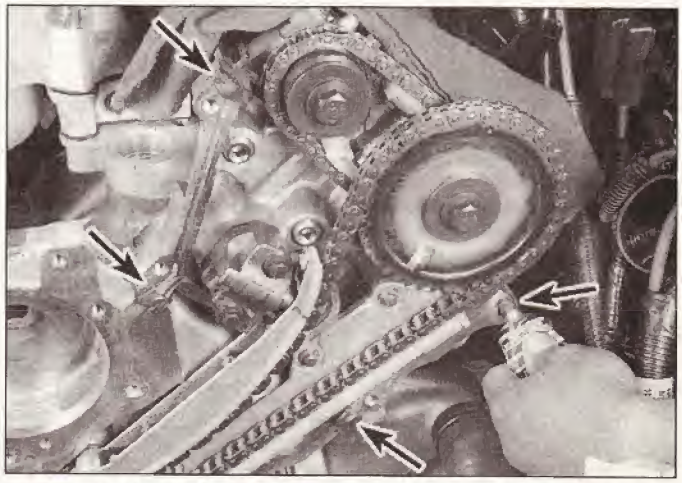
6.13 Separate the timing chain cover from the engine, using a soft-faced hammer if necessary to break the gasket seal



6.15 Install three new gaskets (arrows) into the grooves in the back of the timing chain cover



6.16a Apply a small bead of RTV sealant to the mating edges of the engine block, timing chain cover and oil pan - shown are the lower corners on 4.6L-DOHC, with oil pan in place)



6.16b Apply a dab of RTV at the cylinder head/valve cover and cylinder head/engine block junctions (arrows) before installing the timing chain cover

4 Refer to Section 4 and remove both valve covers. **Note:** *On 4.6L-DOHC engines, the engine compartment brace must be removed.*

5 On 4.6L-DOHC models, drain the cooling system (see Chapter 1) and remove the upper radiator hose and bypass pipes (see Chapter 3).

6 Remove the engine cooling fan/shroud assembly (see Chapter 3).

7 On 4.6L-SOHC models, remove the oil pan (see Section 14).

8 Disconnect the electrical connectors to the camshaft sensor and the crankshaft sensor (see Chapter 6). Disconnect and remove both ignition coil packs (one is attached to each side of the timing chain cover, see Chapter 5).

9 Remove the bolts securing the power steering pump to the engine (see Chapter 10). **Note:** *The front lower bolt on the power steering pump will not come all the way out*, Position the pump aside and secure it out of the way.

10 Unbolt and set aside the power steering fluid reservoir **(see illustration)**.

11 Remove the ignition coil brackets. **(see illustrations)**.

12 Remove the timing chain cover-to-engine block bolts **(see illustration)**. **Note:** *On 4.6L-DOHC models, be sure to remove the four oil pan-to-timing chain cover bolts from underneath* **(see illustration)**.

13 Separate the timing chain cover from the engine block **(see illustration)**. If it's stuck, tap it gently with a soft-face hammer to break the gasket bond. **Caution:** *DO NOT use excessive force or you may crack the cover. If the cover is difficult to remove, double check to make sure all of the bolts have been removed.*

## Installation

*Refer to illustrations 6.15, 6.16a and 6.16b*

14 Clean the mating surfaces of the timing chain cover, engine block and cylinder heads to remove all traces of old gasket material, oil and dirt. Final cleaning should be with lacquer thinner or acetone. On 4.6L-DOHC models, do not use a scraper near the bottom of the engine block, or you could damage the front portion of the existing oil pan gasket. **Warning:** *Be careful when cleaning any of the aluminum components. Use of a metal scraper could cause scratches or gouges that could lead to an oil leak later.*

15 Adhere the three new gaskets to the backside of the timing chain cover **(see illustration)**.

16 Apply a 1/8-inch bead of RTV sealant to the junctions of the oil pan, timing chain cover and engine block **(see illustration)**. Apply a small dab of RTV where the timing chain cover and engine block meet at the valve cover surface **(see illustration)**.

17 Lubricate the timing chains and the lip of the front crankshaft oil seal with clean engine oil.

18 Install the timing chain cover on the engine. On 4.6L-SOHC models, push the cover straight in onto the engine's dowel pins, but on the 4.6L-DOHC model, position the bottom/front edge of the timing chain cover flush with the front edge of the oil pan and "tilt" the top of the cover into place against the engine. Do not shove the cover straight in against the engine or the sealant may be scraped off the front of the oil pan and cause a leak. Tighten the timing chain cover-to-engine block bolts to the torque listed in this Chapter's Specifications, in the sequence shown **(see illustration 6.12a)**.

19 Install the remaining parts in the reverse order of removal.

20 Add the proper type and quantity of engine oil and coolant (see Chapter 1). Run the engine and check for leaks.

10.20a The valve stem seals combine a seal with the valve spring seat

10.20b There is special valve seal installation tool (Ford tool no. T91P-6571-A) available, but a deep socket that fits over the seal can be used to gently tap the seal into place

10.22 Apply a small dab of grease to each keeper as shown here before installation - it'll hold them in place on the valve stem as the spring is released

21 Install the spring in position over the valve.
22 Install the valve spring retainer. Compress the valve spring and carefully position the keepers in the groove. Apply a small dab of grease to the inside of each keeper to hold it in place if necessary **(see illustration)**.
23 Remove the pressure from the spring tool and make sure the keepers are seated.
24 Disconnect the air hose and remove the adapter from the spark plug hole.
25 If the camshaft(s) were removed, reinstall them at this time (see Section 9).
26 Install the spark plug(s) and connect the wire(s).
27 The remaining installation steps are the reverse of removal.
28 Start and run the engine, then check for oil leaks and unusual sounds coming from the valve cover area.

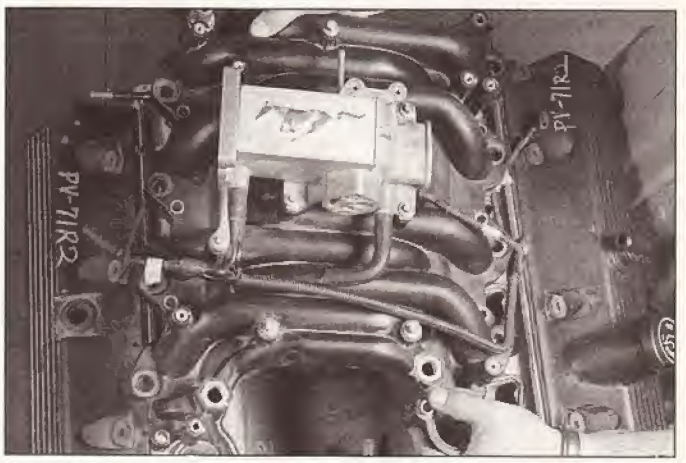
## 11 Intake manifold - removal and installation

### *Removal*

#### 4.6L-SOHC models

*Refer to illustration 11.22*

1 Relieve the fuel system pressure (see Chapter 4). Disconnect the cable from the negative battery terminal.
2 Drain the cooling system and remove the drivebelt (see Chapter 1).
3 Disconnect the radiator, heater and water pump bypass hoses from the water outlet (see Chapter 3).
4 Remove the thermostat housing (see Chapter 3). The thermostat housing bolts also retain the intake manifold.
5 Remove the air inlet tube.
6 Label and disconnect the intake manifold vacuum lines.
7 Remove the PCV and canister purge hoses from the valve covers (see Section 4).
8 Disconnect the accelerator cable, automatic transmission cable and speed control linkage (if so equipped).
9 Disconnect the ignition wire brackets, boots and wires and set them out of the way. **Note:** *Pull the spark plug wire separators from their mounts on the valve cover studs and lay the wires out of the way.*
10 Disconnect the alternator electrical connectors and remove the alternator (see Chapter 5).
11 Remove the bolts retaining the alternator bracket to the intake manifold (see Chapter 5).
12 Disconnect both ignition coils (see Chapter 5).
13 Disconnect the electrical connectors from the camshaft sensor, coolant temperature sending unit, air charge temperature sensor, throttle positioner, idle speed control solenoid, EGR sensors and fuel injectors (see Chapter 5).
14 Disconnect the throttle and cruise control cables, and remove the throttle body (see Chapter 4).
15 Separate the wire loom bracket at the rear of the manifold.
16 Raise the vehicle with a jack and place it securely on jack stands.
17 Disconnect the EGR tube from the right exhaust manifold (see Chapter 4).
18 Disconnect the electrical connector at the oil pressure sending unit (see Chapter 2, Part C).
19 Lower the vehicle and position the harness out of the way.
20 Disconnect the fuel supply and return lines and cap the open fittings (see Chapter 4).
21 Loosen the intake manifold bolts and nuts in 1/4-turn increments, following the reverse order of the tightening sequence **(see illustration 11.37a)**, until they can be removed by hand. The injectors and fuel rails can be left on the intake manifold during removal.
22 Lift the intake manifold from the cylinder heads **(see illustration)**. The manifold may be stuck to the cylinder heads and force may be required to break the gasket seal. A prybar can be used to pry up the manifold, but make sure all bolts and nuts have been removed first!
**Caution:** *The intake manifold is plastic. Don't pry between the engine block and manifold or the cylinder heads, or damage to the gasket sealing surface may occur, leading to vacuum and oil leaks. Pry only at the manifold protrusion.*




11.22 Make sure there is nothing attached to the intake manifold and remove the manifold from the engine

# Chapter 2 Part C
# General engine overhaul procedures



**Contents**



**Specifications**

## General

| | |
|---|---|
| Oil pressure | |
| 3.8L V6 (engine hot at 2500 rpm) | 40 to 60 psi |
| 4.6L V8 (engine hot at 1500 rpm) | 20 to 45 psi |
| 5.0L V8 (engine hot at 2000 rpm) | 40 to 60 psi |
| Cylinder head warpage limit | 0.003 (in any 6 inches)/0.006 inch overall |
| Compression pressure | Lowest reading cylinder must be within 75 psi of highest reading cylinder (100 psi minimum) |

## 3.8L V6 engines

### Valves and related components

| | |
|---|---|
| Valve face angle | 45.8-degrees |
| Seat angle | 44.5-degrees |
| Seat width | 0.060 to 0.080 inch |
| Minimum valve margin width | 1/32 inch |


**9.1 A small plastic bag, with an appropriate label, can be used to store the valve train components so they can be kept together and reinstalled in the original position**

*Valve lifters (4.6L engines)*
*Cylinder heads*
*Oil pan*
*Oil pump (replace)*
*Piston/connecting rod assemblies*
*Crankshaft and main bearings ((replace)*

5 Before beginning the disassembly and overhaul procedures, make sure the following items are available. Also, refer to *Engine overhaul - reassembly sequence* for a list of tools and materials needed for engine reassembly.

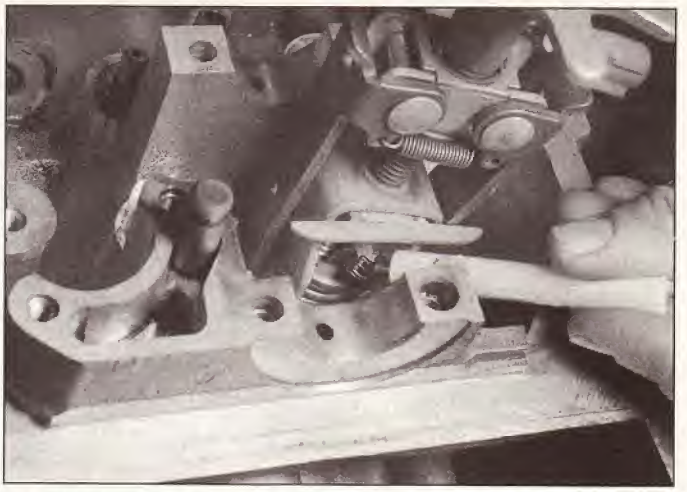
*Common hand tools*
*Small cardboard boxes and plastic bags for storing parts*
*Gasket scraper*
*Ridge reamer*
*Vibration damper puller*
*Micrometers*
*Telescoping gauges*
*Dial indicator set*
*Valve spring compressor*
*Cylinder surfacing hone*
*Piston ring groove cleaning tool*
*Electric drill motor*
*Tap and die set*
*Wire brushes*
*Oil gallery brushes*
*Cleaning solvent*

## 9 Cylinder head - disassembly

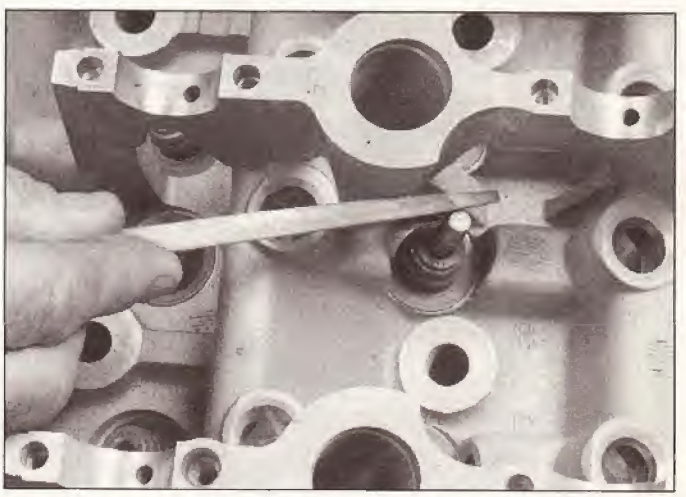
*Refer to illustrations 9.1, 9.2 and 9.3*

**Note:** *New and rebuilt cylinder heads are commonly available for most engines at dealerships and auto parts stores. Due to the fact that some specialized tools are necessary for the disassembly and inspection procedures, and replacement parts may not be readily available, it may be more practical and economical for the home mechanic to purchase replacement head(s) rather than taking the time to disassemble, inspect and recondition the original(s). However, most machine shops will not have a core set of 4.6L DOHC cylinder heads, so chances are you will have to wait until the rebuilding work is done to your heads.*

1 Cylinder head disassembly involves removal of the intake and exhaust valves and related components. If they're still in place, remove the rocker arm nuts, pivot balls and rocker arms from the cylinder head studs. Label the parts or store them separately **(see illustration)** so they can be reinstalled in their original locations and in the same valve guides they are removed from.



**9.2 Use a valve spring compressor to compress the spring, then remove the keepers from the valve stem with needle-nose pliers or a magnet, as shown here on a 4.6L SOHC engine**



**9.3 If the valve won't pull through the guide, deburr the edge of the stem end and the area around the top of the keeper groove with a file or whetstone**

2 Compress the springs on the first valve with a spring compressor and remove the keepers **(see illustration)**. Carefully release the valve spring compressor and remove the retainer, sleeve (if used), the spring and the spring seat (if used).

3 Pull the valve out of the head, then remove the oil seal from the guide. If the valve binds in the guide (won't pull through), push it back into the head and deburr the area around the keeper groove with a fine file or whetstone **(see illustration)**.

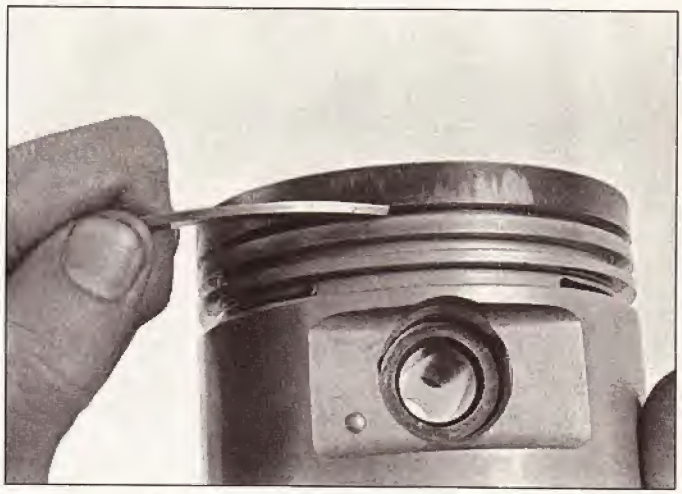
4 Repeat the procedure for the remaining valves. Remember to keep all the parts for each valve together so they can be reinstalled in the same locations.

