Mazda 626 and MX-6
Ford Probe
Automotive Repair Manual

by Jay Storer and John H Haynes
Member of the Guild of Motoring Writers

Models covered:
All Mazda 626 - 1993 through 2001
Mazda MX-6 - 1993 through 1997
Ford Probe - 1993 through 1997

(7E4 - 61042)

ABCDE
FGHIJ
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Haynes

AUTOMOTIVE PARTS & ACCESSORIES ASSOCIATION MEMBER

Haynes Publishing Group
Sparkford Nr Yeovil
Somerset BA22 7JJ England

Haynes North America, Inc
861 Lawrence Drive
Newbury Park
California 91320 USA

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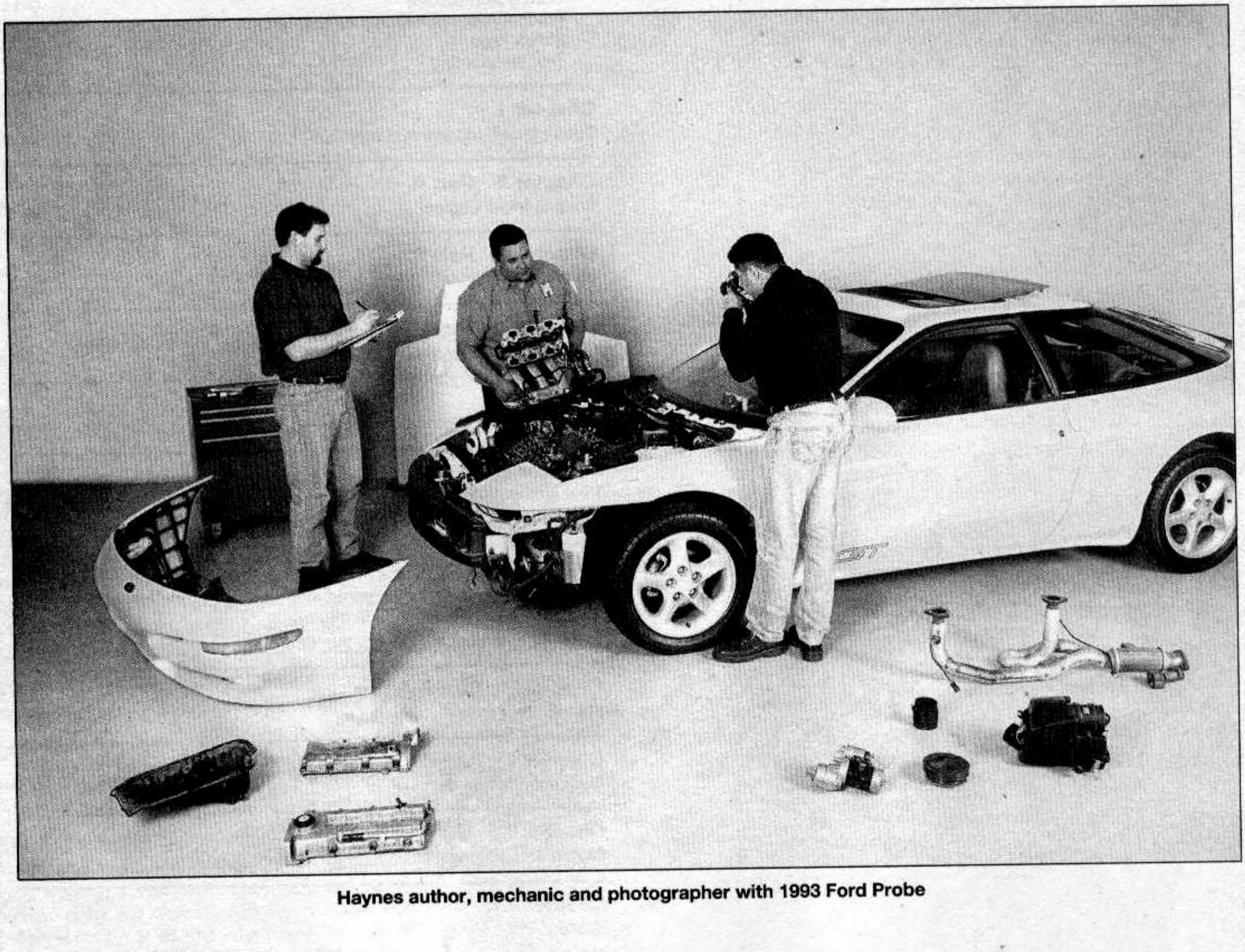


Haynes author, mechanic and photographer with 1993 Ford Probe

About this manual

Its purpose

The purpose of this manual is to help you get the best value from your vehicle. It can do so in several ways. It can help you decide what work must be done, even if you choose to have it done by a dealer service department or a repair shop; it provides information and procedures for routine maintenance and servicing; and it offers diagnostic and repair procedures to follow when trouble occurs.

We hope you use the manual to tackle the work yourself. For many simpler jobs, doing it yourself may be quicker than arranging an appointment to get the vehicle into a shop and making the trips to leave it and pick it up. More importantly, a lot of money can be saved by avoiding the expense the shop must pass on to you to cover its labor and overhead costs. An added benefit is the sense of satisfaction and accomplishment that you feel after doing the job yourself.

Using the manual

The manual is divided into Chapters. Each Chapter is divided into numbered Sections, which are headed in bold type between horizontal lines. Each Section consists of consecutively numbered paragraphs.

At the beginning of each numbered Section you will be referred to any illustrations which apply to the procedures in that Section. The reference numbers used in illustration captions pinpoint the pertinent Section and the Step within that Section. That is, illustration 3.2 means the illustration refers to Section 3 and Step (or paragraph) 2 within that Section.

Procedures, once described in the text, are not normally repeated. When it's necessary to refer to another Chapter, the reference will be given as Chapter and Section number. Cross references given without use of the word "Chapter" apply to Sections and/or paragraphs in the same Chapter. For example, "see Section 8" means in the same Chapter.

References to the left or right side of the vehicle assume you are sitting in the driver's seat, facing forward.

Even though we have prepared this manual with extreme care, neither the publisher nor the author can accept responsibility for any errors in, or omissions from, the information given.

NOTE

A **Note** provides information necessary to properly complete a procedure or information which will make the procedure easier to understand.

CAUTION

A **Caution** provides a special procedure or special steps which must be taken while completing the procedure where the Caution is found. Not heeding a Caution can result in damage to the assembly being worked on.

WARNING

A **Warning** provides a special procedure or special steps which must be taken while completing the procedure where the Warning is found. Not heeding a Warning can result in personal injury.

Introduction to the Mazda 626, MX-6 and Ford Probe

These models are available in two-door hatchback, coupe and four-door sedan body styles.

The transversely mounted inline four-cylinder or V6 engines used in these models are equipped with electronic fuel injection.

The engine drives the front wheels through either a five-speed manual or a four-speed automatic transaxle via independent driveaxles.

Independent suspension, featuring MacPherson struts, is used on all four wheels. The power-assisted rack-and-pinion steering unit is mounted behind the engine.

The brakes are disc at the front and either disc or drum at the rear, with power assist standard. Some models are equipped with Anti-lock Braking Systems (ABS).

Vehicle identification numbers

Modifications are a continuing and unpublicized process in vehicle manufacturing. Since spare parts manuals and lists are compiled on a numerical basis, the individual vehicle numbers are essential to correctly identify the component required.

Vehicle identification number (VIN)

This very important number is stamped on the firewall in the engine compartment and on a plate attached to the dashboard inside the windshield on the driver's side of the vehicle. The VIN also appears on the Vehicle Certificate of Title and Registration. It contains information such as where and when the vehicle was manufactured, the model year and the body style **(see illustration)**.

VIN Engine and model year codes

Two particularly important pieces of information found in the VIN are the engine code and model year code. Counting from the left, the engine code designation is the eighth digit. The model year code is the 10th digit.

Model year codes

P = 1993	W = 1998
R = 1994	X = 1999
S = 1995	Y = 2000
T = 1996	Z = 2001
V = 1997	

Engine codes

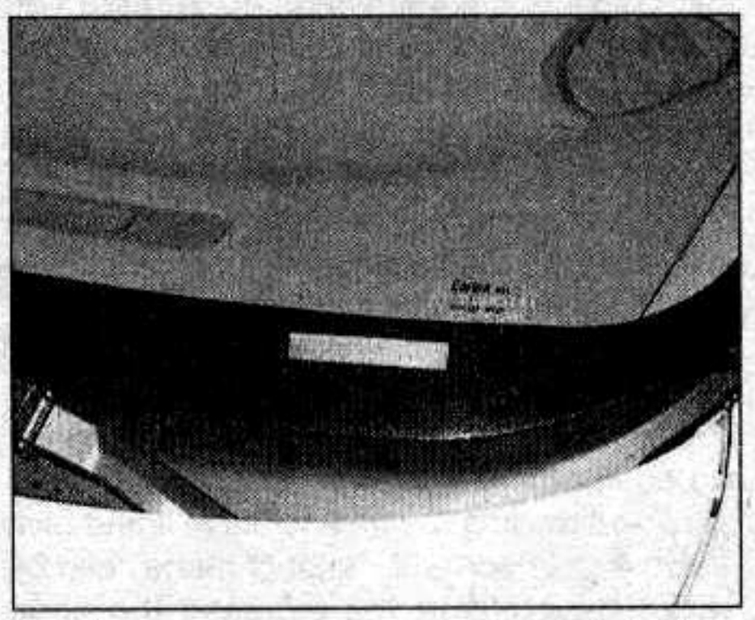
Probe

A = 2.0L DOHC four-cylinder engine
B = 2.5L DOHC V6 engine

626 and MX-6

C = 2.0L DOHC four-cylinder engine
D = 2.5L DOHC V6 engine

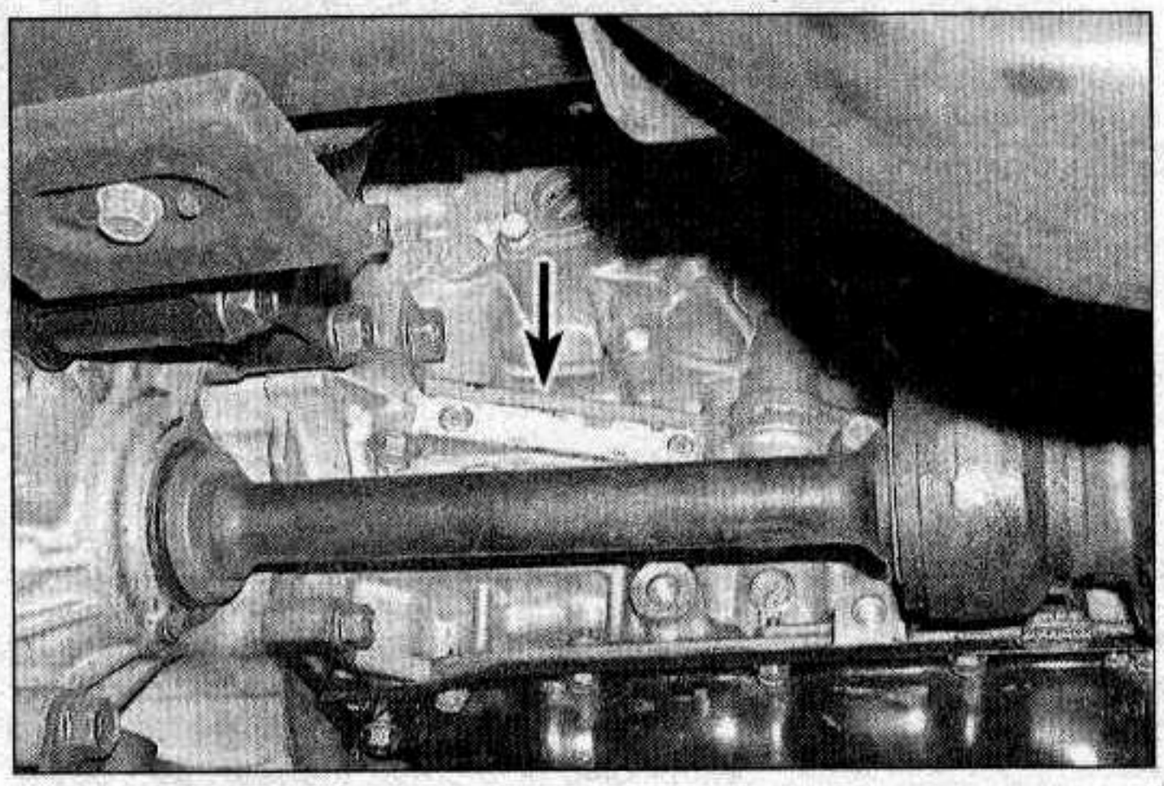
The engine code number is commonly needed when ordering engine parts. Besides being a component of the VIN, this code can also be found on the front (radiator) side of the engine on the left (driver's side) end below the oil filter on four-cylinder engines. On V6 engines it is found on the rear (firewall) side of the engine at the right (passenger's side) end of the engine **(see illustrations)**.



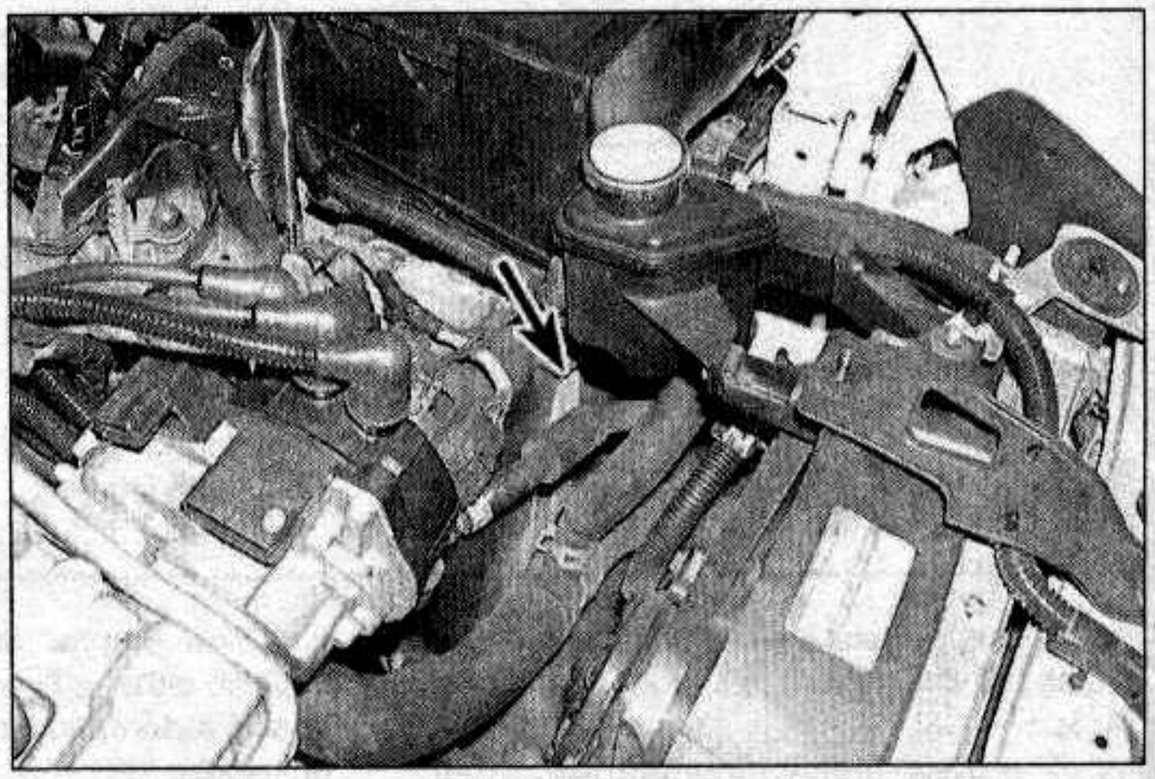
The Vehicle Identification Number (VIN) is stamped into a metal plate fastened to the dashboard on the driver's side - it is visible through the windshield

Transaxle number

The transaxle number is commonly needed when ordering transaxle parts. On manual transaxles it's located on the transaxle case. On automatic transaxles, it's found on a tag on the front of the transaxle case **(see illustration)**.



The V6 engine code (arrow) is located on a pad near the right end of the engine block



The automatic transaxle identification label (arrow) is located on the front side

Buying parts

Replacement parts are available from many sources, which generally fall into one of two categories - authorized dealer parts departments and independent retail auto parts stores. Our advice concerning these parts is as follows:

Retail auto parts stores: Good auto parts stores will stock frequently needed components which wear out relatively fast, such as clutch components, exhaust systems, brake parts, tune-up parts, etc. These stores often supply new or reconditioned parts on an exchange basis, which can save a considerable amount of money. Discount auto parts stores are often very good places to buy materials and parts needed for general vehicle maintenance such as oil, grease, filters, spark plugs, belts, touch-up paint, bulbs, etc. They also usually sell tools and general accessories, have convenient hours, charge lower prices and can often be found not far from home.

Authorized dealer parts department: This is the best source for parts which are unique to the vehicle and not generally available elsewhere (such as major engine parts, transmission parts, trim pieces, etc.).

Warranty information: If the vehicle is still covered under warranty, be sure that any replacement parts purchased - regardless of the source - do not invalidate the warranty!

To be sure of obtaining the correct parts, have engine and chassis numbers available and, if possible, take the old parts along for positive identification.

Maintenance techniques, tools and working facilities

Maintenance techniques

There are a number of techniques involved in maintenance and repair that will be referred to throughout this manual. Application of these techniques will enable the home mechanic to be more efficient, better organized and capable of performing the various tasks properly, which will ensure that the repair job is thorough and complete.

Fasteners

Fasteners are nuts, bolts, studs and screws used to hold two or more parts together. There are a few things to keep in mind when working with fasteners. Almost all of them use a locking device of some type, either a lockwasher, locknut, locking tab or thread adhesive. All threaded fasteners should be clean and straight, with undamaged threads and undamaged corners on the hex head where the wrench fits. Develop the habit of replacing all damaged nuts and bolts with new ones. Special locknuts with nylon or fiber inserts can only be used once. If they are removed, they lose their locking ability and must be replaced with new ones.

Rusted nuts and bolts should be treated with a penetrating fluid to ease removal and prevent breakage. Some mechanics use turpentine in a spout-type oil can, which works quite well. After applying the rust penetrant, let it work for a few minutes before trying to loosen the nut or bolt. Badly rusted fasteners may have to be chiseled or sawed off or removed with a special nut breaker, available at tool stores.

If a bolt or stud breaks off in an assembly, it can be drilled and removed with a special tool commonly available for this purpose. Most automotive machine shops can perform this task, as well as other repair procedures, such as the repair of threaded holes that have been stripped out.

Flat washers and lockwashers, when removed from an assembly, should always be replaced exactly as removed. Replace any damaged washers with new ones. Never use a lockwasher on any soft metal surface (such as aluminum), thin sheet metal or plastic.

Fastener sizes

For a number of reasons, automobile manufacturers are making wider and wider use of metric fasteners. Therefore, it is important to be able to tell the difference between standard (sometimes called U.S. or SAE) and metric hardware, since they cannot be interchanged.

All bolts, whether standard or metric, are sized according to diameter, thread pitch and

length. For example, a standard 1/2 - 13 x 1 bolt is 1/2 inch in diameter, has 13 threads per inch and is 1 inch long. An M12 - 1.75 x 25 metric bolt is 12 mm in diameter, has a thread pitch of 1.75 mm (the distance between threads) and is 25 mm long. The two bolts are nearly identical, and easily confused, but they are not interchangeable.

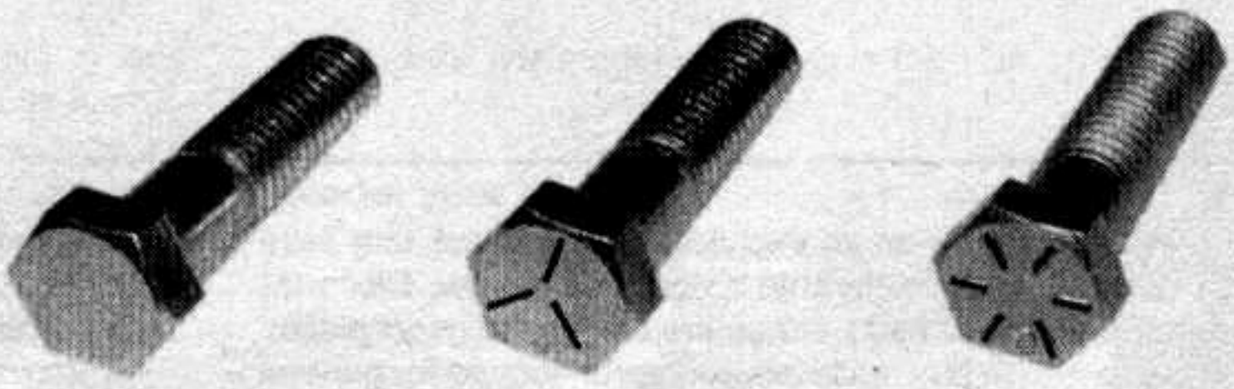
In addition to the differences in diameter, thread pitch and length, metric and standard bolts can also be distinguished by examining the bolt heads. To begin with, the distance across the flats on a standard bolt head is measured in inches, while the same dimension on a metric bolt is sized in millimeters (the same is true for nuts). As a result, a standard wrench should not be used on a metric bolt and a metric wrench should not be used on a standard bolt. Also, most standard bolts have slashes radiating out from the center of the head to denote the grade or strength of the bolt, which is an indication of the amount of torque that can be applied to it. The greater the number of slashes, the greater the strength of the bolt. Grades 0 through 5 are commonly used on automobiles. Metric bolts have a property class (grade) number, rather than a slash, molded into their heads to indicate bolt strength. In this case, the higher the number, the stronger the bolt. Property class numbers 8.8, 9.8 and 10.9 are commonly used on automobiles.

