

General Motors

Chevrolet Cavalier & Pontiac Sunfire

1995 thru 2001 □ All models

38016



Haynes Repair Manual

Based on a complete teardown and rebuild



Includes essential information for today's more complex vehicles

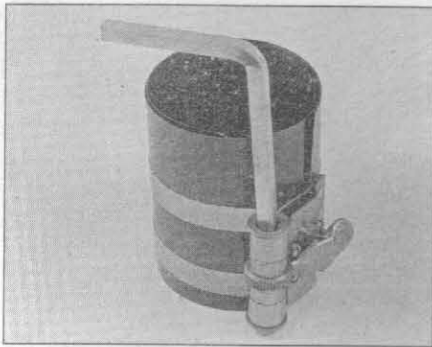
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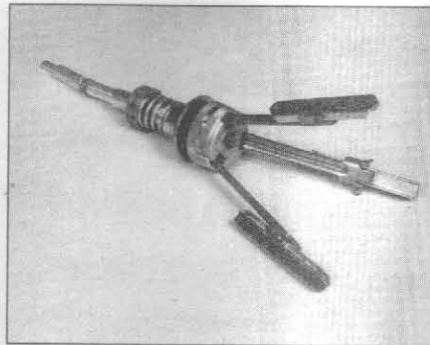


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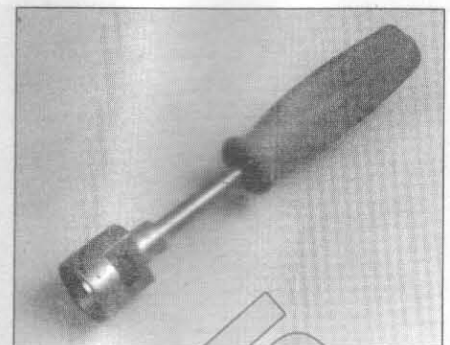
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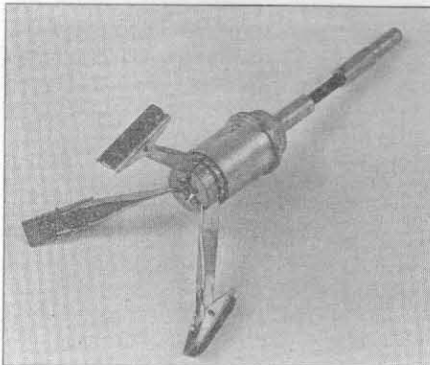
Ring compressor



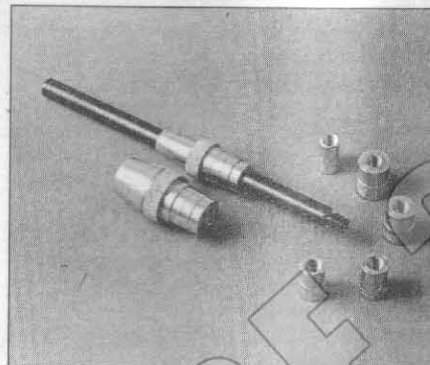
Cylinder hone



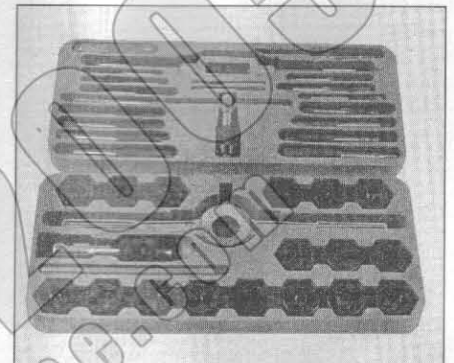
Brake hold-down spring tool



Brake cylinder hone



Clutch plate alignment tool



Tap and die set

range of large sockets. Ideally, however, the mechanic should have a 3/8-inch drive set and a 1/2-inch drive set.

- Socket set(s)
- Reversible ratchet
- Extension - 10 inch
- Universal joint
- Torque wrench (same size drive as sockets)
- Ball peen hammer - 8 ounce
- Soft-face hammer (plastic/rubber)
- Standard screwdriver (1/4-inch x 6 inch)
- Standard screwdriver (stubby - 5/16-inch)
- Phillips screwdriver (No. 3 x 8 inch)
- Phillips screwdriver (stubby - No. 2)
- Pliers - vise grip
- Pliers - lineman's
- Pliers - needle nose
- Pliers - snap-ring (internal and external)
- Cold chisel - 1/2-inch
- Scribe
- Scraper (made from flattened copper tubing)
- Centerpunch
- Pin punches (1/16, 1/8, 3/16-inch)
- Steel rule/straightedge - 12 inch
- Allen wrench set (1/8 to 3/8-inch or 4 mm to 10 mm)
- A selection of files
- Wire brush (large)
- Jackstands (second set)
- Jack (scissor or hydraulic type)

Note: Another tool which is often useful is an electric drill with a chuck capacity of 3/8-inch and a set of good quality drill bits.

Special tools

The tools in this list include those which are not used regularly, are expensive to buy, or which need to be used in accordance with their manufacturer's instructions. Unless these tools will be used frequently, it is not very economical to purchase many of them. A consideration would be to split the cost and use between yourself and a friend or friends. In addition, most of these tools can be obtained from a tool rental shop on a temporary basis.

This list primarily contains only those tools and instruments widely available to the public, and not those special tools produced by the vehicle manufacturer for distribution to dealer service departments. Occasionally, references to the manufacturer's special tools are included in the text of this manual. Generally, an alternative method of doing the job without the special tool is offered. However, sometimes there is no alternative to their use. Where this is the case, and the tool cannot be purchased or borrowed, the work should be turned over to the dealer service department or an automotive repair shop.

- Valve spring compressor
- Piston ring groove cleaning tool
- Piston ring compressor
- Piston ring installation tool
- Cylinder compression gauge
- Cylinder ridge reamer
- Cylinder surfacing hone
- Cylinder bore gauge
- Micrometers and/or dial calipers
- Hydraulic lifter removal tool

- Balljoint separator
- Universal-type puller
- Impact screwdriver
- Dial indicator set
- Stroboscopic timing light (inductive pick-up)
- Hand operated vacuum/pressure pump
- Tachometer/dwell meter
- Universal electrical multimeter
- Cable hoist
- Brake spring removal and installation tools
- Floor jack

Buying tools

For the do-it-yourselfer who is just starting to get involved in vehicle maintenance and repair, there are a number of options available when purchasing tools. If maintenance and minor repair is the extent of the work to be done, the purchase of individual tools is satisfactory. If, on the other hand, extensive work is planned, it would be a good idea to purchase a modest tool set from one of the large retail chain stores. A set can usually be bought at a substantial savings over the individual tool prices, and they often come with a tool box. As additional tools are needed, add-on sets, individual tools and a larger tool box can be purchased to expand the tool selection. Building a tool set gradually allows the cost of the tools to be spread over a longer period of time and gives the mechanic the freedom to choose only those tools that will actually be used.

Tool stores will often be the only source of some of the special tools that are needed,

42 Vibration

- 1 Rough wheel bearing (Chapters 1 and 10).
- 2 Damaged driveaxle (Chapter 8).
- 3 Out of round tires (Chapter 1).
- 4 Tire out of balance (Chapters 1 and 10).
- 5 Worn CV joint (Chapter 8).

43 Noisy in neutral with engine running

- 1 Damaged input gear bearing (Chapter 7A).*
- 2 Damaged clutch release bearing (Chapter 8).

44 Noisy in one particular gear

- 1 Damaged or worn constant-mesh gears (Chapter 7A).*
- 2 Damaged or worn synchronizers (Chapter 7A).*
- 3 Bent reverse fork (Chapter 7A).*
- 4 Damaged fourth speed gear or output gear (Chapter 7A).*
- 5 Worn or damaged reverse idler gear or idler bushing (Chapter 7A).*

45 Noisy in all gears

- 1 Insufficient lubricant (Chapter 7A).
- 2 Damaged or worn bearings (Chapter 7A).*
- 3 Worn or damaged input gear shaft and/or output gear shaft (Chapter 7A).*

46 Slips out of gear

- 1 Worn or improperly adjusted linkage (Chapter 7A).
- 2 Transaxle loose on engine (Chapter 7A).
- 3 Shift linkage does not work freely, binds (Chapter 7A).
- 4 Input gear bearing retainer broken or loose (Chapter 7A).*
- 5 Dirt between clutch cover and engine housing (Chapter 7A).
- 6 Worn shift fork (Chapter 7A).*

47 Leaks lubricant

- 1 Driveshaft seals worn (Chapter 7A).
- 2 Excessive amount of lubricant in transaxle (Chapters 1 and 7A).
- 3 Loose or broken input gear shaft bearing retainer (Chapter 7A).*
- 4 Input gear bearing retainer O-ring and/or lip seal damaged (Chapter 7A).*
- 5 Vehicle speed sensor O-ring leaking (Chapter 7A).

48 Hard to shift

Shift linkage loose or worn (Chapter 7A).

* Although the corrective action necessary to remedy the symptoms described is beyond the scope of this manual, the above information should be helpful in isolating the cause of the condition so that the owner can communicate clearly with a professional mechanic.

Automatic transaxle

Note: Due to the complexity of the automatic transaxle, it is difficult for the home mechanic to properly diagnose and service this component. For problems other than the following, the vehicle should be taken to a dealer or transaxle shop.

49 Fluid leakage

- 1 Automatic transaxle fluid is a deep red color. Fluid leaks should not be confused with engine oil, which can easily be blown onto the transaxle by air flow.
- 2 To pinpoint a leak, first remove all built-up dirt and grime from the transaxle housing with degreasing agents and/or steam cleaning. Then drive the vehicle at low speeds so air flow will not blow the leak far from its source. Raise the vehicle and determine where the leak is coming from. Common areas of leakage are:
 - a) Pan (Chapters 1 and 7)
 - b) Dipstick tube (Chapters 1 and 7)
 - c) Transaxle oil lines (Chapter 7)
 - d) Speed sensor (Chapter 7)
 - e) Driveaxle oil seals (Chapter 7)

50 Transaxle fluid brown or has a burned smell

Transaxle fluid overheated (Chapter 1).

51 General shift mechanism problems

- 1 Chapter 7, Part B, deals with checking and adjusting the shift linkage on automatic transaxles. Common problems which may be attributed to poorly adjusted linkage are:
 - a) Engine starting in gears other than Park or Neutral.
 - b) Indicator on shifter pointing to a gear other than the one actually being used.
 - c) Vehicle moves when in Park.
- 2 Refer to Chapter 7B for the shift linkage adjustment procedure.

52 Transaxle will not downshift with accelerator pedal pressed to the floor

- 1 On non-electronically-controlled transmissions, check the throttle valve (TV) cable.
- 2 On electronically-controlled transaxles, this type of problem - which is caused by a malfunction in the control unit, a sensor or solenoid, or the circuit itself - is beyond the scope of this book. Take the vehicle to a dealer service department or a competent automatic transmission shop.

53 Engine will start in gears other than Park or Neutral

Neutral start switch out of adjustment or malfunctioning (Chapter 7B).

54 Transaxle slips, shifts roughly, is noisy or has no drive in forward or reverse gears

There are many probable causes for the above problems, but the home mechanic should be concerned with only one possibility - fluid level. Before taking the vehicle to a repair shop, check the level and condition of the fluid as described in Chapter 1. Correct the fluid level as necessary or change the fluid and filter if needed. If the problem persists, have a professional diagnose the cause.

Driveaxles**55 Clicking noise in turns**

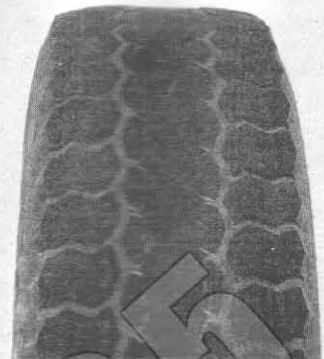
Worn or damaged outboard CV joint (Chapter 8).



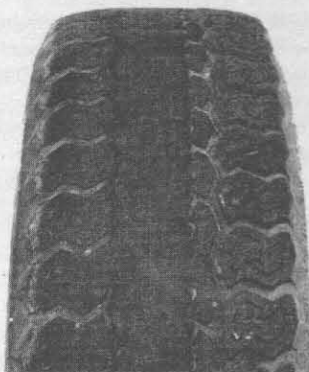
UNDERINFLATION



CUPPING



OVERINFLATION

INCORRECT TOE-IN
OR EXTREME CAMBERFEATHERING DUE
TO MISALIGNMENT

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.

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

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.

4 Look closely for cuts, punctures and embedded nails or tacks. Sometimes a tire will hold air pressure for short time or leak down very slowly after a nail has embedded itself in the tread. If a slow leak persists, check the valve stem core to make sure it's tight (see illustration). Examine the tread for an object that may have embedded itself in the tire or for a "plug" that may have begun to leak (radial tire punctures are repaired with a plug that's installed in a puncture). If a puncture is suspected, it can be easily verified by spraying a solution of soapy water onto the suspected area (see illustration). The soapy solution will bubble if there's a leak. Unless the puncture is unusually large, a tire shop or service station can usually repair the tire.

5 Carefully inspect the inner sidewall of each tire for evidence of brake fluid. If you see any, inspect the brakes immediately.

6 Correct air pressure adds miles to the lifespan of the tires, improves mileage and enhances overall ride quality. Tire pressure cannot be accurately estimated by looking at a tire, especially if it's a radial. A tire pressure gauge is essential. Keep an accurate gauge in the vehicle. The pressure gauges attached to the nozzles of air hoses at gas stations are often inaccurate.

7 Always check tire pressure when the tires are cold. Cold, in this case, means the vehicle has not been driven over a mile in the three hours preceding a tire pressure check. A pressure rise of four to eight

pounds is not uncommon once the tires are warm.

8 Unscrew the valve cap protruding from the wheel or hubcap and push the gauge firmly onto the valve stem (see illustration). Note the reading on the gauge and compare the figure to the recommended tire pressure shown on the label attached to the inside of the glove compartment door. Be sure to reinstall the valve cap to keep dirt and moisture out of the valve stem mechanism. Check all four tires and, if necessary, add enough air to bring them up to the recommended pressure.

9 Don't forget to keep the spare tire inflated to the specified pressure (refer to your owner's manual or the tire sidewall).

6 Power steering fluid level check (every 3000 miles or 3 months)

Refer to illustrations 6.2 and 6.6

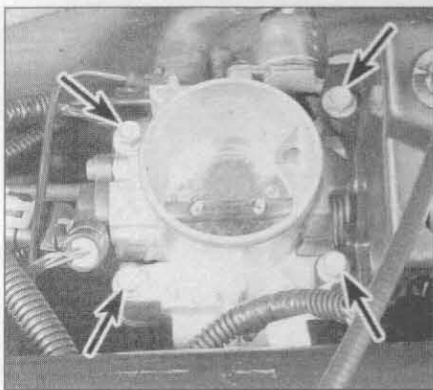
1 Unlike manual steering, the power steering system relies on fluid which may, over a period of time, require replenishing.

2 The fluid reservoir for the power steering pump is located on the passenger side of the engine compartment (see illustration).