5 Once the valves and related components have been removed and stored in an organized manner, the head should be thoroughly cleaned and inspected. If a complete engine overhaul is being done, finish the engine disassembly procedures before beginning the cylinder head cleaning and inspection process.

## 10 Cylinder head - cleaning and inspection

1 Thorough cleaning of the cylinder head(s) and related valve train components, followed by a detailed inspection, will enable you to decide how much valve service work must be done during the engine

18.4a The piston ring grooves can be cleaned with a special tool, as shown here . . .



18.4b . . . or a section of a broken ring

18.10 Check the ring side clearance with a feeler gauge at several points around the groove

18.11 Measure the piston diameter at a 90-degree angle to the piston pin and in line with it



the carbon deposits - don't remove any metal and do not nick or scratch the sides of the ring grooves.

5 Once the deposits have been removed, clean the piston/rod assemblies with solvent and dry them with compressed air (if available). Make sure the oil return holes in the back sides of the ring grooves are clear.

6 If the pistons and cylinder walls aren't damaged or worn excessively, and if the engine block is not rebored, new pistons won't be necessary. Normal piston wear appears as even vertical wear on the piston thrust surfaces and slight looseness of the top ring in its groove. New piston rings, however, should always be used when an engine is rebuilt.

7 Carefully inspect each piston for cracks around the skirt, at the pin bosses and at the ring lands.

8 Look for scoring and scuffing on the thrust faces of the skirt, holes in the piston crown and burned areas at the edge of the crown. If the skirt is scored or scuffed, the engine may have been suffering from overheating and/or abnormal combustion, which caused excessively high operating temperatures. The cooling and lubrication systems should be checked thoroughly. A hole in the piston crown is an indication that abnormal combustion (pre-ignition) was occurring. Burned areas at the edge of the piston crown are usually evidence of spark knock (detonation). If any of the above problems exist, the causes must be corrected or the damage will occur again. The causes may include intake air leaks, incorrect fuel/air mixture, incorrect ignition timing and EGR system malfunctions.

9 Corrosion of the piston, in the form of small pits, indicates that coolant is leaking into the combustion chamber and/or the crankcase. Again, the cause must be corrected or the problem may persist in the rebuilt engine.

10 Measure the piston ring side clearance by laying a new piston ring in each ring groove and slipping a feeler gauge in beside it **(see illustration)**. Check the clearance at three or four locations around each groove. Be sure to use the correct ring for each groove - they are different. If the side clearance is greater than the figure listed in this Chapter's Specifications, new pistons will have to be used.

11 Check the piston-to-bore clearance by measuring the bore (see Section 16) and the piston diameter. Make sure the pistons and bores are correctly matched. Measure the piston across the skirt, at a 90-degree angle to, and in line with, the piston pin **(see illustration)**. Subtract the piston diameter from the bore diameter to obtain the clearance. If it's greater than specified, the block will have to be rebored and new pistons and rings installed.

12 Check the piston-to-rod clearance by twisting the piston and rod in opposite directions. Any noticeable play indicates excessive wear, which must be corrected. The piston/connecting rod assemblies should be taken to an automotive machine shop to have the pistons and rods resized and new pins installed.

13 If the pistons must be removed from the connecting rods for any

## 1 General information

The cooling system consists of a radiator and coolant reserve system, a radiator pressure cap, a thermostat, a temperature-controlled electric cooling fan, and a pulley/belt-driven water pump.

The radiator cooling fan is mounted in a housing/shroud at the engine side of the radiator. It is designed to come on when the engine reaches a certain temperature, and shut off again when the engine cools down some, thereby keeping the engine in the desired operating-temperature range.

The system is pressurized by a spring-loaded radiator cap, which, by maintaining pressure, increases the boiling point of the coolant. If the coolant temperature goes above this increased boiling point, the extra pressure in the system forces the radiator cap valve off its seat and exposes the overflow pipe or hose. The overflow pipe/hose leads to a coolant recovery system. This consists of a plastic reservoir, mounted to the right side of the radiator, into which the coolant that normally escapes due to expansion is retained. When the engine cools, the excess coolant is drawn back into the radiator by the vacuum created as the system cools, maintaining the system at full capacity. This is a continuous process and provided the level in the reservoir is correctly maintained, it is not necessary to add coolant to the radiator.

On 1996 and later models with 4.6L V8 engines, the recovery tank is called a "degas" bottle, and it functions somewhat differently than traditional recovery tanks. Designed to separate any trapped air in the coolant, it is pressurized by the radiator and has a pressure cap on top (the radiator on these models has no cap at all). When the engine's thermostat is closed, no coolant flows in the degas bottle, but when the engine is fully warmed up, coolant flows from the top of the radiator through a small hose that enters the top of the degas bottle. There, air separates and coolant falls to the approximately one quart coolant reserve in the bottle, which is fed to the cooling system through a larger hose connected to the lower radiator hose. Unlike traditional coolant recovery tanks, the cap on the degas bottle should never be opened when the engine is running, since there is a danger of injury from steam or scalding water (see the **Warning** in Section 5).

Coolant in the left side of the radiator circulates through the lower radiator hose to the water pump, where it is forced through the water passages in the cylinder block. The coolant then travels up into the cylinder head, circulates around the combustion chambers and valve seats, travels out of the cylinder head past the open thermostat into the upper radiator hose and back into the radiator.

When the engine is cold, the thermostat restricts the circulation of coolant to the engine. When the minimum operating temperature is reached, the thermostat begins to open, allowing coolant to return to the radiator.

Automatic transmission-equipped models have a cooler element incorporated into the radiator to cool the transmission fluid.

The heating system works by directing air through the heater core, which is like a small radiator mounted behind the dash. Hot engine coolant heats the core, over which air passes to the interior of the vehicle by a system of ducts. Temperature is controlled by mixing heated air with fresh air, using a system of flapper doors in the ducts, and a heater motor.

Air conditioning is an optional accessory, consisting of an evaporator core located under the dash, a condenser in front of the radiator, a accumulator/drier in the engine compartment and a belt-driven compressor mounted at the front of the engine.

## 2 Antifreeze - general information

**Warning:** *Do not allow antifreeze to come in contact with your skin or painted surfaces of the vehicle. Rinse off spills immediately with plenty of water. Antifreeze is highly toxic if ingested. Never leave antifreeze lying around in an open container or in puddles on the floor; children and pets are attracted by it's sweet smell and may drink it. Check with local authorities about disposing of used antifreeze. Many communities have collection centers which will see that antifreeze is disposed of safely. Never dump used antifreeze on the ground or pour it into drains.*

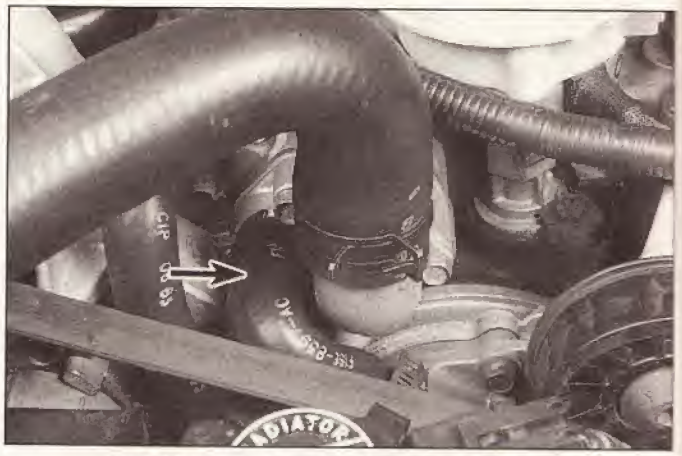
**Note:** *Non-toxic antifreeze is now manufactured and available at local auto parts stores, but even this type should be disposed of properly.*

The cooling system should be filled with a water/ethylene glycol based antifreeze solution which will prevent freezing down to at least -20-degrees F (even lower in cold climates). It also provides protection against corrosion and increases the coolant boiling point. The engines in the covered vehicles have either aluminum heads (V6 and 4.6L SOHC engines) or an aluminum block and heads (4.6L DOHC [Cobra] engine). The manufacturer recommends that only coolant designated as safe for aluminum engine components be used.

The cooling system should be drained, flushed and refilled at least every other year (see Chapter 1). The use of antifreeze solutions for periods of longer than two years is likely to cause damage and encourage the formation of rust and scale in the system.

Before adding antifreeze to the system, check all hose connections. Antifreeze can leak through very minute openings.

The exact mixture of antifreeze to water which you should use depends on the relative weather conditions. The mixture should contain at least 50-percent antifreeze, but should never contain more than 70-percent antifreeze.



**3.8 Thermostat location for the 5.0L engine - arrow indicates the bypass hose**

## 3 Thermostat - check and replacement

**Warning:** *The engine must be completely cool when this procedure is performed.*

**Note:** *Don't drive the vehicle without a thermostat! The computer may stay in open loop and emissions and fuel economy will suffer.*

### Check

1 Before condemning the thermostat, check the coolant level, drivebelt tension and temperature gauge (or light) operation.

2 If the engine takes a long time to warm up, the thermostat is probably stuck open. Replace the thermostat.

3 If the engine runs hot, check the temperature of the upper radiator hose. If the hose isn't hot, the thermostat is probably stuck shut. Replace the thermostat.

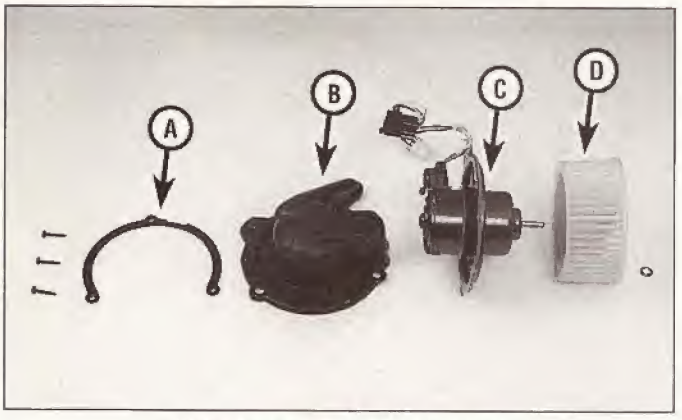
4 If the upper radiator hose is hot, it means the coolant is circulating and the thermostat is open. Refer to the *Troubleshooting* section at the front of this manual for the cause of overheating.

5 If an engine has been overheated, you may find damage such as leaking head gaskets, scuffed pistons and warped or cracked cylinder heads.

### Replacement

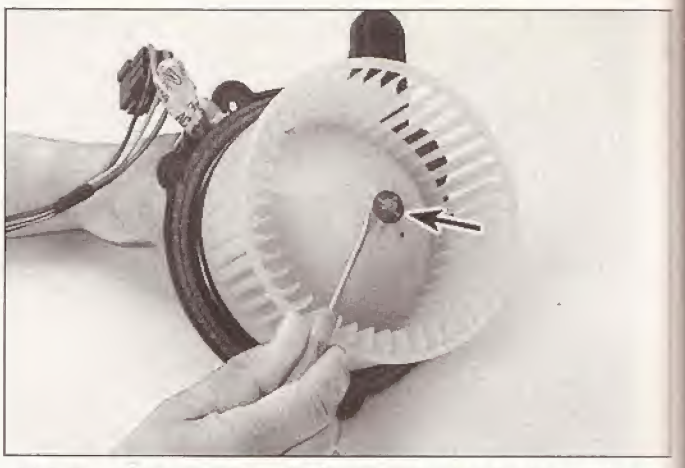
*Refer to illustrations 3.8, 3.9a, 3.9b, 3.9c and 3.12*

6 Drain coolant from the radiator, until the coolant level is below the thermostat housing (See Chapter 1).



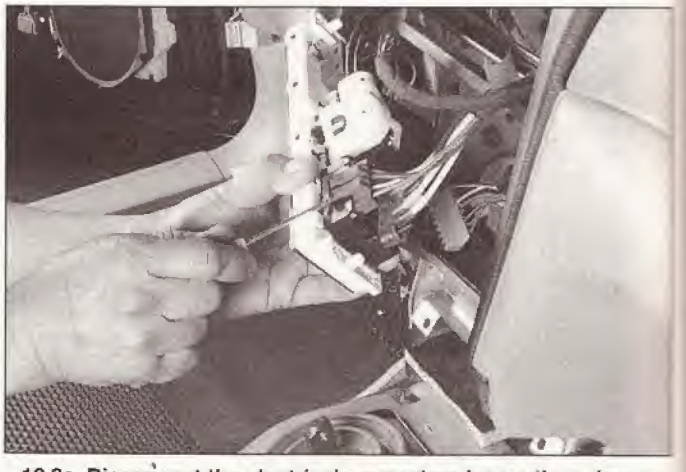

**11.2b Blower motor components**

*A Stiffener plate*
*B Blower motor cover*
*C Blower motor*
*D Fan*

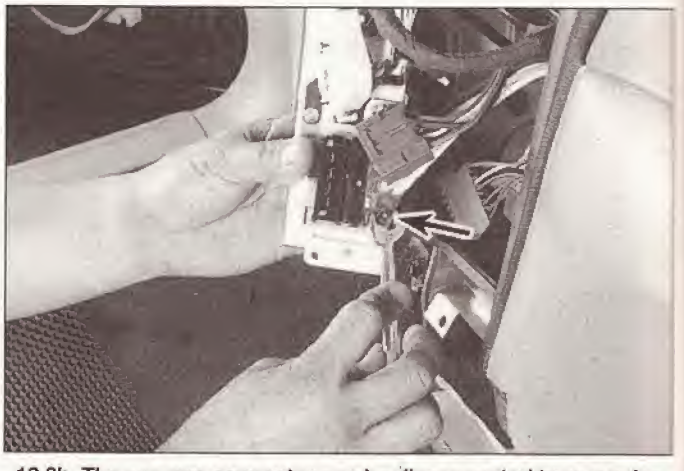


**11.3 Pry off the retaining clip (arrow) retaining the blower fan to the blower motor shaft**

**12.2 After the trim is removed, remove the four screws (arrows) and pull the control assembly out of the dash**



**12.3a Disconnect the electrical connectors by gently prying up the clips and pulling the connectors off**



**12.3b The vacuum connector can be disconnected by removing this nut (arrow)**

3 If the blower motor is being replaced, the fan wheel should be transferred to the new motor at this time. It is attached to the blower motor shaft with a push nut. Grasp the nut with a pliers and pull it off or pry it off with a small screwdriver, being careful not to crack the push nut **(see illustration)**. To reinstall the nut, simply push it on to the shaft.

4 The remainder of the installation is the reverse of removal.

## 12 Heater and air conditioning control assembly - removal and installation

**Warning:** *The models covered by this manual are equipped with Supplemental Restraint Systems (SRS), more commonly known as airbags. Always disconnect the negative battery cable, then the positive battery cable and wait two minutes before working in the vicinity of the impact sensors, steering column or instrument panel to avoid the possibility of accidental deployment of the airbag, which could cause personal injury* (see Chapter 12). *Do not use any electrical test equipment on any of the airbag system wires or tamper with them in any way.*

### Removal

*Refer to illustrations 12.2, 12.3a, 12.3b and 12.3c*

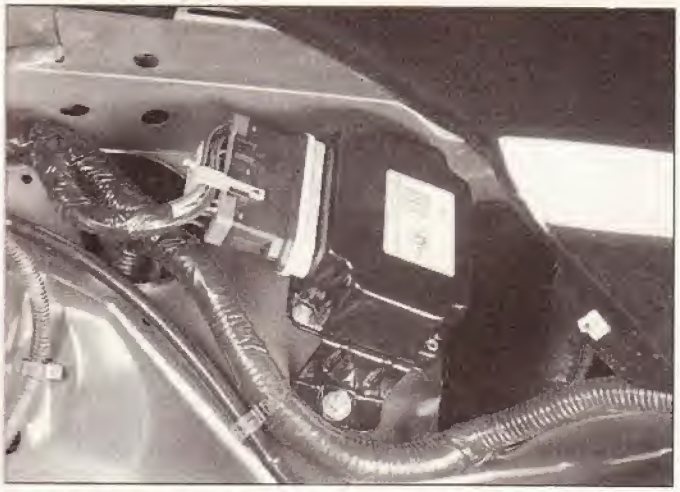
1 Refer to Chapter 11 for removal of the center dash bezel, around the control assembly and radio.