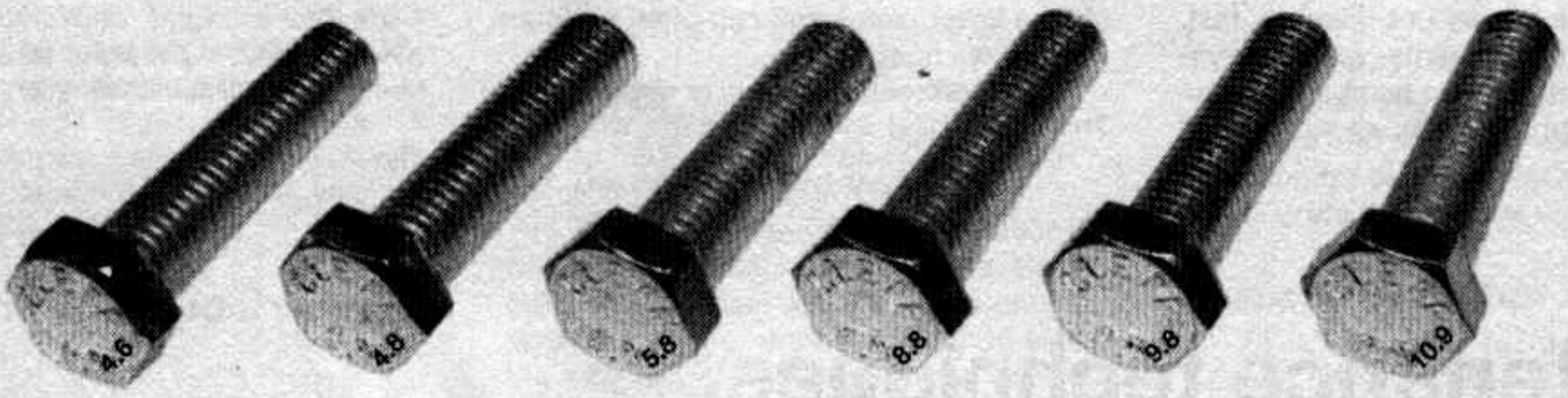
Strength markings can also be used to distinguish standard hex nuts from metric hex nuts. Many standard nuts have dots stamped into one side, while metric nuts are marked with a number. The greater the number of dots, or the higher the number, the greater the strength of the nut.

Metric studs are also marked on their ends according to property class (grade). Larger studs are numbered (the same as metric bolts), while smaller studs carry a geometric code to denote grade.

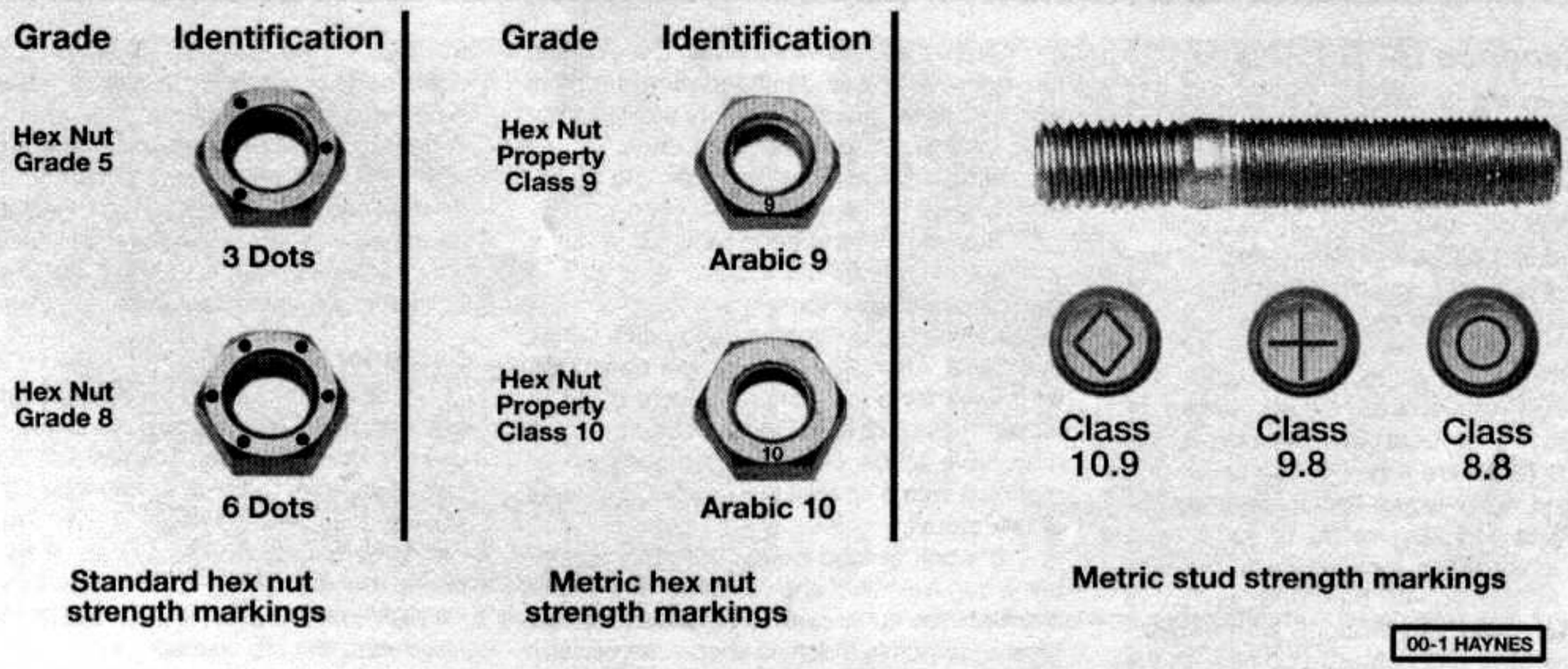
It should be noted that many fasteners, especially Grades 0 through 2, have no distinguishing marks on them. When such is the case, the only way to determine whether it is standard or metric is to measure the thread pitch or compare it to a known fastener of the same size.

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





Bolt strength marking (standard/SAE/USS; bottom - metric)



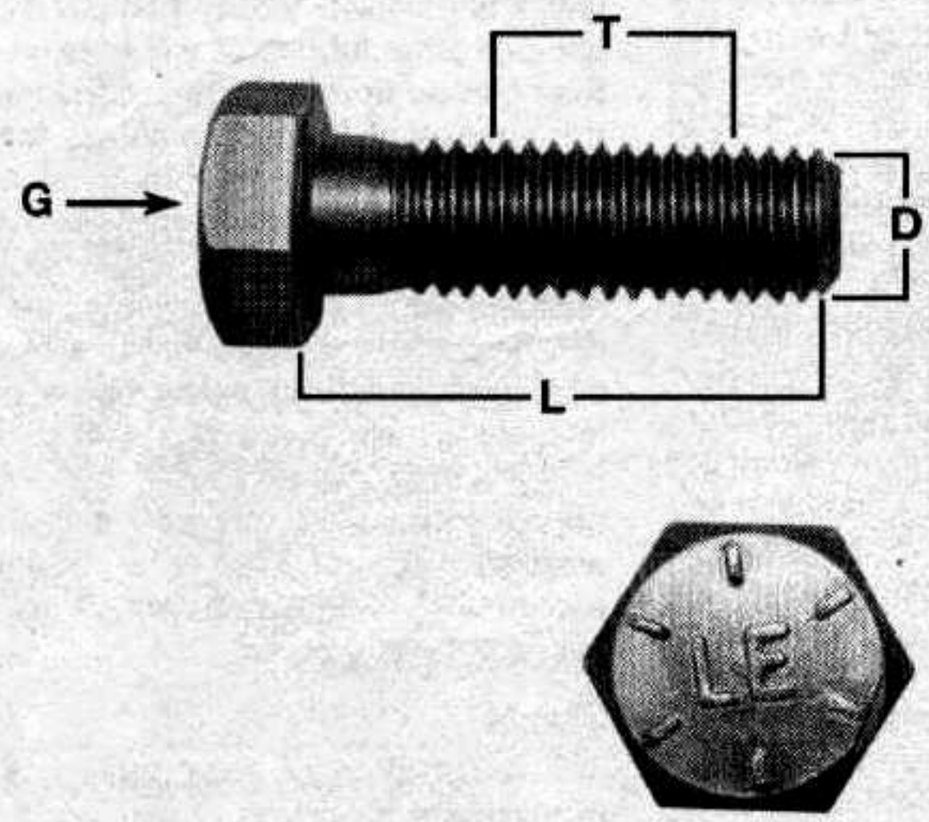
Since fasteners of the same size (both standard and metric) may have different strength ratings, be sure to reinstall any bolts, studs or nuts removed from your vehicle in their original locations. Also, when replacing a fastener with a new one, make sure that the new one has a strength rating equal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

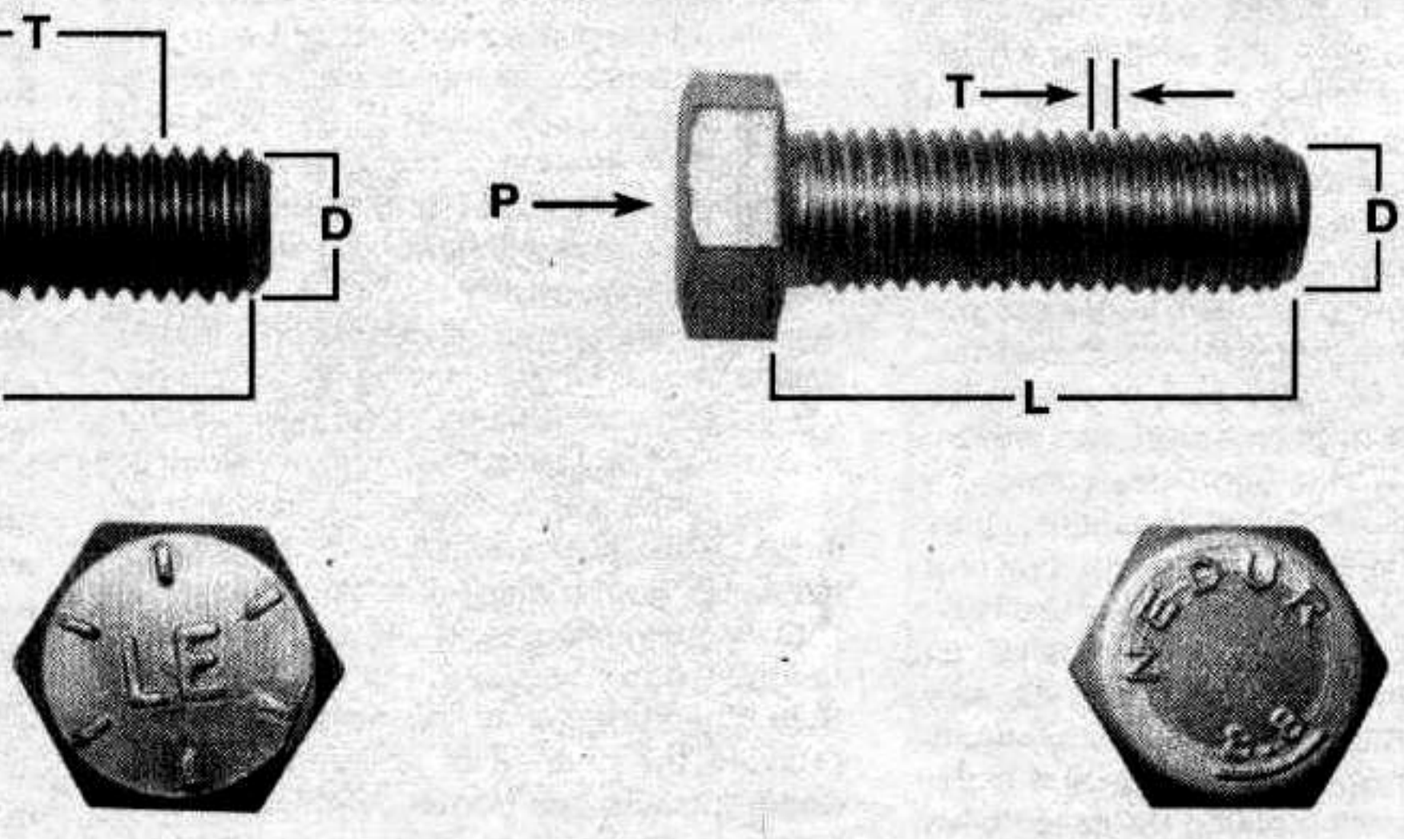
Tightening sequences and procedures

Most threaded fasteners should be tightened to a specific torque value (torque is the twisting force applied to a threaded component such as a nut or bolt). Overtightening the fastener can weaken it and cause it to break, while undertightening can cause it to eventually come loose. Bolts, screws and studs, depending on the material they are made of and their thread diameters, have specific torque values, many of which are noted in the Specifications at the beginning of each Chapter. Be sure to follow the torque recommendations closely. For fasteners not assigned a specific torque, a general torque value chart is presented here as a guide. These torque values are for dry (unlubricated) fasteners threaded into steel or cast iron (not aluminum). As was previously mentioned, the size and grade of a fastener determine the amount of torque that can safely be applied to it. The figures listed here are approximate for Grade 2 and Grade 3 fasteners. Higher grades can tolerate higher torque values.

Fasteners laid out in a pattern, such as cylinder head bolts, oil pan bolts, differential cover bolts, etc., must be loosened or tightened in sequence to avoid warping the component. This sequence will normally be shown in the appropriate Chapter. If a specific pattern is not given, the following procedures can be used to prevent warping.

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





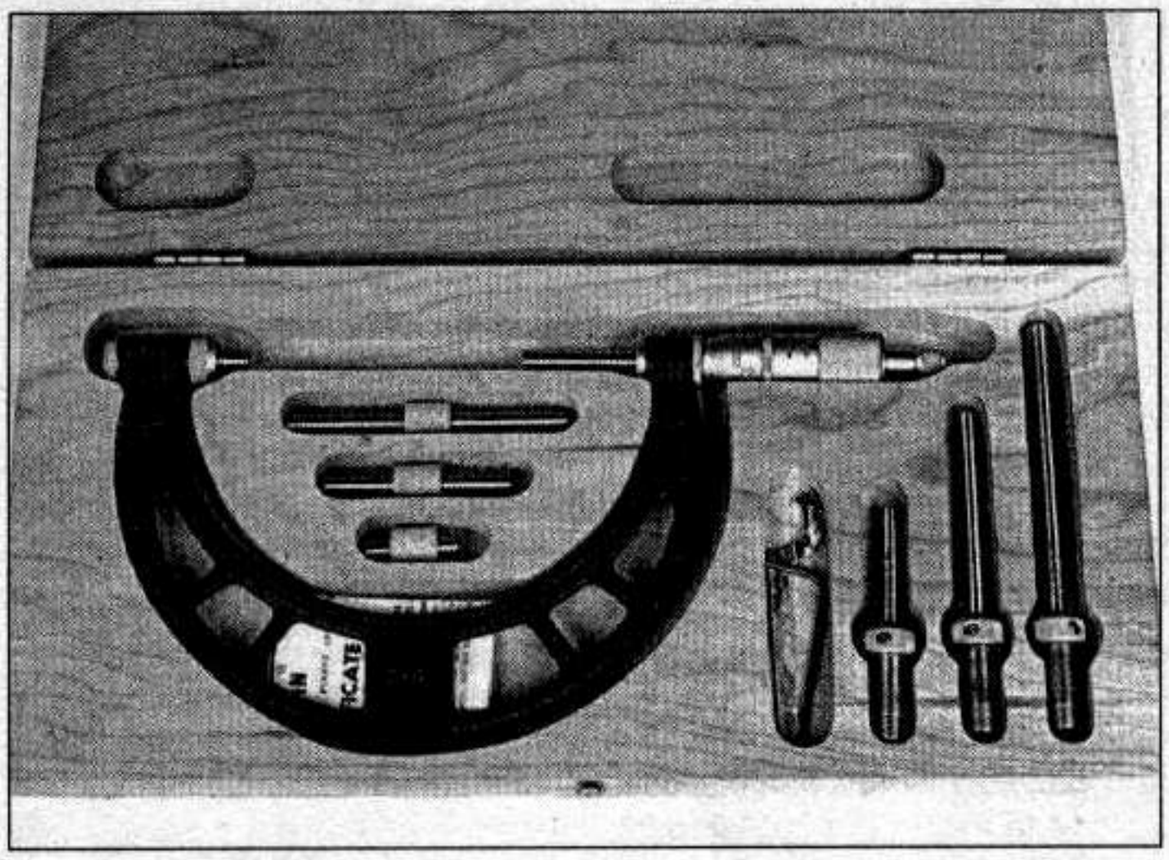
00-2 HAYNES

Standard (SAE and USS) bolt dimensions/grade marks

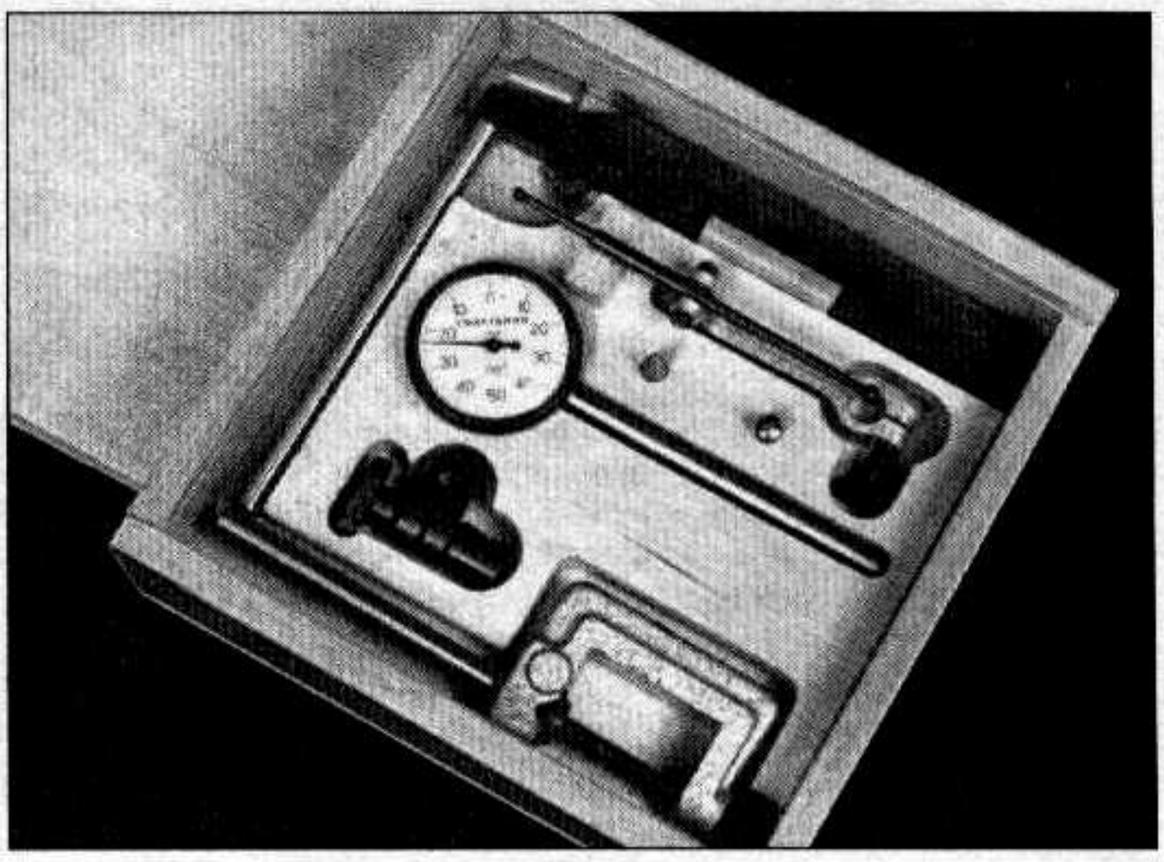
G Grade marks (bolt strength)
L Length (in inches)
T Thread pitch (number of threads per inch)
D Nominal diameter (in inches)

Metric bolt dimensions/grade marks

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



Micrometer set



Dial indicator set

Initially, the bolts or nuts should be assembled finger-tight only. Next, they should be tightened one full turn each, in a criss-cross or diagonal pattern. After each one has been tightened one full turn, return to the first one and tighten them all one-half turn, following the same pattern. Finally, tighten each of them one-quarter turn at a time until each fastener has been tightened to the proper torque. To loosen and remove the fasteners, the procedure would be reversed.

Component disassembly

Component disassembly should be done with care and purpose to help ensure that the parts go back together properly. Always keep track of the sequence in which parts are removed. Make note of special characteristics or marks on parts that can be installed more than one way, such as a grooved thrust washer on a shaft. It is a good idea to lay the disassembled parts out on a clean surface in the order that they were removed. It may also be helpful to make sketches or take instant photos of components before removal.

When removing fasteners from a component, keep track of their locations. Sometimes threading a bolt back in a part, or putting the washers and nut back on a stud, can prevent mix-ups later. If nuts and bolts cannot be returned to their original locations, they should be kept in a compartmented box or a series of small boxes. A cupcake or muffin tin is ideal for this purpose, since each cavity can hold the bolts and nuts from a particular area (i.e. oil pan bolts, valve cover bolts, engine mount bolts, etc.). A pan of this type is especially helpful when working on assemblies with very small parts, such as the carburetor, alternator, valve train or interior dash and trim pieces. The cavities can be marked with paint or tape to identify the contents.

Whenever wiring looms, harnesses or connectors are separated, it is a good idea to identify the two halves with numbered pieces of masking tape so they can be easily reconnected.

Gasket sealing surfaces

Throughout any vehicle, gaskets are used to seal the mating surfaces between two parts and keep lubricants, fluids, vacuum or pressure contained in an assembly.

Many times these gaskets are coated with a liquid or paste-type gasket sealing compound before assembly. Age, heat and pressure can sometimes cause the two parts to stick together so tightly that they are very difficult to separate. Often, the assembly can be loosened by striking it with a soft-face hammer near the mating surfaces. A regular hammer can be used if a block of wood is placed between the hammer and the part. Do not hammer on cast parts or parts that could be easily damaged. With any particularly stubborn part, always recheck to make sure that every fastener has been removed.

Avoid using a screwdriver or bar to pry apart an assembly, as they can easily mar the gasket sealing surfaces of the parts, which must remain smooth. If prying is absolutely necessary, use an old broom handle, but keep in mind that extra clean up will be necessary if the wood splinters.

After the parts are separated, the old gasket must be carefully scraped off and the gasket surfaces cleaned. Stubborn gasket material can be soaked with rust penetrant or treated with a special chemical to soften it so it can be easily scraped off. A scraper can be fashioned from a piece of copper tubing by flattening and sharpening one end. Copper is recommended because it is usually softer than the surfaces to be scraped, which reduces the chance of gouging the part. Some gaskets can be removed with a wire brush, but regardless of the method used, the mating surfaces must be left clean and smooth. If for some reason the gasket surface is gouged, then a gasket sealer thick enough to fill scratches will have to be used during reassembly of the components. For most applications, a non-drying (or semi-drying) gasket sealer should be used.