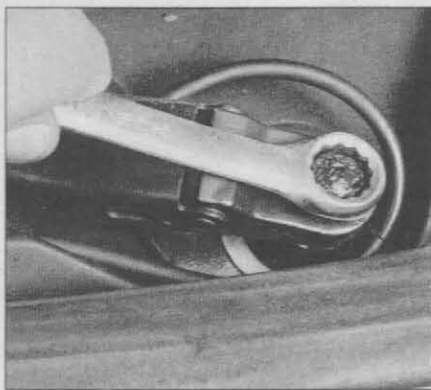
3 For the check, the front wheels should be pointed straight ahead and the engine should be off.

4 Use a clean rag to wipe off the reservoir cap and the area around the cap. This will help prevent any foreign matter from entering the reservoir during the check.

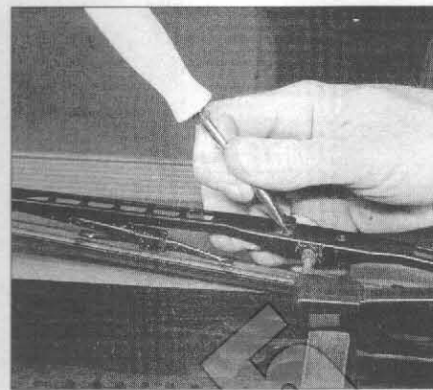
5 Twist off the cap and check the temperature of the fluid at the end of the dipstick with your finger.



19.4 Tighten the throttle body mounting bolts (arrows) to the torque listed in this Chapter's Specifications



20.3 Gently pry off the trim cap and check the tightness of the wiper arm retaining nut



20.5 Lift the release lever with a flat-bladed screwdriver, then slide the blade assembly off the pin on the end of the wiper arm

- 3 Remove the air cleaner assembly, tagging each hose to be disconnected with a piece of numbered tape to make reassembly easier.
- 4 Locate the mounting nuts or bolts at the base of the throttle body (see illustration). Decide what special tools or adapters will be necessary, if any, to tighten the fasteners.
- 5 Tighten the nuts or bolts to the torque listed in this Chapter's Specifications. Do not overtighten them, as the threads could strip.
- 6 If, after the nuts or bolts are properly tightened, a vacuum leak still exists, the throttle body must be removed and a new gasket installed. See Chapter 4 for more information.
- 7 After tightening the fasteners, reinstall the air cleaner and return all hoses to their original positions.

20 Windshield wiper blade inspection and replacement (every 12,000 miles or 12 months)

Refer to illustrations 20.3, 20.5 and 20.7

- 1 The windshield wiper and blade assemblies should be inspected periodically for damage, loose components and cracked or worn blade elements.
- 2 Road film can build up on the wiper blades and affect their efficiency, so they should be washed regularly with a mild detergent solution.
- 3 The action of the wiping mechanism can loosen the bolts, nuts and fasteners, so they should be checked and tightened, as necessary, at the same time the wiper blades are checked (see illustration).
- 4 If the wiper blade elements (sometimes called inserts) are cracked, worn or warped, they should be replaced with new ones.
- 5 Remove the wiper blade assembly from the wiper arm by inserting a screwdriver and lifting the release lever while pulling on the blade to release it (see illustration).
- 6 With the blade removed from the vehicle, you can remove the rubber element from the blade.
- 7 Grasp the end of the wiper bridge securely with one hand and the element with the other. Detach the end of the element from the bridge claw and slide to free it, then slide the element out (see illustration).
- 8 Compare the new element with the old for length, design, etc.
- 9 Slide the new element into the claw into place, notched end last and secure the claw into the notches.
- 10 Reinstall the blade assembly on the arm, wet the windshield and test for proper operation.

21 Seat belt check (every 12,000 miles or 12 months)

- 1 Check the seat belts, buckles, latch plates and guide loops for obvious damage and signs of wear.
- 2 See if the seat belt reminder light comes on when the key is turned to the Run or Start position. A chime should also sound.
- 3 The seat belts are designed to lock up during a sudden stop or

impact, yet allow free movement during normal driving. Make sure the retractors return the belt against your chest while driving and rewind the belt fully when the buckle is unlatched.

- 4 If any of the above checks reveal problems with the seat belt system, replace parts as necessary.

22 Air filter replacement (every 12,000 miles or 12 months)

Refer to illustrations 22.2a and 22.2b

- 1 At the specified intervals, the air filter should be replaced with a new one. The filter should be inspected between changes.
- 2 The air filter is located inside the air cleaner housing which is mounted in the left, front corner of the engine compartment. Remove the mounting screws, separate the housing halves and lift the filter out (see illustrations).
- 3 While the filter housing cover is off, be careful not to drop anything down into the air cleaner housing.
- 4 Wipe out the inside of the air cleaner housing with a clean rag.
- 5 Place the new filter in the air cleaner housing. Make sure it seats properly.
- 6 The remainder of installation is the reverse of removal.

23 Positive Crankcase Ventilation (PCV) system check and replacement (every 30,000 miles or 24 months)

Note: These models are equipped with three different crankcase ventilating systems. On 1997 and earlier 2.2L OHV models, the PCV valve is located on the right side of the valve cover. 1998 and later 2.2L OHV engines are equipped with an oil/air separator located inside the valve rocker arm cover that requires no maintenance. 2.3L and 2.4L OHC engines are equipped with an oil/air separator that is attached to the side of the engine block above the oil filter.

2.2L OHV engine

Refer to illustrations 23.1, 23.3a and 23.3b

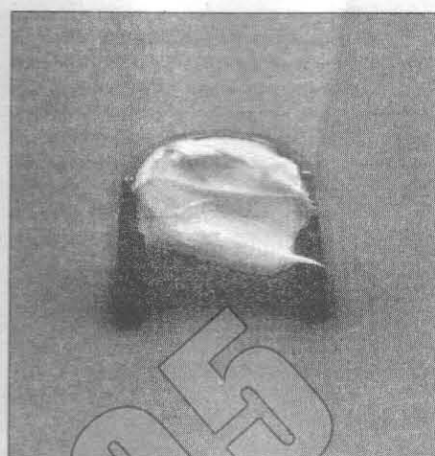
- 1 The PCV valve is located on the right side of the valve cover (see illustration).
- 2 To inspect the PCV valve, remove the hose from the nipple.
- 3 Unscrew the metal retainer and then pull it out of the valve cover using a pair of needlenose pliers (see illustrations). Note its installed position and direction.
- 4 Make sure the PCV valve is not plugged with oil/dirt residue and that vacuum is allowed to pass through without obstruction.
- 5 Shake the PCV valve, listening for a rattle. If the valve doesn't rattle, replace it with a new one.
- 6 When purchasing a replacement PCV valve, make sure it's for



6.4 This is what the air hose adapter that threads into the spark plug looks like - they're commonly available from auto part stores



6.9 Once the spring is depressed, the keepers can be removed with a small magnet or needle-nose pliers (a magnet is preferred to prevent dropping the keepers)



6.17 Apply a small dab of grease to the keepers before installation-it will hold them in place on the valve stem as the spring is released

tions). If you're replacing all of the valve stem seals, begin with cylinder number one and work on the valves for one cylinder at a time. Move from cylinder-to-cylinder following the firing-order sequence (see this Chapter's Specifications).

4 Thread an adapter into the spark plug hole (see illustration) and connect an air hose from a compressed air source to it. Most auto parts stores can supply the air hose adapter. **Note:** Many cylinder compression gauges utilize a screw-in fitting that may work with your air hose quick-disconnect fitting.

5 Remove the nut, pivot ball and rocker arm for the valve with the defective part and pull out the pushrod. If all of the valve stem seals are being replaced, all of the rocker arms and pushrods should be removed (refer to Section 5).

6 Apply compressed air to the cylinder. **Warning:** The piston may be forced down by compressed air, causing the crankshaft to turn suddenly. If the wrench used when positioning the number one piston at TDC is still attached to the bolt in the crankshaft nose, it could cause damage or injury when the crankshaft moves.

7 The valves should be held in place by the air pressure.

8 If you don't have access to compressed air, an alternative method can be used. Position the piston at a point approximately 45-degrees before TDC on the compression stroke, then feed a long piece of nylon rope through the spark plug hole until it fills the combustion chamber. Be sure to leave the end of the rope hanging out of the engine so it can be removed easily. Use a large ratchet and socket to rotate the crankshaft in the normal direction of rotation (clockwise) until slight resistance is felt.

9 Stuff shop rags into the cylinder head holes above and below the valves to prevent parts and tools from falling into the engine, then use a valve spring compressor to compress the spring. Remove the keepers with small needle-nose pliers or a magnet (see illustration). **Note:** A couple of different types of tools are available for compressing the valve springs with the cylinder head in place. The type shown here utilizes the rocker arm stud and nut for leverage, while the other type grips the lower spring coils and presses on the retainer as the knob is turned. Both types work very well, although the lever type is usually less expensive.

10 Remove the spring retainer and valve spring, then remove the valve guide seal. **Note:** If air pressure fails to hold the valve in the closed position during this operation, the valve face or seat is probably damaged. If so, the cylinder head will have to be removed for additional repair operations.

11 Wrap a rubber band or tape around the top of the valve stem so the valve won't fall into the combustion chamber, then release the air pressure. **Note:** If a rope was used instead of air pressure, turn the crankshaft slightly in the direction opposite normal rotation.

12 Inspect the valve stem for damage. Rotate the valve in the guide and check the end for eccentric movement, which would indicate the

valve stem is bent.

13 Move the valve up and down in the guide and make sure it doesn't bind. If the valve stem binds, either the valve is bent or the guide is damaged. In either case, the cylinder head will have to be removed for repair.

14 Reapply air pressure to the cylinder to retain the valve in the closed position, then remove the tape or rubber band from the valve stem. If a rope was used instead of air pressure, rotate the crankshaft in the normal direction of rotation until slight resistance is felt.

15 Lubricate the valve stem with engine oil and install a new valve guide seal. **Note:** Intake and exhaust valve seals are different.

16 Install the spring in position over the valve.

17 Install the valve spring retainer. Compress the valve spring and carefully install 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). Remove the pressure from the spring tool and make sure the keepers are seated.

18 Disconnect the air hose and remove the adapter from the spark plug hole. If a rope was used in place of air pressure, turn the crankshaft counterclockwise and pull it out of the cylinder.

19 Refer to Section 5 and install the rocker arm(s) and pushrod(s).

20 Install the spark plug(s) and hook up the wire(s).

21 Refer to Section 4 and install the valve cover.

22 Start and run the engine, then check for oil leaks and unusual sounds coming from the valve cover area.

7 Intake manifold - removal and installation

Removal

Refer to illustrations 7.10a, 7.10b, 7.11 and 7.12

1 Relieve the fuel pressure (see Chapter 4), then disconnect the negative battery cable from the battery. **Caution:** If the vehicle is equipped with a Delco Loc II or Theftlock audio system, make sure you have the correct activation code before disconnecting the battery. See the information at the front of this manual for the radio re-activation procedure.

2 Remove the air intake ducts (see Chapter 4).

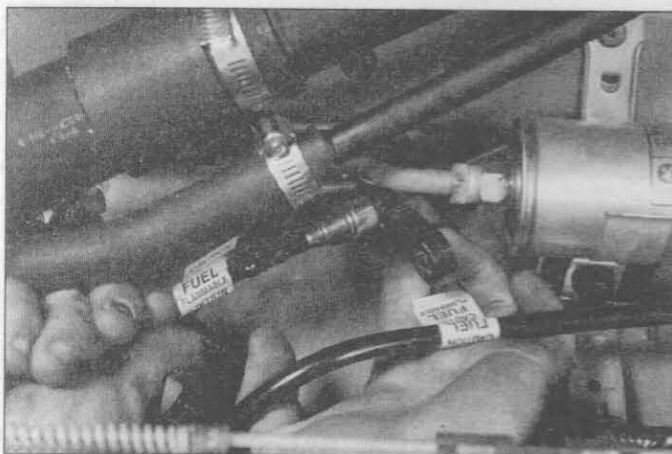
3 On 1998 and later models, remove the resonator from the throttle body and the resonator bracket that shields the fuel rail and harness connectors.

4 Remove the PCV hose from the valve cover.

5 Remove the accelerator cable, the cruise control cable and TV cables and brackets (see Chapter 4).

6 Remove the serpentine drivebelt from the engine (see Chapter 1).

7 Remove the power steering pump (if equipped) and tie it aside in



4.7a Disconnecting the fuel line using the special tool



4.7b Location of the inlet and return lines (arrows) on the fuel rail

13 If battery voltage exists, check the relay (see Chapter 12) or replace the relay with a known good relay and retest. If necessary, have the relay checked by a qualified automotive electrical specialist.

14 If the fuel pump does not activate, check for power to the fuel pump at the fuel tank. Access to the fuel pump is difficult, but it is possible to check for battery voltage at the electrical connector near the tank. If voltage is present at the fuel pump connector, replace the fuel pump.

4 Fuel lines and fittings - repair and replacement

Warning: Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the **Warning** in Section 2.

1 Always relieve the fuel pressure before servicing fuel lines or fittings on fuel-injected vehicles (see Section 2).

2 The fuel feed, return and vapor lines extend from the fuel tank to the engine compartment. The lines are secured to the underbody with clip and screw assemblies. These lines must be occasionally inspected for leaks, kinks and dents.

3 If evidence of dirt is found in the system or fuel filter during disassembly, the line should be disconnected and blown out. Check the fuel strainer on the fuel level sending unit (see Section 8) for damage and deterioration.

Steel and nylon tubing

Refer to illustrations 4.7a and 4.7b

4 Because fuel lines used on fuel-injected vehicles are under high pressure, they require special consideration.

5 If replacement of a metal fuel line or emission line is called for, use welded steel tubing meeting GM specification 124-M or its equivalent. Don't use copper or aluminum tubing to replace steel tubing. These materials cannot withstand normal vehicle vibration.

6 If it becomes necessary to replace a section of nylon fuel line, replace it only with the correct part number - don't use any substitutes.

7 Some fuel lines have threaded fittings with O-rings. Any time the fittings are loosened to service or replace components:

- Use a backup wrench while loosening and tightening the fittings.
- Check all O-rings for cuts, cracks and deterioration. Replace any that appear worn or damaged.
- If the lines are replaced, always use original equipment parts, or parts that meet the manufacturer's standards.
- Use the proper fuel line disconnect tools to release the spring-lock couplings inside the quick-disconnect fittings present in many locations throughout the system (fuel filter, fuel rail, fuel pressure regulator, etc.) (see illustrations).

Rubber hose

Warning: These models are equipped with electronic fuel injection - use only original equipment replacement hoses or their equivalent. Others may fail from the high pressures of this system.

8 When rubber hose is used to replace a metal line, use reinforced, fuel resistant hose (GM Specification 6183-M). Hose other than this could fail prematurely and could fail to meet Federal emission standards. Hose inside diameter must match line outside diameter. **Warning:** Don't substitute rubber hose for metal line on high-pressure systems. Use only genuine factory replacement lines or lines meeting factory specifications.