2 Remove the four screws retaining the control assembly to the instrument panel **(see illustration)**.

3 Pull the control assembly out of the instrument panel and disconnect the electrical connectors, vacuum harness and temperature control cable **(see illustrations)**. **Note:** *When disconnecting the vacuum lines. be careful to avoid cracking the plastic connectors and causing a vacuum leak (possibly internal within the control head).*

4 Refer to Section 10 for electrical checks of the blower motor speed switch.

5 Installation is the reverse of the removal procedure.



**3.3a Remove the center bolt, disconnect the CCRM harness connector and check for battery voltage on terminal number 11 with the ignition key ON (engine not running). This checks power from the 20 amp fuel pump fuse**

assistant turn the ignition key to the On position (engine not running) while you listen at the fuel filler opening. You should hear a whirring sound that lasts for a couple of seconds.

2 If you don't hear anything, check the fuel pump fuse (see Chapter 12). If the fuse is blown, replace it and see if it blows again. If it does, trace the fuel pump circuit for a short. If it isn't blown, remove the fuel pump relay and install a jumper wire into the fuel pump relay terminals that power the fuel pump. Listen at the fuel filler opening again - if you now hear the whirring sound, the fuel pump relay or its control circuit is faulty. If there is still no whirring sound, there is a problem in the fuel pump circuit from the relay panel to the fuel pump, defective power relay or a defective fuel pump.

3 Check for battery voltage to the fuel pump relay connector and the power relay connector **(see illustrations)**. If there is battery voltage present, have the CCRM tested at a dealer service department or other qualified automotive repair shop. **Note 1:** *The fuel pump relay, the PCM power relay, the EDF relay and the EDF relay control are all located in the Constant Control Relay Module (CCRM) which is located on the right side fenderwell on OBD II models and up front near the radiator on OBD I models.* **Note 2:** *4.6L DOHC engines are equipped with another fuel pump relay that is located in the passenger's side kick panel near the PCM. Be sure to check for battery voltage to the relay.* **Note 3:** *The inertia switch is an electrical device wired into the fuel pump circuit that will shut down power to the fuel pump in an accident. Be sure to check that the inertia switch is activated and in working order if the fuel pump is not receiving the proper voltage (see Section 2).*

4 If there is no voltage present, check the fuse(s) and the wiring circuit for the fuel pump relay and/or power relay (see Chapter 12). If voltage is present, check for battery voltage at the fuel pump connector.

## Operating pressure check

*Refer to illustrations 3.7 and 3.15*

5 Relieve the fuel system pressure (see Section 2).

6 Detach the cable from the negative battery terminal.

7 Remove the cap from the fuel pressure test port and attach a fuel pressure gauge **(see illustration)**. If you don't have the correct adapter for the test port, remove the Schrader valve and connect the gauge hose to the fitting, using a hose clamp.

8 Attach the cable to the negative battery terminal.

9 Start the engine.

10 Check the fuel pressure at idle. Compare your readings with the values listed in this Chapter's Specifications. Disconnect the vacuum hose from the fuel pressure regulator and watch the fuel pressure gauge - the fuel pressure should jump up considerably as soon as the hose is disconnected. If it doesn't, check for a vacuum signal to the fuel pressure regulator (see Step 15).

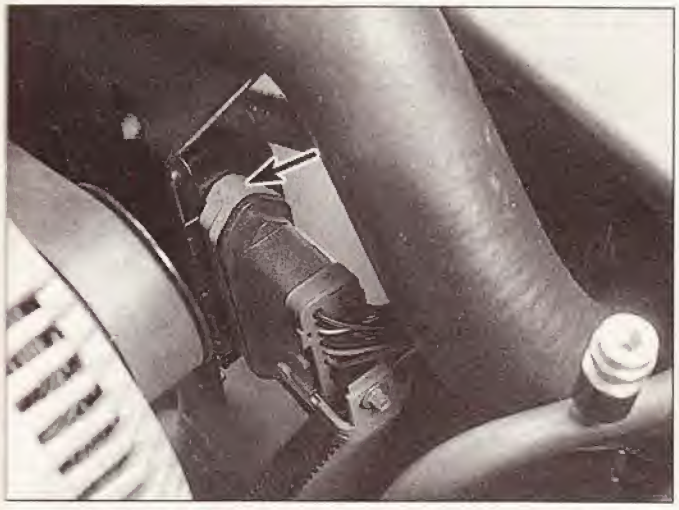
11 If the fuel pressure is low, pinch the fuel return line shut and watch the gauge. If the pressure doesn't rise, the fuel pump is defective or there is a restriction in the fuel feed line. If the pressure rises sharply, replace the pressure regulator. **Note:** *If the vehicle is equipped with a nylon fuel return line (or fuel lines made up of steel or other rigid material), it will be necessary to install a special fuel testing harness between the fuel rail and the return line. This can be made up from compatible fuel line connectors (available at the dealer parts department and some auto parts stores), fuel hose and hose clamps.*

12 If the fuel pressure is too high, turn the engine off. Disconnect the fuel return line and blow through it to check for a blockage. If there is no blockage, replace the fuel pressure regulator.

13 Hook up a hand-held vacuum pump to the port on the fuel pressure regulator.

14 Read the fuel pressure gauge with vacuum applied to the fuel pressure regulator and also with no vacuum applied. The fuel pressure should decrease as vacuum increases (and increase as vacuum decreases).

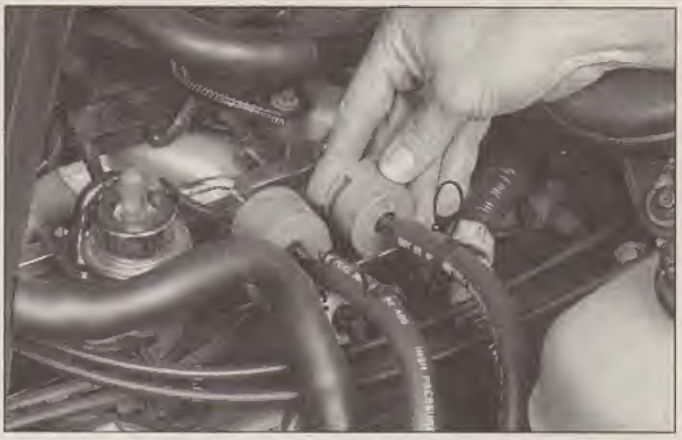




**3.3b The CCRM is located up front near the radiator on 5.0L engines (arrow)**

**3.7 If you don't have the correct adapter, it is possible to remove the Schrader valve from the fitting and install a standard fuel pressure gauge, using a hose clamp (4.6L SOHC engine shown)**

13.36a Press down to release the safety clamp from the fuel line connectors



13.36b Install the correct diameter spring lock coupling tool and push away from the fuel rail to release the internal locking mechanism

## Throttle Position (TP) sensor

31 Refer to Chapter 6, Section 4 for the check and replacement procedures for the TP sensor.

## Idle Air Control (IAC) valve

32 Refer to Section 14 for the check, adjustment and replacement procedures for the IAC valve.

## Fuel rail assembly

*Refer to illustration 13.36a, 13.36b, 13.36c, 13.37 and 13.38*

### Removal

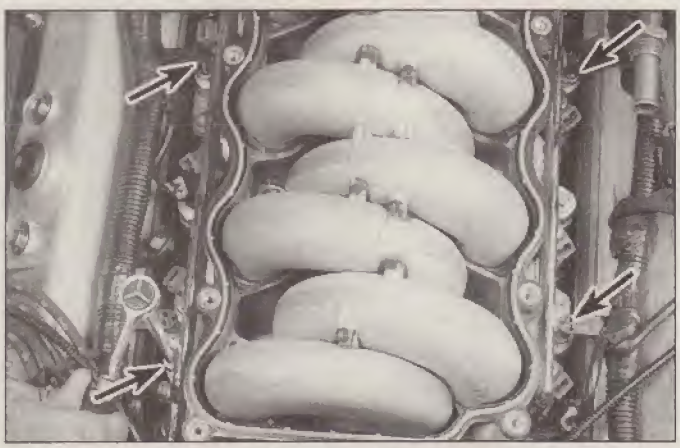
33 Relieve the fuel pressure (see Section 2).
34 Detach the cable from the negative terminal of the battery.
35 Remove the air intake plenum assembly (see Steps 1 through 23).
36 Using the special spring lock coupler tool D87L-9280-A or equivalent, disconnect the fuel feed and return lines from the fuel rail assembly **(see illustrations)**. **Note:** *Refer to Section 4 for additional information on disconnecting fuel lines.*
37 Remove the four fuel rail retaining bolts (two on each side) **(see illustration)**.
38 Carefully disengage the fuel rail from the fuel injectors and remove the fuel rail **(see illustration)**. **Note:** *It may be easier to remove the injectors with the fuel rail as an assembly.*
39 Use a rocking, side-to-side motion while lifting to remove the injectors from the fuel rail.

13.36c Detach the fuel line from the fuel rail

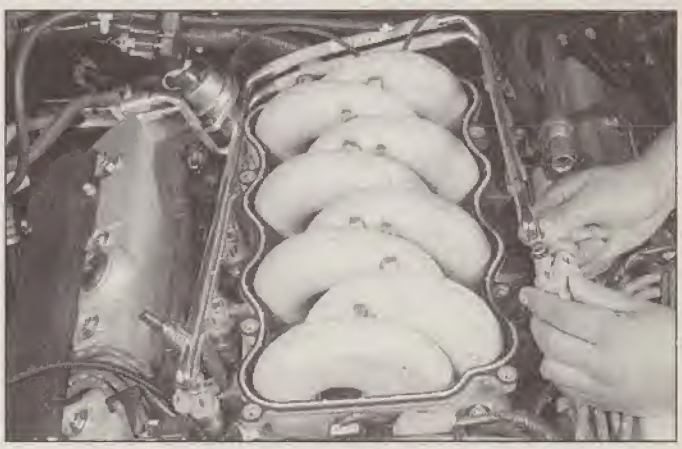
### Installation

**Note:** *It's a good idea to replace the injector O-rings whenever the fuel rail is removed.*

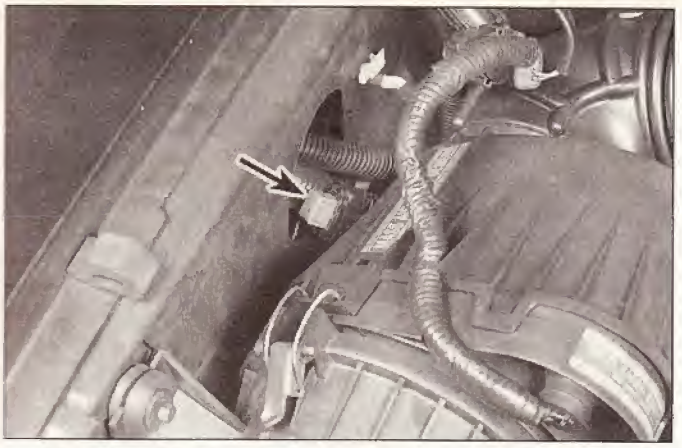
40 Ensure that the injector caps are clean and free of contamination.
41 Place the fuel rail over each of the injectors and seat the injectors into the fuel rail. Ensure that the injectors are well seated in the fuel rail assembly. **Note:** *It may be easier to seat the injectors in the fuel rail and then seat the entire assembly in the lower intake manifold.*
42 Secure the fuel rail assembly with the four retaining bolts and tighten them to the torque listed in this Chapter's Specifications.
43 The remainder of installation is the reverse of removal.



13.37 Fuel rail mounting bolt locations (arrows) on the 4.6L DOHC engine



13.38 Lift the fuel rail and separate the fuel injectors from the fuel rail assembly



**9.3 Before adjusting the ignition timing, unplug the SPOUT (arrow) (single wire connector) attached to the ignition module wire harness (if you do not, the EEC-IV system will still be controlling the base ignition timing)**

*the computer. Disconnecting the SPOUT will display only the base timing settings without any changes from the computer.*

4 Connect an inductive timing light and a tachometer in accordance with the manufacturer's instructions. **Caution:** *Make sure that the timing light and tachometer wires don't hang anywhere near the cooling fan or they may become entangled in the fan blades when the fan begins to rotate.*

5 Locate the timing marks on the crankshaft pulley (see Chapter 2).

6 Start the engine again.

7 Point the timing light at the pulley timing marks and note whether the specified timing mark (see the VECI label) is aligned with the timing pointer on the front of the timing chain cover.

8 If the proper mark isn't aligned with the stationary pointer, loosen the distributor hold-down bolt. Turn the distributor clockwise (to retard timing) or counterclockwise (to advance timing) until the correct timing mark on the crankshaft pulley is aligned with the stationary pointer. Tighten the distributor hold-down bolt securely when the timing is correct and recheck it to make sure it didn't change when the bolt was tightened.

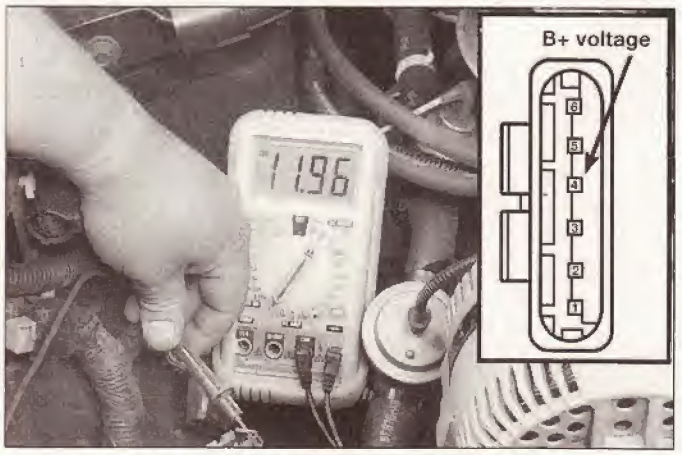
9 Turn off the engine.

10 Plug in the SPOUT connector located in the harness near the air cleaner assembly.

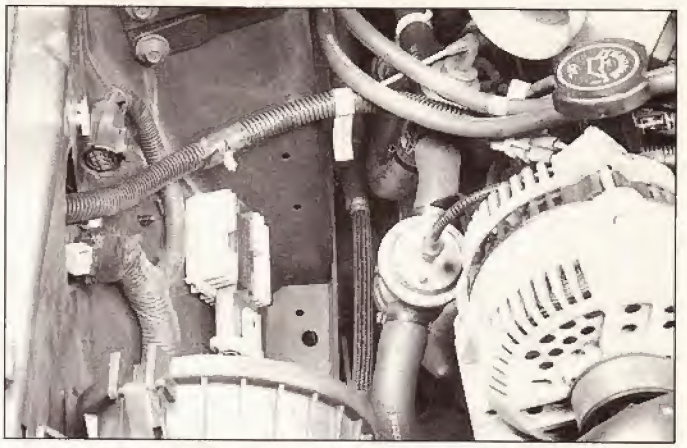
11 Restart the engine and check the idle speed. The specified rpm for each vehicle is different (see your VECI Label). On vehicles with an adjustable idle speed, see Chapter 4 for adjustment procedure.