Hose removal tips

Warning: *If the vehicle is equipped with air conditioning, do not disconnect any of the A/C hoses without first having the system depressurized by a dealer service department or a service station.*

Hose removal precautions closely parallel gasket removal precautions. Avoid scratching or gouging the surface that the hose mates against or the connection may leak. This is especially true for radiator hoses. Because of various chemical reactions, the rubber in hoses can bond itself to the metal spigot that the hose fits over. To remove a hose, first loosen the hose clamps that secure it to the spigot. Then, with slip-joint pliers, grab the hose at the clamp and rotate it around the spigot. Work it back and forth until it is completely free, then pull it off. Silicone or other lubricants will ease removal if they can be applied between the hose and the outside of the spigot. Apply the same lubricant to the inside of the hose and the outside of the spigot to simplify installation.

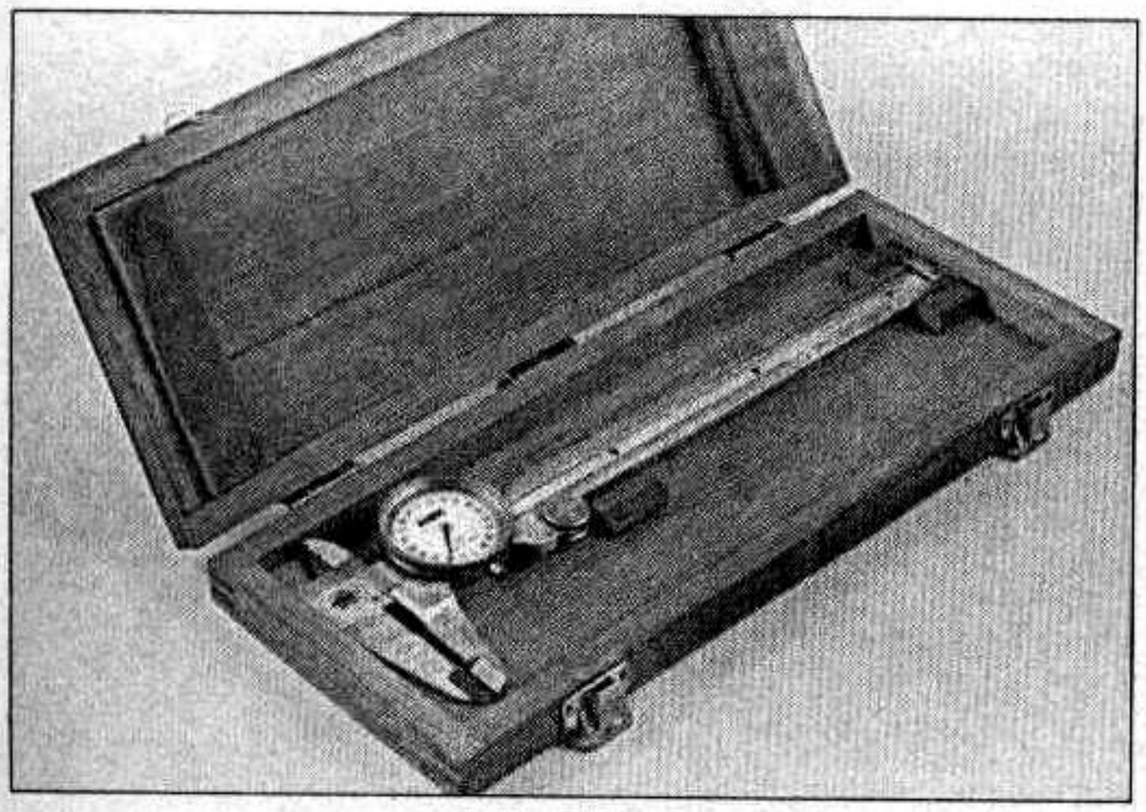
As a last resort (and if the hose is to be replaced with a new one anyway), the rubber can be slit with a knife and the hose peeled from the spigot. If this must be done, be careful that the metal connection is not damaged.

If a hose clamp is broken or damaged, do not reuse it. Wire-type clamps usually weaken with age, so it is a good idea to replace them with screw-type clamps whenever a hose is removed.

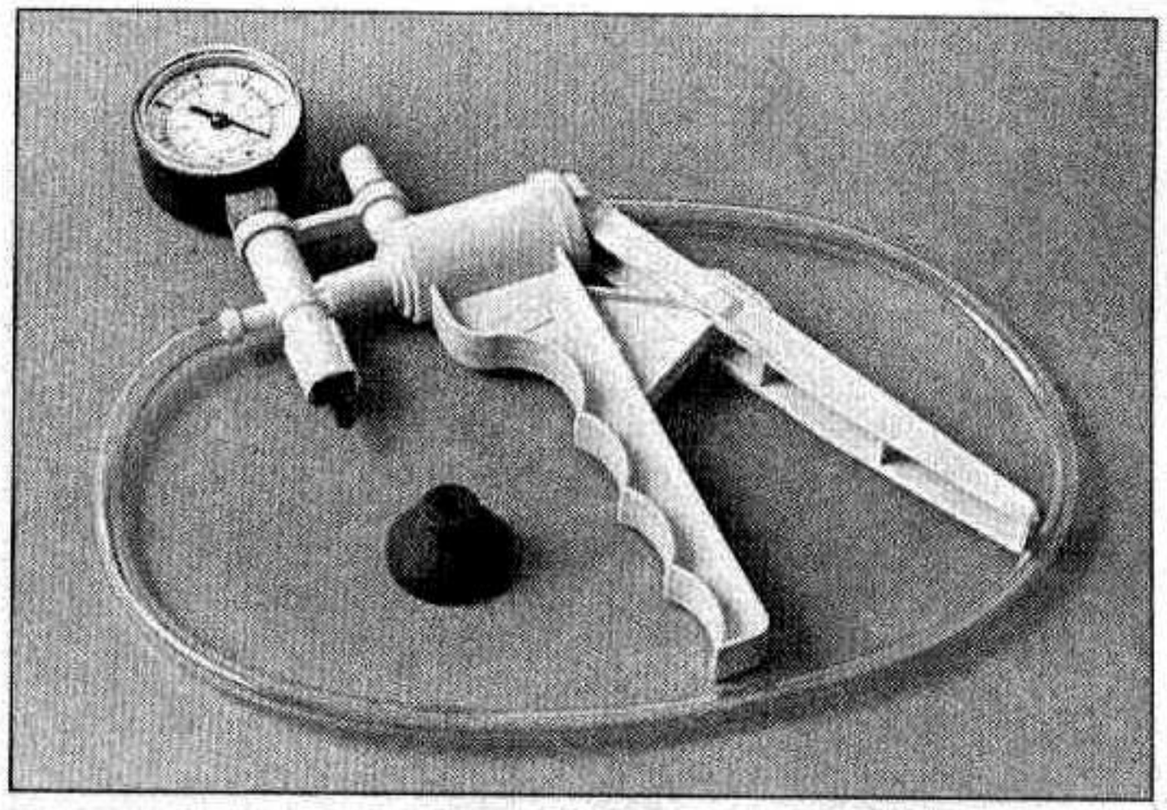
Tools

A selection of good tools is a basic requirement for anyone who plans to maintain and repair his or her own vehicle. For the owner who has few tools, the initial investment might seem high, but when compared to the spiraling costs of professional auto maintenance and repair, it is a wise one.

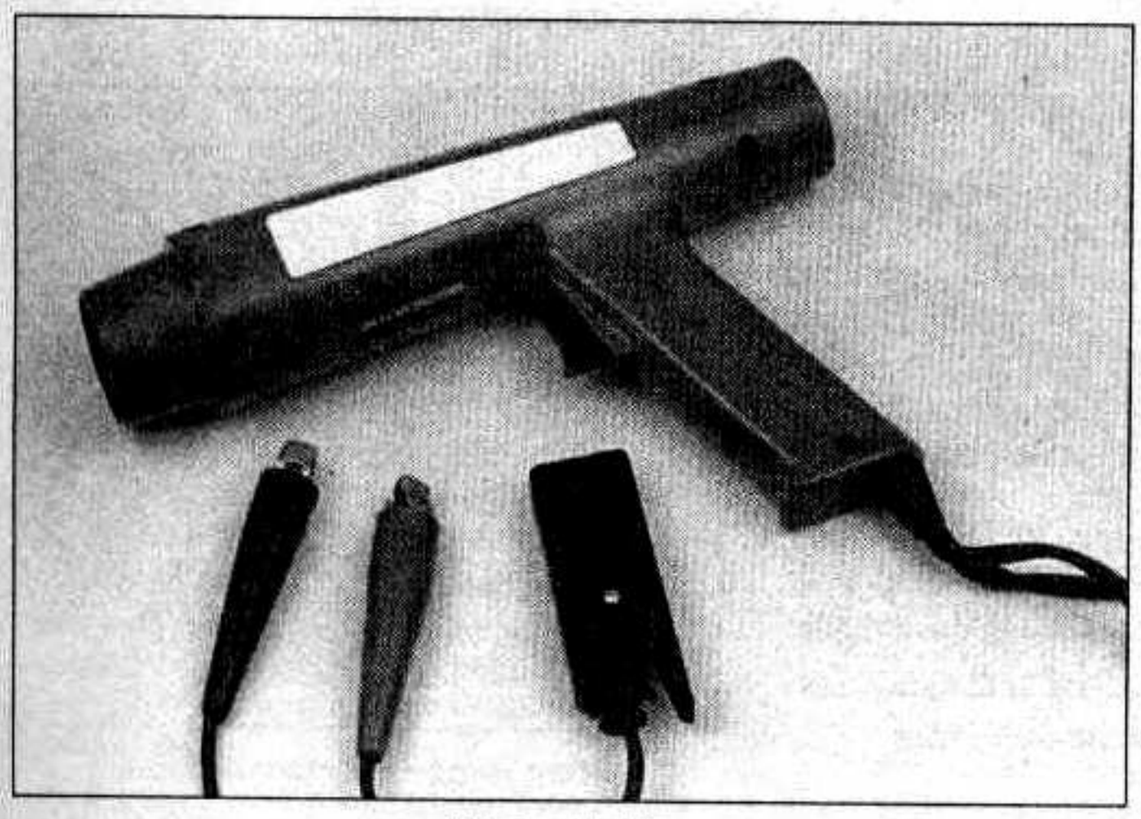
To help the owner decide which tools are needed to perform the tasks detailed in this manual, the following tool lists are offered: *Maintenance and minor repair,*



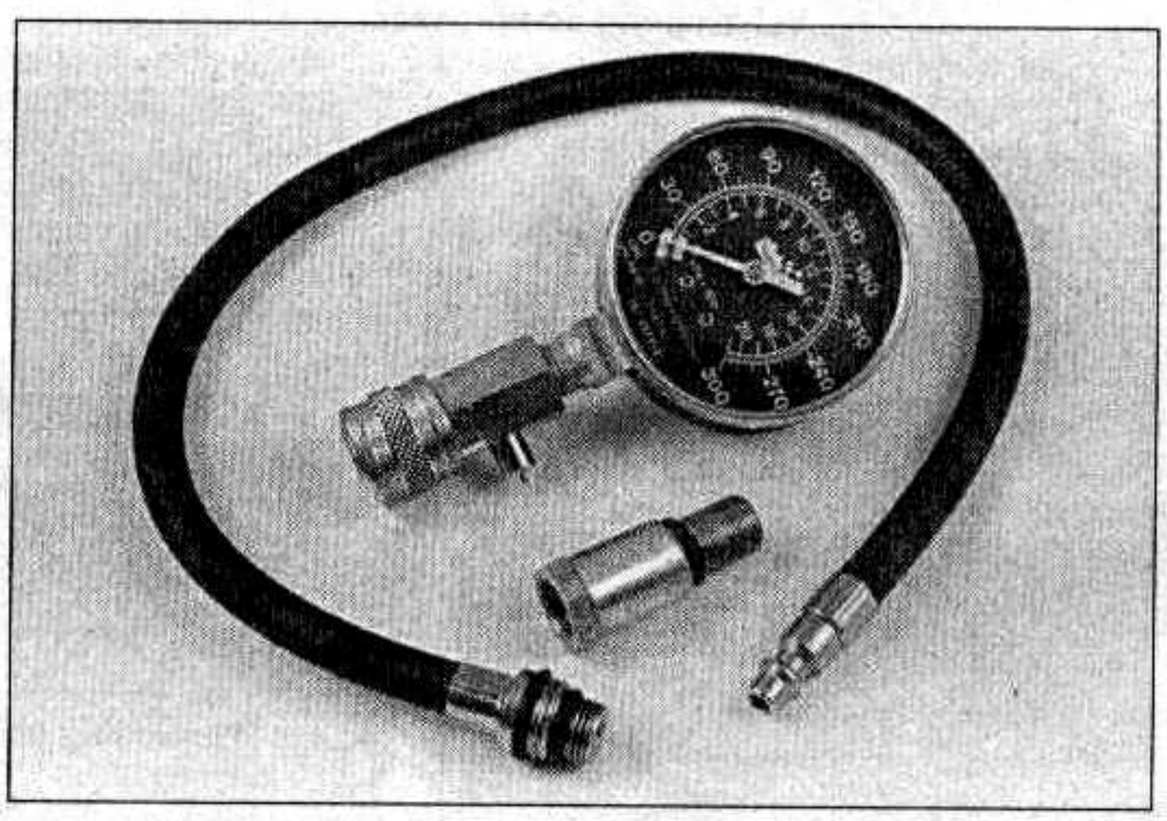
Dial caliper



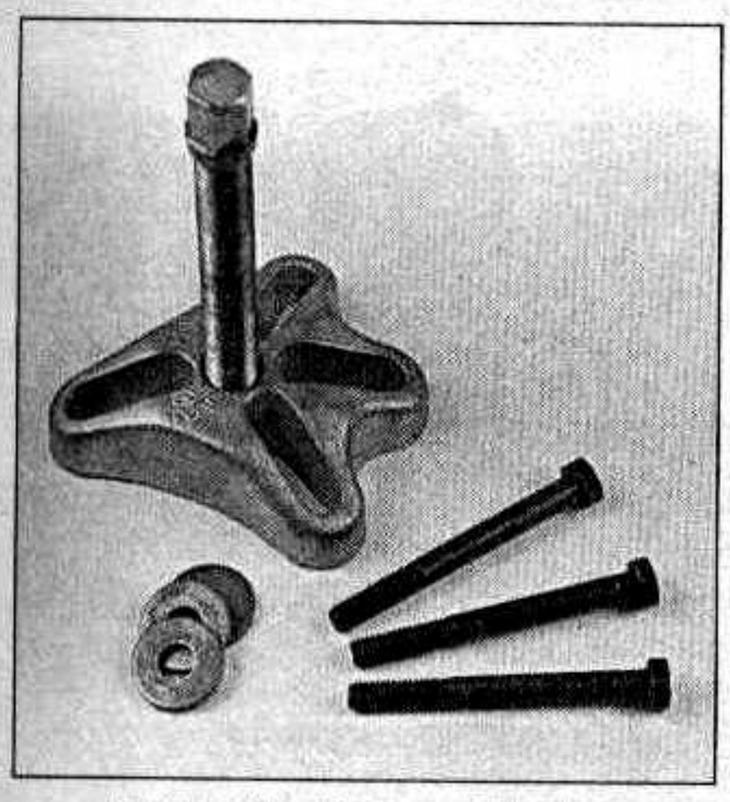
Hand-operated vacuum pump



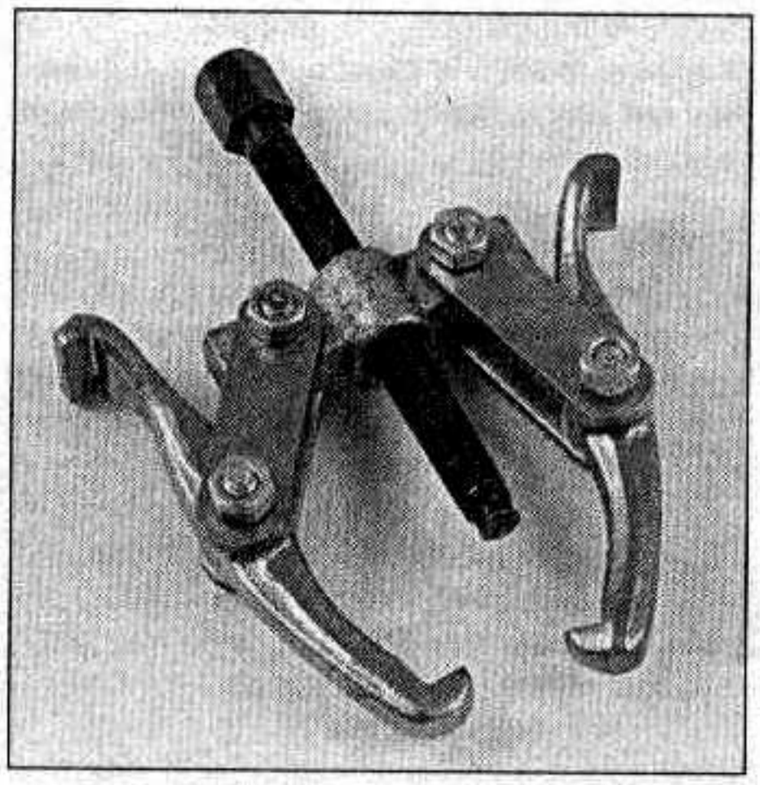
Timing light



Compression gauge with spark plug hole adapter



Damper/steering wheel puller



General purpose puller

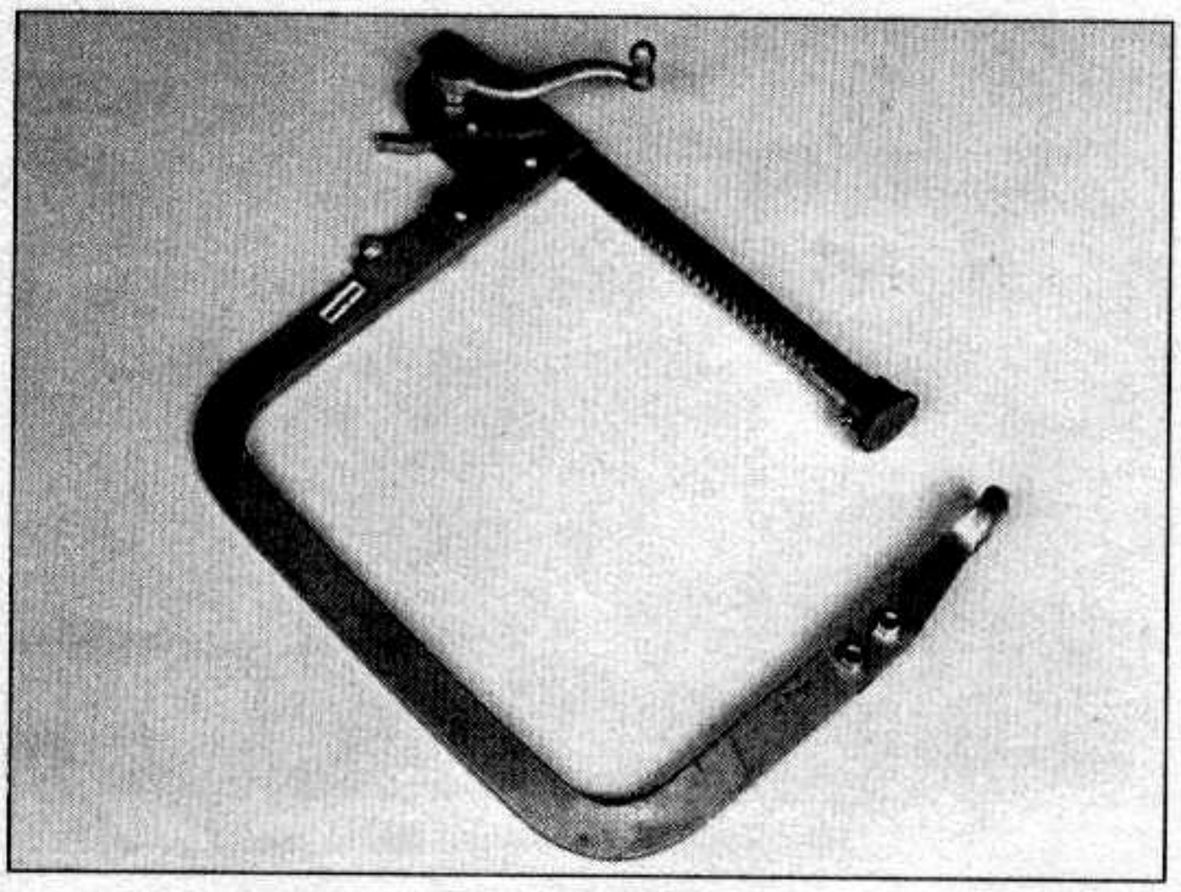
Hydraulic lifter removal tool

Repair/overhaul and *Special*.

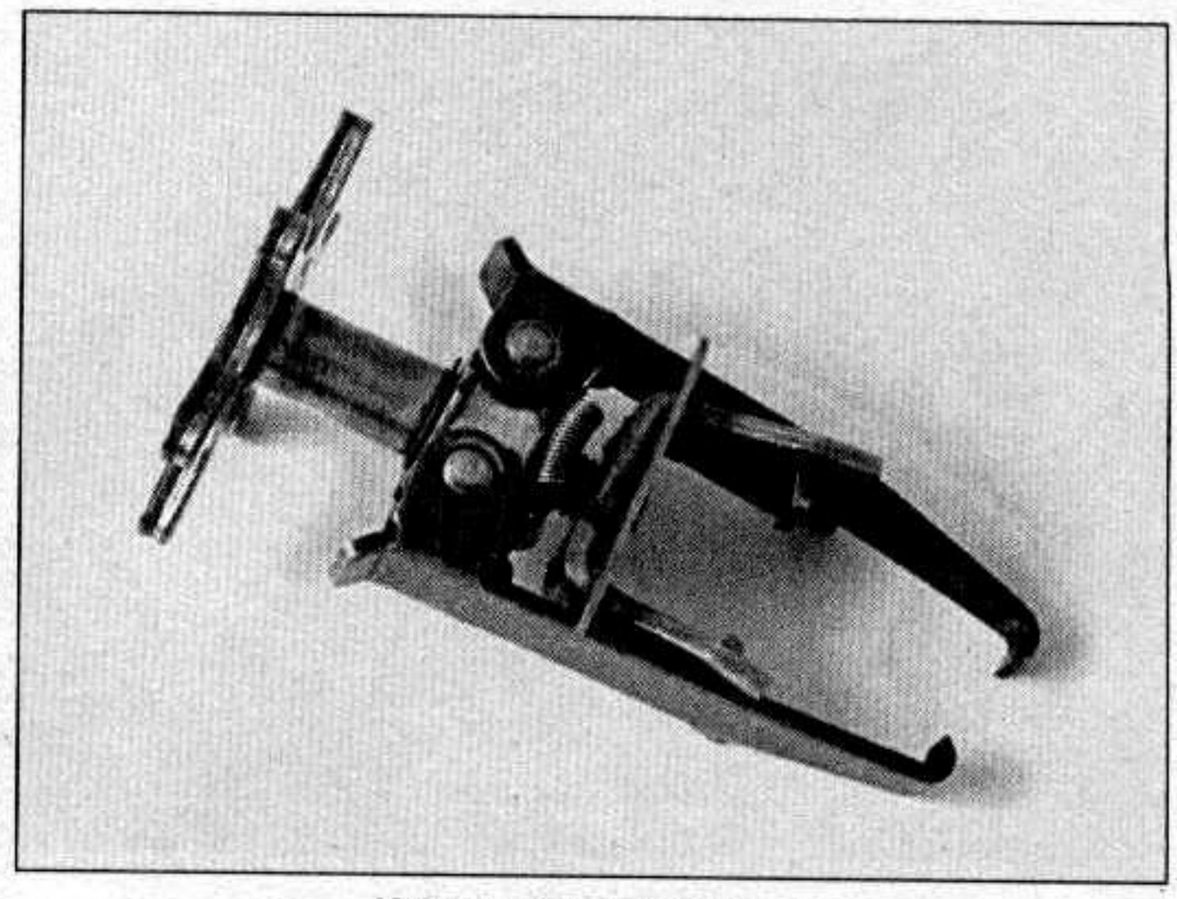
The newcomer to practical mechanics should start off with the *maintenance and minor repair* tool kit, which is adequate for the simpler jobs performed on a vehicle. Then, as confidence and experience grow, the owner can tackle more difficult tasks, buying additional tools as they are needed. Eventually the basic kit will be expanded into the *repair and overhaul* tool set. Over a period of time, the experienced do-it-yourselfer will assemble a tool set complete enough for most repair and overhaul procedures and will add tools from the special category when it is felt that the expense is justified by the frequency of use.