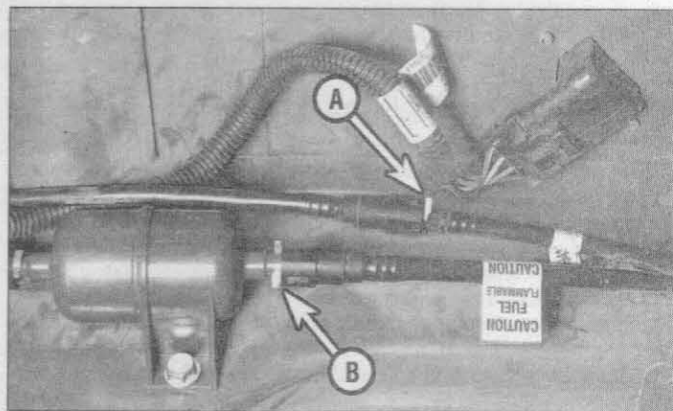
9 Don't use rubber hose within four inches of any part of the exhaust system or within ten inches of the catalytic converter. Metal lines and rubber hoses must never be allowed to chafe against the frame. A minimum of 1/4-inch clearance must be maintained around a line or hose to prevent contact with the frame.

Removal and installation

Refer to illustrations 4.10, 4.12a, 4.12b and 4.13

Note: The following procedure and accompanying illustrations are typical for vehicles covered by this manual. On quick-disconnect (non-threaded) fittings, clean off the fittings before disconnection to prevent dirt from getting in the fittings. After disconnection, clean the fittings with compressed air and apply a few drops of oil.

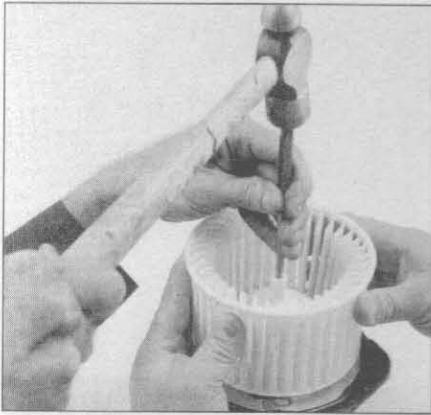
10 Relieve the fuel pressure (see Section 2) and disconnect the cable from the negative terminal of the battery. **Caution:** If the vehicle is equipped with a Delco Loc II or Theftlock audio system, make sure you



4.10 Some models are equipped with fuel lines that can be disconnected by pinching the tabs and separating each connector

A Fuel return line

B Fuel feed line



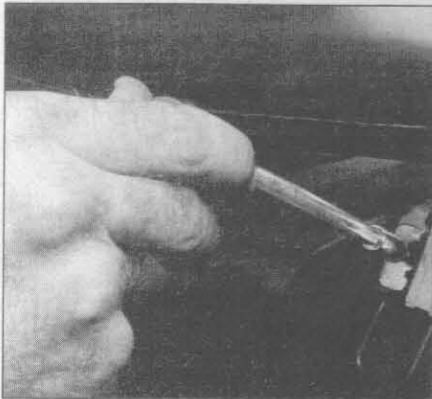
10.4 Have an assistant hold the blower assembly while tapping the motor shaft with a narrow punch and carefully drive the shaft out of the blower fan



11.3 Disconnect the heater core hoses (arrows) at the engine compartment firewall



11.5 Disconnect the ducts from the heater core cover



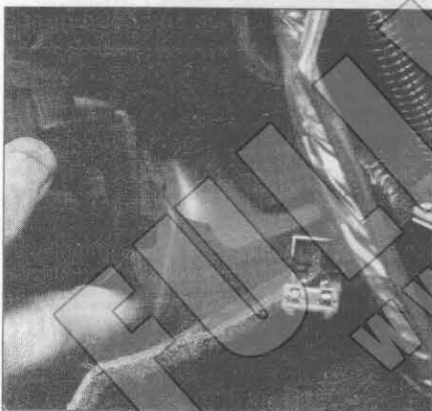
11.7a Remove the heater core cover bolts from the face of the assembly



11.7b Remove the bolt from under the ledge area of the cover. Don't forget the recessed mounting bolt near the middle, rear section of the heater core cover



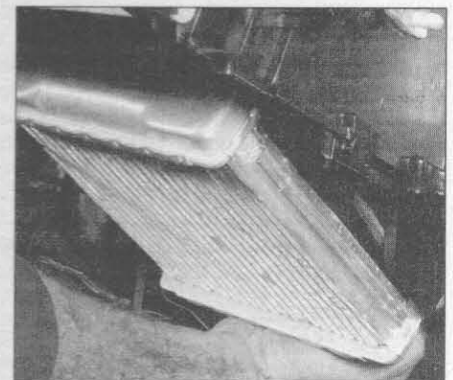
11.7c Separate the lower panel from the heater core housing



11.7d Pull the heater cover from the bottom to dislodge the condenser drain hoses



11.8a Remove the heater core straps (arrows) from the assembly



11.8b Lower the forward section of the heater core and angle the assembly toward the rear of the vehicle to separate it from the heater core housing

3 Disconnect the heater hoses at the heater core inlet and outlet on the engine side of the firewall (passenger side) (see illustration) and plug the open fittings. If the hoses are stuck to the pipes, cut them off.

4 From the inside of the car, remove the lower right dash insulator panel (below the glove box) and the glove box (see Chapter 11).

5 disconnect the ducts from the heater cover (see illustration).

6 Remove the instrument panel from the passenger compartment (see Chapter 11).

7 Remove the heater core cover (see illustrations).

8 Remove the heater core clamp bolts and clamps (see illustration), then slide the heater core out carefully (see illustration).

Installation

9 Installation is the reverse of removal. **Note:** When reinstalling the heater core, make sure any original insulating/sealing materials are in place around the heater core pipes and around the core.

10 Refill the cooling system (see Chapter 1).

11 Start the engine and check for proper operation.

was measured. Also, recheck the journal diameter. If the Plastigage was wider at one end than the other, the journal may be tapered (refer to Section 20).

Final connecting rod installation

19 Carefully scrape all traces of the Plastigage material off the rod journal and/or bearing face. Be very careful not to scratch the bearing - use your fingernail or the edge of a credit card.

20 Make sure the bearing faces are perfectly clean, then apply a uniform layer of clean moly-base grease or engine assembly lube to both of them. You'll have to push the piston into the cylinder to expose the face of the bearing insert in the connecting rod - be sure to slip the protective hoses over the rod bolts first.

21 Slide the connecting rod back into place on the journal, remove the protective hoses from the rod cap bolts, install the rod cap and tighten the nuts to the torque specified in this Chapter. Again, work up to the torque in three steps.

22 Repeat the entire procedure for the remaining pistons/connecting rods.

23 The important points to remember are:

- a) Keep the back sides of the bearing inserts and the insides of the connecting rods and caps perfectly clean when assembling them.
- b) Make sure you have the correct piston/rod assembly for each cylinder.
- c) The arrow or mark on the piston must face the front (timing chain end) of the engine.
- d) Lubricate the cylinder walls with clean oil.
- e) Lubricate the bearing faces when installing the rod caps after the oil clearance has been checked.

24 After all the piston/connecting rod assemblies have been properly installed, rotate the crankshaft a number of times by hand to check for any obvious binding.

25 As a final step, the connecting rod endplay must be checked. Refer to Section 14 for this procedure.

26 Compare the measured endplay to this Chapter's Specifications to make sure it's correct. If it was correct before disassembly and the original crankshaft and rods were reinstalled, it should still be right. If

new rods or a new crankshaft were installed, the endplay may be inadequate. If so, the rods will have to be removed and taken to an automotive machine shop for resizing.

27 Initial start-up and break-in after overhaul

Warning: Have a fire extinguisher handy when starting the engine for the first time.

1 Once the engine has been installed in the vehicle, double-check the oil and coolant levels.

2 With the spark plugs out of the engine and the ECM fuse removed, crank the engine until oil pressure registers on the gauge or the light goes out.

3 Install the spark plugs, hook up the plug wires (except OHC engine) and install the ECM fuse.

4 Start the engine. It may take a few moments for the fuel system to build up pressure, but the engine should start without a great deal of effort. **Note:** If the engine keeps backfiring, recheck the valve timing (and spark plug wires, where applicable).

5 After the engine starts, it should be allowed to warm up to normal operating temperature. While the engine is warming up, make a thorough check for fuel, oil and coolant leaks.

6 Shut the engine off and recheck the engine oil and coolant levels.

7 Drive the vehicle to an area with minimum traffic, accelerate from 30 to 50 mph, then allow the vehicle to slow to 30 mph with the throttle closed. Repeat the procedure 10 or 12 times. This will load the piston rings and cause them to seat properly against the cylinder walls. Check again for oil and coolant leaks.

8 Drive the vehicle gently for the first 500 miles (no sustained high speeds) and keep a constant check on the oil level. It's not unusual for an engine to use oil during the break-in period.

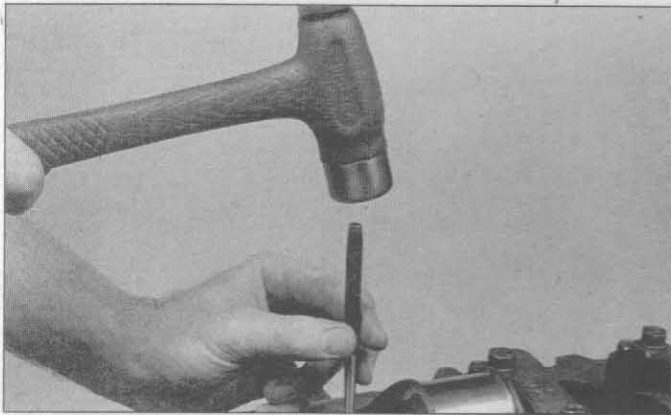
9 At approximately 500 to 600 miles, change the oil and filter.

10 For the next few hundred miles, drive the vehicle normally. Don't pamper it or abuse it.

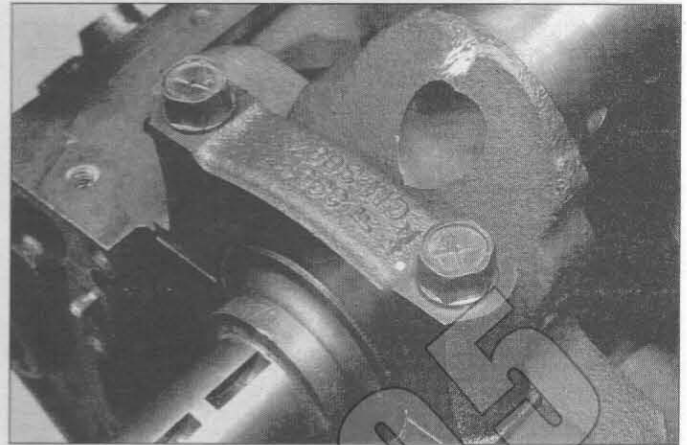
11 After 2000 miles, change the oil and filter again and consider the engine broken in.

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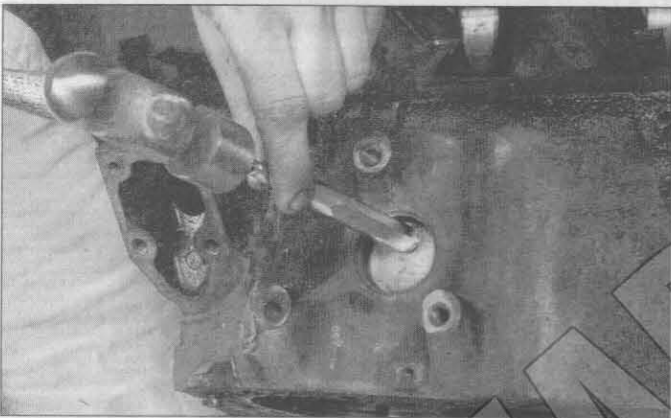
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15.4a Use a center-punch or number stamping dies to mark the main bearing caps to ensure installation in their original locations on the block (make the punch marks near one of the bolt heads)



15.4b The arrow on the main bearing cap indicates the front of the engine



16.4a A hammer and large punch can be used to knock the core plugs sideways in their bores



16.4b Pull the core plugs from the block with pliers

their locations. They should be numbered consecutively from the front of the engine to the rear. If they aren't, mark them with number stamping dies or a center punch (see illustration). Main bearing caps generally have a cast-in arrow, which points to the front of the engine (see illustration). Loosen the main bearing cap bolts 1/4-turn at a time each, until they can be removed by hand. Note if any stud bolts are used and make sure they're returned to their original locations when the crankshaft is reinstalled.

5 On OHV models, remove the balance shaft assembly. Be sure to note the exact location of the oil pump drive and drive chain before disassembly to ensure the correct timing of the balance shafts to the crankshaft rotation. Refer to Chapter 2B for additional information on the balance shaft assembly removal and installation procedure.

6 Gently tap the caps with a soft-face hammer, then separate them from the engine block. If necessary, use the bolts as levers to remove the caps. Try not to drop the bearing inserts if they come out with the caps.

7 Carefully lift the crankshaft out of the engine. It may be a good idea to have an assistant available, since the crankshaft is quite heavy. With the bearing inserts in place in the engine block and main bearing caps, return the caps to their respective locations on the engine block and tighten the bolts finger tight.

16 Engine block - cleaning

Refer to illustrations 16.4a, 16.4b, 16.8 and 16.10

1 Remove the main bearing caps and separate the bearing inserts from the caps and the engine block. Tag the bearings, indicating which cylinder they were removed from and whether they

were in the cap or the block, then set them aside.

2 Using a gasket scraper, remove all traces of gasket material from the engine block. Be very careful not to nick or gouge the gasket sealing surfaces.

3 Remove all of the covers and threaded oil gallery plugs from the block. The plugs are usually very tight - they may have to be drilled out and the holes retapped. Use new plugs when the engine is reassembled.

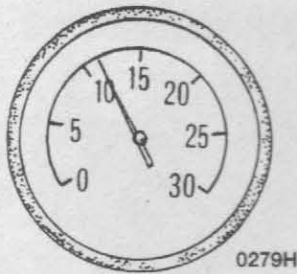
4 Remove the core plugs from the engine block. To do this, knock one side of the core plug into the block with a hammer and punch, then grasp them with a pair of large adjustable pliers and lever them out (see illustrations). **Caution:** The core plugs (also known as freeze or soft plugs) may be difficult or impossible to retrieve if they're driven into the block coolant passages.

5 If the engine is extremely dirty, it should be taken to an automotive machine shop to be steam cleaned or hot tanked.

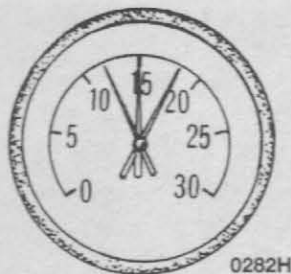
6 After the block is returned, clean all oil holes and oil galleries one more time. Brushes specifically designed for this purpose are available at most auto parts stores. Flush the passages with warm water until the water runs clear, dry the block thoroughly and wipe all machined surfaces with a light, rust preventive oil. If you have access to compressed air, use it to speed the drying process and blow out all the oil holes and galleries. **Warning:** Wear eye protection when using compressed air!