12 Turn off the engine.

13 Remove the timing light and tachometer.




**10.2 Check battery voltage to the ignition module on terminal number 4**



**10.1 The ignition module is located under the air cleaner housing on the fenderwell on 5.0L engines**

## 10 Ignition module and stator - check and replacement

**Caution:** *The ignition module is a delicate and relatively expensive electronic component. Failure to follow the step-by-step procedures could result in damage to the module and/or other electronic devices, including the EEC-IV or V microprocessor itself. Additionally, all devices under computer control are protected by a Federally mandated extended warranty. Check with your dealer concerning this warranty before attempting to diagnose and replace the module yourself.*

### *Distributor Ignition (DI) module (1994 and 1995 5.0L engines)*

#### Check

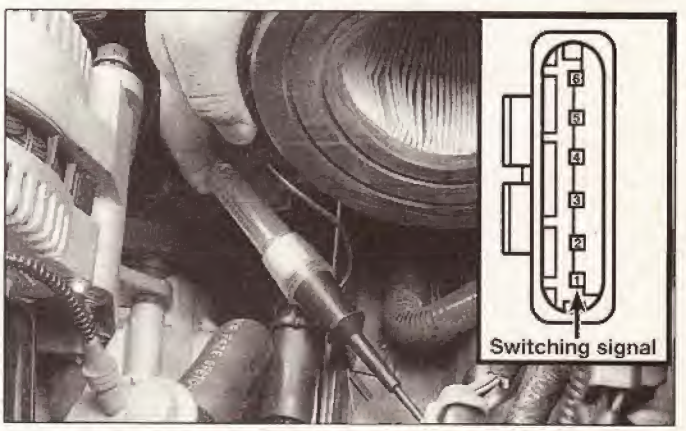
*Refer to illustrations 10.1, 10.2, 10.3, 10.4 and 10.5*

**Note:** *Refer to the ignition checking procedure in Section 6 and the wiring schematics at the end of Chapter 12 for additional information.*

1 Distributor Ignition (DI) systems are equipped with an external ignition module located under the air cleaner assembly **(see illustration)**.

2 Check for power to the ignition module. Using a voltmeter, probe the red/light green wire (terminal 4) to the module **(see illustration)**. With the ignition ON (engine not running), there should be battery voltage.

3 Check the PIP signal from the stator (Hall Effect switching device) in the distributor to the ignition module. Backprobe the dark green wire (terminal 1) on the ignition control module **(see illustration)** with an LED test light, crank the engine over and confirm that the test light




**10.3 Have an assistant crank the engine while backprobing terminal number 1 on the ignition control module. The test light should flash as the ignition module switches primary voltage**

5

extracting codes from the engine management computer by simply "plugging in" to the diagnostic connector on the vehicle wiring harness. **Note:** *Some diagnostic connectors are located under the dash, kick panel or glovebox while others are located in the engine compartment.*

## OBD system general description

5 Vehicles equipped with the 5.0L V8 engine use the Electronic Engine Control (EEC) IV system. Vehicles equipped with the 3.8L V6 or 4.6L V8 engines use the EEC-V system. Both systems consist of an onboard computer, known as the Powertrain Control Module (PCM), and information sensors, which monitor various functions of the engine and send data to the PCM. Based on the data and the information programmed into the computer's memory, the PCM generates output signals to control various engine functions via control relays, solenoids and other output actuators.

6 The PCM, located under the instrument panel, is the "brain" of the EEC-IV system. It receives data from a number of sensors and other electronic components (switches, relays, etc.). Based on the information it receives, the PCM generates output signals to control various relays, solenoids and other actuators. The PCM is specifically calibrated to optimize the emissions, fuel economy and driveability of the vehicle.

7 Because of a Federally-mandated extended warranty which covers the EEC-IV system components and because any owner-induced damage to the PCM, the sensors and/or the control devices may void the warranty, it isn't a good idea to attempt diagnosis or replacement of the PCM at home while the vehicle is under warranty. Take the vehicle to a dealer service department if the PCM or a system component malfunctions.

## Information sensors

8 When battery voltage is applied to the air conditioning compressor clutch, a signal is sent to the PCM, which interprets the signal as an added load created by the compressor and increases engine idle speed accordingly to compensate.

9 The **Intake Air Temperature sensor (IAT)**, threaded into a runner of the intake manifold (see Section 4), provides the PCM with fuel/air mixture temperature information. The PCM uses this information to control fuel flow, ignition timing and EGR system operation.

10 The **Engine Coolant Temperature (ECT) sensor**, which is threaded into a coolant passage in the intake manifold, monitors engine coolant temperature. The ECT sends the PCM a voltage signal which influences PCM control of the fuel mixture, ignition timing and EGR operation.

11 The **Heated Exhaust Gas Oxygen (HEGO) sensors**, which are threaded into the exhaust manifolds, constantly monitor the oxygen content of the exhaust gases. A voltage signal which varies in accordance with the difference between the oxygen content of the exhaust gases and the surrounding atmosphere is sent to the PCM. The PCM converts this exhaust gas oxygen content signal to the fuel/air ratio, compares it to the ideal ratio for current engine operating conditions and alters the signal to the injectors accordingly.

12 The **Throttle Position Sensor (TPS)**, which is mounted on the side of the throttle body (see Section 4) and connected directly to the throttle shaft, senses throttle movement and position, then transmits an electrical signal to the PCM. This signal enables the PCM to determine when the throttle is closed, in its normal cruise condition or wide open.

13 The **Mass Air Flow (MAF) sensor**, which is mounted in the air cleaner intake passage, measures the mass of the air entering the engine (see Section 4). Because air mass varies with air temperature (cold air is denser than warm air), measuring air mass provides the PCM with a very accurate way of determining the correct amount of fuel to obtain the ideal fuel/air mixture.

## Output actuators

14 The **EEC power relay,** which is activated by the ignition switch, supplies battery voltage to the EEC-IV or V system components when the switch is in the Start or Run position. **Note:** *The fuel pump relay, the PCM power relay, the EDF relay and the EDF relay control are all located in the Constant Control Relay Module (CCRM) which is located on the right side fenderwell on 3.8L V6 and 4.6L V8 models and up front near the radiator on 5.0L V8 models.*

15 The **canister purge solenoid (CANP)** switches manifold vacuum to operate the canister purge valve when a signal is received from the PCM. Vacuum opens the purge valve when the solenoid is energized, allowing fuel vapor to flow from the canister to the intake manifold.

16 The solenoid-operated fuel injectors are located above the intake ports (see Chapter 4). The PCM controls the length of time the injector is open. The "open" time of the injector determines the amount of fuel delivered. For information regarding injector replacement, refer to Chapter 4.

17 The **fuel pump relay** is activated by the PCM with the ignition switch in the On position. When the ignition switch is turned to the On position, the relay is activated to supply initial line pressure to the system. For information regarding fuel pump check and replacement, refer to Chapter 4.

18 The **EDIS ignition module** (see Chapter 5) installed on all 3.8L and 4.6L engines, mounted on a bracket between the upper intake manifold and the valve cover, triggers the ignition coils and determines dwell. The PCM uses a signal from the Profile Ignition Pick-Up (PIP) to determine crankshaft position. Ignition timing is determined by the PCM, which then signals the module to fire the coil. For further information regarding the ignition module, refer to the appropriate Section in Chapter 5.

## Obtaining codes on the 5.0L V8 engine

19 The diagnostic codes for the EEC-IV systems are arranged in such a way that a series of tests must be completed in order to extract ALL the codes from the system. If one portion of the test is performed without the others, there may be a chance the trouble code that will pinpoint a problem in your particular vehicle will remain stored in the PCM without detection. The tests start first with a Key On, Engine Off (KOEO) test followed by a computed timing test then finally a Engine Running (ER) test. Here is a brief overview of the code extracting procedures of the EEC-IV system followed by the actual test:

### Quick Test - Key On Engine Off (KOEO)

20 The following tests are all included with the key on, engine off:

**Self test codes** - These codes are accessed on the test connector by using a jumper wire and an analog voltmeter or the factory diagnostic tool called the Star tester. These codes are also called *Hard Codes.*

**Separator pulse codes** - After the initial Hard Codes, the system will flash a code 111 and then will flash a series of Soft (or Continuous Memory) Codes.

**Continuous Memory Codes** - These codes indicate a fault that may or may not be present at the time of testing. These codes usually indicate an intermittent failure. Continuous Memory codes are stored in the system and they will flash after the normal Hard Codes. These codes are three digit codes. These codes can indicate chronic or intermittent problems. Also called *Soft Codes.*

**Fast codes** - These codes are transmitted 100 times faster than normal codes and can only be read by a Ford Star Tester or an equivalent SCAN tool.

### Engine running codes (KOER) or (ER)

21 **Running tests** - These tests make it possible for the PCM to pick-up a diagnostic trouble code that cannot be set while the engine is in KOEO. These problems usually occur during driving conditions. Some codes are detected by cold or warm running conditions, some are detected at low rpm or high rpm and some are detected at closed throttle or WOT.

**ID Pulse codes** - These codes indicate the type of engine (6 or 8 cylinder) or the correct module and Self Test mode access.

**Computed engine timing test** - This engine running test determines base timing for the engine and starts the process of allowing the engine to store running codes.

**Wiggle test** - This engine running test checks the wiring system to the sensors and output actuators as the engine performs.

| Circuits | Terminals for ohmmeter probes | Gear selection positions | Known good values |
|---|---|---|---|
| Transmission Circuits | Terminal 7 and Terminal 6 | Park | 3,770 to 4,607 ohms |
| | | Reverse | 1,304 to 1,593 ohms |
| | | Neutral | 660 to 807 ohms |
| | | Overdrive | 361 to 442 ohms |
| | | Drive | 190 to 232 ohms |
| | | First gear | 78 to 95 ohms |
| Back-up lamp circuit | Terminal 2 and Terminal 3 | Park | Greater than 100 K-ohms |
| | | Reverse | Less than 5.0 ohms |
| | | Neutral | Greater than 100 K-ohms |
| | | Overdrive | Greater than 100 K-ohms |
| | | Drive | Greater than 100 K-ohms |
| | | First gear | Greater than 100 K-ohms |
| Starter Relay Circuit | Terminal 4 and Terminal 1 | Park | Greater than 100 K-ohms |
| | | Reverse | Less than 5.0 ohms |
| | | Neutral | Greater than 100 K-ohms |
| | | Overdrive | Greater than 100 K-ohms |
| | | Drive | Greater than 100 K-ohms |
| | | First gear | Less than 5.0 ohms |

43 Check the adjustment of the switch. If the switch is out of adjustment, perform the procedure and clear the codes. Recheck the system for any other problems.

### Adjustment

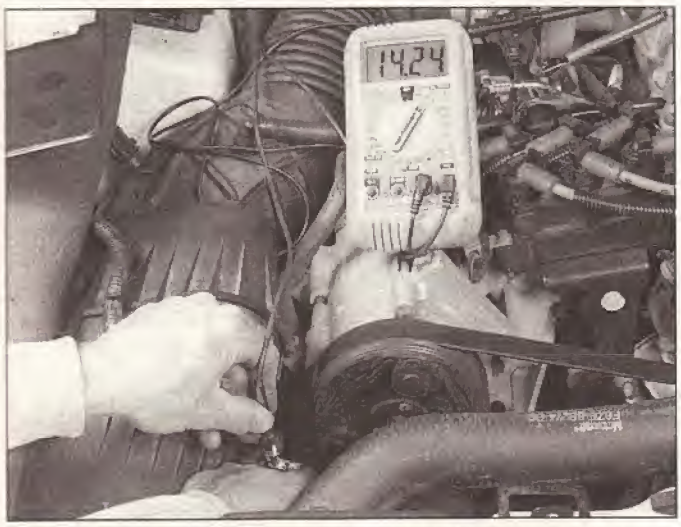
44 Follow the transmission shift control cable adjustment in Chapter 7 and check for a distinct "click" when the shift lever selects each gear (Park, Reverse, Neutral, Drive etc.).

45 The shift button should release smoothly and there should not be any cable binding preventing smooth transition between gears.

## *Air conditioning clutch control*

*Refer to illustration 4.47*

46 During air conditioning operation, the PCM controls the application of the air conditioning compressor clutch. The PCM controls the air conditioning clutch control relay to delay clutch engagement after the air conditioning is turned ON to allow the ISC valve to adjust the idle speed of the engine to compensate for the additional load. The PCM also controls the relay to disengage the clutch in the event of an excessively high or low pressure within the system or an overheating problem.




**4.47 Disconnect the air conditioning clutch harness connector and check for battery voltage with the system activated (ignition key ON - engine not running)**

47 First, check for battery voltage to the air conditioning clutch with the engine running, the air conditioning system activated and the air conditioning clutch harness connector disconnected **(see illustration)**. Battery voltage should be available. If not, check the air conditioning clutch relay. **Note:** *The air conditioning clutch relay is housed in the Computer Controlled Relay Module (CCRM). Refer to Chapter 4 for detailed information concerning the location of the CCRM module.*

48 Use a jumper wire from the battery positive terminal (+) and apply voltage to the air conditioning clutch. There should be a definite "click" when the clutch is activated.

49 Check for battery voltage to the air conditioning clutch relay on terminal 21. **Note:** *The air conditioning clutch relay is housed in the Computer Controlled Relay Module (CCRM). Refer to Chapter 4 for detailed information concerning the location of the CCRM module. If no power exists, then check the air conditioning high pressure cut-out fan switch, the air conditioning clutch cycling pressure switch, the air conditioning/heater control assembly (see Chapter 3) and the 15 amp fuse that protects the circuit (see Chapter 12).*

50 In most cases, if the air conditioning does not function, the problem is probably related to the air conditioning system relays and switches and not the PCM. Refer to Chapter 3 for additional information on the air conditioning system and diagnostics.

## *Vehicle Speed Sensor (VSS)*

### General description

51 The Vehicle Speed Sensor (VSS) is located near the rear section of the transmission. This sensor is a variable reluctance sensor that produces a pulsing voltage proportional to the speed of the vehicle. These pulses are translated by the PCM and provided for other systems for fuel and transmission shift control. The VSS is part of the Transmission Converter Clutch (TCC) system.

### Check

*Refer to illustrations 4.52 and 4.53*

52 To check the vehicle speed sensor, remove the electrical connec-

# Chapter 7 Part A
# Manual transmission

## Contents



## Specifications



### General

| | |
|---|---|
| Transmission type | |
| 1996 and 1997 4.6L V8 models | T45 |
| All other models | T5 |
| Lubricant type | See Chapter 1 |

### Torque specifications

| | Ft-lbs |
|---|---|
| Shift lever retaining bolts | 23 to 31 |
| Transmission-to-bellhousing bolts (T5) | 45 to 64 |
| Transmission bellhousing-to-engine bolts (T45) | 28 to 38 |

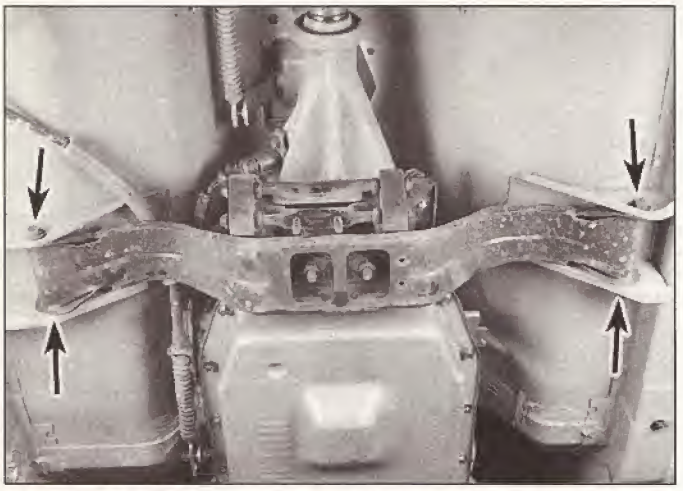
## 1 General information

All vehicles covered in this manual come equipped with either a 5-speed manual transmission or a four-speed automatic transmission. All information on the manual transmission, is included in this Part of Chapter 7. Information for the automatic transmission can be found in Part B of this Chapter.

The manual transmission used in most models is a 5-speed unit known as the T5. 1996 and 1997 models with the 4.6L engine use a heavier-duty unit known as the T45.