Maintenance and minor repair tool kit

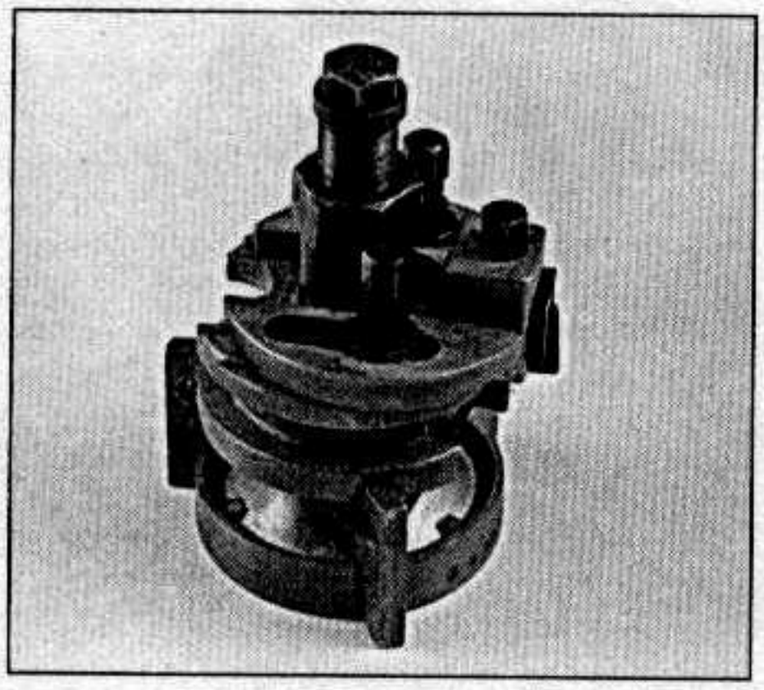
The tools in this list should be considered the minimum required for performance of routine maintenance, servicing and minor repair work. We recommend the purchase of combination wrenches (box-end and open-



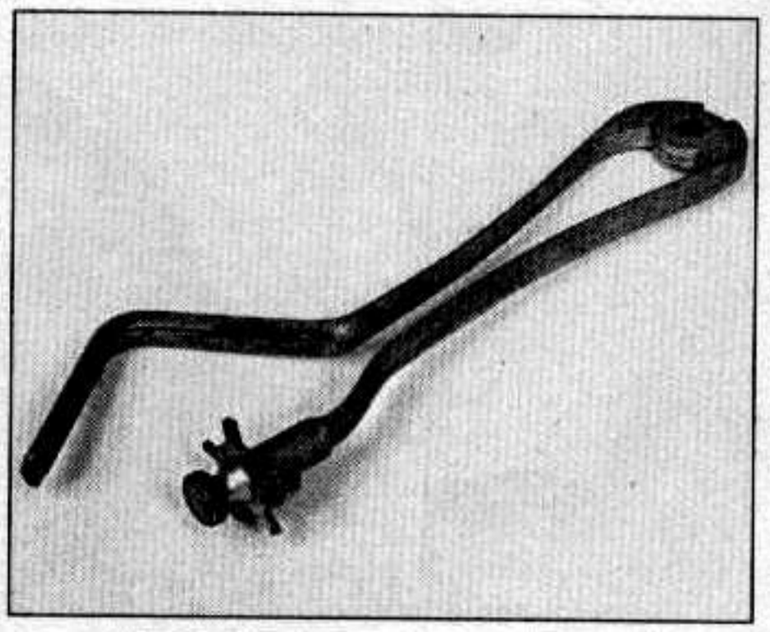
Valve spring compressor



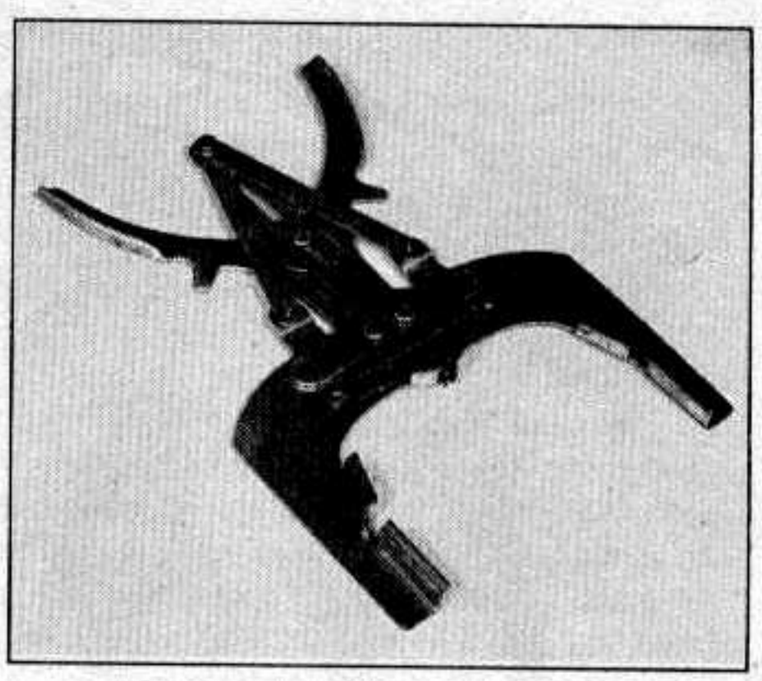
Valve spring compressor



Ridge reamer



Piston ring groove cleaning tool



Ring removal/installation tool

end combined in one wrench). While more expensive than open end wrenches, they offer the advantages of both types of wrench.

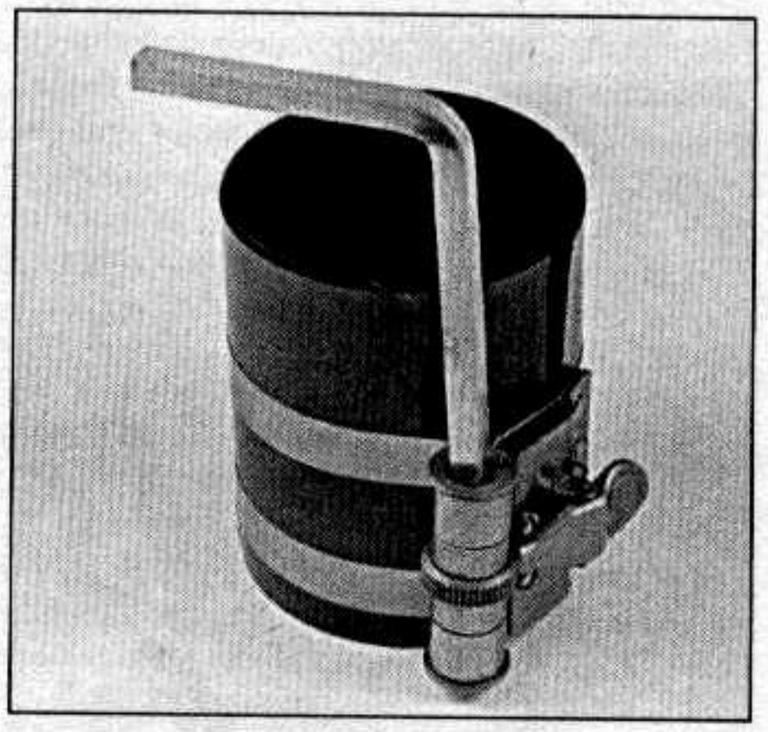
Combination wrench set (1/4-inch to 1 inch or 6 mm to 19 mm)
Adjustable wrench, 8 inch
Spark plug wrench with rubber insert
Spark plug gap adjusting tool
Feeler gauge set
Brake bleeder wrench
Standard screwdriver (5/16-inch x 6 inch)
Phillips screwdriver (No. 2 x 6 inch)
Combination pliers - 6 inch
Hacksaw and assortment of blades
Tire pressure gauge
Grease gun
Oil can
Fine emery cloth
Wire brush
Battery post and cable cleaning tool
Oil filter wrench
Funnel (medium size)
Safety goggles
Jackstands (2)
Drain pan

Note: *If basic tune-ups are going to be part of routine maintenance, it will be necessary to purchase a good quality stroboscopic timing light and combination tachometer/dwell meter. Although they are included in the list of special tools, it is mentioned here because they are absolutely necessary for tuning most vehicles properly.*

Repair and overhaul tool set

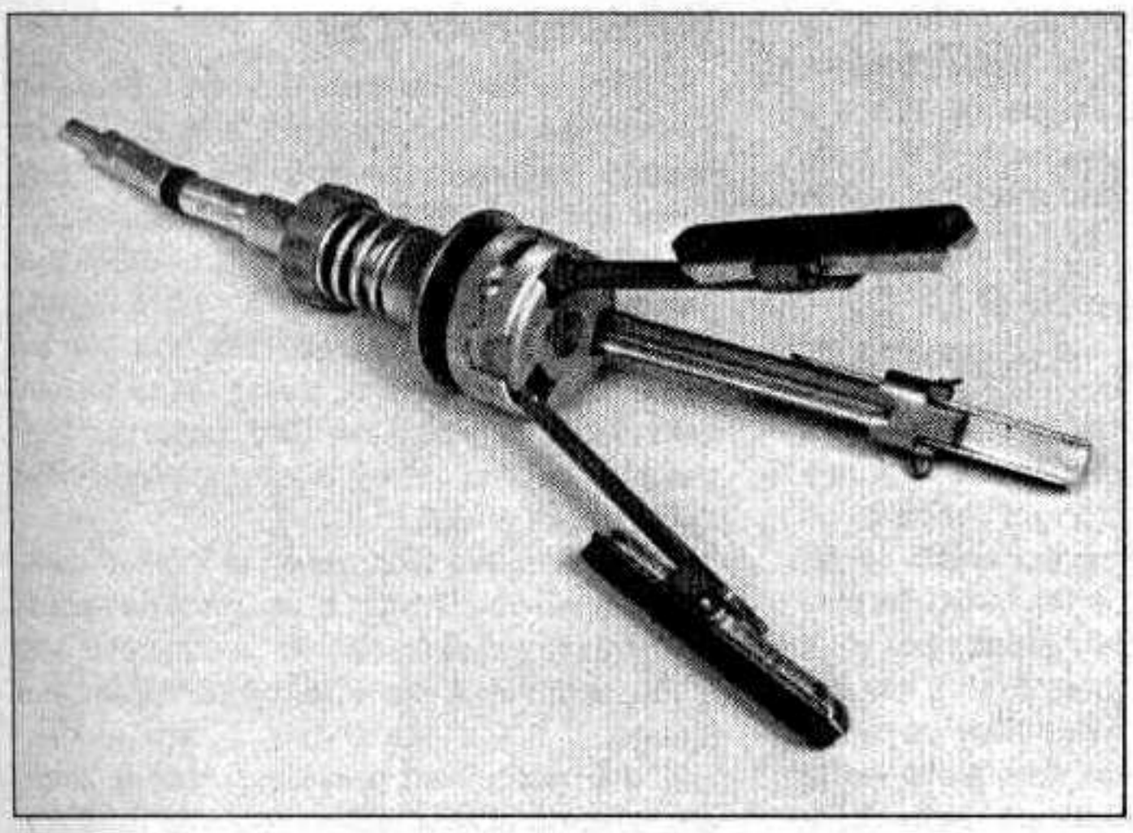
These tools are essential for anyone who plans to perform major repairs and are in addition to those in the maintenance and minor repair tool kit. Included is a comprehensive set of sockets which, though expensive, are invaluable because of their versatility, especially when various extensions and drives are available. We recommend the 1/2-inch drive over the 3/8-inch drive. Although the larger drive is bulky and more expensive, it has the capacity of accepting a very wide 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)

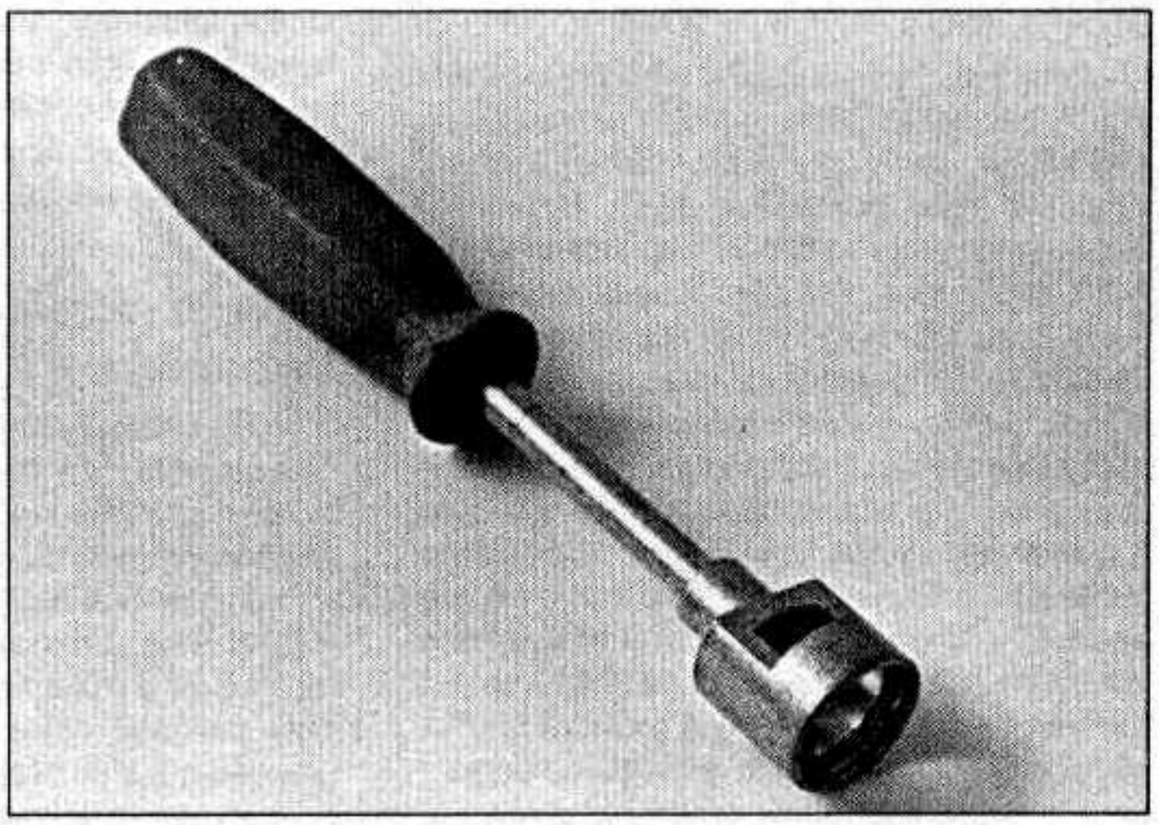


Ring compressor

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



Cylinder hone



Brake hold-down spring tool

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)

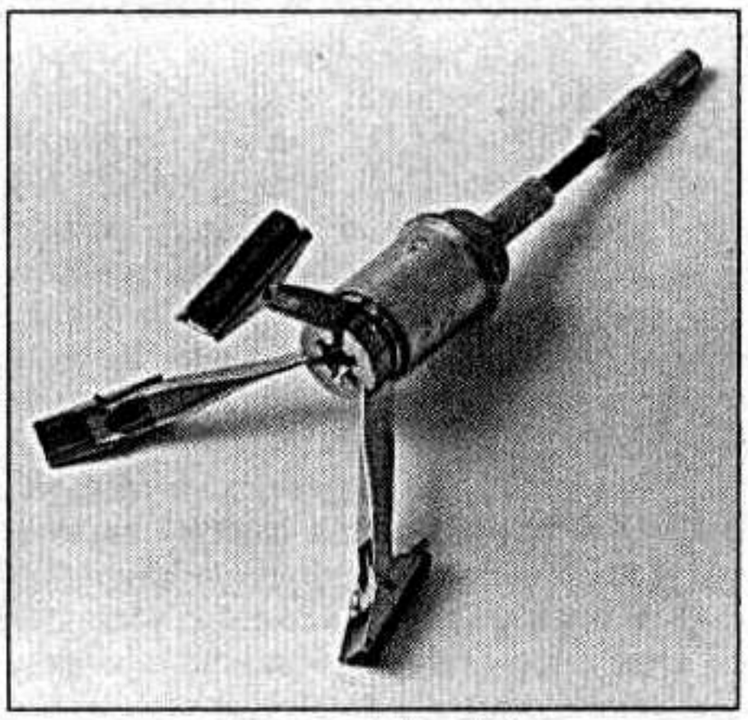
Note: *Another tool which is often useful is an electric drill with a chuck capacity of 3/8-inch and a set of good quality drill bits.*

Special tools

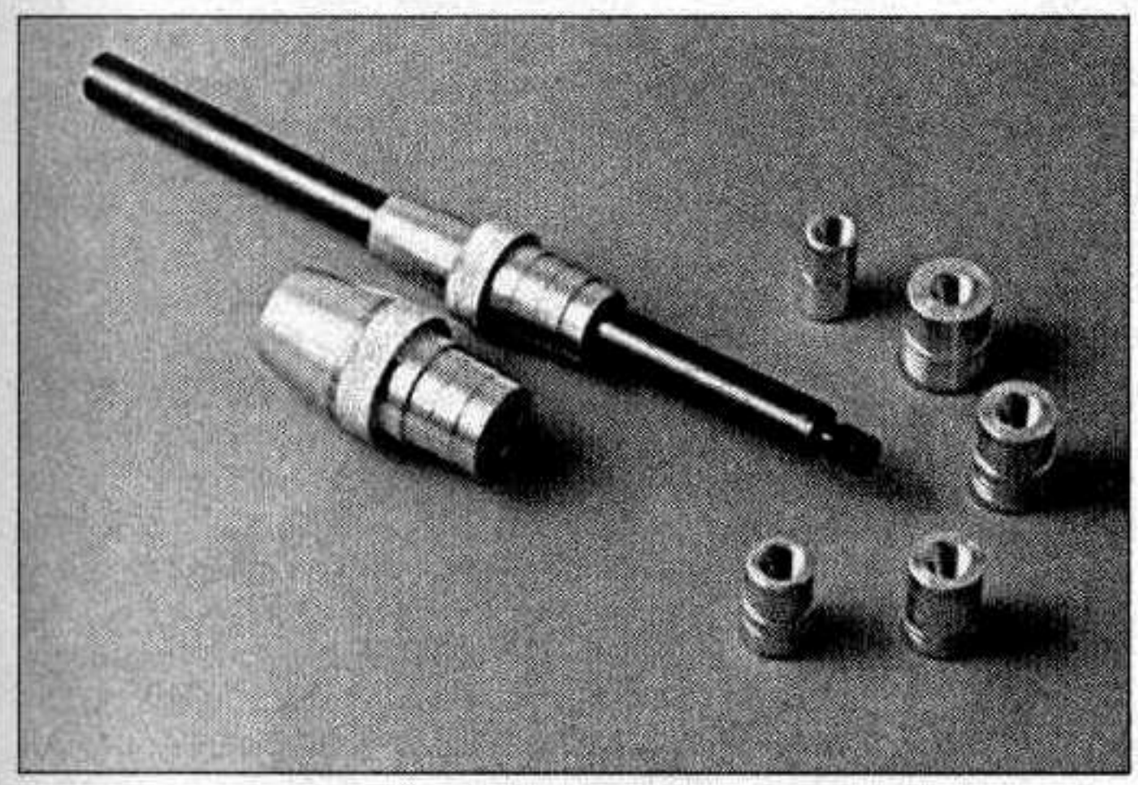
The tools in this list include those which are not used regularly, are expensive to buy, or which need to be used in accordance with their manufacturer's instructions. Unless these tools will be used frequently, it is not very economical to purchase many of them. A consideration would be to split the 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.