7 If the block isn't extremely dirty or sludged up, you can do an adequate cleaning job with hot soapy water and a stiff brush. Take plenty of time and do a thorough job. Regardless of the cleaning method used, be sure to clean all oil holes and galleries very thoroughly, dry the block completely and coat all machined surfaces with light oil.

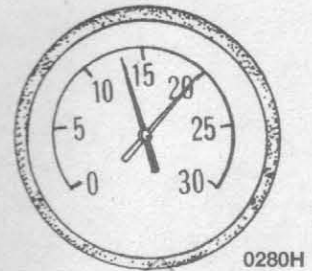
8 The threaded holes in the block must be clean to ensure accurate torque readings during reassembly. Run the proper size tap into each of



4.1 Low, steady reading



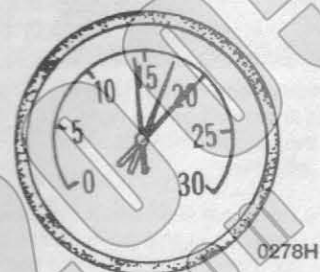
4.2 Low, fluctuating needle



4.3 Regular drops



4.4 Irregular drops



4.5 Rapid vibration

rings. A low compression reading on the first stroke, which doesn't build up during successive strokes, indicates leaking valves or a blown head gasket (a cracked head could also be the cause). Deposits on the undersides of the valve heads can also cause low compression. Record the highest gauge reading obtained.

8 Repeat the procedure for the remaining cylinders, turning the engine over for the same length of time for each cylinder, and compare the results to this Chapter's Specifications.

9 If the readings are below normal, add some engine oil (about three squirts from a plunger-type oil can) to each cylinder, through the spark plug hole, and repeat the test.

10 If the compression increases after the oil is added, the piston rings are definitely worn. If the compression doesn't increase significantly, the leakage is occurring at the valves or head gasket. Leakage past the valves may be caused by burned valve seats and/or faces or warped, cracked or bent valves.

11 If two adjacent cylinders have equally low compression, there's a strong possibility the head gasket between them is blown. The appearance of coolant in the combustion chambers or the crankcase would verify this condition.

12 If one cylinder is about 20-percent lower than the others, and the engine has a slightly rough idle, a worn exhaust lobe on the camshaft could be the cause.

13 If the compression is unusually high, the combustion chambers are probably coated with carbon deposits. If that's the case, the cylinder heads should be removed and decarbonized.

14 If compression is way down or varies greatly between cylinders, it would be a good idea to have a leak-down test performed by an automotive repair shop. This test will pinpoint exactly where the leakage is occurring and how severe it is.

15 Install the fuses and drive the vehicle to restore the "block learn" memory.

cylinder walls, leaking head or intake manifold gaskets, incorrect carburetor adjustments, restricted exhaust, stuck or burned valves, weak valve springs, improper ignition or valve timing and ignition problems.

Unfortunately, vacuum gauge readings are easy to misinterpret, so they should be used in conjunction with other tests to confirm the diagnosis.

Both the gauge readings and the rate of needle movement are important for accurate interpretation. Most gauges measure vacuum in inches of mercury (in-Hg). The following references to vacuum assume the diagnosis is being performed at sea level. As elevation increases (or atmospheric pressure decreases), the reading will decrease. For every 1,000-foot increase in elevation above approximately 2000 feet, the gauge readings will decrease about one inch of mercury.

Connect the vacuum gauge directly to intake manifold vacuum, not to ported (before throttle plate) vacuum. Be sure no hoses are left disconnected during the test or false readings will result.

Before you begin the test, allow the engine to warm up completely. Block the wheels and set the parking brake. With the transmission in Park, start the engine and allow it to run at normal idle speed.

Read the vacuum gauge; an average, healthy engine should normally produce about 17 to 22 inches of vacuum with a fairly steady needle. Refer to the following vacuum gauge readings and what they indicate about the engine's condition:

1 A low, steady reading usually indicates a leaking gasket between the intake manifold and throttle body, a leaky vacuum hose, late ignition timing or incorrect camshaft timing (see illustration). Eliminate all other possible causes, utilizing the tests provided in this Chapter before you remove the timing chain cover to check the timing marks.

2 If the reading is three to eight inches below normal and it fluctuates at that low reading, suspect an intake manifold gasket leak at an intake port (see illustration).

3 If the needle has regular drops of about two to four inches at a steady rate, the valves are probably leaking. Perform a compression or leak-down test to confirm this (see illustration).

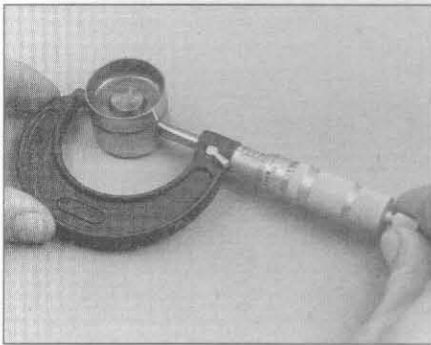
4 An irregular drop or down-flick of the needle can be caused by a sticking valve or an ignition misfire. Perform a compression or leak-down test and read the spark plugs (see illustration).

5 A rapid vibration of about four inches-Hg vibration at idle combined with exhaust smoke indicates worn valve guides (see illustration). Perform a leak-down test to confirm this. If the rapid vibration

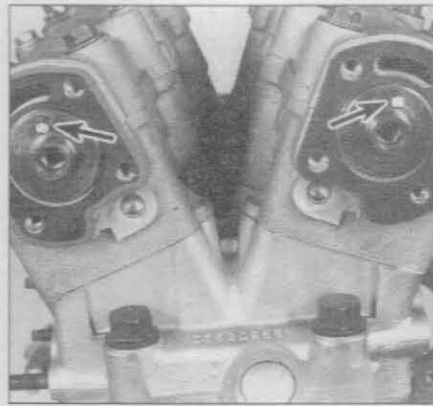
4 Vacuum gauge diagnostic checks

Refer to illustrations 4.1, 4.2, 4.3, 4.4, 4.5, 4.7 and 4.9

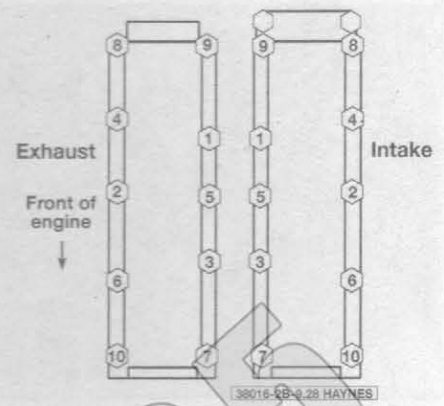
A vacuum gauge provides valuable information about what is going on in the engine at a low cost. You can check for worn rings or



9.19 ... then measure the lifters with a micrometer - subtract each lift diameter from the corresponding bore diameter to obtain the lifter-to-bore clearances



9.24 The dowel pins (arrows) should be at the top (12 o'clock position)



9.28 Camshaft housing-to-cylinder head bolt tightening sequence

19 Measure each lifter outside diameter and record the results (see illustration).

20 Subtract the lifter outside diameter from the corresponding bore inside diameter to determine the clearance. Compare the results to this Chapter's specifications and replace parts as necessary.

Installation

Refer to illustrations 9.24 and 9.28

21 Using a new gasket, position the camshaft housing on the cylinder head and temporarily hold it in place with one bolt.

22 Coat the camshaft journals and lobes and the lifters with camshaft assembly lube and install them in their original locations.

23 On the intake camshaft only, lubricate the lip of the oil seal with clean engine oil, then position the seal on the camshaft journal with the spring side facing in.

24 Install the camshaft in the housing with the sprocket dowel pin UP (12 o'clock position) (see illustration). Position the cover on the housing, holding it in place with the two bolts, as described previously.

25 Apply thread sealant to the threads of the camshaft housing and cover bolts.

26 Install new housing seals. **Note:** Each housing seal is different shape and color. The intake seals are green with the inner seal configured differently than the outer seal. The exhaust seals are orange and they are also configured differently.

27 Install the camshaft cover and bolts while positioning the oil seal (intake side only). Be sure the seal is installed to a precise 0.020 inch depth from the outer housing face.

28 Tighten the bolts in the sequence shown (see illustration) to the torque and angle of rotation listed in this Chapter's Specifications. Be sure to tighten the camshaft cover-to-housing bolts (rear two on the intake camshaft housing) at the prescribed lighter torque setting.

29 Install the power steering pump.

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

31 Change the oil and filter (see Chapter 1). Add a can of engine oil supplement (GM part no. 1052367, or equivalent) if the camshafts and lifters have been replaced. **Note:** If new lifters have been installed or the lifters bled down while the engine was disassembled, excessive lifter noise may be experienced after startup - this is normal. Use the following procedure to purge the lifters of air.

- Start the engine and allow it to warm up at idle for five minutes.
- Increase engine speed to 2,000 rpm until the lifter noise is gone.
- Return the engine to idle for an additional five minutes.

32 Road test the vehicle and check for oil and coolant leaks.

10 Valve springs, retainers and seals - replacement

Refer to illustrations 10.5 and 10.18

Note: Broken valve springs and defective valve stem seals can be replaced without removing the cylinder head. Two special tools and a

compressed air source are normally required to perform this operation, so read through this Section carefully and rent or buy the tools before beginning the job. If compressed air isn't available, a length of nylon rope can be used to keep the valves from falling into the cylinder during this procedure.

1 Remove the spark plug from the cylinder which has the defective part. Due to the design of this engine, the intake and exhaust camshaft housings can be removed separately to service their respective components. If all of the valve stem seals are being replaced, all of the spark plugs and both camshaft housings should be removed.

2 Refer to Chapter 5 and remove the ignition coil assembly.

3 Remove the camshaft(s), lifters and housing(s) as described in Section 9.

4 Turn the crankshaft until the piston in the affected cylinder is at top dead center on the compression stroke (refer to Chapter 2, Part C, for instructions). If you're replacing all of the valve stem seals, begin with cylinder number one and work on the valves for one cylinder at a time. Move from cylinder-to-cylinder following the firing order sequence (see this Chapter's Specifications).

5 Thread an adapter into the spark plug hole (see illustration) and connect an air hose from a compressed air source to it. Most auto parts stores can supply the air hose adapter. **Note:** Many cylinder compression gauges utilize a screw-in fitting that may work with your air hose quick-disconnect fitting.

6 Apply compressed air to the cylinder. **Warning:** The piston may be forced down by compressed air, causing the crankshaft to turn suddenly. If the wrench used when positioning the number one piston at TDC is still attached to the bolt in the crankshaft nose, it could cause damage or injury when the crankshaft moves.

7 The valves should be held in place by the air pressure.

8 If you don't have access to compressed air, an alternative method can be used. Position the piston at a point approximately 45-degrees before TDC on the compression stroke, then feed a long piece of nylon rope through the spark plug hole until it fills the combustion chamber. Be sure to leave the end of the rope hanging out of the engine so it can be removed easily. Use a large ratchet and socket to rotate the crankshaft in the normal direction of rotation (clockwise) until slight resistance is felt.

9 Stuff shop rags into the cylinder head holes adjacent to the valves to prevent parts and tools from falling into the engine, then use a valve spring compressor to compress the spring. Remove the keepers with small needle-nose pliers or a magnet.

10 Remove the retainer and valve spring, then remove the valve guide seal and rotator. **Note:** If air pressure fails to hold the valve in the closed position during this operation, the valve face or seat is probably damaged. If so, the cylinder head will have to be removed for additional repair operations.

11 Wrap a rubber band or tape around the top of the valve stem so the valve won't fall into the combustion chamber, then release the air pressure. **Note:** If a rope was used instead of air pressure, turn the crankshaft slightly in a counterclockwise direction (opposite normal rotation).

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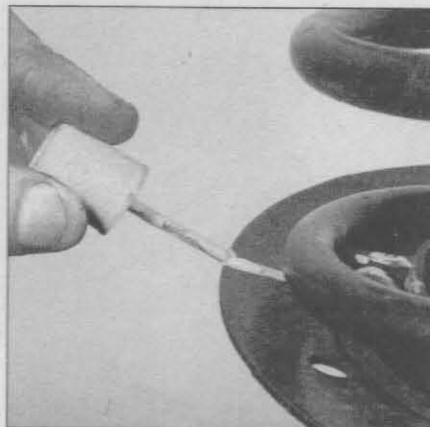


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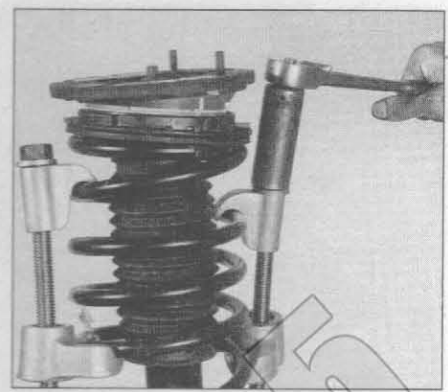
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4.3a Mark the relationship of the coil spring to the upper spring seat and insulator and to the strut mount...



4.3b ... and to the lower seat of the strut



4.4 Following the tool manufacturer's instructions, install the spring compressor on the spring and compress it sufficiently to relieve all pressure from the upper spring seat



4.5 Using a wrench on the damper shaft to prevent it from turning, loosen the damper shaft nut



4.6a Remove the washer...

4 Strut/shock absorber or coil spring - replacement

1 If the struts/shock absorbers or coil springs exhibit the telltale signs of wear (leaking fluid, loss of damping capability, chipped, sagging or cracked coil springs) explore all options before beginning any work. The strut/shock absorber assemblies are not serviceable and must be replaced if a problem develops. However, strut assemblies complete with springs may be available on an exchange basis, which eliminates much time and work. Whichever route you choose to take, check on the cost and availability of parts before disassembling your vehicle. **Warning:** *Disassembling a strut is potentially dangerous and utmost attention must be directed to the job, or serious injury may result. Use only a high-quality spring compressor and carefully follow the manufacturer's instructions furnished with the tool. After removing the coil spring from the strut assembly, set it aside in a safe, isolated area.*

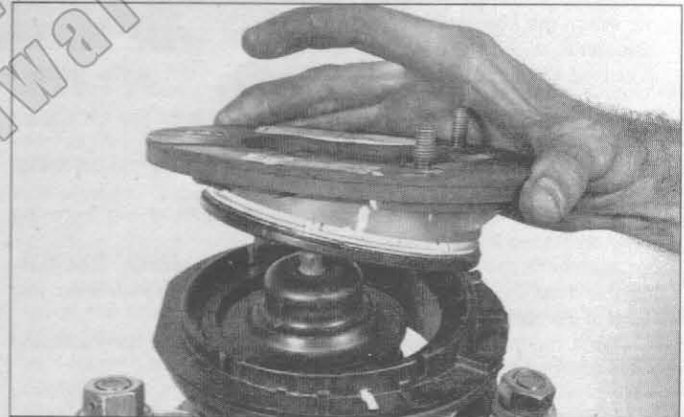
Disassembly

Refer to illustrations 4.3a, 4.3b, 4.4, 4.5, 4.6a, 4.6b, 4.7, 4.8 and 4.9

2 Remove the strut and spring assembly (see Section 3) or shock absorber/coil spring assembly (see Section 9). Mount the strut assembly in a vise. Line the vise jaws with wood or rags to prevent damage to the unit and don't tighten the vise excessively.