Due to the complexity, unavailability of replacement parts and the special tools necessary, internal repair procedures for these two units are not recommended for the home mechanic. The information contained within this manual will be limited to general information and removal and installation of the transmission assembly.

Depending on the expense involved in having a faulty transmission overhauled, it may be an advantage to consider replacing the unit with either a new or rebuilt one. Your local dealer or transmission shop should be able to supply you with information concerning cost, availability and exchange policy. Regardless of how you decide to remedy a transmission problem, you can still save considerable expense by removing and installing the unit yourself.



**6.17 Remove the crossmember-to-frame nuts and bolts (arrows), then remove the crossmember**

17 Raise the transmission slightly, remove the crossmember-to-frame nuts and bolts **(see illustration)**, then remove the crossmember and lower the jack a few inches (as this is done, the engine will have to be lowered, too.

18 Remove the bolts securing the lower part of the transmission bellhousing to the engine **(see illustrations)**.

19 Lower the transmission slightly.

20 Remove the upper transmission bellhousing-to-engine bolts.

21 Remove the transmission dipstick tube.

22 Move the transmission to the rear to disengage it from the engine block dowel pins and make sure the torque converter is detached from the driveplate. Secure the torque converter to the transmission so it won't fall out during removal.

## *Installation*

23 Prior to installation, make sure the torque converter hub is securely engaged in the pump. This can be done by turning the torque converter while pushing it in toward the transmission. If the converter was not fully engaged, it will "clunk" into place (it may even "clunk" more than once).

24 With the transmission secured to the jack, raise it into position. Be sure to keep it level so the torque converter does not slide forward.

25 Turn the torque converter to line up the studs with the holes in the driveplate. The marks on the torque converter and driveplate made in Step 5 must line up.

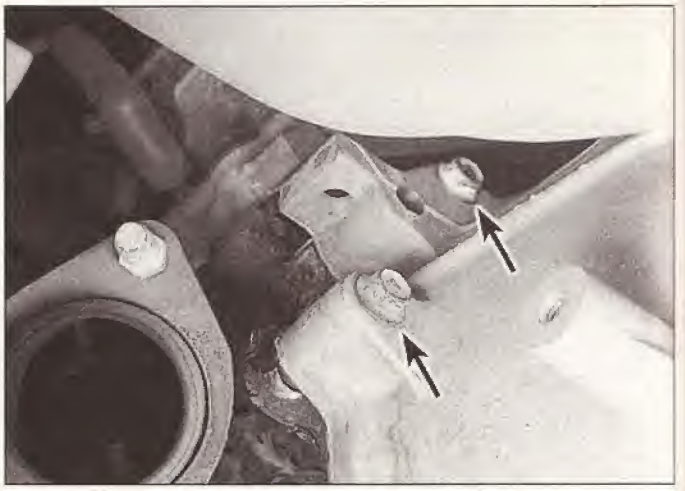
26 Move the transmission forward carefully until the dowel pins and the torque converter are engaged.

27 Install the transmission-to-engine bolts. Tighten them to the torque listed in this Chapter's Specifications. **Caution:** *Do not force the engine and transmission together by tightening the bolts.*

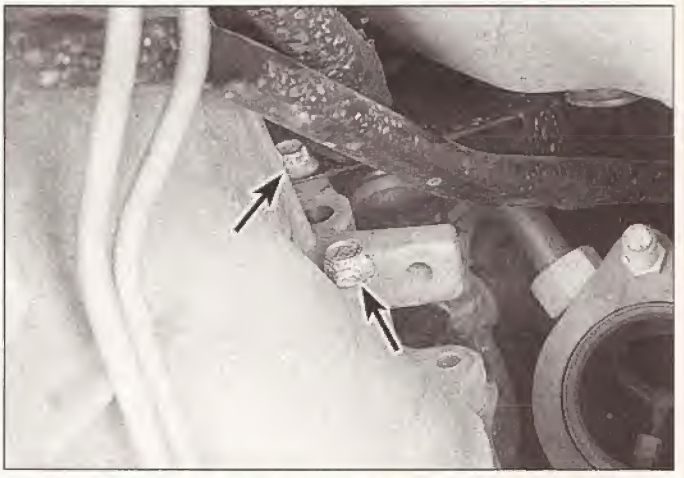
28 Install the torque converter-to-driveplate nuts. Tighten the nuts to the torque listed in this Chapter's Specifications.

29 Connect the transmission fluid cooler lines.

30 Install the transmission mount and crossmember through-bolts. Tighten the bolts and nuts securely.



**6.18a Remove the bolts (arrows) securing the left side of the transmission bellhousing to the engine**



**6.18b Remove the bolts (arrows) securing the right side of the transmission bellhousing to the engine**

31 Remove the jacks supporting the transmission and the engine.

32 Install the dipstick tube. Install the oil cooler line fittings and tighten them securely.

33 Install the starter motor (see Chapter 5).

34 Connect the shift cable (see Section 3).

35 Plug in all transmission electrical connectors.

36 Install the torque converter cover plate and plug.

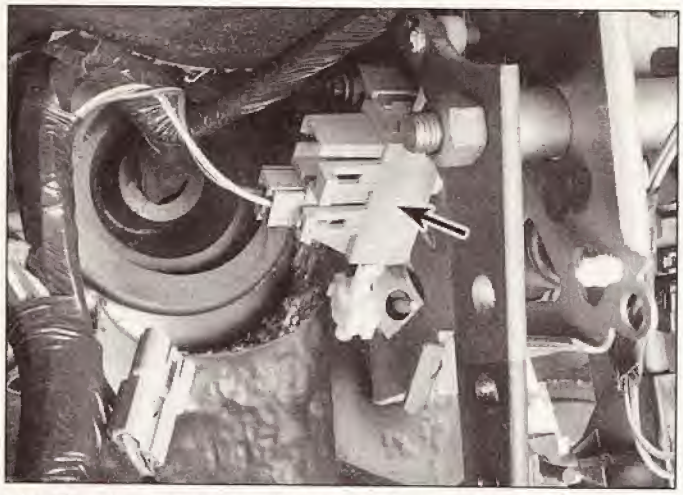
37 Install the driveshaft (see Chapter 8).

38 Adjust the shift cable (see Section 3).

39 Install any exhaust system components that were removed or disconnected (see Chapter 4).

40 Lower the vehicle.

41 Fill the transmission with the specified fluid (see Chapter 1), run the engine and check for fluid leaks.



7.1 The clutch pedal position switch (arrow) is located at the top of the clutch pedal

## 7 Clutch pedal position switch - check and replacement

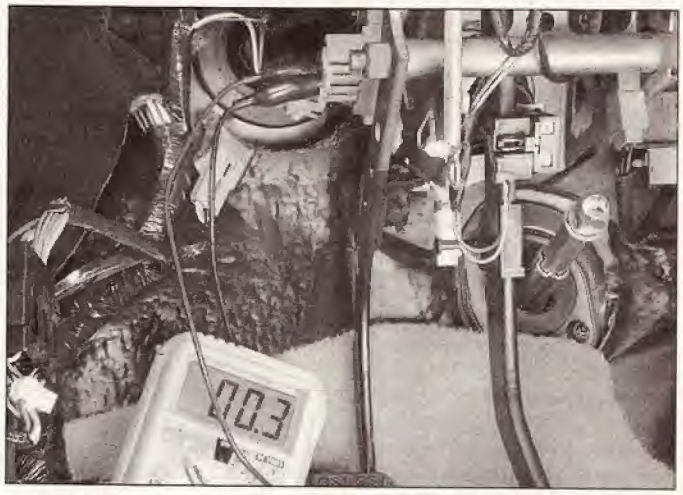
*Refer to illustrations 7.1, 7.4, 7.6a and 7.6b*

1 The clutch pedal must be depressed to start the engine. When the pedal is depressed, the clutch pedal position switch closes the circuit between the ignition switch and the rest of the starting circuit (which includes the battery, starter relay and starter motor and, on some models, an anti-theft system). The switch **(see illustration)** is located at the top of the clutch pedal. To access the switch, remove the lower steering column trim panel (see Chapter 11).

2 The switch plunger contacts the clutch pedal when the pedal is in its normal position; the plunger is depressed and the circuit is open. When the clutch pedal is depressed, the spring-loaded plunger protrudes from the switch, closing the starter relay circuit, which in turn allows full battery voltage to the starter motor.

3 To check the switch, verify that the engine can be started only when the clutch pedal is depressed.

4 If the engine can be started without depressing the clutch pedal, the switch may be shorted. Unplug the switch connector and hook up an ohmmeter to the connector terminals for the red and blue wire and the white and pink wire **(see illustration)**. There should be no continuity when the clutch pedal is released (switch plunger depressed), and continuity when the pedal is depressed (plunger released). If the switch doesn't operate as described, replace it.



7.4 To check the operation of the switch, unplug the switch electrical connector and hook up an ohmmeter to the terminals for the red and light blue and the pink and white wires; with the clutch pedal released, there should be no continuity, but when the pedal is depressed, there should be continuity (shown)

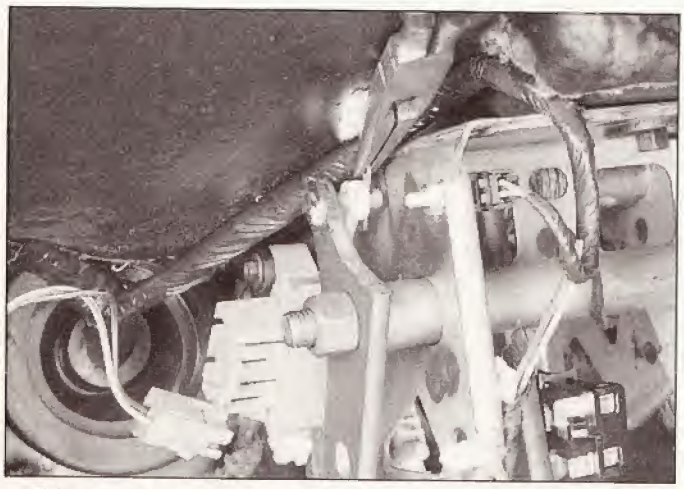
5 If the engine can't be started even when the clutch pedal *is* depressed, either the switch is bad, the electrical connector is unplugged, or there's a ground, open or short in the circuit between the ignition switch and the clutch pedal position switch, or between the pedal position switch and the rest of the starter circuit. Check the switch as described in the previous step. If the switch is okay, refer to the *Wiring Diagrams* at the end of Chapter 12 and troubleshoot the circuit.

6 To remove the clutch pedal position switch, disconnect the negative battery cable, unplug the switch electrical connector, remove the cotter pin **(see illustration)** that secures the switch pushrod to the pin at the top of the clutch pedal, remove the switch mounting bolt **(see illustrations)**. and push the pushrod off the clutch pedal pin at the top of the clutch pedal.

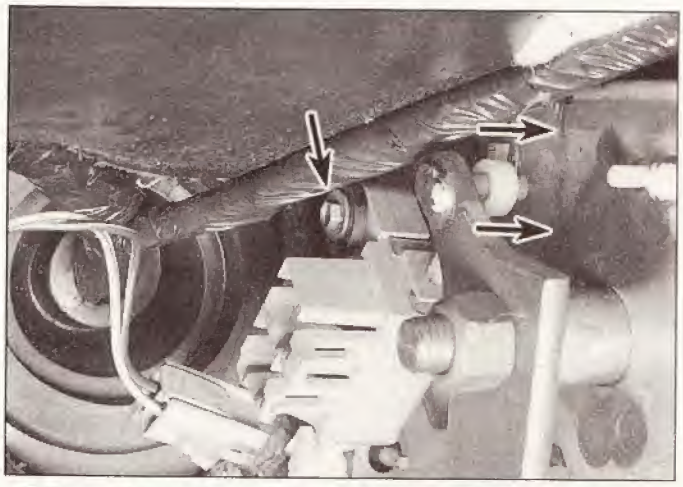
7 Installation is the reverse of removal.

## 8 Driveshaft - inspection

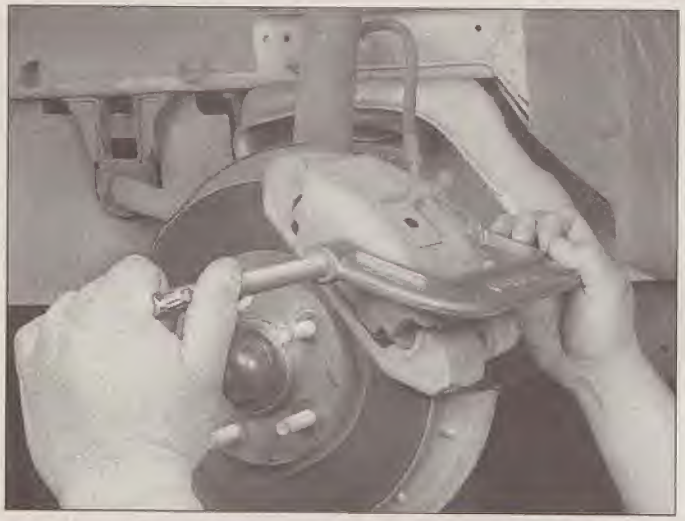
1 Raise the rear of the vehicle and support it securely on jackstands.



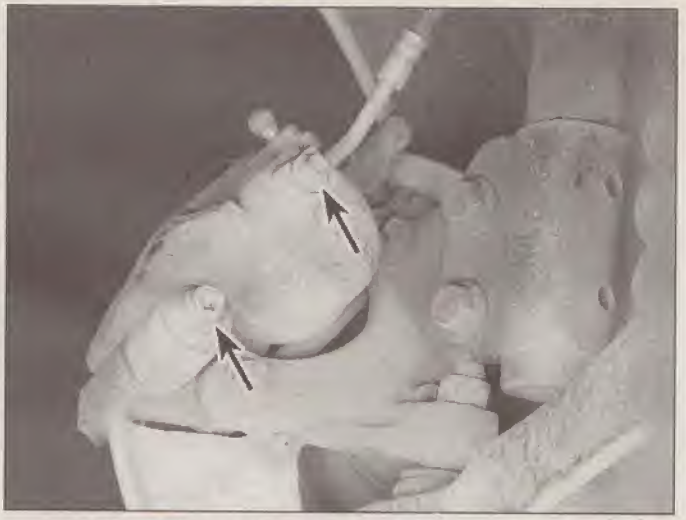
7.6a To remove the clutch pedal position switch, unplug the switch electrical connector, remove the cotter pin that secures the switch pushrod to the pin at the top of the clutch pedal . . .