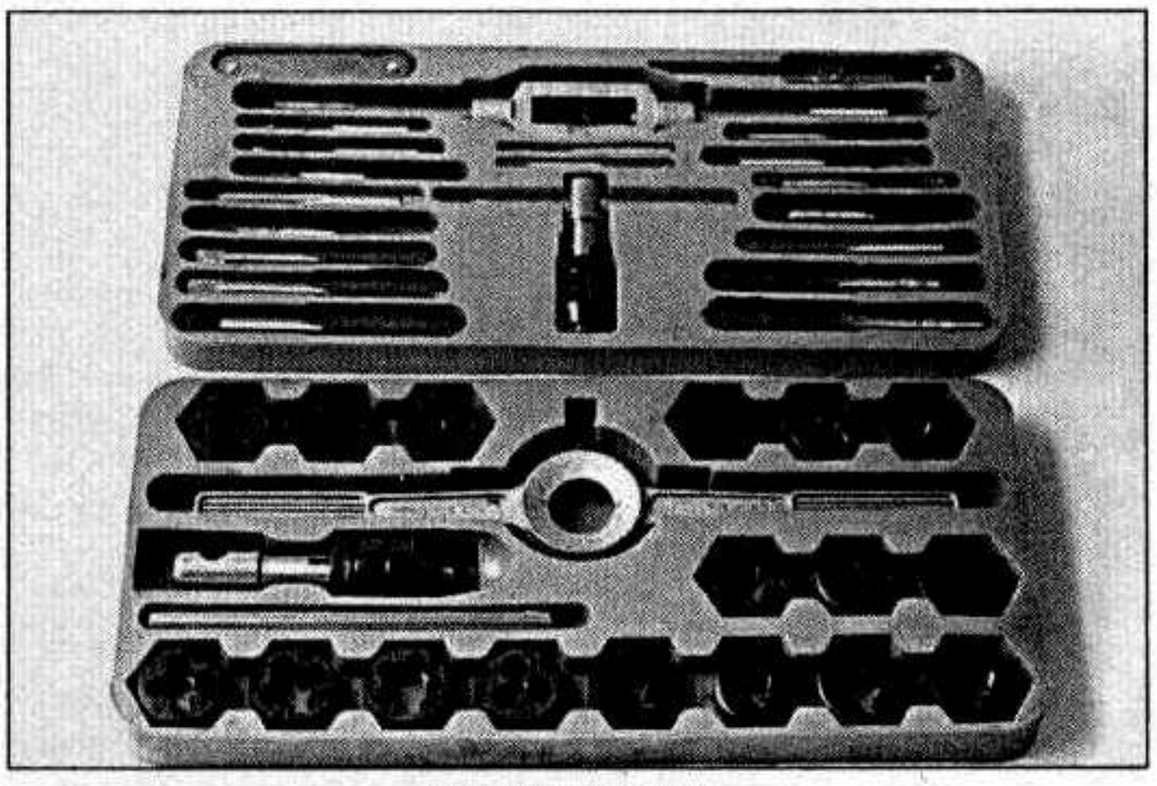
Valve spring compressor
Piston ring groove cleaning tool
Piston ring compressor
Piston ring installation tool
Cylinder compression gauge
Cylinder ridge reamer
Cylinder surfacing hone
Cylinder bore gauge
Micrometers and/or dial calipers
Hydraulic lifter removal tool
Balljoint separator
Universal-type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



Brake cylinder hone



Clutch plate alignment tool



Tap and die set

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, but regardless of where tools are bought, try to avoid cheap ones, especially when buying screwdrivers and sockets, because they won't last very long. The expense involved in replacing cheap tools will eventually be greater than the initial cost of quality tools.

Care and maintenance of tools

Good tools are expensive, so it makes sense to treat them with respect. Keep them clean and in usable condition and store them properly when not in use. Always wipe off any dirt, grease or metal chips before putting them away. Never leave tools lying around in the work area. Upon completion of a job, always check closely under the hood for tools that may have been left there so they won't get lost during a test drive.

Some tools, such as screwdrivers, pliers, wrenches and sockets, can be hung on a panel mounted on the garage or workshop wall, while others should be kept in a tool box or tray. Measuring instruments, gauges, meters, etc. must be carefully stored where they cannot be damaged by weather or impact from other tools.

When tools are used with care and stored properly, they will last a very long time. Even with the best of care, though, tools will wear out if used frequently. When a tool is damaged or worn out, replace it. Subsequent jobs will be safer and more enjoyable if you do.

How to repair damaged threads

Sometimes, the internal threads of a nut or bolt hole can become stripped, usually from overtightening. Stripping threads is an all-too-common occurrence, especially when working with aluminum parts, because aluminum is so soft that it easily strips out.

Usually, external or internal threads are only partially stripped. After they've been cleaned up with a tap or die, they'll still work. Sometimes, however, threads are badly damaged. When this happens, you've got three choices:

1) *Drill and tap the hole to the next suitable oversize and install a larger diameter bolt, screw or stud.*
2) *Drill and tap the hole to accept a threaded plug, then drill and tap the plug to the original screw size. You can also buy a plug already threaded to the original size. Then you simply drill a hole to the specified size, then run the threaded plug into the hole with a bolt and jam nut. Once the plug is fully seated, remove the jam nut and bolt.*
3) *The third method uses a patented thread repair kit like Heli-Coil or Slimsert. These easy-to-use kits are designed to repair damaged threads in straight-through holes and blind holes. Both are available as kits which can handle a variety of sizes and thread patterns. Drill the hole, then tap it with the special included tap. Install the Heli-Coil and the hole is back to its original diameter and thread pitch.*

Regardless of which method you use, be sure to proceed calmly and carefully. A little impatience or carelessness during one of these relatively simple procedures can ruin your whole day's work and cost you a bundle if you wreck an expensive part.

Working facilities

Not to be overlooked when discussing tools is the workshop. If anything more than routine maintenance is to be carried out, some sort of suitable work area is essential.

It is understood, and appreciated, that many home mechanics do not have a good workshop or garage available, and end up removing an engine or doing major repairs outside. It is recommended, however, that the overhaul or repair be completed under the cover of a roof.

A clean, flat workbench or table of comfortable working height is an absolute necessity. The workbench should be equipped with a vise that has a jaw opening of at least four inches.

As mentioned previously, some clean, dry storage space is also required for tools, as well as the lubricants, fluids, cleaning solvents, etc. which soon become necessary.

Sometimes waste oil and fluids, drained from the engine or cooling system during normal maintenance or repairs, present a disposal problem. To avoid pouring them on the ground or into a sewage system, pour the used fluids into large containers, seal them with caps and take them to an authorized disposal site or recycling center. Plastic jugs, such as old antifreeze containers, are ideal for this purpose.

Always keep a supply of old newspapers and clean rags available. Old towels are excellent for mopping up spills. Many mechanics use rolls of paper towels for most work because they are readily available and disposable. To help keep the area under the vehicle clean, a large cardboard box can be cut open and flattened to protect the garage or shop floor.

Whenever working over a painted surface, such as when leaning over a fender to service something under the hood, always cover it with an old blanket or bedspread to protect the finish. Vinyl covered pads, made especially for this purpose, are available at auto parts stores.

Anti-theft audio system

1 Some models were originally equipped with an audio system which includes an anti-theft feature that will render the stereo inoperative. If the power source to the stereo is cut, the stereo will not work until a five-digit code (furnished with the vehicle when it was originally purchased from the dealer) is entered. Even if the power is immediately reconnected, the stereo will not function. If your vehicle is equipped with this anti-theft system, do not disconnect the battery, remove the radio fuse or remove the stereo unless you have the code number for the stereo.

2 Refer to your vehicle's owner's manual for more complete information on this audio system and it's anti-theft feature.

Unlocking the stereo after a power loss

3 Turn on the radio. Press the Scan and Auto M buttons at the same time for two seconds. The word "cod e" should appear on the display.

4 Press SCAN and AUTO M until four bars appear on the display.

5 Using the station reset selector buttons, enter the four-digit code. **Note:** *You have three attempts to enter the correct code.*

5 Once the code has been entered correctly, press SCAN and AUTO M. The word "cod e" should flash and after approximately five seconds the time will be displayed and the radio should play (you'll have to tune in and enter your preset stations, however).

Booster battery (jump) starting

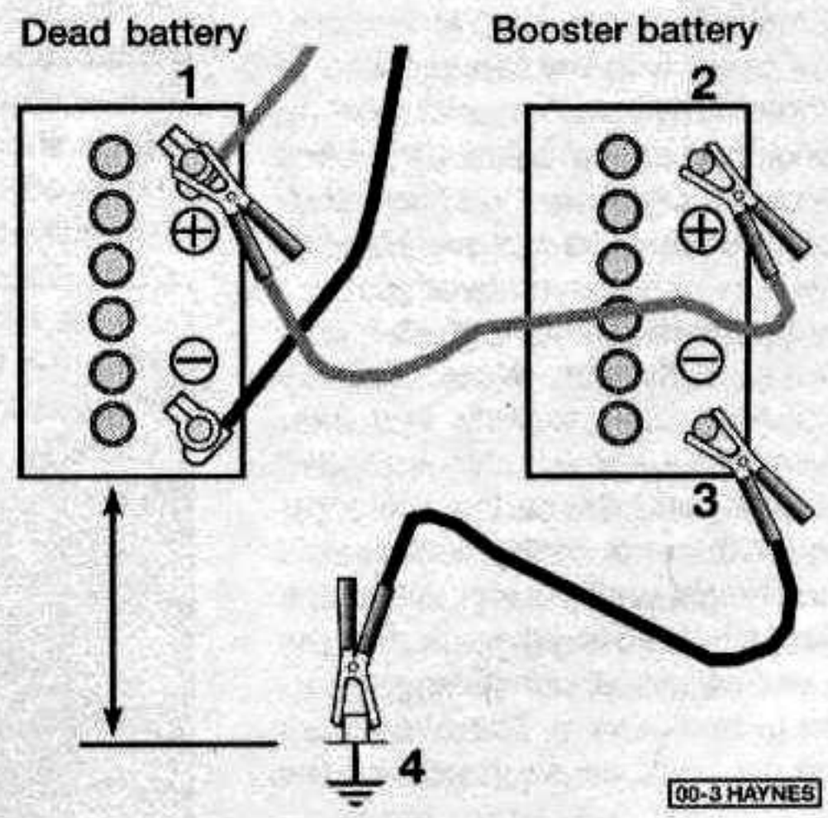
Observe the following precautions when using a booster battery to start a vehicle:

a) *Before connecting the booster battery, make sure the ignition switch is in the Off position.*
b) *Turn off the lights, heater and other electrical loads.*
c) *Your eyes should be shielded. Safety goggles are a good idea.*
d) *Make sure the booster battery is the same voltage as the dead one in the vehicle.*
e) *The two vehicles MUST NOT TOUCH each other.*
f) *Make sure the transmission is in Neutral (manual transaxle) or Park (automatic transaxle).*
g) *If the booster battery is not a maintenance-free type, remove the vent caps and lay a cloth over the vent holes.*

Connect the red jumper cable to the positive (+) terminals of each battery.

Connect one end of the black cable to the negative (-) terminal of the booster battery. The other end of this cable should be connected to a good ground on the engine block **(see illustration)**. Make sure the cable will not come into contact with the fan, drivebelts or other moving parts of the engine.

Start the engine using the booster battery, then, with the engine running at idle speed, disconnect the jumper cables in the reverse order of connection.



Make the booster battery cable connections in the numerical order shown (note that the negative cable of the booster battery is NOT attached to the negative terminal of the dead battery)

Jacking and towing

Jacking

Warning: *The jack supplied with the vehicle should only be used for changing a tire or placing jackstands under the frame. Never work under the vehicle or start the engine while this jack is being used as the only means of support.*

The vehicle should be on level ground. Place the shift lever in Park, if you have an automatic, or Reverse if you have a manual transaxle. Block the wheel diagonally opposite the wheel being changed. Set the parking brake.

Remove the spare tire and jack from stowage. Remove the wheel cover and trim ring (if so equipped) with the tapered end of the lug nut wrench by inserting and twisting the handle and then prying against the back of the wheel cover. **Caution**: *On some models the wheel cover can't be removed by prying; the wheel nuts must be removed first.*

Loosen, but do not remove, the lug nuts (one-half turn is sufficient). **Note:** *Factory alloy wheels have one locking nut that requires a special keyed adapter (supplied with the vehicle).* Next, place the scissors-type jack under the side of the vehicle and adjust the jack height until the slot in the jack head engages with the raised portion of the ridge on the vertical rocker panel flange nearest the wheel to be changed. There is a front and rear jacking point on each side of the vehicle.

Turn the jack handle clockwise until the tire clears the ground. Remove the lug nuts and pull the wheel off. Replace it with the spare.

Install the lug nuts with the beveled edges facing in. Tighten them snugly. Don't attempt to tighten them completely until the vehicle is lowered or it could slip off the jack. Turn the jack handle counterclockwise to lower the vehicle. Remove the jack and tighten the lug nuts in a criss-cross pattern.

Install the cover (and trim ring, if used) and be sure it's snapped into place all the way around.

Stow the tire, jack and wrench. Unblock the wheels.

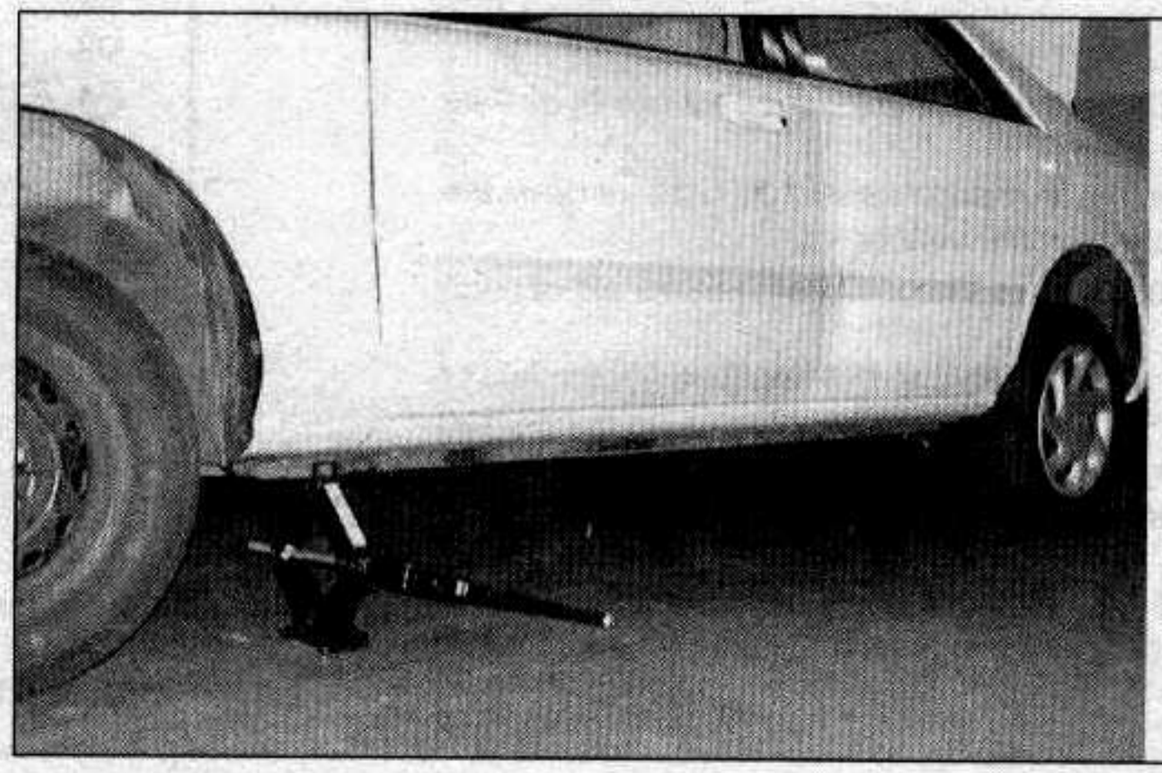
Towing

Vehicles equipped with an automatic transaxle should not be towed with all four wheels on the ground. As a general rule, the vehicle should be towed with the front (drive) wheels off the ground (the best method is to have the vehicle placed on a flat-bed tow truck). If they can't be raised, place them on a dolly.

When towing a vehicle equipped with a manual transaxle with all four wheels on the ground, be sure to place the shift lever in neutral and release the parking brake. The ignition key must be in the ACC position, since the steering lock mechanism isn't strong enough to hold the front wheels straight while towing.

Equipment specifically designed for towing should be used. It should be attached to the main structural members of the vehicle, not the bumpers or brackets.

Safety is a major consideration when towing and all applicable state and local laws must be obeyed. A safety chain system must be used at all times. Remember that power steering and power brakes will not work with the engine off.



The jack fits over the rocker panel flange (there are two jacking points on each side of the vehicle, indicated by notches in the rocker panel flange)

Automotive chemicals and lubricants

A number of automotive chemicals and lubricants are available for use during vehicle maintenance and repair. They include a wide variety of products ranging from cleaning solvents and degreasers to lubricants and protective sprays for rubber, plastic and vinyl.

Cleaners

Carburetor cleaner and choke cleaner is a strong solvent for gum, varnish and carbon. Most carburetor cleaners leave a dry-type lubricant film which will not harden or gum up. Because of this film it is not recommended for use on electrical components.

Brake system cleaner is used to remove grease and brake fluid from the brake system, where clean surfaces are absolutely necessary. It leaves no residue and often eliminates brake squeal caused by contaminants.

Electrical cleaner removes oxidation, corrosion and carbon deposits from electrical contacts, restoring full current flow. It can also be used to clean spark plugs, carburetor jets, voltage regulators and other parts where an oil-free surface is desired.

Demoisturants remove water and moisture from electrical components such as alternators, voltage regulators, electrical connectors and fuse blocks. They are non-conductive, non-corrosive and non-flammable.

Degreasers are heavy-duty solvents used to remove grease from the outside of the engine and from chassis components. They can be sprayed or brushed on and, depending on the type, are rinsed off either with water or solvent.

Lubricants

Motor oil is the lubricant formulated for use in engines. It normally contains a wide variety of additives to prevent corrosion and reduce foaming and wear. Motor oil comes in various weights (viscosity ratings) from 0 to 50. The recommended weight of the oil depends on the season, temperature and the demands on the engine. Light oil is used in cold climates and under light load conditions. Heavy oil is used in hot climates and where high loads are encountered. Multi-viscosity oils are designed to have characteristics of both light and heavy oils and are available in a number of weights from 5W-20 to 20W-50.

Gear oil is designed to be used in differentials, manual transmissions and other areas where high-temperature lubrication is required.

Chassis and wheel bearing grease is a heavy grease used where increased loads and friction are encountered, such as for wheel bearings, balljoints, tie-rod ends and universal joints.

High-temperature wheel bearing grease is designed to withstand the extreme temperatures encountered by wheel bearings in disc brake equipped vehicles. It usually contains molybdenum disulfide (moly), which is a dry-type lubricant.

White grease is a heavy grease for metal-to-metal applications where water is a problem. White grease stays soft under both low and high temperatures (usually from -100 to +190-degrees F), and will not wash off or dilute in the presence of water.

Assembly lube is a special extreme pressure lubricant, usually containing moly, used to lubricate high-load parts (such as main and rod bearings and cam lobes) for initial start-up of a new engine. The assembly lube lubricates the parts without being squeezed out or washed away until the engine oiling system begins to function.

Silicone lubricants are used to protect rubber, plastic, vinyl and nylon parts.

Graphite lubricants are used where oils cannot be used due to contamination problems, such as in locks. The dry graphite will lubricate metal parts while remaining uncontaminated by dirt, water, oil or acids. It is electrically conductive and will not foul electrical contacts in locks such as the ignition switch.

Moly penetrants loosen and lubricate frozen, rusted and corroded fasteners and prevent future rusting or freezing.

Heat-sink grease is a special electrically non-conductive grease that is used for mounting electronic ignition modules where it is essential that heat is transferred away from the module.

Sealants

RTV sealant is one of the most widely used gasket compounds. Made from silicone, RTV is air curing, it seals, bonds, waterproofs, fills surface irregularities, remains flexible, doesn't shrink, is relatively easy to remove, and is used as a supplementary sealer with almost all low and medium temperature gaskets.

Anaerobic sealant is much like RTV in that it can be used either to seal gaskets or to form gaskets by itself. It remains flexible, is solvent resistant and fills surface imperfections. The difference between an anaerobic sealant and an RTV-type sealant is in the curing. RTV cures when exposed to air, while an anaerobic sealant cures only in the absence of air. This means that an anaerobic sealant cures only after the assembly of parts, sealing them together.

Thread and pipe sealant is used for sealing hydraulic and pneumatic fittings and vacuum lines. It is usually made from a Teflon compound, and comes in a spray, a paint-on liquid and as a wrap-around tape.

Chemicals

Anti-seize compound prevents seizing, galling, cold welding, rust and corrosion in fasteners. High-temperature anti-seize, usually made with copper and graphite lubricants, is used for exhaust system and exhaust manifold bolts.

Anaerobic locking compounds are used to keep fasteners from vibrating or working loose and cure only after installation, in the absence of air. Medium strength locking compound is used for small nuts, bolts and screws that may be removed later. High-strength locking compound is for large nuts, bolts and studs which aren't removed on a regular basis.

Oil additives range from viscosity index improvers to chemical treatments that claim to reduce internal engine friction. It should be noted that most oil manufacturers caution against using additives with their oils.

Gas additives perform several functions, depending on their chemical makeup. They usually contain solvents that help dissolve gum and varnish that build up on carburetor, fuel injection and intake parts. They also serve to break down carbon deposits that form on the inside surfaces of the combustion chambers. Some additives contain upper cylinder lubricants for valves and piston rings, and others contain chemicals to remove condensation from the gas tank.

Miscellaneous

Brake fluid is specially formulated hydraulic fluid that can withstand the heat and pressure encountered in brake systems. Care must be taken so this fluid does not come in contact with painted surfaces or plastics. An opened container should always be resealed to prevent contamination by water or dirt.

Weatherstrip adhesive is used to bond weatherstripping around doors, windows and trunk lids. It is sometimes used to attach trim pieces.

Undercoating is a petroleum-based, tar-like substance that is designed to protect metal surfaces on the underside of the vehicle from corrosion. It also acts as a sound-deadening agent by insulating the bottom of the vehicle.

Waxes and polishes are used to help protect painted and plated surfaces from the weather. Different types of paint may require the use of different types of wax and polish. Some polishes utilize a chemical or abrasive cleaner to help remove the top layer of oxidized (dull) paint on older vehicles. In recent years many non-wax polishes that contain a wide variety of chemicals such as polymers and silicones have been introduced. These non-wax polishes are usually easier to apply and last longer than conventional waxes and polishes.