3 Mark the relationship of the coil spring to the upper insulator and mount and to the lower seat (see illustrations).

4 Following the tool manufacturer's instructions, install the spring compressor (which can be obtained at most auto parts stores or at equipment rental yards) on the spring and compress it sufficiently to relieve all pressure from the upper spring seat (see illustration). This



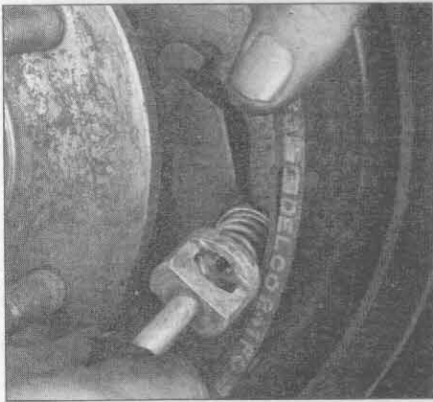
4.6b ... and the strut mount; inspect the bearing in the mount for smooth operation and the rubber portion of the mount for cracking and general deterioration, if the bearing doesn't turn smoothly, or if there's any separation of the rubber, replace the mount

can be verified by wiggling the spring.

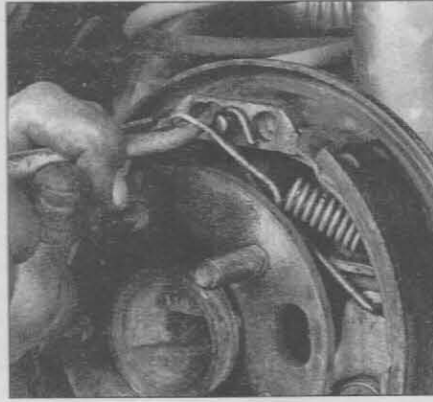
5 Loosen the damper shaft nut (see illustration).

6 Remove the washer and strut mount (see illustrations). Inspect the bearing in the strut mount for smooth operation. If it doesn't turn smoothly, replace the strut mount. Check the rubber portion of the strut mount for cracking and general deterioration. If there is any separation of the rubber, replace it.

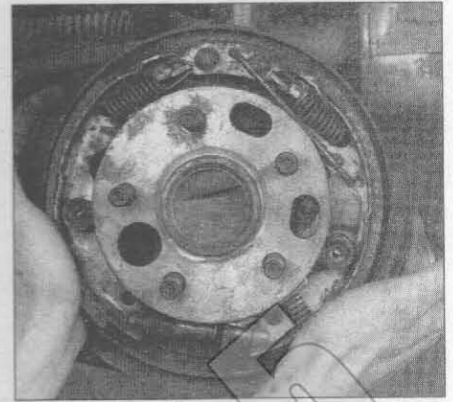
7 Remove the upper spring seat and insulator from the damper



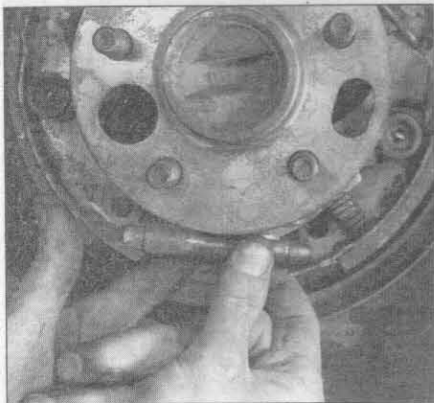
6.4t Install the secondary brake shoe hold-down pin and spring



6.4u Install the return springs



6.4v Center the brake shoe assembly so the drum will slide over it



6.4w Turn the adjusting screw so the drum fits snugly over the shoes, then back-off the adjustment until the drum can be turned without the shoes dragging



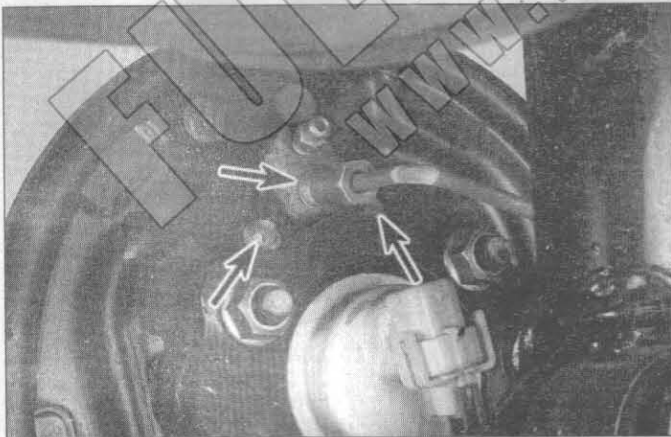
6.4x Remove the glaze from the drum with sandpaper or emery cloth, using a swirling motion



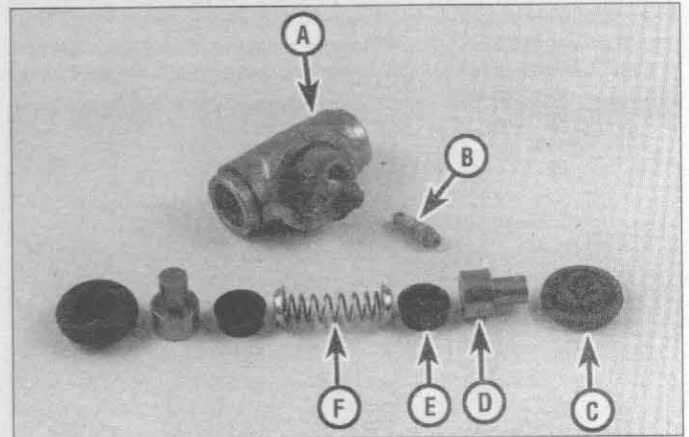
6.5 The maximum allowable diameter is cast into the brake drum

- 3 Remove the wheel cylinder retaining bolts from the rear of the backing plate.
- 4 Remove the cylinder and place it on a clean workbench.
- 5 Remove the bleeder valve, seals, pistons, boots and spring assembly from the cylinder body (see illustration).
- 6 Clean the wheel cylinder with brake fluid or brake system cleaner. Do not, under any circumstances, use petroleum-based solvents to clean brake parts.

- 7 Use filtered, unlubricated compressed air to remove excess fluid from the wheel cylinder and to blow out the passages.
- 8 Check the cylinder bore for corrosion and scoring. Crocus cloth may be used to remove light corrosion and stains, but the cylinder must be replaced with a new one if the defects cannot be removed easily, or if the bore is scored.
- 9 Lubricate the new seals with clean brake fluid.
- 10 Assemble the brake cylinder, making sure the lips of the seals

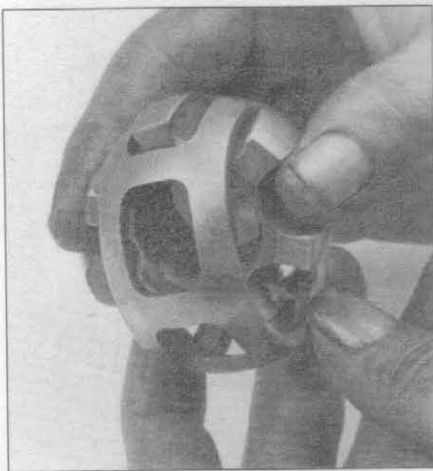


7.2 Unscrew the brake line fitting (upper arrow) from the rear of the wheel cylinder with a flare-nut wrench to prevent rounding off the corners of the nut, then remove the wheel cylinder retaining bolts (lower arrows)

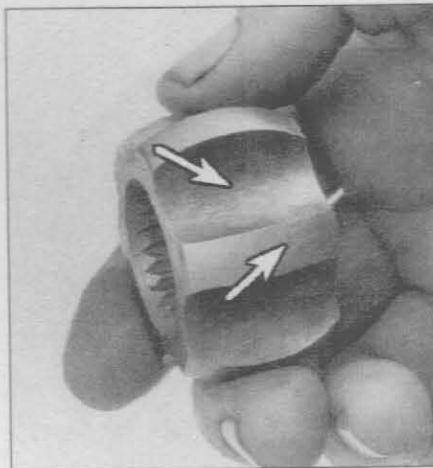


7.5 A typical wheel cylinder assembly

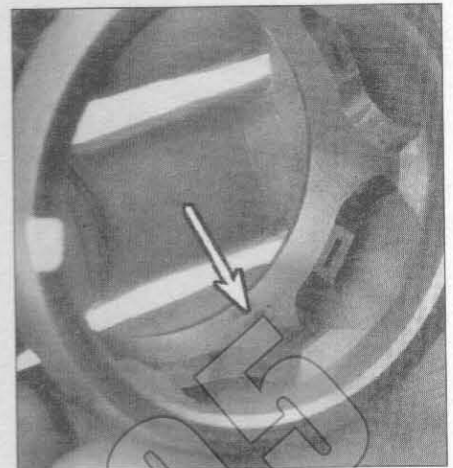
- | | | | |
|---|---------------------|---|--------|
| A | Wheel cylinder body | D | Piston |
| B | Bleeder screw | E | Seal |
| C | Boot | F | Spring |



11.4i Align the inner race lands with the cage window and rotate the inner race out of the cage



11.4j After cleaning the components with solvent, check the inner race lands and grooves for pitting and score marks



11.4k Check the cage for cracks, pitting and score marks - shiny spots are normal and don't affect operation



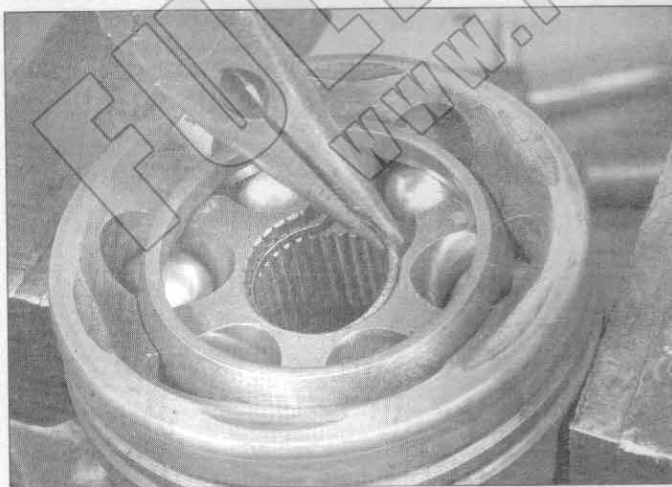
11.4l With the race and cage tilted at 90-degrees, lower the assembly into the housing



11.4m Rotate the assembly by gently tapping with a hammer and brass punch, then ...



11.4n ... press the balls into the cage windows, repeating until all of the balls are installed



11.4o On models so equipped, use needle-nose pliers to lower a new snap-ring into the groove ...



11.4p ... then seat it into the groove with snap-ring pliers

Chapter 8

Clutch and driveaxles

Contents

	Section		Section
Clutch - description and check.....	2	Driveaxle - removal and installation.....	9
Clutch components - removal, inspection and installation.....	3	Driveaxle boot check.....	See Chapter 1
Clutch fluid level check.....	See Chapter 1	Driveaxle boot - replacement.....	11
Clutch hydraulic system - bleeding.....	6	Driveaxle oil seal - replacement.....	See Chapter 7B
Clutch master cylinder - removal and installation.....	4	Driveaxles - general information and inspection.....	8
Clutch release cylinder and bearing - removal, inspection and installation.....	5	Flywheel - removal and installation.....	See Chapter 2
Clutch start switch - check and replacement.....	7	General information.....	1
		Intermediate shaft - removal and installation.....	10

Specifications

Clutch

Fluid type.....	See Chapter 1
CV joint boot length (see illustrations 11.3u and 11.3v)	
1995 models	
Ball-and-cage type joint.....	5-1/4 inches
Tripot type joint	
29/32 inch diameter axleshaft.....	7-1/2 inches
1-1/32 inch diameter axleshaft.....	6-11/16 inches
1996 and 1997 models (all).....	4-29/32 inches
1998 and later models	
2.2L engine.....	4.0 inches
2.4L engine.....	4-29/32 inches

Torque specifications

Clutch master cylinder mounting nuts.....	180 in-lbs
Clutch pressure plate-to-flywheel bolts	
2.2L.....	180 in-lbs, then rotate 30-degrees
2.3L, 2.4L.....	180 in-lbs, then rotate 45-degrees
Driveaxle/hub nut.....	185
Intermediate shaft support bolts.....	48
Wheel lug nuts.....	See Chapter 1

Ft-lbs (unless otherwise indicated)

180 in-lbs

180 in-lbs, then rotate 30-degrees

180 in-lbs, then rotate 45-degrees

185

48

See Chapter 1

1 General information

The information in this Chapter deals with the components from the rear of the engine to the front wheels, except for the transaxle, which is dealt with in Chapters 7A and 7B. For the purposes of this Chapter, these components are grouped into two categories: clutch and driveaxles. Separate Sections within this Chapter offer general descriptions and checking procedures for both groups.

Since nearly all the procedures covered in this Chapter involve working under the vehicle, make sure it's securely supported on sturdy jackstands or a hoist where the vehicle can be easily raised and lowered.

2 Clutch - description and check

1 All vehicles with a manual transaxle use a single dry plate, diaphragm spring type clutch. The clutch disc has a splined hub which allows it to slide along the splines of the transaxle input shaft. The clutch and pressure plate are held in contact by spring pressure exerted by the diaphragm in the pressure plate.

2 The clutch release system is operated by hydraulic pressure. The hydraulic release system consists of the clutch pedal, a master cylinder and fluid reservoir, the clutch fluid hydraulic line, and an integral clutch release cylinder and release bearing assembly.

3 When pressure is applied to the clutch pedal to release the clutch,

- 35 Install the flywheel housing cover and tighten the bolts securely.
- 36 Install the driveaxles (see Chapter 8).
- 37 Install the left suspension support and tighten the bolts securely.
- 38 Install the left stabilizer bar U-bolt (see Chapter 10).
- 39 Attach the left and right balljoints to the steering knuckles (see Chapter 10).
- 40 Install the left stabilizer bar link (see Chapter 10).
- 41 Reroute the ABS harnesses and connectors and plug the connectors into the front wheel speed sensors.
- 42 Install the front inner splash shield.
- 43 Install the wheels.
- 44 Install the vehicle speed sensor (see Chapter 6).
- 45 Lower the vehicle.
- 46 Connect the ground cables to their transaxle mounting studs.
- 47 Attach the vent tube to the transaxle.
- 48 Plug in the connector for the back-up light switch.
- 49 Install the upper transaxle-to-engine bolts and tighten them to the torque listed in this Chapter's Specifications.
- 50 Connect the clutch master cylinder to the clutch release cylinder (see Chapter 8).
- 51 Install the rear transaxle mount and tighten the nuts and bolts securely.
- 52 Attach the wiring harness to the mount bracket.
- 53 Remove the engine support.
- 54 Connect the shift and select cables to the shift levers and to the shift cable bracket.
- 55 Install the air cleaner and ducting (see Chapter 4).
- 56 Connect the clutch master cylinder pushrod to the clutch pedal (see Chapter 8).
- 57 Install the left sound insulator (see Chapter 11).
- 58 Fill the transaxle with the specified lubricant (see Chapter 1).
- 59 Connect the negative battery cable.