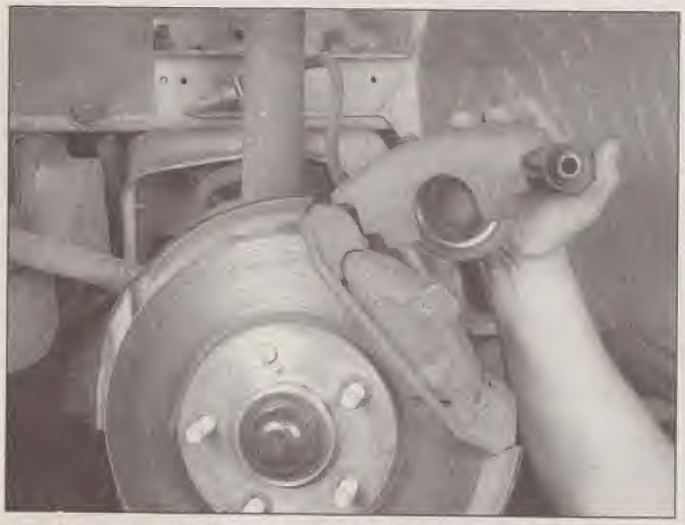
7.6b . . . remove the switch retaining bolt (arrow) and slide the pushrod to the right to disengage it from the clutch pedal pin



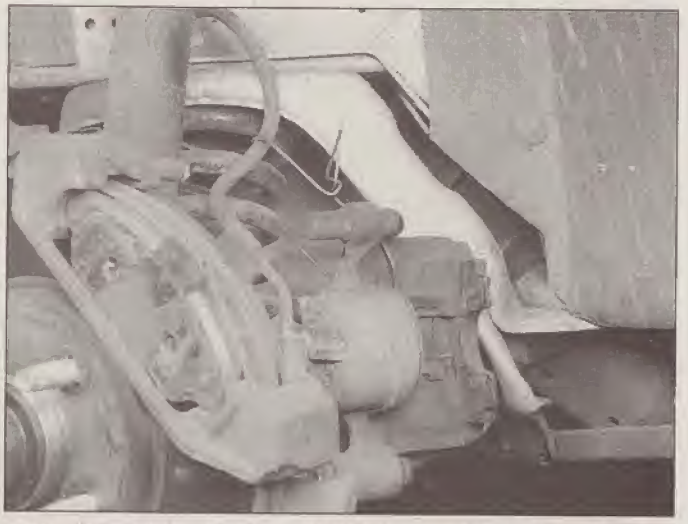
3.6b To make room for the new brake pads, compress the piston into the caliper with a large C-clamp



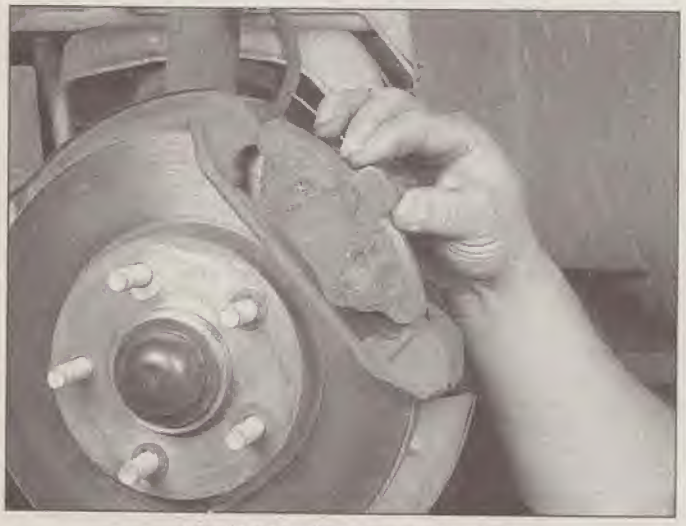
3.6c Remove the caliper mounting bolt (lower arrow); upper arrow points at brake hose-to-caliper banjo bolt - it's not necessary to remove this bolt unless you're removing the caliper for overhaul



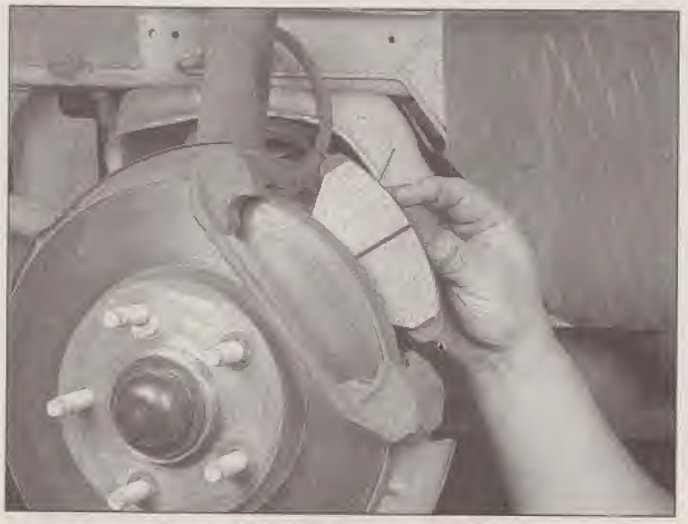
3.6d Pivot the caliper up, off the brake pads, and slide it off the pin at the top



3.6e Hang the caliper from the coil spring with a piece of coat-hanger wire; do NOT hang the caliper from its brake hose!



3.6f Remove the outer brake pad

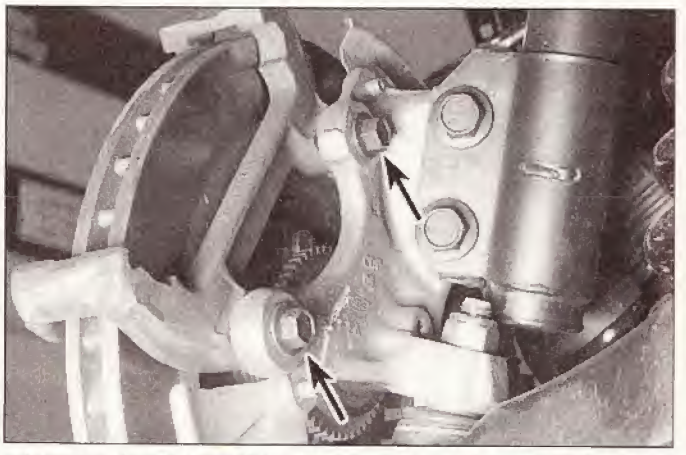


3.6g Remove the inner brake pad

5.5b Using a swirling motion, remove the glaze from the disc with sandpaper or emery cloth


5.6a The minimum thickness limit is cast into the inside of the disc

5.6b Use a micrometer to measure disc thickness at several points, about 1/2-inch from the edge



5.7a Front caliper anchor plate bolts (arrows) (anchor plate for dual-piston caliper shown; single-piston anchor plate similar)

*resurfacing of brake discs regardless of the dial indicator reading (to produce a smooth, flat surface that will eliminate brake pedal pulsations and other undesirable symptoms related to questionable discs). At the very least, if you elect not to have the discs resurfaced, deglaze the brake pad surface with emery cloth or sandpaper (use a swirling motion to ensure a non-directional finish)* **(see illustration)**.

6 The disc must not be machined to a thickness less than the specified minimum refinish thickness. The minimum wear (or discard) thickness is cast into the inside of the disc **(see illustration)**. The disc thickness can be checked with a micrometer **(see illustration)**.

## Removal and installation

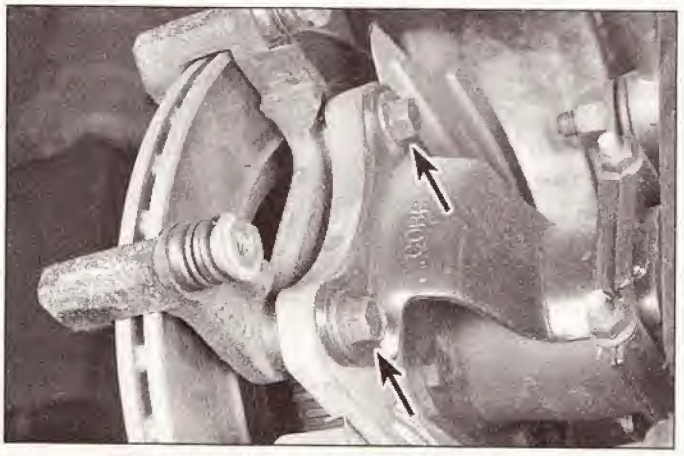
*Refer to illustrations 5.7a, 5.7b and 5.8*

7 Remove the caliper anchor plate **(see illustrations)**.

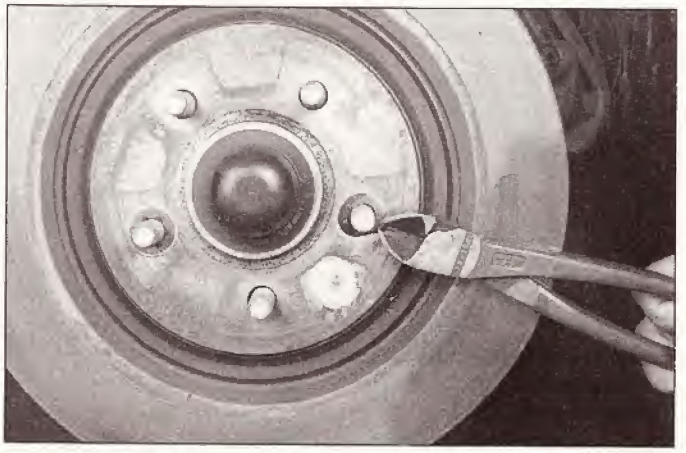
8 Remove the disc. If it's stuck, make sure you have removed any lug nuts installed during inspection. If the disc has never been removed, it may have some wave washers securing it to the lug nut studs; cut them off **(see illustration)** and discard them.

9 Install the disc onto the hub assembly.

10 Install the caliper and brake pad assembly over the disc and posi-

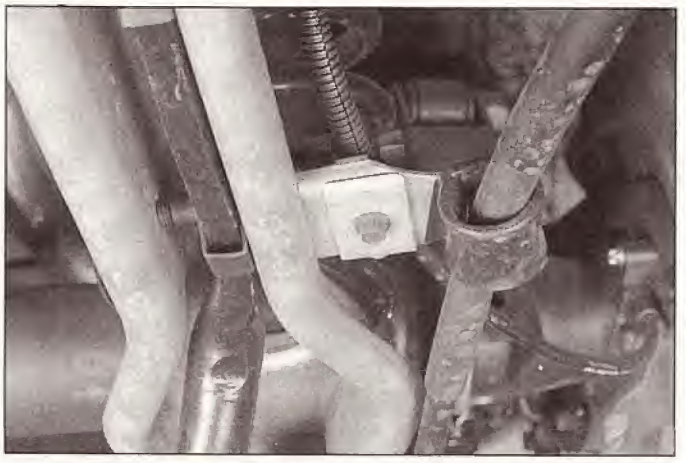


5.7b Rear caliper anchor plate bolts (arrows)



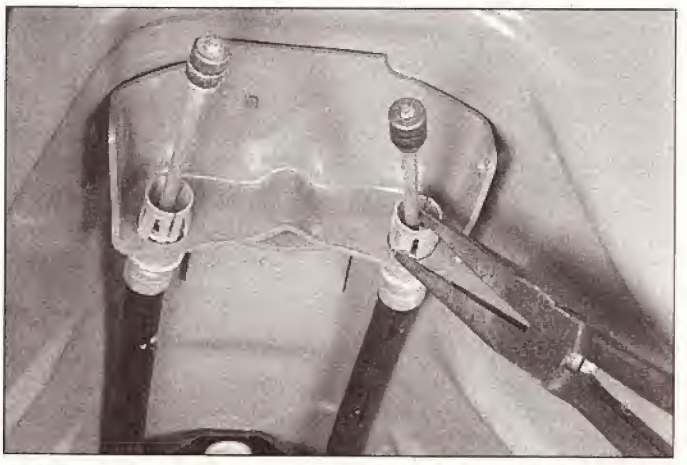
5.8 If the disc has wave-type retainer washers like these, simply cut them off and discard them

10.12b . . . remove this C-clip from the cable boss on the rear caliper, . . .



10.12c . . . remove this cable bracket bolt (arrow) from the lower suspension arm, . . .

10.12d . . . remove this cable bracket bolt (arrow) from the underside of the pan, . . .



10.12e . . . then squeeze the tangs of the cable housing together and disengage the cable from this bracket

(see illustrations).

13 Installation is the reverse of removal.

## 11 Brake light switch - check and replacement

### Check

*Refer to illustrations 11.1 and 11.4*

1 The brake light switch **(see illustration)**, which is located near the top of the brake pedal, closes the circuit for the brake lights when the brake pedal is applied. If the switch doesn't operate as described, either it's not getting voltage, or there's a problem in the circuit between the switch and the brake lights, or the switch is bad.

2 Check the brake light circuit fuse (see Chapter 12).

3 If the fuse is okay, remove the lower steering column trim panel (see Chapter 11), then backprobe the switch electrical connector (light green wire with a red stripe and ground) to verify that the switch is getting voltage.

4 If the switch is getting voltage, verify that there's continuity on the brake light side of the switch when the brake pedal is applied by backprobing the light green wire with a red stripe (power to the switch) and the red wire with a light green stripe (brake light circuit) **(see illustration)** and that there's no continuity when the pedal is released.

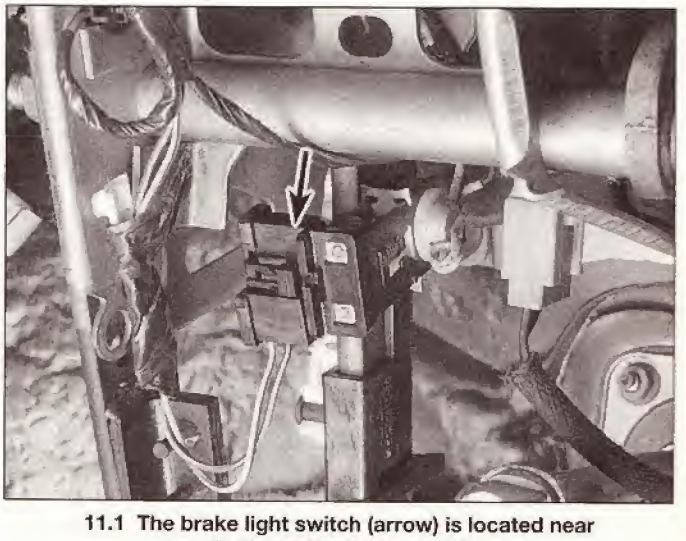
5 If the switch is operating correctly, troubleshoot the circuit between the switch and the brake lights (see the Wiring Diagrams at the end of Chapter 12).

### Replacement

*Refer to illustrations 11.7a, 11.7b, 11.7c, 11.7d, 11.8 and 11.10*

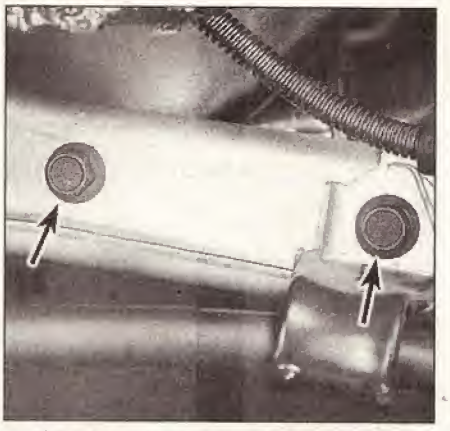
6 Remove the lower steering column trim panel (see Chapter 11).

7 Remove the retainer, remove the white nylon washer, remove the



11.1 The brake light switch (arrow) is located near the top of the brake pedal

**9.2. If the vehicle is equipped with ABS, disengage the ABS lead from its bracket on the lower suspension arm**



**9.3 To detach the rear stabilizer bar from the lower suspension arms, remove these two bolts (arrows) from each arm (left lower suspension arm shown)**

**10.3 Locate the upper retaining nut for the shock absorber inside the trunk; to prevent the piston rod from turning, hold it with a wrench or locking pliers while you break loose the nut**

8 Remove the splash shield from the steering knuckle. The splash shield is riveted onto the steering knuckle with three rivets. Cut the backs off the rivets and drive out the rivets with a punch.
9 Install the splash shield. You can use appropriately sized bolts and self-locking nuts instead of rivets.
10 Installation is otherwise the reverse of removal. Be sure to tighten all fasteners to the torque listed in this Chapter's Specifications.
11 Install the wheel and lug nuts. Lower the vehicle to the ground and tighten the nuts to the torque listed in the Chapter 1 Specifications.
12 Have the alignment checked by a dealer service department or an alignment shop.

## 9 Stabilizer bar (rear) - removal and installation

*Refer to illustrations 9.2 and 9.3*
1 Raise the rear of the vehicle and support it securely on jackstands. Place the jackstands under the frame, not under the axle housing. The axle housing must be free to hang down so that the shock absorbers are fully extended.
2 Detach the ABS lead, if equipped **(see illustration)**, from the lower suspension arm.
3 Remove the four bolts (two on each arm) that attach the stabilizer bar to the lower suspension arms **(see illustration)** and remove the bar.
4 Installation is the reverse of the removal procedure. Be sure to tighten all fasteners to the torque values listed in this Chapter's Specifications.
5 Remove the jackstands and lower the vehicle.