Conversion factors

Length (distance)					
Inches (in)	X 25.4	= Millimeters (mm)	X 0.0394	= Inches (in)	
Feet (ft)	X 0.305	= Meters (m)	X 3.281	= Feet (ft)	
Miles	X 1.609	= Kilometers (km)	X 0.621	= Miles	
Volume (capacity)					
Cubic inches (cu in; in^3)	X 16.387	= Cubic centimeters (cc; cm^3)	X 0.061	= Cubic inches (cu in; in^3)	
Imperial pints (Imp pt)	X 0.568	= Liters (l)	X 1.76	= Imperial pints (Imp pt)	
Imperial quarts (Imp qt)	X 1.137	= Liters (l)	X 0.88	= Imperial quarts (Imp qt)	
Imperial quarts (Imp qt)	X 1.201	= US quarts (US qt)	X 0.833	= Imperial quarts (Imp qt)	
US quarts (US qt)	X 0.946	= Liters (l)	X 1.057	= US quarts (US qt)	
Imperial gallons (Imp gal)	X 4.546	= Liters (l)	X 0.22	= Imperial gallons (Imp gal)	
Imperial gallons (Imp gal)	X 1.201	= US gallons (US gal)	X 0.833	= Imperial gallons (Imp gal)	
US gallons (US gal)	X 3.785	= Liters (l)	X 0.264	= US gallons (US gal)	
Mass (weight)					
Ounces (oz)	X 28.35	= Grams (g)	X 0.035	= Ounces (oz)	
Pounds (lb)	X 0.454	= Kilograms (kg)	X 2.205	= Pounds (lb)	
Force					
Ounces-force (ozf; oz)	X 0.278	= Newtons (N)	X 3.6	= Ounces-force (ozf; oz)	
Pounds-force (lbf; lb)	X 4.448	= Newtons (N)	X 0.225	= Pounds-force (lbf; lb)	
Newtons (N)	X 0.1	= Kilograms-force (kgf; kg)	X 9.81	= Newtons (N)	
Pressure					
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X 0.070	= Kilograms-force per square centimeter (kgf/cm^2; kg/cm^2)	X 14.223	= Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X 0.068	= Atmospheres (atm)	X 14.696	= Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X 0.069	= Bars	X 14.5	= Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	
Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	X 6.895	= Kilopascals (kPa)	X 0.145	= Pounds-force per square inch (psi; lbf/in^2; lb/in^2)	
Kilopascals (kPa)	X 0.01	= Kilograms-force per square centimeter (kgf/cm^2; kg/cm^2)	X 98.1	= Kilopascals (kPa)	
Torque (moment of force)					
Pounds-force inches (lbf in; lb in)	X 1.152	= Kilograms-force centimeter (kgf cm; kg cm)	X 0.868	= Pounds-force inches (lbf in; lb in)	
Pounds-force inches (lbf in; lb in)	X 0.113	= Newton meters (Nm)	X 8.85	= Pounds-force inches (lbf in; lb in)	
Pounds-force inches (lbf in; lb in)	X 0.083	= Pounds-force feet (lbf ft; lb ft)	X 12	= Pounds-force inches (lbf in; lb in)	
Pounds-force feet (lbf ft; lb ft)	X 0.138	= Kilograms-force meters (kgf m; kg m)	X 7.233	= Pounds-force feet (lbf ft; lb ft)	
Pounds-force feet (lbf ft; lb ft)	X 1.356	= Newton meters (Nm)	X 0.738	= Pounds-force feet (lbf ft; lb ft)	
Newton meters (Nm)	X 0.102	= Kilograms-force meters (kgf m; kg m)	X 9.804	= Newton meters (Nm)	
Vacuum					
Inches mercury (in. Hg)	X 3.377	= Kilopascals (kPa)	X 0.2961	= Inches mercury	
Inches mercury (in. Hg)	X 25.4	= Millimeters mercury (mm Hg)	X 0.0394	= Inches mercury	
Power					
Horsepower (hp)	X 745.7	= Watts (W)	X 0.0013	= Horsepower (hp)	
Velocity (speed)					
Miles per hour (miles/hr; mph)	X 1.609	= Kilometers per hour (km/hr; kph)	X 0.621	= Miles per hour (miles/hr; mph)	
Fuel consumption*					
Miles per gallon, Imperial (mpg)	X 0.354	= Kilometers per liter (km/l)	X 2.825	= Miles per gallon, Imperial (mpg)	
Miles per gallon, US (mpg)	X 0.425	= Kilometers per liter (km/l)	X 2.352	= Miles per gallon, US (mpg)	

Temperature

Degrees Fahrenheit = (°C x 1.8) + 32

Degrees Celsius (Degrees Centigrade; °C) = (°F - 32) x 0.56

**It is common practice to convert from miles per gallon (mpg) to liters/100 kilometers (l/100km), where mpg (Imperial) x l/100 km = 282 and mpg (US) x l/100 km = 235*

DECIMALS to MILLIMETERS

Decimal	mm	Decimal	mm
0.001	0.0254	0.500	12.7000
0.002	0.0508	0.510	12.9540
0.003	0.0762	0.520	13.2080
0.004	0.1016	0.530	13.4620
0.005	0.1270	0.540	13.7160
0.006	0.1524	0.550	13.9700
0.007	0.1778	0.560	14.2240
0.008	0.2032	0.570	14.4780
0.009	0.2286	0.580	14.7320
		0.590	14.9860
0.010	0.2540		
0.020	0.5080		
0.030	0.7620		
0.040	1.0160	0.600	15.2400
0.050	1.2700	0.610	15.4940
0.060	1.5240	0.620	15.7480
0.070	1.7780	0.630	16.0020
0.080	2.0320	0.640	16.2560
0.090	2.2860	0.650	16.5100
		0.660	16.7640
0.100	2.5400	0.670	17.0180
0.110	2.7940	0.680	17.2720
0.120	3.0480	0.690	17.5260
0.130	3.3020		
0.140	3.5560		
0.150	3.8100		
0.160	4.0640	0.700	17.7800
0.170	4.3180	0.710	18.0340
0.180	4.5720	0.720	18.2880
0.190	4.8260	0.730	18.5420
		0.740	18.7960
0.200	5.0800	0.750	19.0500
0.210	5.3340	0.760	19.3040
0.220	5.5880	0.770	19.5580
0.230	5.8420	0.780	19.8120
0.240	6.0960	0.790	20.0660
0.250	6.3500		
0.260	6.6040		
0.270	6.8580	0.800	20.3200
0.280	7.1120	0.810	20.5740
0.290	7.3660	0.820	21.8280
		0.830	21.0820
0.300	7.6200	0.840	21.3360
0.310	7.8740	0.850	21.5900
0.320	8.1280	0.860	21.8440
0.330	8.3820	0.870	22.0980
0.340	8.6360	0.880	22.3520
0.350	8.8900	0.890	22.6060
0.360	9.1440		
0.370	9.3980		
0.380	9.6520		
0.390	9.9060		
		0.900	22.8600
0.400	10.1600	0.910	23.1140
0.410	10.4140	0.920	23.3680
0.420	10.6680	0.930	23.6220
0.430	10.9220	0.940	23.8760
0.440	11.1760	0.950	24.1300
0.450	11.4300	0.960	24.3840
0.460	11.6840	0.970	24.6380
0.470	11.9380	0.980	24.8920
0.480	12.1920	0.990	25.1460
0.490	12.4460	1.000	25.4000

FRACTIONS to DECIMALS to MILLIMETERS

Fraction	Decimal	mm	Fraction	Decimal	mm
1/64	0.0156	0.3969	33/64	0.5156	13.0969
1/32	0.0312	0.7938	17/32	0.5312	13.4938
3/64	0.0469	1.1906	35/64	0.5469	13.8906
1/16	0.0625	1.5875	9/16	0.5625	14.2875
5/64	0.0781	1.9844	37/64	0.5781	14.6844
3/32	0.0938	2.3812	19/32	0.5938	15.0812
7/64	0.1094	2.7781	39/64	0.6094	15.4781
1/8	0.1250	3.1750	5/8	0.6250	15.8750
9/64	0.1406	3.5719	41/64	0.6406	16.2719
5/32	0.1562	3.9688	21/32	0.6562	16.6688
11/64	0.1719	4.3656	43/64	0.6719	17.0656
3/16	0.1875	4.7625	11/16	0.6875	17.4625
13/64	0.2031	5.1594	45/64	0.7031	17.8594
7/32	0.2188	5.5562	23/32	0.7188	18.2562
15/64	0.2344	5.9531	47/64	0.7344	18.6531
1/4	0.2500	6.3500	3/4	0.7500	19.0500
17/64	0.2656	6.7469	49/64	0.7656	19.4469
9/32	0.2812	7.1438	25/32	0.7812	19.8438
19/64	0.2969	7.5406	51/64	0.7969	20.2406
5/16	0.3125	7.9375	13/16	0.8125	20.6375
21/64	0.3281	8.3344	53/64	0.8281	21.0344
11/32	0.3438	8.7312	27/32	0.8438	21.4312
23/64	0.3594	9.1281	55/64	0.8594	21.8281
3/8	0.3750	9.5250	7/8	0.8750	22.2250
25/64	0.3906	9.9219	57/64	0.8906	22.6219
13/32	0.4062	10.3188	29/32	0.9062	23.0188
27/64	0.4219	10.7156	59/64	0.9219	23.4156
7/16	0.4375	11.1125	15/16	0.9375	23.8125
29/64	0.4531	11.5094	61/64	0.9531	24.2094
15/32	0.4688	11.9062	31/32	0.9688	24.6062
31/64	0.4844	12.3031	63/64	0.9844	25.0031
1/2	0.5000	12.7000	1	1.0000	25.4000

Safety first!

Regardless of how enthusiastic you may be about getting on with the job at hand, take the time to ensure that your safety is not jeopardized. A moment's lack of attention can result in an accident, as can failure to observe certain simple safety precautions. The possibility of an accident will always exist, and the following points should not be considered a comprehensive list of all dangers. Rather, they are intended to make you aware of the risks and to encourage a safety conscious approach to all work you carry out on your vehicle.

Essential DOs and DON'Ts

DON'T rely on a jack when working under the vehicle. Always use approved jackstands to support the weight of the vehicle and place them under the recommended lift or support points.

DON'T attempt to loosen extremely tight fasteners (i.e. wheel lug nuts) while the vehicle is on a jack - it may fall.

DON'T start the engine without first making sure that the transmission is in Neutral (or Park where applicable) and the parking brake is set.

DON'T remove the radiator cap from a hot cooling system - let it cool or cover it with a cloth and release the pressure gradually.

DON'T attempt to drain the engine oil until you are sure it has cooled to the point that it will not burn you.

DON'T touch any part of the engine or exhaust system until it has cooled sufficiently to avoid burns.

DON'T siphon toxic liquids such as gasoline, antifreeze and brake fluid by mouth, or allow them to remain on your skin.

DON'T inhale brake lining dust - it is potentially hazardous (see *Asbestos* below).

DON'T allow spilled oil or grease to remain on the floor - wipe it up before someone slips on it.

DON'T use loose fitting wrenches or other tools which may slip and cause injury.

DON'T push on wrenches when loosening or tightening nuts or bolts. Always try to pull the wrench toward you. If the situation calls for pushing the wrench away, push with an open hand to avoid scraped knuckles if the wrench should slip.

DON'T attempt to lift a heavy component alone - get someone to help you.

DON'T rush or take unsafe shortcuts to finish a job.

DON'T allow children or animals in or around the vehicle while you are working on it.

DO wear eye protection when using power tools such as a drill, sander, bench grinder, etc. and when working under a vehicle.

DO keep loose clothing and long hair well out of the way of moving parts.

DO make sure that any hoist used has a safe working load rating adequate for the job.

DO get someone to check on you periodically when working alone on a vehicle.

DO carry out work in a logical sequence and make sure that everything is correctly assembled and tightened.

DO keep chemicals and fluids tightly capped and out of the reach of children and pets.

DO remember that your vehicle's safety affects that of yourself and others. If in doubt on any point get professional advice.

Asbestos

Certain friction, insulating, sealing, and other products - such as brake linings, brake bands, clutch linings, torque converters, gaskets, etc. - may contain asbestos. Extreme care must be taken to avoid inhalation of dust from such products, since it is hazardous to health. If in doubt, assume that they do contain asbestos.

Fire

Remember at all times that gasoline is highly flammable. Never smoke or have any kind of open flame around when working on a vehicle. But the risk does not end there. A spark caused by an electrical short circuit, by two metal surfaces contacting each other, or even by static electricity built up in your body under certain conditions, can ignite gasoline vapors, which in a confined space are highly explosive. Do not, under any circumstances, use gasoline for cleaning parts. Use an approved safety solvent.

Always disconnect the battery ground (-) cable at the battery before working on any part of the fuel system or electrical system. Never risk spilling fuel on a hot engine or exhaust component. It is strongly recommended that a fire extinguisher suitable for use on fuel and electrical fires be kept handy in the garage or workshop at all times. Never try to extinguish a fuel or electrical fire with water.

Fumes

Certain fumes are highly toxic and can quickly cause unconsciousness and even death if inhaled to any extent. Gasoline vapor falls into this category, as do the vapors from some cleaning solvents. Any draining or pouring of such volatile fluids should be done in a well ventilated area.

When using cleaning fluids and solvents, read the instructions on the container carefully. Never use materials from unmarked containers.

Never run the engine in an enclosed space, such as a garage. Exhaust fumes contain carbon monoxide, which is extremely poisonous. If you need to run the engine, always do so in the open air, or at least have the rear of the vehicle outside the work area.

If you are fortunate enough to have the use of an inspection pit, never drain or pour gasoline and never run the engine while the vehicle is over the pit. The fumes, being heavier than air, will concentrate in the pit with possibly lethal results.

The battery

Never create a spark or allow a bare light bulb near a battery. They normally give off a certain amount of hydrogen gas, which is highly explosive.

Always disconnect the battery ground (-) cable at the battery before working on the fuel or electrical systems.

If possible, loosen the filler caps or cover when charging the battery from an external source (this does not apply to sealed or maintenance-free batteries). Do not charge at an excessive rate or the battery may burst.

Take care when adding water to a non maintenance-free battery and when carrying a battery. The electrolyte, even when diluted, is very corrosive and should not be allowed to contact clothing or skin.

Always wear eye protection when cleaning the battery to prevent the caustic deposits from entering your eyes.

Household current

When using an electric power tool, inspection light, etc., which operates on household current, always make sure that the tool is correctly connected to its plug and that, where necessary, it is properly grounded. Do not use such items in damp conditions and, again, do not create a spark or apply excessive heat in the vicinity of fuel or fuel vapor.

Secondary ignition system voltage

A severe electric shock can result from touching certain parts of the ignition system (such as the spark plug wires) when the engine is running or being cranked, particularly if components are damp or the insulation is defective. In the case of an electronic ignition system, the secondary system voltage is much higher and could prove fatal.

Troubleshooting

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This section provides an easy reference guide to the more common problems which may occur during the operation of your vehicle. These problems and their possible causes are grouped under headings denoting various components or systems, such as Engine, Cooling system, etc. They also refer you to the chapter and/or section which deals with the problem.

Remember that successful troubleshooting is not a mysterious black art practiced only by professional mechanics. It is simply the result of the right knowledge combined with an intelligent, systematic approach to the problem. Always work by a process of elimination, starting with the simplest solution and working through to the most complex - and never overlook the obvious. Anyone can run the gas tank dry or leave the lights on overnight, so don't assume that you are exempt from such oversights.

Finally, always establish a clear idea of why a problem has occurred and take steps to ensure that it doesn't happen again. If the electrical system fails because of a poor connection, check the other connections in the system to make sure that they don't fail as well. If a particular fuse continues to blow, find out why - don't just replace one fuse after another. Remember, failure of a small component can often be indicative of potential failure or incorrect functioning of a more important component or system.

Engine

1 Engine will not rotate when attempting to start

1 Battery terminal connections loose or corroded (Chapter 1).
2 Battery discharged or faulty (Chapter 1).
3 Automatic transmission not completely engaged in Park (Chapter 7B) or clutch not completely depressed (Chapter 8).
4 Broken, loose or disconnected wiring in the starting circuit (Chapters 5 and 12).
5 Starter motor pinion jammed in flywheel ring gear (Chapter 5).
6 Starter solenoid faulty (Chapter 5).
7 Starter motor faulty (Chapter 5).
8 Ignition switch faulty (Chapter 12).
9 Starter pinion or flywheel teeth worn or broken (Chapter 5).

2 Engine rotates but will not start

1 Fuel tank empty.
2 Battery discharged (engine rotates slowly) (Chapter 5).
3 Battery terminal connections loose or corroded (Chapter 1).
4 Leaking fuel injector(s), faulty fuel pump, pressure regulator, etc. (Chapter 4).
5 Fuel not reaching fuel rail (Chapter 4).
6 Ignition components damp or damaged (Chapter 5).
7 Worn, faulty or incorrectly gapped spark plugs (Chapter 1).
8 Broken, loose or disconnected wiring in the starting circuit (Chapter 5).
9 Loose distributor is changing ignition timing (Chapter 5).
10 Broken, loose or disconnected wires at the ignition coil or faulty coil (Chapter 5).
11 Broken or stripped timing belt (Chapter 2).
12 Defective fuel pump relay and/or harness at relay (Chapter 4)

3 Engine hard to start when cold

1 Battery discharged or low (Chapter 1).
2 Malfunctioning fuel system (Chapter 4).
3 Injector(s) leaking (Chapter 4).
4 Distributor rotor carbon tracked (Chapter 5).

4 Engine hard to start when hot

1 Air filter clogged (Chapter 1).
2 Fuel not reaching the fuel injection system (Chapter 4).
3 Corroded battery connections, especially ground (Chapter 1).
4 Malfunctioning EVAP system (Chapter 6).

5 Starter motor noisy or excessively rough in engagement

1 Pinion or flywheel gear teeth worn or broken (Chapter 5).
2 Starter motor mounting bolts loose or missing (Chapter 5).

6 Engine starts but stops immediately

1 Loose or faulty electrical connections at distributor, coil or alternator (Chapter 5).
2 Insufficient fuel reaching the fuel injector(s) (Chapters 1 and 4).
3 Vacuum leak at the gasket between the intake manifold and throttle body (Chapters 1 and 4).

7 Oil puddle under engine

1 Oil pan gasket and/or oil pan drain bolt washer leaking (Chapter 2).
2 Oil pressure sending unit leaking (Chapter 2).
3 Valve covers leaking (Chapter 2).
4 Engine oil seals leaking (Chapter 2).

8 Engine lopes while idling or idles erratically

1 Vacuum leakage (Chapters 2 and 4).
2 Defective EGR valve (Chapter 6).
3 Air filter clogged (Chapter 1).
4 Fuel pump not delivering sufficient fuel to the fuel injection system (Chapter 4).
5 Leaking head gasket (Chapter 2).
6 Timing belt and/or pulleys worn (Chapter 2).
7 Camshaft lobes worn (Chapter 2).

9 Engine misses at idle speed

1 Spark plugs worn or not gapped properly (Chapter 1).
2 Faulty spark plug wires (Chapter 1).
3 Vacuum leaks (Chapter 1).
4 Incorrect ignition timing (Chapter 1).
5 Uneven or low compression (Chapter 2).

10 Engine misses throughout the driving speed range

1 Fuel filter clogged and/or impurities in the fuel system (Chapter 1).
2 Low fuel pressure (Chapter 4).
3 Faulty or incorrectly gapped spark plugs (Chapter 1).
4 Incorrect ignition timing (Chapter 5).
5 Cracked distributor cap, disconnected distributor wires or damaged distributor components (Chapters 1 and 5).
6 Spark plug wires damaged and shorting out (Chapters 1 or 5).
7 Faulty emission system components (Chapter 6).
8 Low or uneven cylinder compression pressures (Chapter 2).
9 Weak or faulty ignition system (Chapter 5).
10 Vacuum leak in fuel injection system (Chapter 4), intake manifold (Chapters 2A/2B), fuel injection air control valve (Chapter 6) or vacuum hoses.

11 Engine stumbles on acceleration

1 Spark plugs fouled (Chapter 1).
2 Fuel injection system faulty (Chapter 4).
3 Fuel filter clogged (Chapters 1 and 4).
4 Incorrect ignition timing (Chapter 5).
5 Intake air leak (Chapters 2 and 4).

12 Engine surges while holding accelerator steady

1 Intake air leak (Chapter 4).
2 Fuel pump faulty (Chapter 4).
3 Loose fuel injector wire harness connectors (Chapter 4).
4 Defective ECU or information sensor (Chapter 6).

13 Engine stalls

1 Idle speed incorrect (Chapter 1).
2 Fuel filter clogged and/or water and impurities in the fuel system (Chapters 1 and 4).
3 Distributor components damp or damaged (Chapter 5).
4 Faulty emissions system components (Chapter 6).
5 Faulty or incorrectly gapped spark plugs (Chapter 1).
6 Faulty spark plug wires (Chapter 1).
7 Vacuum leak in the intake manifold or vacuum hoses (Chapters 2 and 4).
8 Valve clearances incorrectly set (Chapter 1).

14 Engine lacks power

1 Incorrect ignition timing (Chapter 5).
2 Excessive play in distributor shaft (Chapter 5).
3 Worn rotor, distributor cap or wires (Chapters 1 and 5).
4 Faulty or incorrectly gapped spark plugs (Chapter 1).
5 Fuel injection system malfunction (Chapter 4).
6 Faulty coil (Chapter 5).
7 Brakes binding (Chapter 9).
8 Automatic transaxle fluid level incorrect (Chapter 1).
9 Clutch slipping (Chapter 8).
10 Fuel filter clogged and/or impurities in the fuel system (Chapters 1 and 4).
11 Emission control system not functioning properly (Chapter 6).
12 Low or uneven cylinder compression pressures (Chapter 2).
13 Obstructed exhaust system (Chapter 4).

15 Engine backfires

1 Emission control system not functioning properly (Chapter 6).
2 Ignition timing incorrect (Chapter 5).
3 Faulty secondary ignition system (cracked spark plug insulator, faulty plug wires, distributor cap and/or rotor) (Chapters 1 and 5).
4 Fuel injection system malfunctioning (Chapter 4).
5 Vacuum leak at fuel injector(s), intake manifold, air control valve or vacuum hoses (Chapters 2 and 4).
6 Valve clearances incorrectly set and/or valves sticking (Chapter 1).

16 Pinging or knocking engine sounds during acceleration or uphill

1 Incorrect grade of fuel.
2 Ignition timing incorrect (Chapter 5).
3 Fuel injection system faulty (Chapter 4).
4 Improper or damaged spark plugs or wires (Chapter 1).
5 Worn or damaged distributor components (Chapter 5).
6 EGR valve not functioning (Chapter 6).
7 Vacuum leak (Chapters 2 and 4).
8 Knock sensor malfunctioning (Chapter 6).

17 Engine runs with oil pressure light on

1 Low oil level (Chapter 1).
2 Short in wiring circuit (Chapter 12).
3 Faulty oil pressure sender (Chapter 2).
4 Worn engine bearings and/or oil pump (Chapter 2).

18 Engine diesels (continues to run) after switching off

1 Leaking fuel injector(s).
2 Excessive engine operating temperature (Section 24).
3 Excessive carbon build-up on piston crowns (Chapter 2).

Engine electrical system

19 Battery will not hold a charge

1 Alternator drivebelt defective or not adjusted properly (Chapter 1).
2 Battery electrolyte level low (Chapter 1).
3 Battery terminals loose or corroded (Chapter 1).
4 Alternator not charging properly (Chapter 5).
5 Loose, broken or faulty wiring in the charging circuit (Chapter 5).
6 Short in vehicle wiring (Chapter 12).
7 Internally defective battery (Chapters 1 and 5).