6 Manual transaxle overhaul - general information

Overhauling a manual transaxle is a difficult job for the do-it-yourselfer. It involves the disassembly and reassembly of many small parts. Numerous clearances must be precisely measured and, if necessary, changed with select fit spacers and snap-rings. As a result, if transaxle problems arise, it can be removed and installed by a competent do-it-yourselfer, but overhaul should be left to a transmission repair shop. Rebuilt transaxles may be available - check with your dealer parts department and auto parts stores. At any rate, the time and money involved in an overhaul is almost sure to exceed the cost of a rebuilt unit.

Nevertheless, it's not impossible for an inexperienced mechanic to rebuild a transaxle if the special tools are available and the job is done in a deliberate, step-by-step manner so nothing is overlooked.

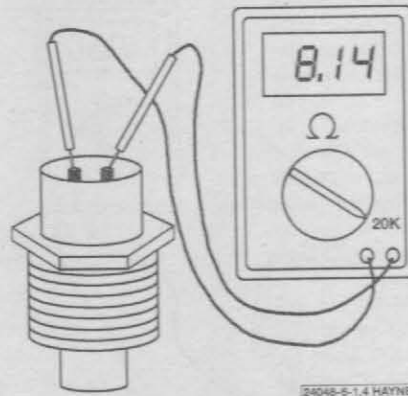
The tools necessary for an overhaul include internal and external snap-ring pliers, a bearing puller, a slide hammer, a set of pin punches, a dial indicator and possibly a hydraulic press. In addition, a large, sturdy workbench and a vise or transaxle stand will be required.

During disassembly of the transaxle, make careful notes of how each piece comes off, where it fits in relation to other pieces and what holds it in place. Note how the parts are installed when you remove them; this will make it much easier to get the transaxle back together.

Before taking the transaxle apart for repair, it will help if you have some idea what area of the transaxle is malfunctioning. Certain problems can be closely tied to specific areas in the transaxle, which can make component examination and replacement easier. Refer to the Troubleshooting section at the front of this manual for information regarding possible sources of trouble.



3.10 Lower the PCM out from the bottom of the fenderwell



4.1a Be sure the meter probes make clean contact with the terminals of the sensor when checking the resistance (thermister type sensor shown)

Temperature (degrees-F)	Resistance (ohms)
212	176
194	240
176	332
158	458
140	668
122	972
112	1182
104	1458
95	1800
86	2238
76	2795
68	3520
58	4450
50	5670
40	7280
32	9420

4.1b Coolant temperature and intake air temperature sensors approximate temperature vs. resistance relationships

- 8 Unplug the electrical connectors from the PCM. Each connector is color coded to fit its respective receptacle in the PCM.
- 9 Remove the bolts from the PCM retainer brackets (see illustrations).
- 10 Carefully lift the PCM out the bottom of the engine compartment without damaging the electrical connectors and wiring harness to the computer (see illustration).
- 11 Installation is the reverse of removal.

EEPROM reprogramming

- 12 These models are equipped with Electrical Erasable Programmable Read Only Memory (EEPROM) chip that is permanently soldered to the PCM circuit board. The EEPROM can be reprogrammed using the GM TECH 1 SCAN tool. Do not attempt to remove this component from the PCM. Have the EEPROM reprogrammed at a dealer service department or other qualified repair shop.

4 Information sensors - general information and testing

Caution 1: When performing the following tests, use only a high-impedance (10 mega-ohms) digital multi-meter to prevent damage to the PCM.

Caution 2: On models equipped with a Delco-Loc II or Theftlock audio system, be sure the lockout feature is turned off before disconnecting the battery cable.

Thermister (two-wire) sensors (coolant temperature, intake air temperature, air charge sensors, etc.)

Refer to illustrations 4.1a and 4.1b

- 1 Thermistors are variable resistors that sense temperature level changes and convert them to a voltage signal. The coolant temperature sensor (ECT) and the intake air temperature sensor (IAT) are thermister type sensors. Select the ohms range with the rotary switch, disconnect the harness connector at the sensor and connect the test probes to the sensor terminals (see illustration). The resistance reading (ohms) should be high when the sensor is cold and low when the sensor is hot (see illustration). Be sure the tips of the probe make clean contact with the terminals inside the sensor to ensure an accurate reading.
- 2 After the resistance of the sensor has been checked, test the system for the proper reference voltage from the computer. Simply disconnect the harness connector at the sensor, select the voltage range on the rotary switch on the meter and probe the correct terminals on the harness for the voltage signal. Reference voltage should be

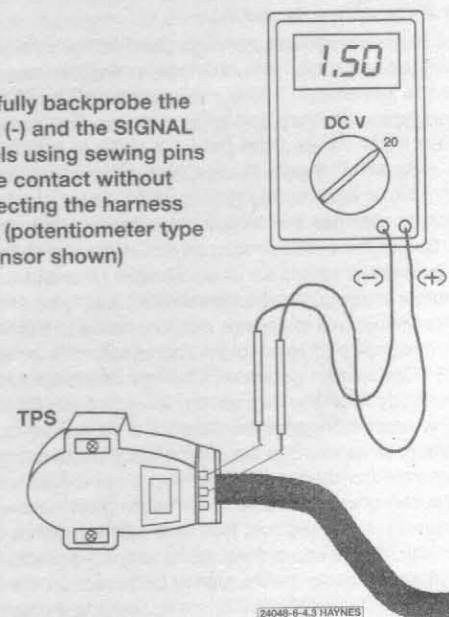
approximately 5 volts. The ignition switch must be in the ON position (engine not running). If there is no reference voltage available to the sensor, then the circuit and the computer must be checked.

Potentiometers (three-wire) sensors (TPS, EGR position sensors, etc.)

Refer to illustration 4.3

- 3 The potentiometer is a variable resistor that converts the voltage signal by varying the resistance according to the driving situations. The signal the potentiometer generates is used by the computer to determine position and direction of the device within the component. Although it is possible to measure resistance changes of the sensor, it is best to measure voltage changes as the end result of the potentiometer's performance. Select the DC volts function on the multimeter, carefully backprobe the harness connector using pins inserted into the correct terminals and connect the meter probes to the pins. Connect the negative probe (-) to the ground terminal and the positive probe to the SIGNAL terminal. It will be necessary to refer to the wiring diagrams at the end of this manual for the correct terminals. Observe

4.3 Carefully backprobe the GROUND (-) and the SIGNAL (+) terminals using sewing pins to make contact without disconnecting the harness connector (potentiometer type sensor shown)



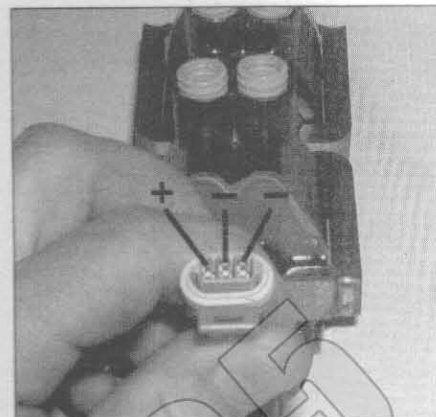
24048-6-4.3 HAYNES



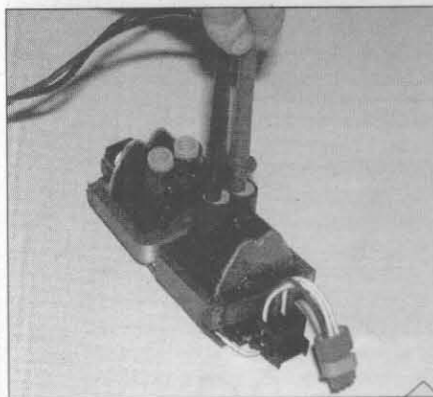
6.16a On 2.3L and 2.4L engines, first disconnect the ignition coil-to-ignition module connector and check for battery voltage to the coil with the ignition key On ...



6.16b ... then connect an LED test light to the positive terminal of the battery and to each of the coil negative (-) terminals on the ignition module and watch for a blinking light when the engine is cranked



6.17a To check the primary resistance of the ignition coil on 2.3L and 2.4L engines, connect the positive probe to the positive (+) terminal and the negative probe to each of the negative (-) terminals of the coil connector. The resistance should be the same for each check



6.17b Checking the secondary coil resistance (2.3L and 2.4L engines) - be sure the probes touch the contact in the center of each socket



7.4a Remove the bolts from the coil pack assembly



7.4b Some coil pack assemblies are mounted on the side of the engine block

16 If voltage is available at the ignition control module and there's still no spark, check for a trigger signal from the ignition module. Remove the coil housing cover and the ignition coil to ignition module electrical connector to expose the module output terminals (see Section 7). First check for battery voltage to the coils with the ignition key On, then connect a test light to the positive terminal of the battery and to each of the coil/module negative terminals and have an assistant crank the engine over (see illustrations). The test light should blink quickly and constantly as each coil pack is triggered to fire by the switching signal from the ignition module. This test checks for the trigger signal (ground) from the computer and Ignition Control Module. **Caution:** Use only an LED test light to avoid damaging the PCM

17 If a trigger signal is present at the coil, the computer and the Ignition Control Module are functioning properly and the problem lies in the ignition coils or the wiring to the ignition coils. Check the primary and secondary resistance of the ignition coils and compare it to the Specifications at the beginning of this Chapter (see illustrations). **Note:** On 2.3L and 2.4L engines, primary resistance can be checked at the coil/ignition module connector or at the bottom of each coil. Always verify that the wires leading to the coils are not defective (have continuity) before replacing an ignition coil.

18 If the test light does not flash, the ignition module is most likely the problem but not always. Check the crankshaft and camshaft sensors for proper operation. **Note:** Refer to Chapter 6 for additional infor-

mation and testing procedures on the crankshaft and the camshaft sensors. It will be necessary to verify that the crankshaft sensors and camshaft sensor is operating correctly before changing the ignition module. A defective ignition module can only be diagnosed by process of elimination.

19 If the crankshaft and the camshaft sensors check out OK, have the PCM checked by a dealer service department or other qualified automotive repair shop.

7 Ignition coil and module - replacement

2.2L OHV engine

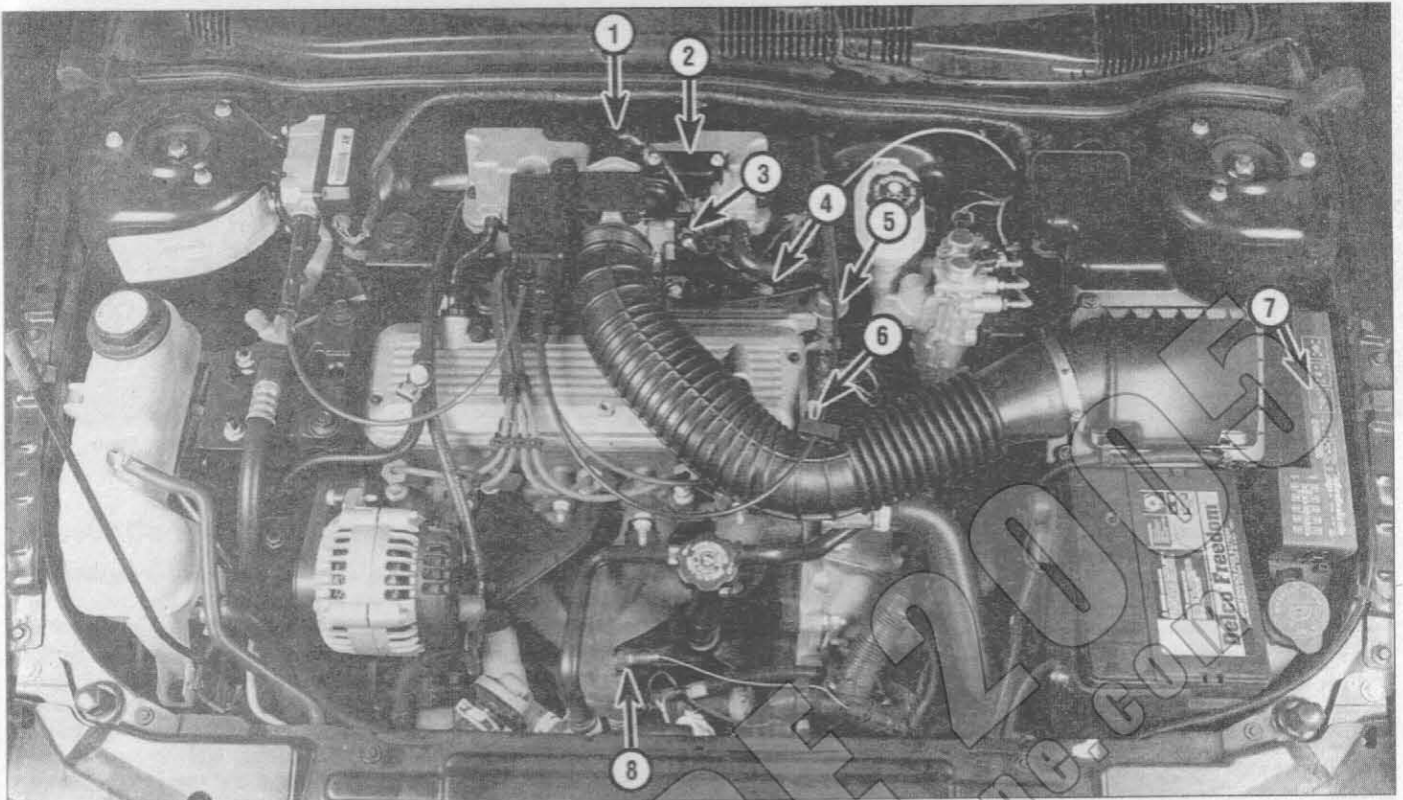
Refer to illustrations 7.4a, 7.4b, 7.5a and 7.5b

1 Detach the cable from the negative terminal of the battery. **Caution:** If the vehicle is equipped with a Delco Loc II or Theftlock audio system, make sure you have the correct activation code before disconnecting the battery.

2 Unplug the electrical connectors from the module.

3 If the plug wires are not numbered, label them and detach the plug wires at the coil assembly.

4 Remove the module/coil assembly mounting bolts and lift the assembly from the vehicle (see illustrations).



11.3 Fuel injection and engine control component locations (1996 2.2L OHV engine)

- | | | |
|---|----------------------------------|---------------------------------------|
| 1 Idle Air Control (IAC) valve | 3 Throttle Position Sensor (TPS) | 6 Intake Air Temperature (IAT) sensor |
| 2 Manifold Absolute Pressure (MAP) sensor | 4 Fuel injectors | 7 Fuel pump relay |
| | 5 Fuel pressure regulator | 8 Oxygen sensor |

- 2 Check the air filter element - a dirty or partially blocked filter will severely impede performance and economy (see Chapter 1).
- 3 Check the fuel filter and replace it if necessary (see Chapter 1).
- 5 Check the ground wire connections on the intake manifold for tightness. Check all electrical connectors that are related to the system. Loose connectors and poor grounds can cause many problems that resemble more serious malfunctions.
- 5 If a blown fuse is found, replace it and see if it blows again. If it does, search for a grounded wire in the harness.
- 6 Check the air intake duct to the intake manifold for leaks, which will result in an excessively lean mixture. Also check the condition of all vacuum hoses connected to the intake manifold.