## 10 Shock absorber (rear) - removal and installation

*Refer to illustrations 10.3 and 10.4*
1 Raise the rear of the vehicle and support it securely on jackstands placed under the frame, not under the axle housing.
2 Support the rear axle with a floor jack to prevent it from dropping when the shock absorber is disconnected.
3 Locate the upper retaining nut for the shock absorber inside the trunk **(see illustration)**. To prevent the piston rod from turning, hold it with a wrench or locking pliers while you break loose the nut. Remove the nut, washer and upper insulator. Discard the nut.
4 Remove the lower retaining nut and bolt **(see illustration)** and remove the shock absorber from the vehicle.
5 Installation is the reverse of removal. Be sure to tighten the upper and lower shock absorber fasteners to the torque listed in this Chapter's Specifications.
6 Remove the jackstands and lower the vehicle.

## 11 Coil spring (rear) - removal and installation

### *Removal*

**Note:** *Rear coil springs should always be replaced in pairs.*
1 Loosen the wheel lug nuts, raise the rear of the vehicle and support it securely on jackstands placed under the frame. Remove the wheel and block the front wheels.
2 Remove the rear stabilizer bar (see Section 9).
3 Support the rear axle assembly with a floor jack placed under the axle housing.
4 Pass a length of chain up through the suspension arm and coil spring, then bolt the chain together. This will prevent the spring from flying out before it's fully extended. Be sure to leave enough slack in the chain to allow the coil spring to extend fully.
5 Detach the parking brake cable clips from the lower suspension arm (see Chapter 9).
6 Place a floor jack under the lower suspension arm pivot bolt and remove the pivot bolt and nut (see Section 12, Step 12).
7 Slowly lower the jack under the suspension arm until all tension is removed from the coil spring. Remove the chain, coil spring and insulators from between the suspension arm and the spring upper seat.

### *Installation*

8 Set the upper insulator on top of the spring, using tape to hold it in place, if necessary.
9 Place the spring between its seat on the axle tube and the frame seat, so that the pigtail (the lower end of the spring) is at the rear and pointing toward the left side of the vehicle. Install the safety chain.
10 Raise the lower suspension arm with the floor jack and install the arm pivot bolt and nut (see Section 12).
11 Repeat Steps 4 through 7 for the other spring.
12 Reattach the parking brake cables to the lower suspension arms (see Chapter 10).
13 Install the rear stabilizer bar (see Section 9).
14 Install the wheel and lug nuts. Lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

## 12 Suspension arms (rear) - removal and installation

**Warning:** *If you're going to remove both the upper and the lower arms at the same time, then remove the coil springs first* (see Section 11).

## 3 Vinyl trim - maintenance

Don't clean vinyl trim with detergents, caustic soap or petroleum-based cleaners. Plain soap and water works just fine, with a soft brush to clean dirt that may be ingrained. Wash the vinyl as frequently as the rest of the vehicle.

After cleaning, application of a high quality rubber and vinyl protectant will help prevent oxidation and cracks. The protectant can also be applied to weatherstripping, vacuum lines and rubber hoses (which often fail as a result of chemical degradation) and to the tires.

## 4 Upholstery and carpets - maintenance

1 Every three months remove the carpets or mats and clean the interior of the vehicle (more frequently if necessary). Vacuum the upholstery and carpets to remove loose dirt and dust.

2 Leather upholstery requires special care. Stains should be removed with warm water and a very mild soap solution. Use a clean, damp cloth to remove the soap, then wipe again with a dry cloth. Never use alcohol, gasoline, nail polish remover or thinner to clean leather upholstery.

3 After cleaning, regularly treat leather upholstery with a leather wax. Never use car wax on leather upholstery.

4 In areas where the interior of the vehicle is subject to bright sunlight, cover leather seats with a sheet if the vehicle is to be left out for any length of time.

## 5 Body repair - minor damage

*See photo sequence*

### Repair of minor scratches

1 If the scratch is superficial and does not penetrate to the metal of the body, repair is very simple. Lightly rub the scratched area with a fine rubbing compound to remove loose paint and built-up wax. Rinse the area with clean water.

2 Apply touch-up paint to the scratch, using a small brush. Continue to apply thin layers of paint until the surface of the paint in the scratch is level with the surrounding paint. Allow the new paint at least two weeks to harden, then blend it into the surrounding paint by rubbing with a very fine rubbing compound. Finally, apply a coat of wax to the scratch area.

3 If the scratch has penetrated the paint and exposed the metal of the body, causing the metal to rust, a different repair technique is required. Remove all loose rust from the bottom of the scratch with a pocket knife, then apply rust inhibiting paint to prevent the formation of rust in the future. Using a rubber or nylon applicator, coat the scratched area with glaze-type filler. If required, the filler can be mixed with thinner to provide a very thin paste, which is ideal for filling narrow scratches. Before the glaze filler in the scratch hardens, wrap a piece of smooth cotton cloth around the tip of a finger. Dip the cloth in thinner and then quickly wipe it along the surface of the scratch. This will ensure that the surface of the filler is slightly hollow. The scratch can now be painted over as described earlier in this Section.

### Repair of dents

4 When repairing dents, the first job is to pull the dent out until the affected area is as close as possible to its original shape. There is no point in trying to restore the original shape completely as the metal in the damaged area will have stretched on impact and cannot be restored to its original contours. It is better to bring the level of the dent up to a point which is about 1/8-inch below the level of the surrounding metal. In cases where the dent is very shallow, it is not worth trying to pull it out at all.

5 If the back side of the dent is accessible, it can be hammered out gently from behind using a soft-face hammer. While doing this, hold a block of wood firmly against the opposite side of the metal to absorb the hammer blows and prevent the metal from being stretched.

6 If the dent is in a section of the body which has double layers, or some other factor makes it inaccessible from behind, a different technique is required. Drill several small holes through the metal inside the damaged area, particularly in the deeper sections. Screw long, self-tapping screws into the holes just enough for them to get a good grip in the metal. Now the dent can be pulled out by pulling on the protruding heads of the screws with locking pliers.

7 The next stage of repair is the removal of paint from the damaged area and from an inch or so of the surrounding metal. This is done with a wire brush or sanding disk in a drill motor, although it can be done just as effectively by hand with sandpaper. To complete the preparation for filling, score the surface of the bare metal with a screwdriver or the tang of a file, or drill small holes in the affected area. This will provide a good grip for the filler material. To complete the repair, see the subsection on filling and painting later in this Section.

### Repair of rust holes or gashes

8 Remove all paint from the affected area and from an inch or so of the surrounding metal using a sanding disk or wire brush mounted in a drill motor. If these are not available, a few sheets of sandpaper will do the job just as effectively.

9 With the paint removed, you will be able to determine the severity of the corrosion and decide whether to replace the whole panel, if possible, or repair the affected area. New body panels are not as expensive as most people think and it is often quicker to install a new panel than to repair large areas of rust.

10 Remove all trim pieces from the affected area except those which will act as a guide to the original shape of the damaged body, such as headlight shells, etc. Using metal snips or a hacksaw blade, remove all loose metal and any other metal that is badly affected by rust. Hammer the edges of the hole in to create a slight depression for the filler material.

11 Wire brush the affected area to remove the powdery rust from the surface of the metal. If the back of the rusted area is accessible, treat it with rust inhibiting paint.

12 Before filling is done, block the hole in some way. This can be done with sheet metal riveted or screwed into place, or by stuffing the hole with wire mesh.

13 Once the hole is blocked off, the affected area can be filled and painted. See the following subsection on filling and painting.

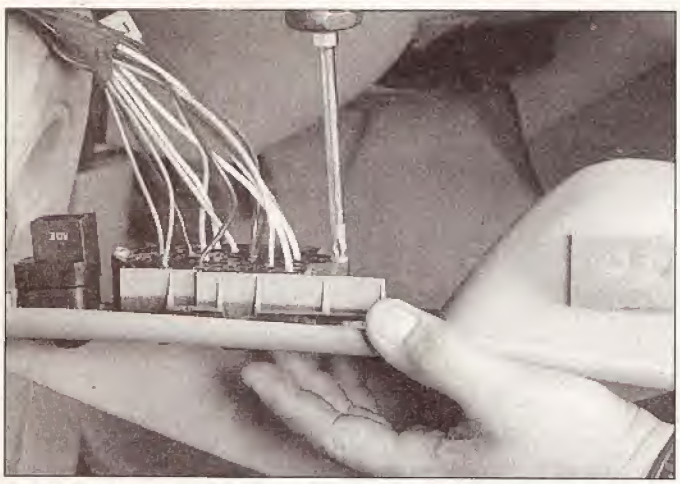
### Filling and painting

14 Many types of body fillers are available, but generally speaking, body repair kits which contain filler paste and a tube of resin hardener are best for this type of repair work. A wide, flexible plastic or nylon applicator will be necessary for imparting a smooth and contoured finish to the surface of the filler material. Mix up a small amount of filler on a clean piece of wood or cardboard (use the hardener sparingly). Follow the manufacturer's instructions on the package, otherwise the filler will set incorrectly.

15 Using the applicator, apply the filler paste to the prepared area. Draw the applicator across the surface of the filler to achieve the desired contour and to level the filler surface. As soon as a contour that approximates the original one is achieved, stop working the paste. If you continue, the paste will begin to stick to the applicator. Continue to add thin layers of paste at 20-minute intervals until the level of the filler is just above the surrounding metal.

16 Once the filler has hardened, the excess can be removed with a body file. From then on, progressively finer grades of sandpaper should be used, starting with a 180-grit paper and finishing with 600-grit wet-or-dry paper. Always wrap the sandpaper around a flat rubber or wooden block, otherwise the surface of the filler will not be completely flat. During the sanding of the filler surface, the wet-or-dry paper should be periodically rinsed in water. This will ensure that a very smooth finish is produced in the final stage.

17 At this point, the repair area should be surrounded by a ring of bare metal, which in turn should be encircled by the finely feathered edge of good paint. Rinse the repair area with clean water until all of



17.3b Detach the electrical connector from the backside of the armrest switch control plate

17.4 Remove the retaining screws (arrows) located behind the armrest switch control plate

17.5 Detach the plastic clip (arrow) securing the front edge of the door trim panel

17.6a Pull straight out to remove the side view mirror trim cover or speaker cover (if equipped)

control plate and disconnect the electrical connections **(see illustrations)**.

4 Detach the retaining screws located behind the armrest switch control plate **(see illustration)**.

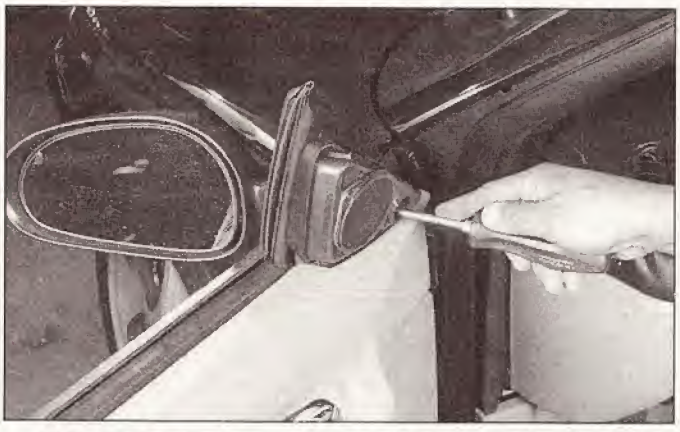
5 Using a wide putty knife, a thin screwdriver or a special trim panel removal tool, pry out the plastic retaining clip securing the front edge of the door trim panel **(see illustration)**.

6 Detach the side view mirror trim cover by pulling straight out. Some models are equipped with an optional door speaker at this location. Pull straight out on the speaker cover then detach the speaker retaining screws and remove the speaker assembly from the vehicle **(see illustrations)**.

7 Once all of the clips and screws are disengaged, detach the trim panel, disconnect any electrical connectors and remove the trim panel from the vehicle by gently pulling it up and out.

8 For access to the inner door, peel back the watershield, taking care not to tear it. To install the trim panel, first press the watershield back into place. If necessary, add more sealant to hold it in place.

9 The remainder of the installation is the reverse of removal.



17.6b Detach the screws securing the speaker (if equipped)

## 18 Door - removal, installation and adjustment

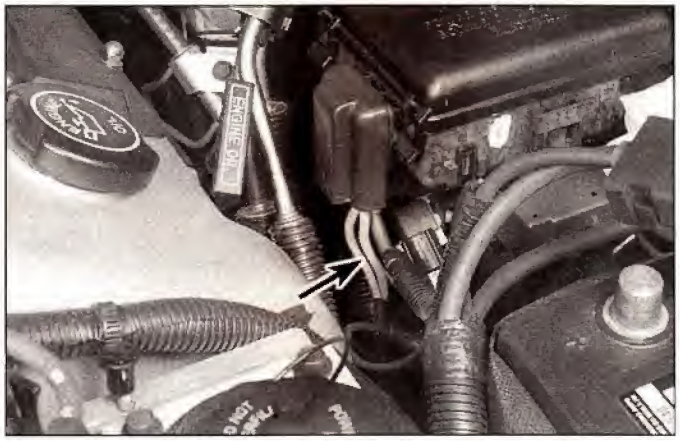
**Note:** *The door is heavy and somewhat awkward to remove and install - at least two people should perform this procedure.*

### *Removal and installation*

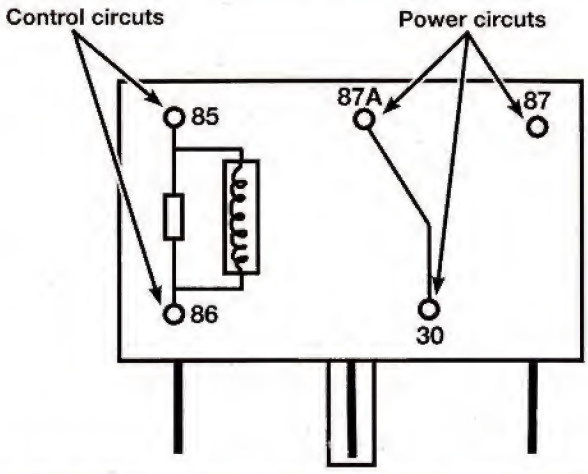
*Refer to illustration 18.8*

1 Lower the window completely in the door and then disconnect the negative cable from the battery

2 Open the door all the way and support it on jacks or blocks covered with rags to prevent damaging the paint.



4.2 Conventional type fusible links can be found exiting the engine compartment fuse block (arrow)




6.4 Most relays are marked on the outside to easily identify the control and power circuits

If the replacement fuse immediately fails, don't replace it again until the cause of the problem is isolated and corrected. In most cases, the cause will be a short circuit in the wiring caused by a broken or deteriorated wire.

## 4 Fusible links - general information

*Refer to illustrations 4.2*

Some circuits are protected by fusible links. The links are used in circuits which are not ordinarily fused, such as the ignition circuit.

In addition to the conventional type of fusible link (described below) which is located in the wiring harness **(see illustration)**, there is also cartridge type fusible links located in the engine compartment fuse block that are similar to a large fuses **(see illustration 3.1b)**, and, after disconnecting the negative battery cable, are simply unplugged and replaced by a unit of the same amperage. Some fusible links are held in place by a screw which must be loosened before removing the link.

Conventional type fusible links cannot be repaired, a new link of the same size wire should be installed in its place. The procedure is as follows:

*a) Disconnect the cable from the negative battery terminal.*
*b) Disconnect the fusible link from the wiring harness.*
*c) Cut the damaged fusible link out of the wiring just behind the connector.*
*d) Strip the insulation back approximately 1/2-inch.*
*e) Position the connector on the new fusible link and crimp it into place.*


5.2 Perform a continuity test with an ohmmeter to check a circuit breaker - no reading indicates a bad circuit breaker

*f) Use rosin core solder at each end of the new link to obtain a good solder joint.*
*g) Use plenty of electrical tape around the soldered joint. No wires should be exposed.*
*h) Connect the battery ground cable. Test the circuit for proper operation.*

## 5 Circuit breakers - general information

*Refer to illustration 5.2*

Circuit breakers protect components such as power windows, power door locks and headlights. Most of the circuit breakers are located in the passenger compartment fuse box **(see illustration 3.1a).**

On some models the circuit breaker resets itself automatically, so an electrical overload in a circuit breaker protected system will cause the circuit to fail momentarily, then come back on. If the circuit does not come back on, check it immediately **(see illustration).** Once the condition is corrected, the circuit breaker will resume its normal function.