20 Alternator light fails to go out

1 Faulty alternator or charging circuit (Chapter 5).
2 Alternator drivebelt defective or out of adjustment (Chapter 1).
3 Alternator voltage regulator inoperative (Chapter 5).

21 Alternator light fails to come on when key is turned on

1 Warning light bulb defective (Chapter 5).
2 Fault in the printed circuit, dash wiring or bulb holder (Chapter 12).

Fuel system

22 Excessive fuel consumption

1 Dirty or clogged air filter element (Chapter 1).
2 Incorrectly set ignition timing (Chapters 1 and 5).
3 Emissions system not functioning properly (Chapter 6).
4 Fuel injection system malfunctioning (Chapter 4).
5 Low tire pressure or incorrect tire size (Chapter 1).

23 Fuel leakage and/or fuel odor

1 Leaking fuel feed or return line (Chapters 1 and 4).
2 Tank overfilled.
3 Evaporative canister filter clogged (Chapters 1 and 6).
4 Fuel injectors faulty (Chapter 4).

Cooling system

24 Overheating

1 Insufficient coolant in system (Chapter 1).
2 Radiator core blocked or grille restricted (Chapter 3).
3 Thermostat faulty (Chapter 3).
4 Electric cooling fan circuit problem (Chapter 3).
5 Radiator cap not maintaining proper pressure (Chapter 3).
6 Ignition timing incorrect (Chapters 1 and 5).

25 Overcooling

1 Faulty thermostat (Chapter 3).
2 Inaccurate temperature gauge sending unit (Chapter 3).
3 Electric cooling fan circuit problem (Chapter 3).

26 External coolant leakage

1 Deteriorated/damaged hoses; loose clamps (Chapters 1 and 3).
2 Water pump defective (Chapter 3).
3 Leakage from radiator core or coolant reservoir bottle (Chapter 3).
4 Engine drain or water jacket core plugs leaking (Chapter 2).

27 Internal coolant leakage

1 Leaking cylinder head gasket (Chapter 2).
2 Cracked cylinder bore or cylinder head (Chapter 2).

28 Coolant loss

1 Too much coolant in system (Chapter 1).
2 Coolant boiling away because of overheating (Chapter 3).
3 Internal or external leakage (Chapter 3).
4 Faulty radiator cap (Chapter 3).

29 Poor coolant circulation

1 Inoperative water pump (Chapter 3).
2 Restriction in cooling system (Chapters 1 and 3).
3 Thermostat sticking (Chapter 3).

Clutch

30 Pedal travels to floor - no pressure or very little resistance

1 No fluid in reservoir (Chapter 1)
2 Faulty clutch master cylinder, release cylinder or hydraulic line (Chapter 8).
3 Broken release bearing or fork (Chapter 8).

31 Unable to select gears

1 Faulty transaxle (Chapter 7).
2 Faulty clutch disc (Chapter 8).
3 Release lever and bearing not assembled properly (Chapter 8).
4 Faulty pressure plate (Chapter 8).
5 Pressure plate-to-flywheel bolts loose (Chapter 8).

32 Clutch slips (engine speed increases with no increase in vehicle speed)

1 Clutch plate worn (Chapter 8).
2 Clutch plate is oil soaked by leaking rear main seal (Chapter 8).
3 Clutch plate not seated. It may take 30 or 40 normal starts for a new one to seat.
4 Warped pressure plate or flywheel (Chapter 8).
5 Weak diaphragm spring (Chapter 8).
6 Clutch plate overheated. Allow to cool.

33 Grabbing (chattering) as clutch is engaged

1 Oil on clutch plate lining, burned or glazed facings (Chapter 8).
2 Worn or loose engine or transaxle mounts (Chapters 2 and 7).
3 Worn splines on clutch plate hub (Chapter 8).
4 Warped pressure plate or flywheel (Chapter 8).
5 Burned or smeared resin on flywheel or pressure plate (Chapter 8).

34 Transaxle rattling (clicking)

1 Release lever loose (Chapter 8).
2 Low engine idle speed (Chapters 1 and 5).

35 Noise in clutch area

1 Fork shaft improperly installed (Chapter 8).
2 Faulty bearing (Chapter 8).

36 Clutch pedal stays on floor

1 Faulty clutch master or release cylinder (Chapter 8).
2 Broken release bearing or fork (Chapter 8).

37 High pedal effort

1 Piston binding in bore of clutch master or release cylinder (Chapter 8).
2 Pressure plate faulty (Chapter 8).

Manual transaxle

38 Knocking noise at low speeds

1 Worn driveaxle constant velocity (CV) joints (Chapter 8).
2 Worn driveaxle bore in differential case (Chapter 7A).*

39 Noise most pronounced when turning

Differential gear noise (Chapter 7A).*

40 Clunk on acceleration or deceleration

1 Loose engine or transaxle mounts (Chapters 2 and 7A).
2 Worn differential pinion shaft in case.*
3 Worn driveaxle bore in differential case (Chapter 7A).*
4 Worn or damaged driveaxle inboard CV joints (Chapter 8).

41 Clicking noise in turns

Worn or damaged outboard CV joint (Chapter 8).

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 block (Chapter 7A).
6 Worn shift fork (Chapter 7A).*

47 Leaks lubricant

1 Driveaxle oil seals worn (Chapter 7).
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).*

48 Locked in gear

Lock pin or interlock pin missing (Chapter 7A).*

** Although the corrective action necessary to remedy the symptoms described is beyond the scope of the home mechanic, 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 transmission shop.*

49 Fluid leakage

1 Automatic transmission 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)

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

Kick-down solenoid faulty (Chapter 7B).

53 Engine will start in gears other than Park or Neutral

Neutral start switch 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 fluid level and fluid and filter condition. 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).

56 Shudder or vibration during acceleration

1 Excessive toe-in (Chapter 10).
2 Incorrect spring heights (Chapter 10).
3 Worn or damaged inboard or outboard CV joints (Chapter 8).
4 Sticking inboard CV joint assembly (Chapter 8).

57 Vibration at highway speeds

1 Out of balance front wheels and/or tires (Chapters 1 and 10).
2 Out of round front tires (Chapters 1 and 10).
3 Worn CV joint(s) (Chapter 8).

Brakes

Note: *Before assuming that a brake problem exists, make sure that:*

a) The tires are in good condition and properly inflated (Chapter 1).
b) The front end alignment is correct (Chapter 10).
c) The vehicle is not loaded with weight in an unequal manner.

58 Vehicle pulls to one side during braking

1 Incorrect tire pressures (Chapter 1).
2 Front end out of line (have the front end aligned).
3 Front, or rear, tires not matched to one another.
4 Restricted brake lines or hoses (Chapter 9).
5 Malfunctioning drum brake or caliper assembly (Chapter 9).
6 Loose suspension parts (Chapter 10).
7 Loose calipers (Chapter 9).
8 Excessive wear of brake shoe or pad material or disc/drum on one side.

59 Noise (high-pitched squeal when the brakes are applied)

Disc brake pads worn out (Chapter 9).

60 Brake roughness or chatter (pedal pulsates)

1 Excessive lateral runout (Chapter 9).
2 Uneven pad wear (Chapter 9).
3 Defective disc (Chapter 9).

61 Excessive brake pedal effort required to stop vehicle

1 Malfunctioning power brake booster (Chapter 9).
2 Partial system failure (Chapter 9).
3 Excessively worn pads or shoes (Chapter 9).
4 Piston in caliper or wheel cylinder stuck or sluggish (Chapter 9).
5 Brake pads or shoes contaminated with oil or grease (Chapter 9).
6 New pads or shoes installed and not yet seated. It will take a while for the new material to seat against the disc or drum.

62 Excessive brake pedal travel

1 Partial brake system failure (Chapter 9).
2 Insufficient fluid in master cylinder (Chapters 1 and 9).
3 Air trapped in system (Chapters 1 and 9).

63 Dragging brakes

1 Incorrect adjustment of brake light switch (Chapter 9).
2 Master cylinder pistons not returning correctly (Chapter 9).
3 Restricted brakes lines or hoses (Chapters 1 and 9).
4 Incorrect parking brake adjustment (Chapter 9).

64 Grabbing or uneven braking action

1 Brake pads or shoes worn out (Chapter 9).
2 Malfunction of proportioning valve (Chapter 9).
3 Binding brake pedal mechanism (Chapter 9).

65 Brake pedal feels spongy when depressed

1 Air in hydraulic lines (Chapter 9).
2 Master cylinder mounting bolts loose (Chapter 9).
3 Master cylinder defective (Chapter 9).

66 Brake pedal travels to the floor with little resistance

1 Little or no fluid in the master cylinder reservoir caused by a leak in the system (Chapter 9).
2 Loose, damaged or disconnected brake lines (Chapter 9).
3 Defective master cylinder (Chapter 9).

67 Parking brake does not hold

Parking brake linkage improperly adjusted (Chapters 1 and 9).

Suspension and steering systems

Note: *Before attempting to diagnose the suspension and steering systems, perform the following preliminary checks:*

a) *Tires for wrong pressure and uneven wear.*
b) *Steering universal joints from the column to the steering gear for loose connectors or wear.*
c) *Front and rear suspension and the steering gear assembly for loose or damaged parts.*
d) *Out-of-round or out-of-balance tires, bent rims and loose and/or rough wheel bearings.*

68 Vehicle pulls to one side

1 Mismatched or uneven tires (Chapter 10).
2 Broken or sagging springs (Chapter 10).
3 Wheel alignment (Chapter 10).
4 Front brake dragging (Chapter 9).

69 Abnormal or excessive tire wear

1 Wheel alignment (Chapter 10).
2 Sagging or broken springs (Chapter 10).
3 Tire out of balance (Chapter 10).
4 Worn strut damper (Chapter 10).
5 Overloaded vehicle.
6 Tires not rotated regularly.

70 Wheel makes a thumping noise

1 Blister or bump on tire (Chapter 10).
2 Worn strut damper (Chapter 10).

71 Shimmy, shake or vibration

1 Tire or wheel out-of-balance or out-of-round (Chapter 10).
2 Loose or worn front hub or wheel bearings (Chapters 1, 8 and 10).
3 Worn tie-rod ends (Chapter 10).
4 Worn lower balljoints (Chapters 1 and 10).
5 Excessive wheel runout (Chapter 10).
6 Blister or bump on tire (Chapter 10).

72 Hard steering

1 Lack of lubrication at balljoints and tie-rod ends (Chapters 1 and 10).
2 Front wheel alignment (Chapter 10).
3 Low tire pressure(s) (Chapters 1 and 10).

73 Poor returnability of steering to center

1 Lack of lubrication at balljoints and tie-rod ends (Chapters 1 and 10).
2 Binding in balljoints (Chapter 10).
3 Binding in steering column (Chapter 10).
4 Lack of lubricant in steering gear assembly (Chapter 10).
5 Front wheel alignment (Chapter 10).

74 Abnormal noise at the front end

1 Lack of lubrication at balljoints and tie-rod ends (Chapters 1 and 10).
2 Damaged shock absorber mount (Chapter 10).
3 Worn control arm bushings or tie-rod ends (Chapter 10).
4 Loose stabilizer bar (Chapter 10).
5 Loose wheel nuts (Chapters 1 and 10).
6 Loose suspension bolts (Chapter 10)

75 Wander or poor steering stability

1 Mismatched or uneven tires (Chapter 10).
2 Lack of lubrication at balljoints and tie-rod ends (Chapters 1 and 10).
3 Worn strut assemblies (Chapter 10).
4 Loose stabilizer bar (Chapter 10).
5 Broken or sagging springs (Chapter 10).
6 Wheels out of alignment (Chapter 10).

76 Erratic steering when braking

1 Front hub bearings worn (Chapter 10).
2 Broken or sagging springs (Chapter 10).
3 Leaking wheel cylinder or caliper (Chapter 10).
4 Warped discs or drums (Chapter 10).

77 Excessive pitching and/or rolling around corners or during braking

1 Loose stabilizer bar (Chapter 10).
2 Worn strut assemblies or mountings (Chapter 10).
3 Broken or sagging springs (Chapter 10).
4 Overloaded vehicle.

78 Suspension bottoms

1 Overloaded vehicle.
2 Worn strut assemblies (Chapter 10).
3 Incorrect, broken or sagging springs (Chapter 10).

79 Cupped tires

1 Front wheel or rear wheel alignment (Chapter 10).
2 Worn strut assemblies (Chapter 10).
3 Wheel bearings worn (Chapter 10).
4 Excessive tire or wheel runout (Chapter 10).
5 Worn balljoints (Chapter 10).

80 Excessive tire wear on outside edge

1 Inflation pressures incorrect (Chapter 1).
2 Excessive speed in turns.

3 Front end alignment incorrect (excessive toe-in). Have professionally aligned.
4 Suspension arm bent or twisted (Chapter 10).

81 Excessive tire wear on inside edge

1 Inflation pressures incorrect (Chapter 1).
2 Front end alignment incorrect (toe-out). Have professionally aligned.
3 Loose or damaged steering or suspension components (Chapter 10).

82 Tire tread worn in one place

1 Tires out of balance.
2 Damaged or buckled wheel. Inspect and replace if necessary.
3 Defective tire (Chapter 1).

83 Excessive play or looseness in steering system

1 Front hub bearing(s) worn (Chapter 10).
2 Tie-rod end loose (Chapter 10).
3 Steering gear loose or worn (Chapter 10).
4 Worn or loose steering intermediate shaft (Chapter 10).

84 Rattling or clicking noise in steering gear

1 Steering gear loose (Chapter 10).
2 Steering gear defective.

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Chapter 1
Tune-up and routine maintenance

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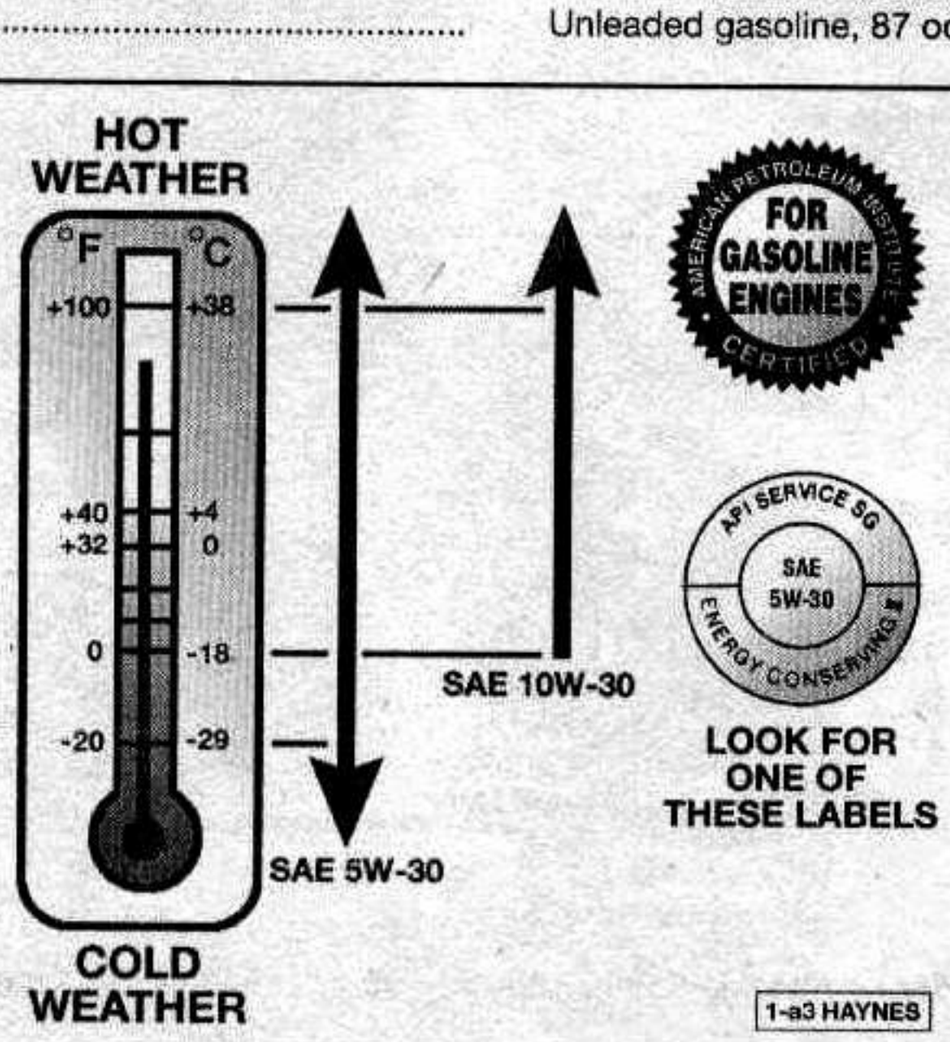
Specifications

Recommended lubricants and fluids

Note: *Manufacturers occasionally upgrade their fluid and lubricant specifications. Check with your local auto parts store for the most current recommendations.*

Engine oil	
Type	API grade SJ multigrade fuel efficient oil
Viscosity	5W-30
Automatic transmission fluid	Mercon III automatic transmission fluid
Manual transaxle lubricant	SAE 75W/90 gear oil
Brake fluid type	DOT 3 brake fluid
Power steering system fluid	Mercon III automatic transmission fluid
Fuel type	Unleaded gasoline, 87 octane or higher



Engine oil viscosity chart - for best fuel economy and cold starting, select the lowest SAE viscosity grade for the expected temperature range

Capacities*

Engine oil, with filter change	
V6 engine	4.2 qts
Four-cylinder engine	3.7 qts
Automatic transaxle**	
Four-cylinder engine	6.0 qts
V6 engine	7.2 qts
Manual transaxle	2.9 qts
Coolant	
V6 engine	7.9 qts
Four-cylinder engine	7.4 qts

**All capacities approximate. Fill below total capacity, then add as necessary to bring to appropriate level.*

***Listed are total new-unit fill capacities (less torque converter). Refill after draining is substantially less. The best way to determine the amount of fluid to add during a routine fluid change is to measure the amount drained.*

Ignition system

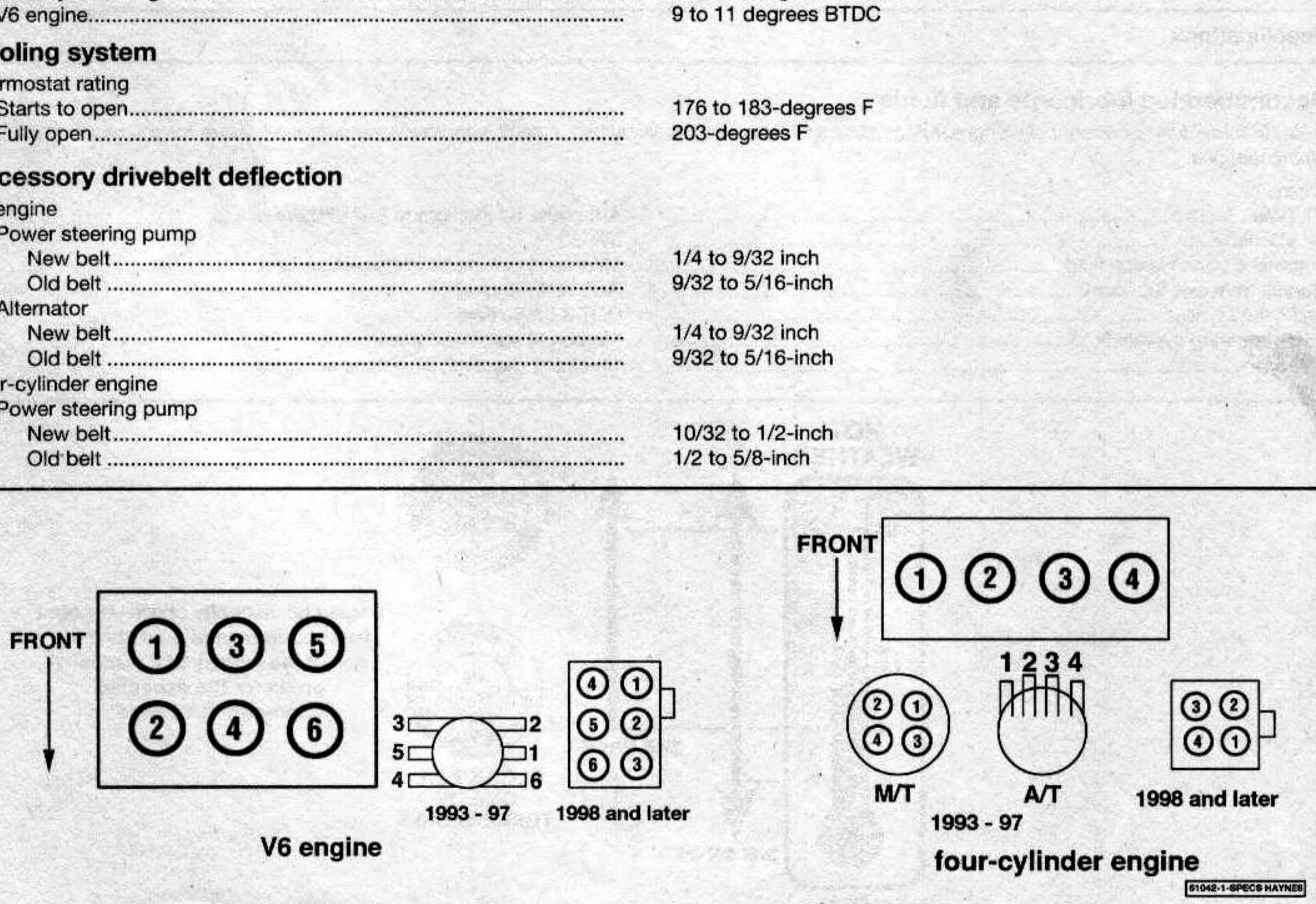
Spark plug type and gap	
Type	
Four-cylinder models	NGK BKR5E-11 or Motorcraft AGSP 32C
V6 models	
1993 to 1997	NGK ZFR5F-11 or Motorcraft AGSP 33C
1998 and later	Nippondenso PKJ16CR8
Gap	
All except 1998 and later V6	0.039 to 0.043-inch
1998 and later V6	0.028 to 0.031-inch
Spark plug wire resistance	16 K-ohms per 40 inches of length
Engine firing order	
Four-cylinder engine	1-3-4-2
V6 engine	1-2-3-4-5-6
Ignition timing	
Four-cylinder engine	11 to 13 degrees BTDC
V6 engine	9 to 11 degrees BTDC

Cooling system

Thermostat rating	
Starts to open	176 to 183-degrees F
Fully open	203-degrees F

Accessory drivebelt deflection

V6 engine	
Power steering pump	
New belt	1/4 to 9/32 inch
Old belt	9/32 to 5/16-inch
Alternator	
New belt	1/4 to 9/32 inch
Old belt	9/32 to 5/16-inch
Four-cylinder engine	
Power steering pump	
New belt	10/32 to 1/2-inch
Old belt	1/2 to 5/8-inch