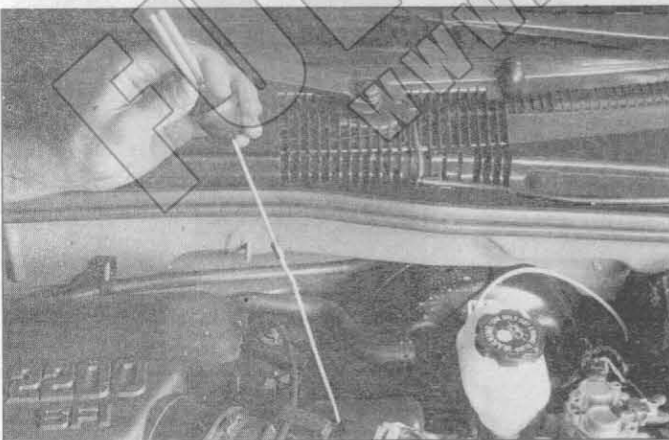
uum hoses connected to the intake manifold.

7 Remove the air intake duct from the throttle body and check for dirt, carbon or other residue build-up. If it's dirty, clean it with aerosol carburetor cleaner and a rag.

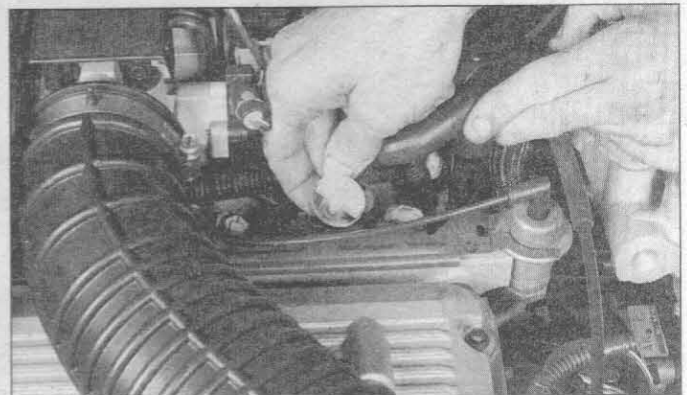
8 With the engine running, place an automotive stethoscope against each injector, one at a time, and listen for a clicking sound, indicating operation (see illustration). If you don't have a stethoscope, place the tip of a screwdriver against the injector and listen through the handle.

9 Unplug the injector electrical connector(s) and test the resistance of each injector. Compare the values to the Specifications listed in this Chapter.

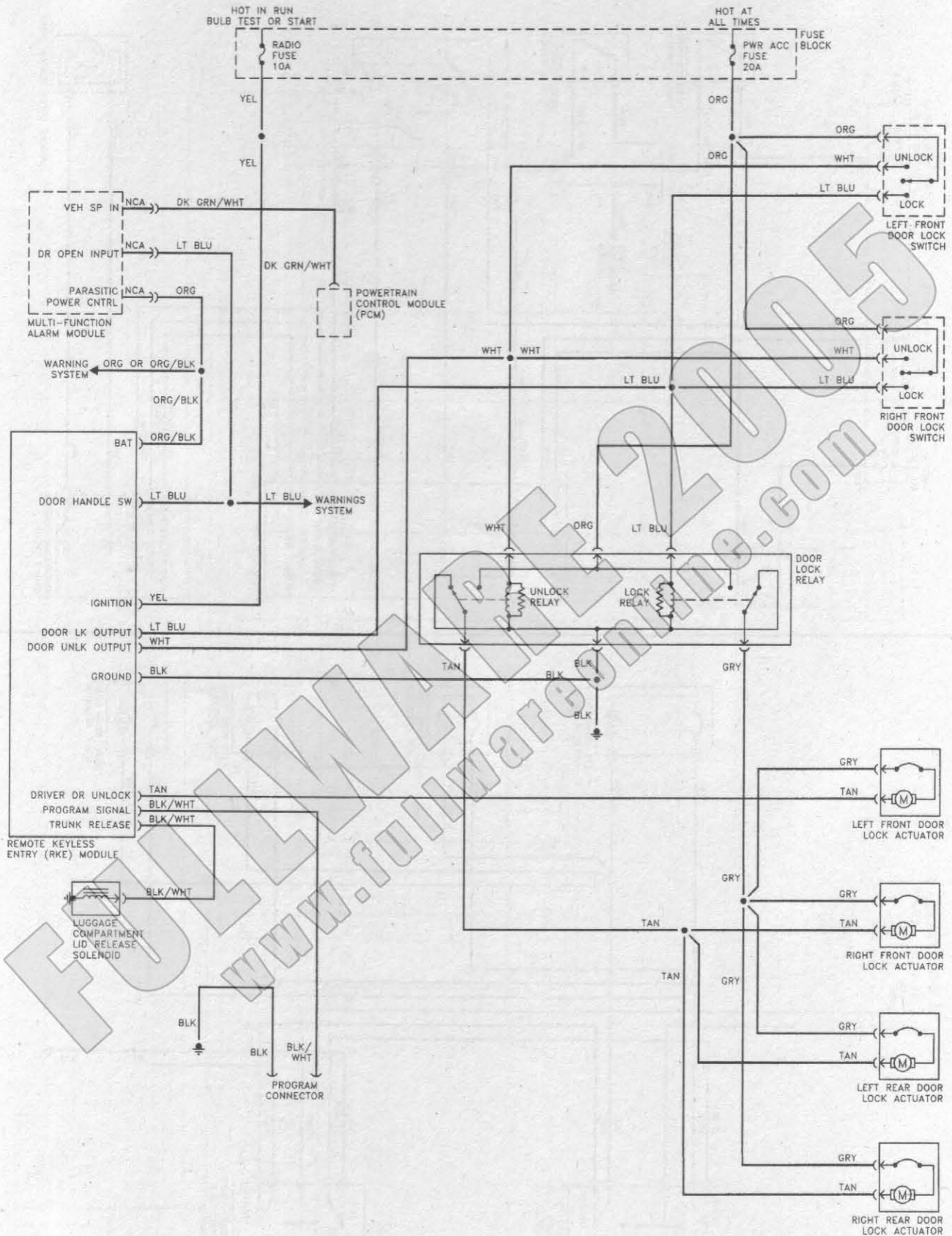
10 Install an injector test light ("noid" light) into each injector electrical connector, one at a time (see illustration). Crank the engine over. Confirm that the light flashes evenly on each connector. This will test



12.8 Use a stethoscope or screwdriver to determine if the injectors are working properly - they should make a steady clicking sound that rises and falls with engine speed changes (MFI system)

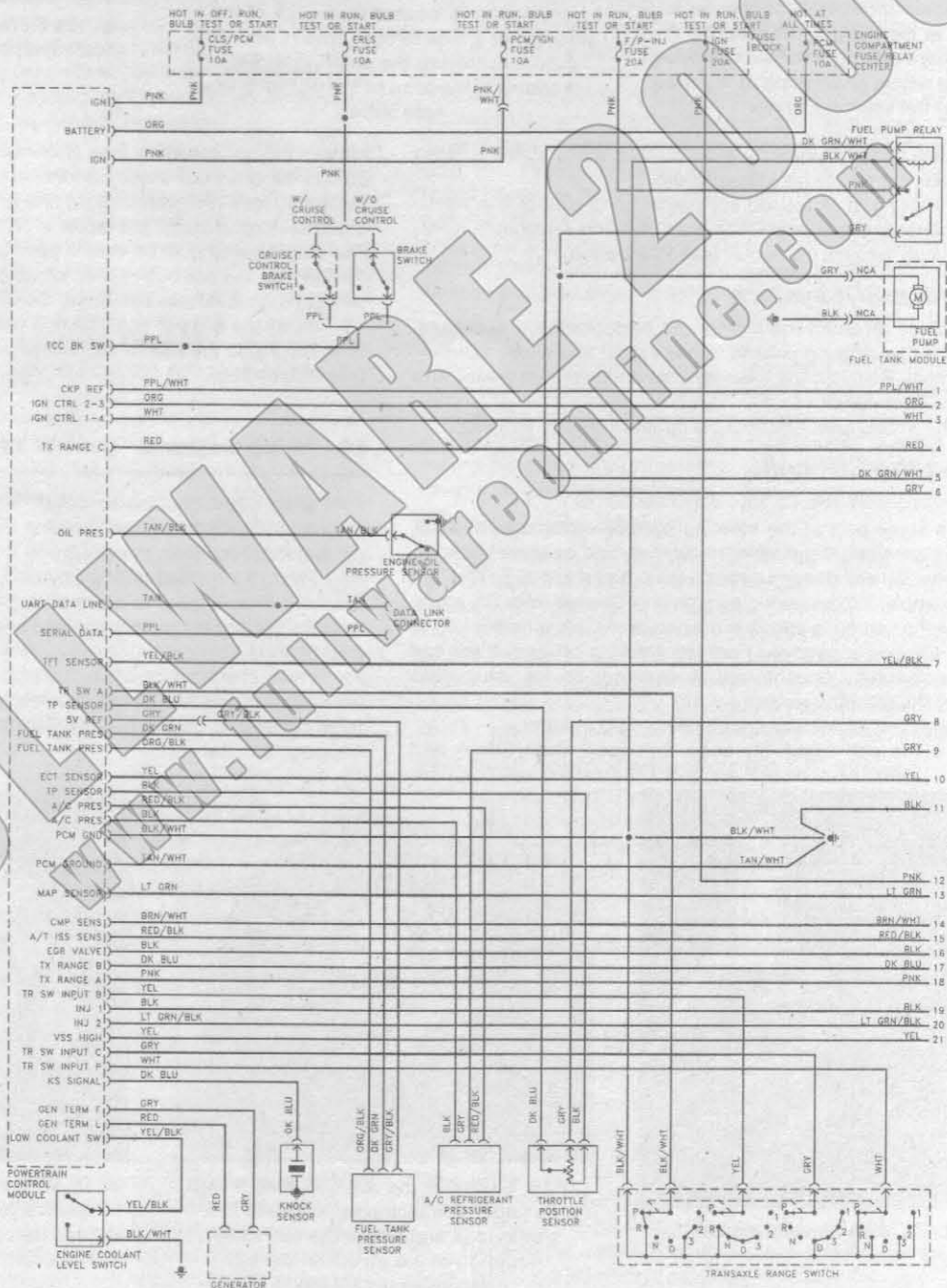
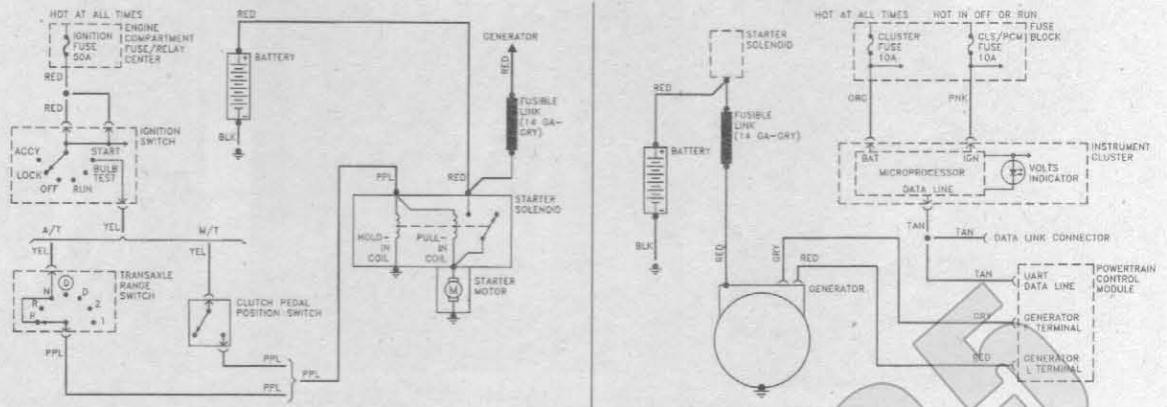


12.10 Install a "noid" light into each injector electrical connector and confirm that it blinks when the engine is cranking or running

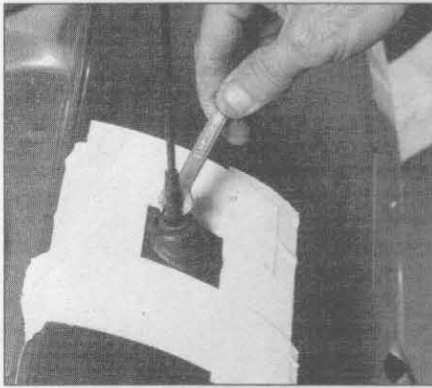


Power door lock system (with keyless entry)

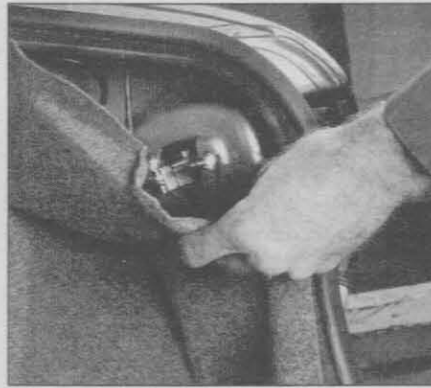
Starting and charging systems



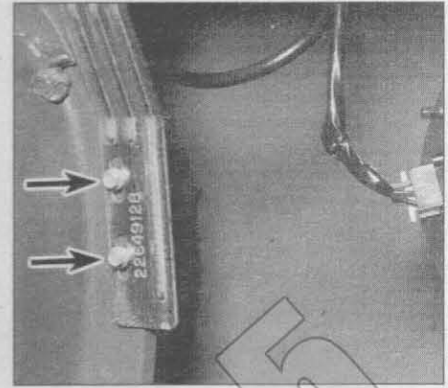
Engine control system (1 of 3)



12.1 To detach the antenna mast from the bezel, loosen the nut at the bottom of the mast with a small wrench, back it off, and unscrew the mast



12.2a Peel back the carpet in the trunk area . . .



12.2b . . . then remove these two antenna bracket screws (arrows)

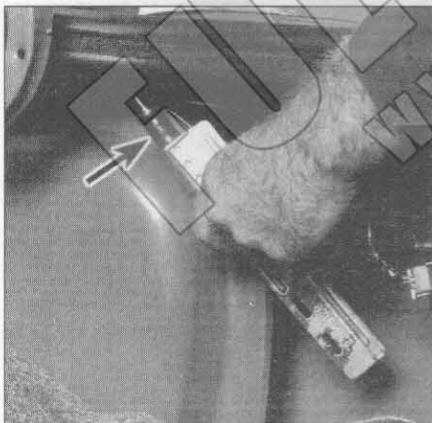
- 13 To disengage either rear speaker, push down on the tab on front of the speaker spacer, lift the spacer and pull the speaker forward. Unplug the electrical connector and remove the speaker from the vehicle.
- 14 Installation is the reverse of removal.