## 6 Relays - general information and testing

### General information

1 Several electrical accessories in the vehicle, such as the fuel injection system, horns, starter, and fog lamps use relays to transmit the electrical signal to the component. Relays use a low-current circuit (the control circuit) to open and close a high-current circuit (the power circuit). If the relay is defective, that component will not operate properly. The various relays are mounted in engine compartment **(see illustration 3.1b)** and several locations throughout the vehicle (see Chapter 5). If a faulty relay is suspected, it can be removed and tested using the procedure below or by a dealer service department or a repair shop. Defective relays must be replaced as a unit.

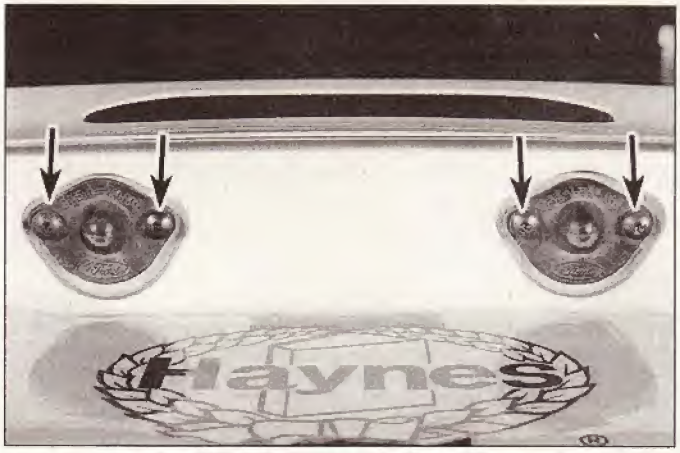
### Testing

*Refer to illustration 6.4*

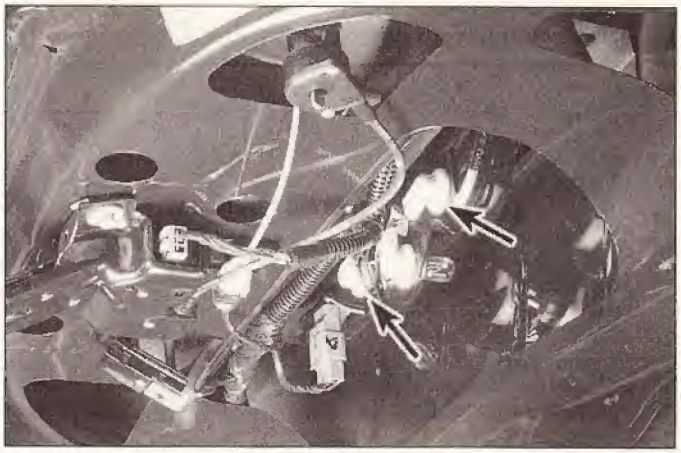
2 It's best to refer to the wiring diagram for the circuit to determine the proper hook-ups for the relay you're testing. However, if you're not able to determine the correct hook-up from the wiring diagrams, you may be able to determine the test hook-ups from the information that follows.

3 On most relays, two of the terminals are the relay's control circuit (they connect to the relay coil which, when energized, closes the large contacts to complete the circuit). The other terminals are the power circuit (they are connected together within the relay when the control-circuit coil is energized).

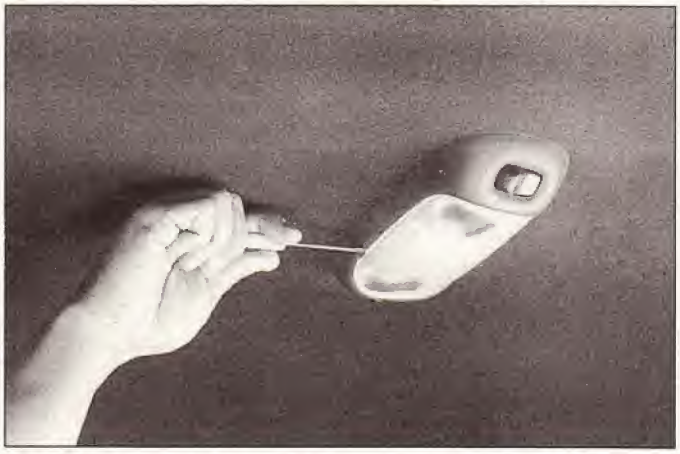
4 The relays are marked as an aid to help you determine which terminals are the control circuit and which are the power circuit **(see illustration).**



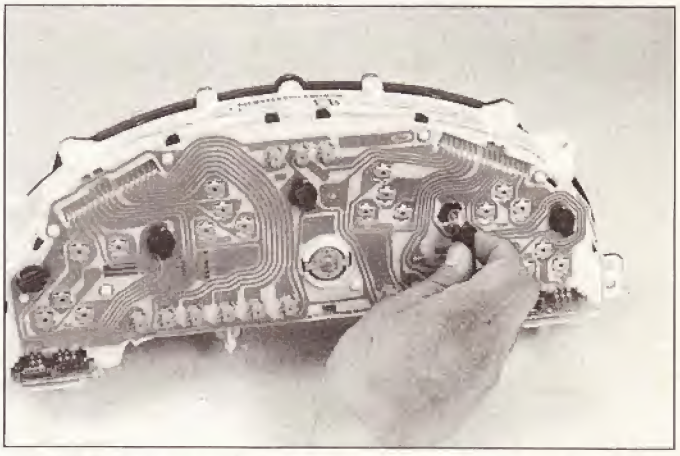
18.11 Detach the screws (arrows) securing the lenses to replace the license plate light bulbs



18.14 Twist the bulb holder (arrows) counterclockwise to remove the high mounted brake light bulbs



18.17 Use a small screwdriver to pry out the interior light lens



18.18 To remove an instrument cluster bulb, depress the bulb and rotate it counterclockwise

### *License plate light*

*Refer to illustration 18.11*

11 Detach the retaining screws which secure the lens to the trunk lid **(see illustration)**.

12 The defective bulb can then be pulled straight out of the socket and replaced.

13 Installation of the lens is the reverse of removal.

### *High-mounted brake light*

*Refer to illustration 18.14*

14 The high mounted brake light bulbs can be accessed from the trunk compartment **(see illustration)**.

15 Twist the bulb socket a quarter turn counterclockwise, then remove the bulb assembly from the housing.

16 The defective bulb can then be pulled straight out of the socket and replaced.

### *Interior lights*

*Refer to illustration 18.17*

17 Using a small screwdriver, remove the lens and replace the bulb **(see illustration)**.

### *Instrument cluster illumination*

*Refer to illustration 18.18*

18 To gain access to the instrument cluster illumination lights, the instrument cluster will have to be removed (see Section 21). The bulbs can then be removed and replaced from the rear of the cluster **(see illustration)**.

## 19 Daytime Running Lights (DRL) - general information

The Daytime Running Lights (DRL) system used on Canadian models illuminates the headlights whenever the engine is running. The only exception is with the engine running and the parking brake engaged. Once the parking brake is released, the lights will remain on as long as the ignition switch is on, even if the parking brake is later applied.

The DRL system supplies reduced power to the headlights so they won't be too bright for daytime use, while prolonging headlight life.

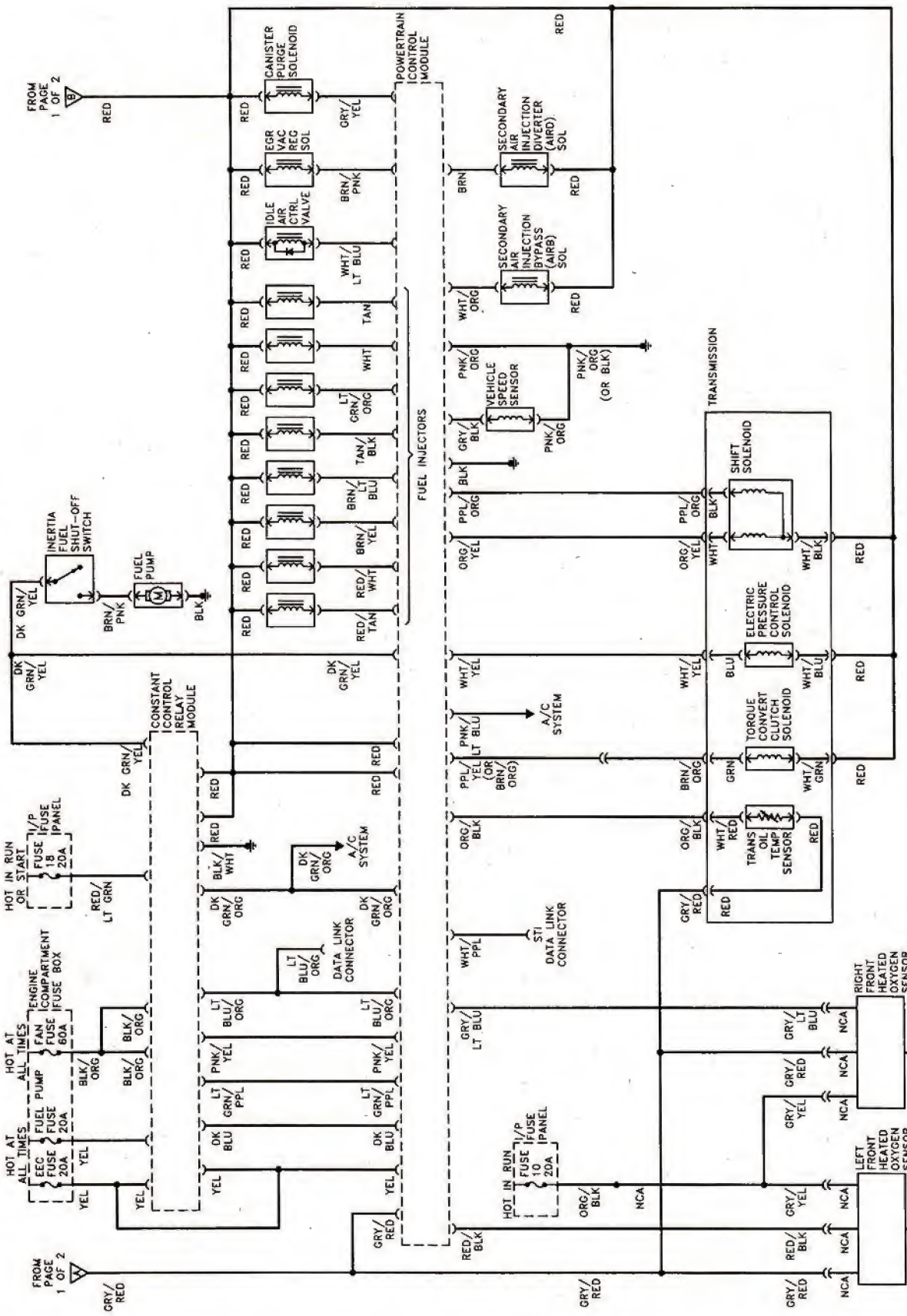
## 20 Wiper motor - check and replacement

### *Wiper motor circuit check*

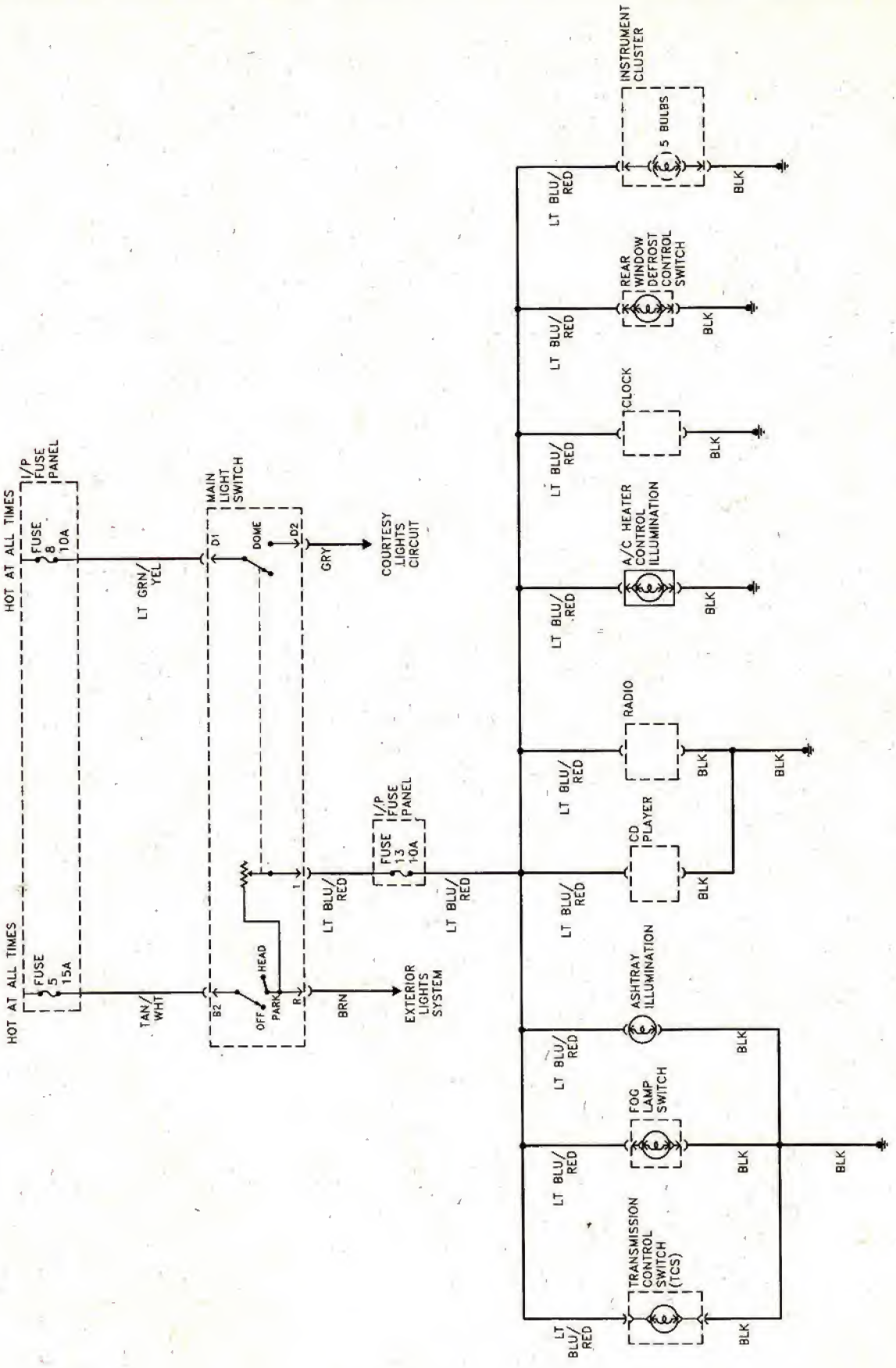
*Refer to illustration 20.2*

**Note:** *Refer to the wiring diagrams for wire colors and locations in the following checks. Keep in mind that power wires are generally larger in diameter and brighter colors, where ground wires are usually smaller in diameter and darker colors. When checking for voltage, probe a grounded 12-volt test light to each terminal at a connector until it lights; this verifies voltage (power) at the terminal.*

1 If the wipers work slowly, make sure the battery is in good condition and has a strong charge (see Chapter 1). If the battery is in good condition, remove the wiper motor (see below) and operate the wiper arms by hand. Check for binding linkage and pivots. Lubricate or repair




Typical 5.0L engine control system (part 2 of 2)




Typical instrument panel illumination system