12 Antenna - removal and installation

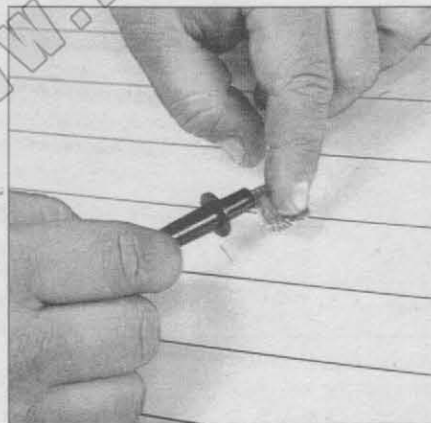
Refer to illustrations 12.1, 12.2a, 12.2b and 12.3

Caution: If the vehicle is equipped with a Delco Loc II or Theftlock audio system, make sure you have the correct activation code before disconnecting the battery.

- Use a small wrench to remove the antenna mast (see illustration).
- Open the trunk, peel back the trunk liner (see illustration) and remove the antenna base/bracket retaining screws (see illustration).
- Remove the antenna base/bracket from the outer bezel and the quarter panel then remove the antenna lead from the antenna base (see illustration).
- If the antenna lead is to be replaced detach the radio and disconnect the antenna lead from the backside of the radio (see Section 11). Then remove any retaining clips under the instrument panel securing the antenna lead.
- To facilitate the removal of the antenna lead it will be necessary to remove the following interior trim panels: the right side Kick panel, the right door sill plate and the right rear quarter trim panel. **Note:** On 4-door models it will be necessary to remove the center pillar trim panel



12.3 Remove the antenna base/bracket from the outer bezel and the quarter panel, then detach the antenna lead (arrow)



13.4 When measuring the voltage at the rear window defogger grid, wrap a piece of aluminum foil around the positive probe of the voltmeter and press the foil against the wire with your finger

and the rear door sill plate.

- Attach a piece of stiff wire to the end of the antenna lead in the trunk compartment.
- Working in the interior of the vehicle pull the antenna lead from the trunk compartment into the passenger compartment.
- Detach the wire from the end of the antenna lead and remove the antenna lead from the vehicle.
- Fasten the end of the new antenna lead to the wire leading to the trunk compartment and pull the antenna lead into the trunk compartment.
- The remainder of the installation is the reverse of removal.

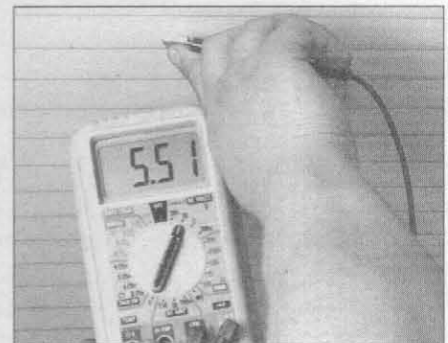
13 Rear window defogger - check and repair

- The rear window defogger consists of a number of horizontal elements baked onto the glass surface.
- Small breaks in the element can be repaired without removing the rear window.

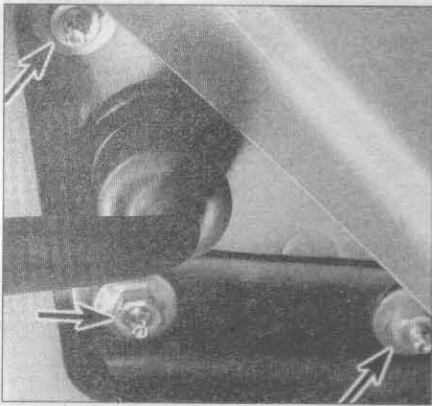
Check

Refer to illustrations 13.4, 13.5 and 13.7

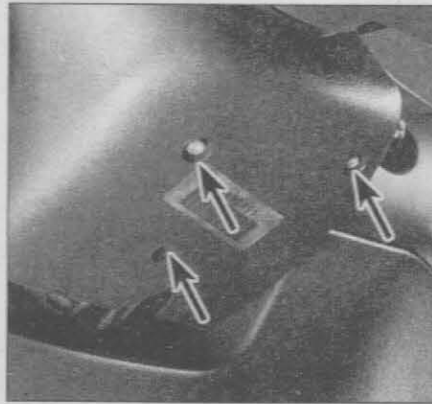
- Turn the ignition switch and defogger system switches to the ON position. Using a voltmeter, place the positive probe against the defogger grid positive terminal and the negative lead against the ground terminal. If the battery voltage is not indicated, check the fuse, defogger switch and related wiring.



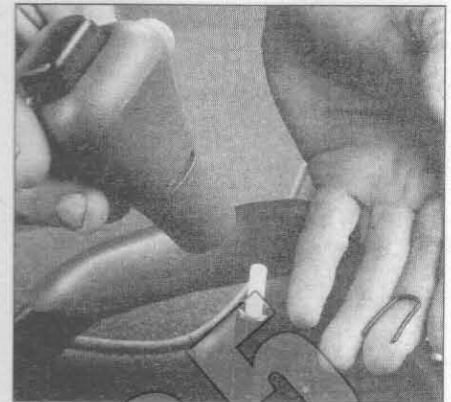
13.5 To determine if a heating element has broken, check the voltage at the center of each element - if the voltage is 6-volts, the element is unbroken - if the voltage is 12-volts, the element is broken between the center and the ground side - if there is no voltage, the element is broken between the center and the positive side



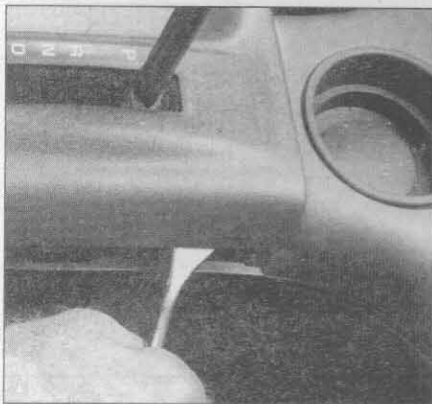
20.3 To detach the outside mirror from the door, remove these retaining nuts (arrows)



21.1 To detach the steering column covers from the steering column, remove these three screws (arrows) from the lower cover



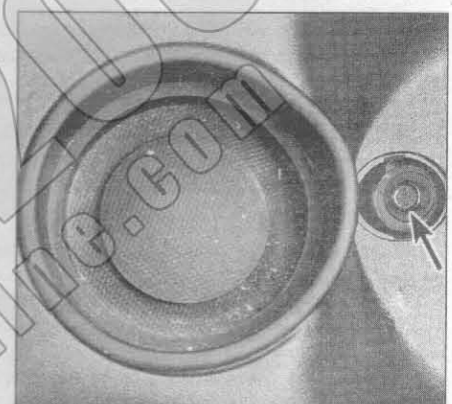
22.3 To detach the knob from the shift lever, pry out this retainer and pull the knob straight up



22.4a Pry the gear position indicator trim panel straight up to disengage the retaining clips . . .



22.4b . . . then remove the trim panel



22.5a To detach the center console from the floor, remove this screw (arrow) from the front storage well . . .

power mirrors, unplug the electrical connector from the power mirror switch.

- 3 Remove the three mirror retaining nuts (see illustration) and detach the mirror from the vehicle.
- 4 Installation is the reverse of removal.

21 Steering column covers - removal and installation

Refer to illustration 21.1

- 1 Remove the three screws from the lower steering column cover half (see illustration) and remove the steering column covers.
- 2 Installation is the reverse of removal.

22 Center console - removal and installation

Refer to illustrations 22.3, 22.4a, 22.4b, 22.5a, 22.5b, 22.5c and 22.5d
Warning: The models covered by this manual are equipped with airbags. Always disable the airbag system before working in the vicinity of the impact sensors, steering column or instrument panel to avoid the possibility of accidental deployment of the airbag(s), which could cause personal injury (see Chapter 12). The yellow wires and connectors routed through the console are for this system. Do not use electrical test equipment on these yellow wires or tamper with them in any way while working around the console.

- 1 Disconnect the negative cable from the battery. **Caution:** If the vehicle is equipped with a Delco Loc II or Theftlock audio system, make sure you have the correct activation code before disconnecting

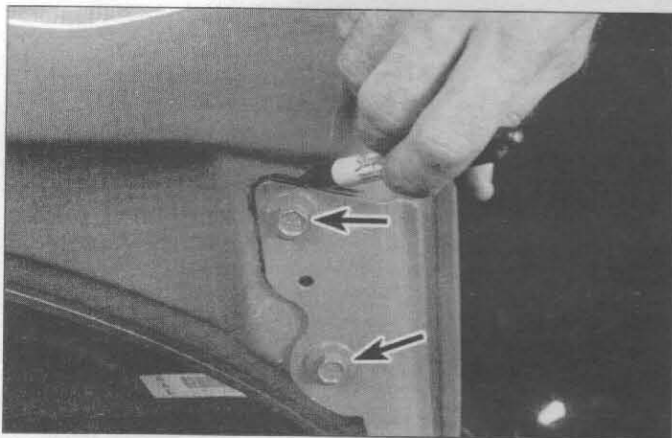
the battery.

- 2 Apply the parking brake lever and place the shift lever in the Neutral position.
- 3 On vehicles equipped with an automatic transaxle pry out the shift lever knob retaining clip and remove the knob (see illustration). On vehicles equipped with a manual transaxle unscrew the shift lever knob and pry out the shift lever boot.
- 4 On vehicles equipped with an automatic transaxle pry out and remove the gear position indicator trim bezel (see illustrations).
- 5 Remove the console retaining screws, raise up the console (see illustrations), unplug any electrical connectors and remove the console from the vehicle.
- 6 Installation is the reverse of removal.

23 Dashboard trim panels - removal and installation

Warning: The models covered by this manual are equipped with airbags. Always disable the air bag system before working in the vicinity of the impact sensors, steering column or instrument panel to avoid the possibility of accidental deployment of the airbag(s), which could cause personal injury (see Chapter 12). The yellow wires and connectors routed through the instrument panel are for this system. Do not use electrical test equipment on these yellow wires or tamper with them in any way while working around the instrument panel.

- 1 Disconnect the negative battery cable. **Caution:** If the vehicle is equipped with a Delco Loc II or Theftlock audio system, make sure you have the correct activation code before disconnecting the battery.
- 2 Disable the airbag system (see Chapter 12).



9.2 Mark the relationship of the hinges to the hood as shown, then, with the help of an assistant to hold the hood, remove the retaining bolts (arrows) from each hinge plate and lift off the hood

be lubricated with a thin coat of grease to reduce wear and ensure free movement. Lubricate the door and trunk locks with spray-on graphite lubricant.

8 Windshield and fixed glass - replacement

Replacement of the windshield and fixed glass requires the use of special fast setting adhesive/caulk materials. These operations should be left to a dealer or a shop specializing in glass work.

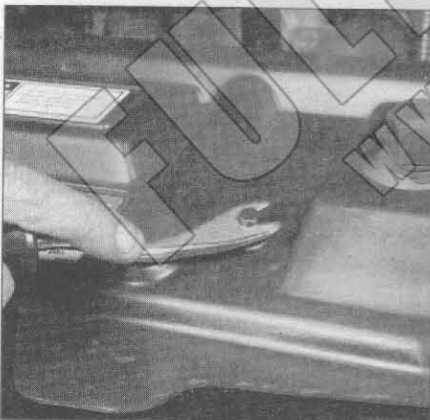
9 Hood - removal, installation and adjustment

Removal and installation

Refer to illustration 9.2

Note: The hood is somewhat awkward to remove and install; at least two people should perform this procedure.

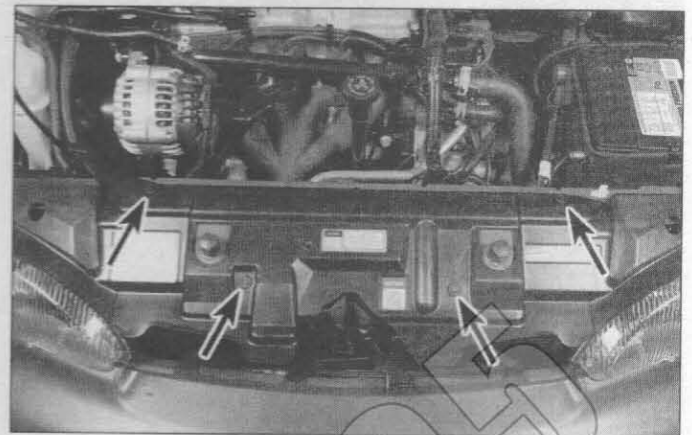
- 1 Open the hood, then place blankets or pads over the fenders and cowl area of the body. This will protect the body and paint as the hood is lifted off.
- 2 Make marks or scribe a line around the hood hinge to ensure proper alignment during installation (see illustration).
- 3 Disconnect any cables or wires that will interfere with removal.
- 4 With an assistant supporting the weight of the hood, remove the



9.10b To release a push-in retainer, simply pry up the center part with a tool like this one or a flat-blade screwdriver



9.10c Mark the relationship of the hood latch to the crossmember to provide a visual indicator of the adjustment



9.10a To remove the hood latch cover, release the push-in retainers (arrows) (1996 model shown, other model years similar)

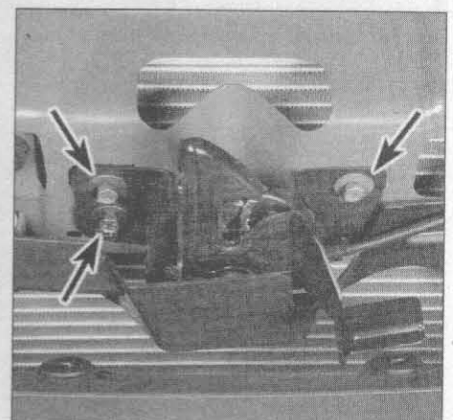
hinge-to-hood bolts and lift off the hood.

6 Installation is the reverse of removal. Align the hinge bolts with the marks made in step 2.

Adjustment

Refer to illustrations 9.10a, 9.10b, 9.10c, 9.10d and 9.11

- 7 Fore-and-aft and side-to-side adjustment of the hood is done by moving the hinge plate slot after loosening the bolts or nuts.
- 8 Scribe a line around the entire hinge plate so you can determine the amount of movement.
- 9 Loosen the bolts or nuts and move the hood into correct alignment. Move it only a little at a time. Tighten the hinge bolts and carefully lower the hood to check the position.
- 10 If necessary after installation, the entire hood latch assembly can be adjusted up and down as well as from side-to-side on the radiator support so the hood closes securely and flush with the fenders. First, remove the hood latch cover (see illustrations). To make the adjustment, scribe a line or mark around the hood latch to provide a reference point (see illustration), then loosen the latch retaining bolts (see illustration) and reposition the latch assembly, as necessary. Following adjustment, retighten the mounting bolts.
- 11 Finally, adjust the hood bumpers (see illustration) on the radiator support so the hood, when closed, is flush with the fenders.
- 12 The hood latch assembly, as well as the hinges, should be periodically lubricated with white, lithium-base grease to prevent binding and wear.



9.10d To adjust the position of the closed hood, loosen the hood latch bolts (arrows) and move the hood latch a little at a time, alternately closing the hood and noting its position in relation to the gaps between the hood and the fenders

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