Engine cylinder numbering and distributor cap or coil pack terminal locations

Alternator	
Without air-conditioning	
New belt	5/16 to 3/8-inch
Old belt	7/16 to 1/2-inch
With air-conditioning	
New belt	3/16 to 1/4-inch
Old belt	5/16 to 3/8-inch

Brakes

Disc brake pad lining thickness (minimum)	1/16-inch
Drum brake shoe lining thickness (minimum)	1/16-inch
Parking brake adjustment	
Drum rear brake	4 to 7 clicks
Disc rear brake	6 to 9 clicks

Idle Speed

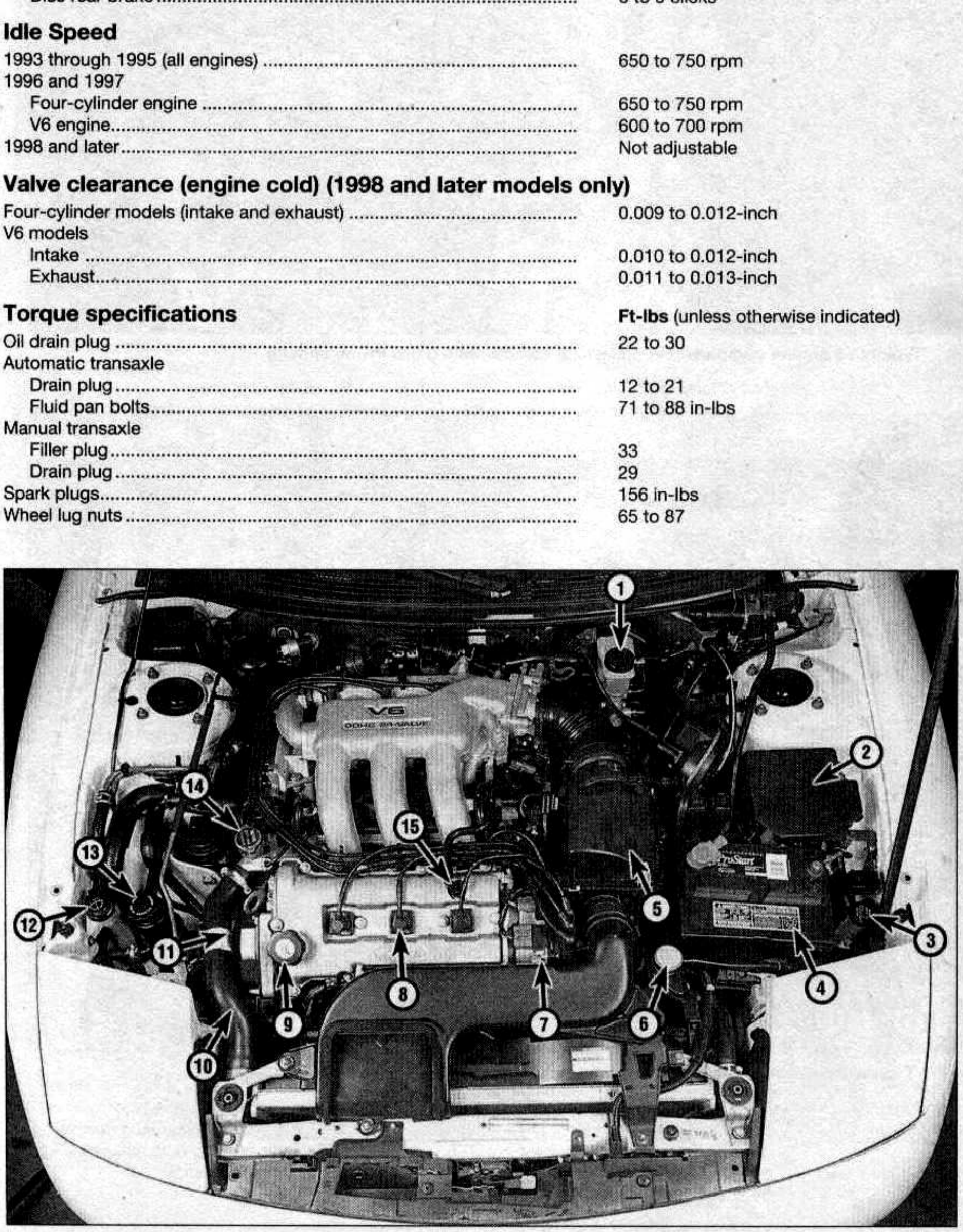
1993 through 1995 (all engines)	650 to 750 rpm
1996 and 1997	
Four-cylinder engine	650 to 750 rpm
V6 engine	600 to 700 rpm
1998 and later	Not adjustable

Valve clearance (engine cold) (1998 and later models only)

Four-cylinder models (intake and exhaust)	0.009 to 0.012-inch
V6 models	
Intake	0.010 to 0.012-inch
Exhaust	0.011 to 0.013-inch

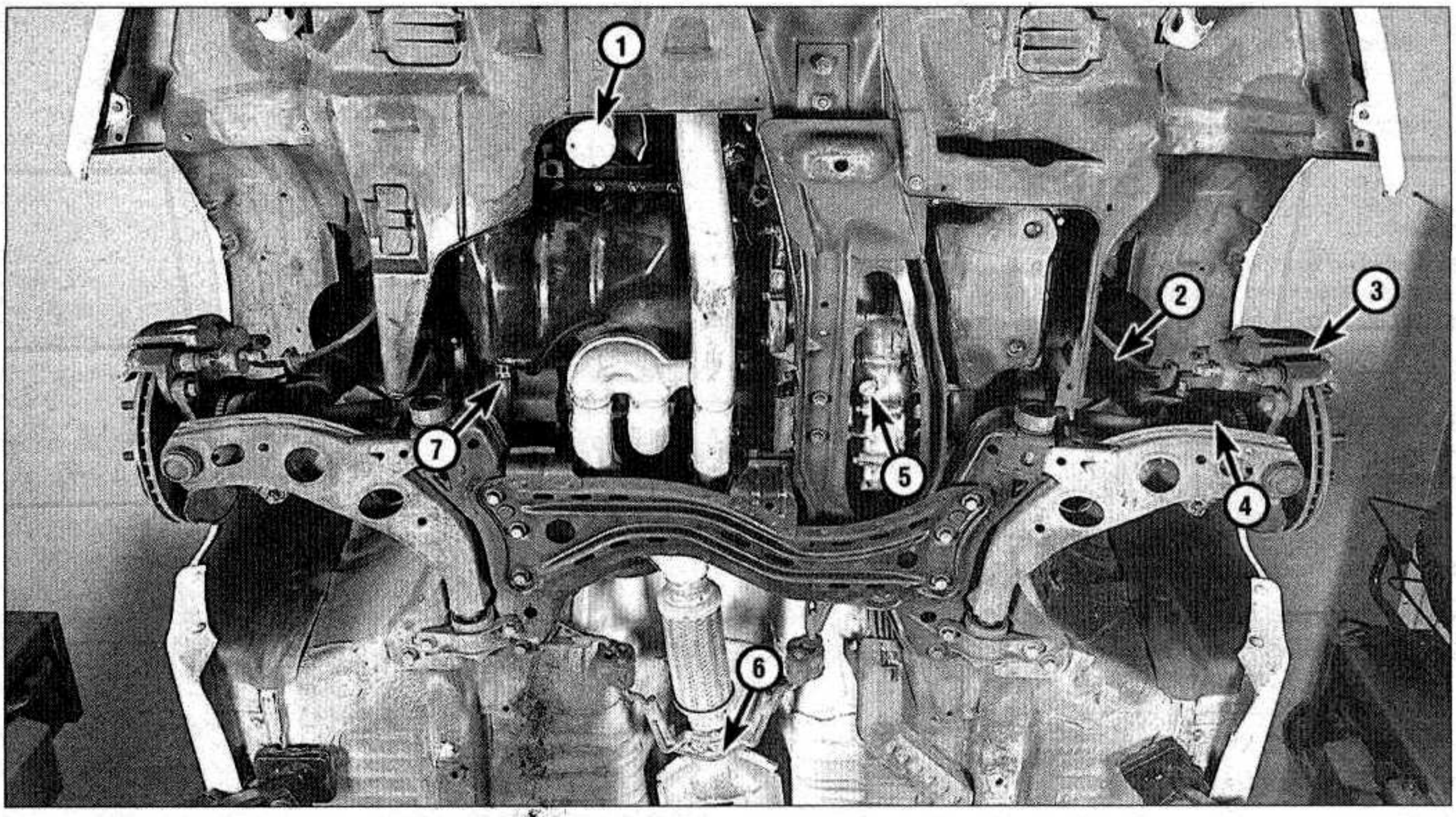
Torque specifications

	Ft-lbs (unless otherwise indicated)
Oil drain plug	22 to 30
Automatic transaxle	
Drain plug	12 to 21
Fluid pan bolts	71 to 88 in-lbs
Manual transaxle	
Filler plug	33
Drain plug	29
Spark plugs	156 in-lbs
Wheel lug nuts	65 to 87



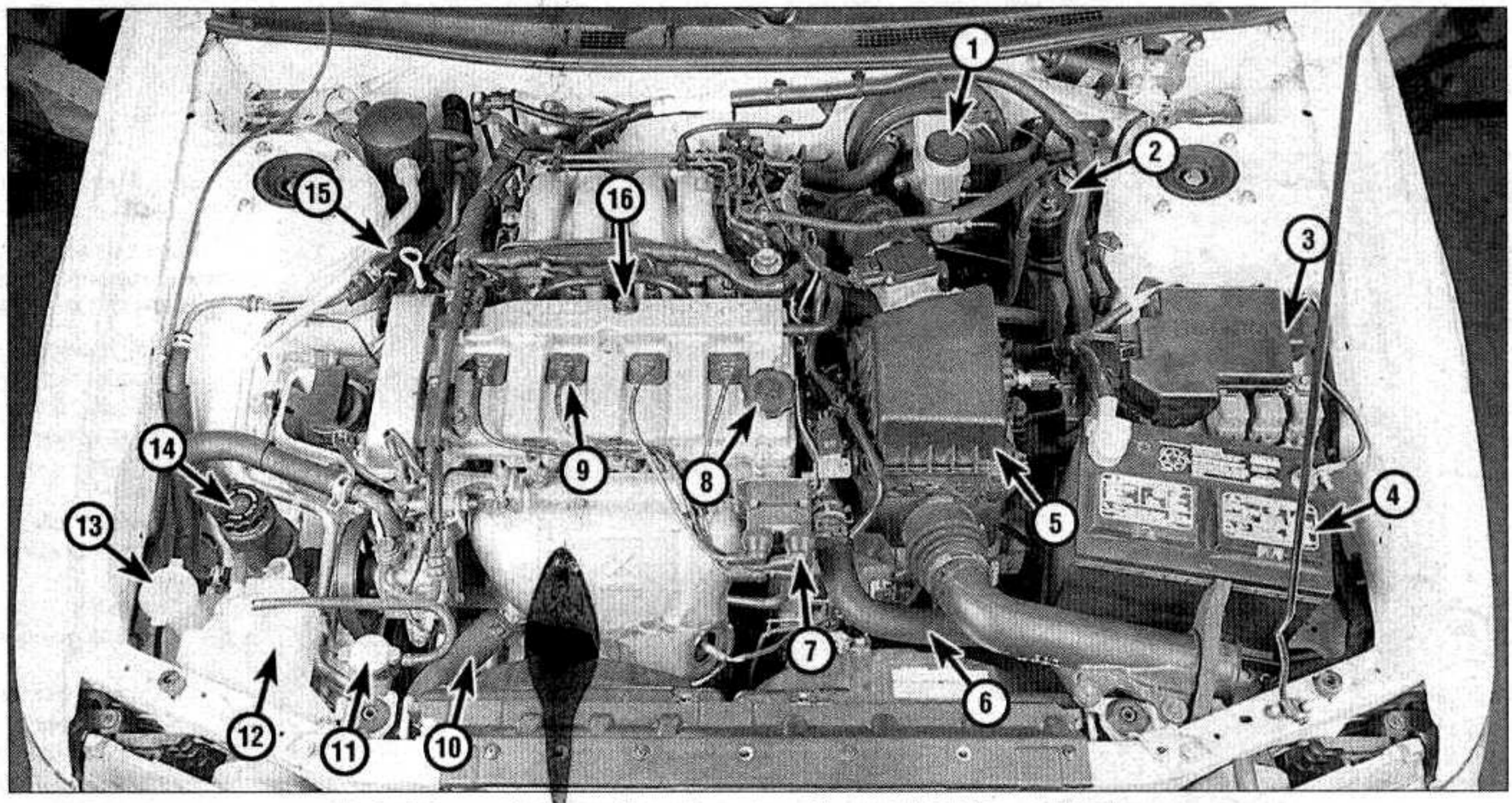
Typical V6 engine compartment layout (Ford Probe shown)

1 *Brake master cylinder reservoir*
2 *Fuse/relay panel*
3 *Engine coolant reservoir*
4 *Battery*
5 *Air filter housing*
6 *Radiator breather cap*
7 *Distributor*
8 *Spark plug and wire boot*
9 *Engine oil filler cap*
10 *Radiator hose*
11 *Engine oil dipstick*
12 *Windshield washer fluid reservoir*
13 *Power steering fluid reservoir*
14 *Coolant filler cap*
15 *PCV valve*



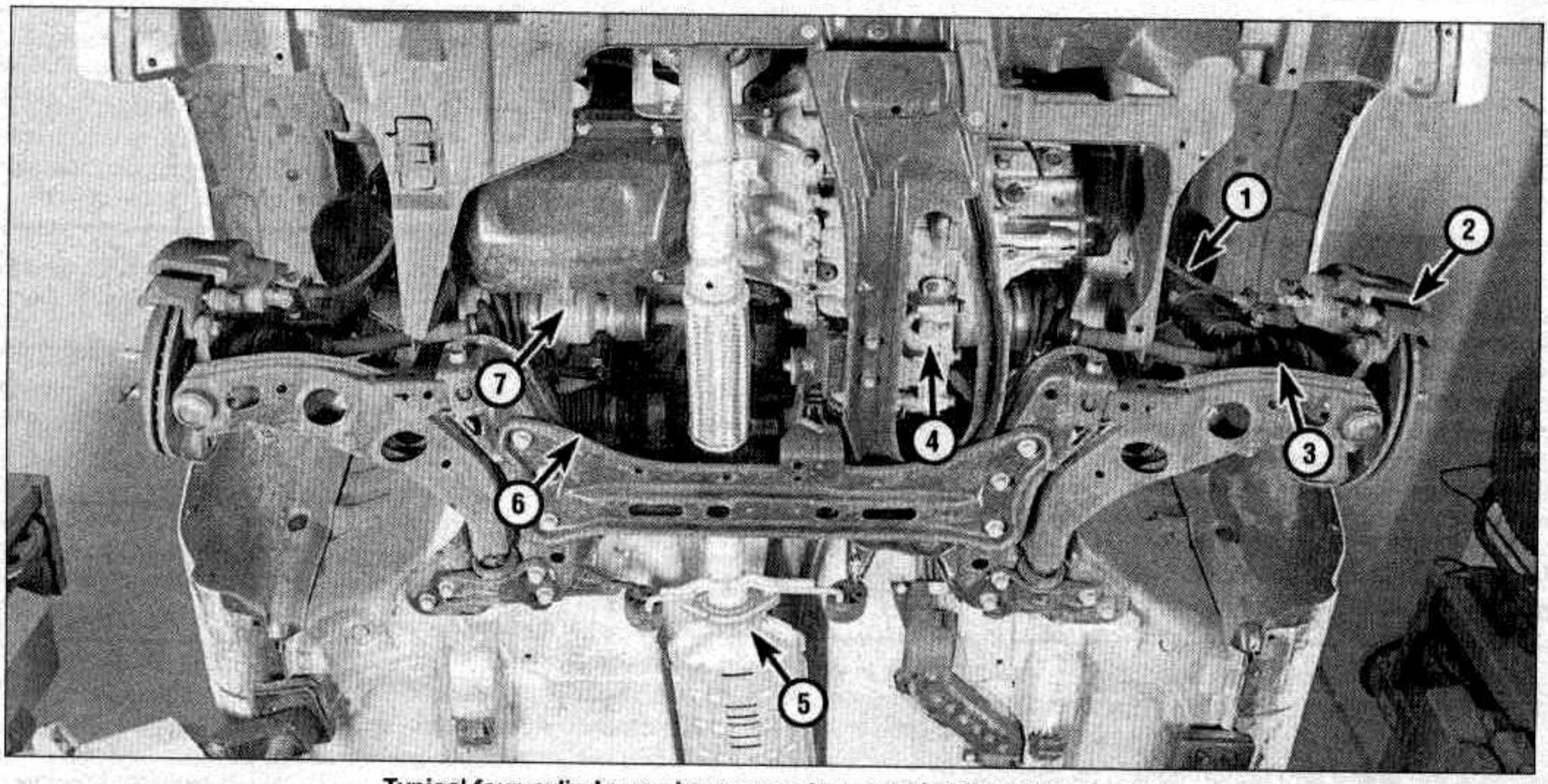
Typical V6 engine compartment underside components (Ford Probe shown)

1 *Engine oil filter*
2 *Brake line*
3 *Front brake caliper*
4 *Outer driveaxle boot*
5 *Transaxle drain plug (Automatic)*
6 *Exhaust system*
7 *Engine oil drain plug*



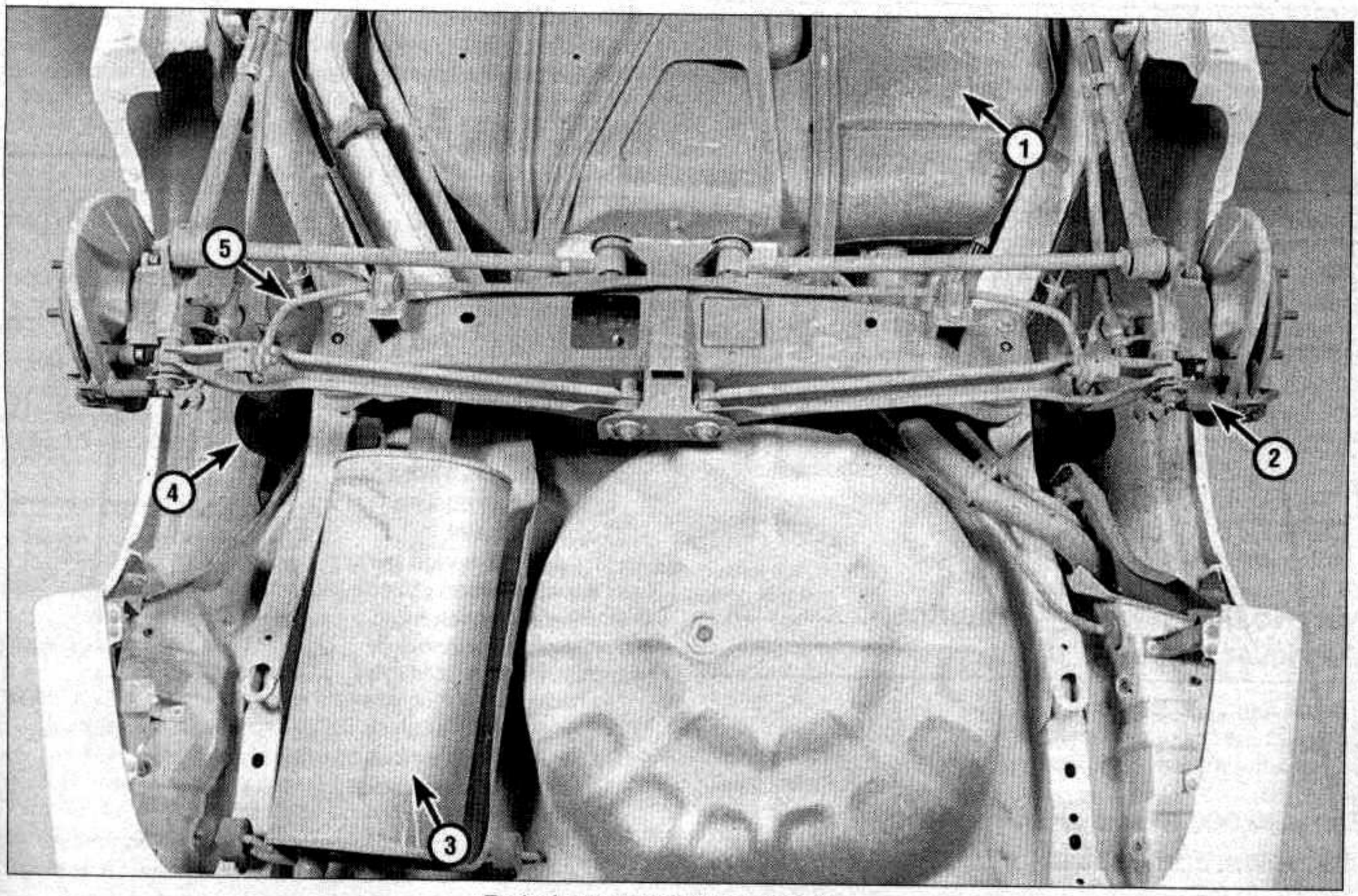
Typical four-cylinder engine compartment layout (1998 Mazda 626 shown)

1 *Brake master cylinder reservoir*
2 *Fuel filter*
3 *Fuse/relay panel*
4 *Battery*
5 *Air filter housing*
6 *Upper radiator hose*
7 *Ignition coil pack*
8 *Engine oil filler cap*
9 *Spark plug and wire boot*
10 *Lower radiator hose*
11 *Radiator cap*
12 *Engine coolant reservoir*
13 *Windshield washer fluid reservoir*
14 *Power steering fluid reservoir*
15 *Engine oil dipstick*
16 *PCV valve*



Typical four-cylinder engine compartment underside components

1 *Brake line*
2 *Front brake caliper*
3 *Outer driveaxle boot*
4 *Transaxle drain plug (Manual)*
5 *Exhaust system*
6 *Steering gear boot*
7 *Engine oil drain plug*



Typical rear underside components

1 *Fuel tank*
2 *Brake caliper*
3 *Muffler*
4 *Shock and spring assembly*
5 *Stabilizer bar*

1 Ford Probe, Mazda 626 and MX-6 Maintenance schedule

The maintenance intervals in this manual are provided with the assumption that you, not the dealer, will be doing the work. These are the minimum maintenance intervals recommended by the factory for vehicles that are driven daily. If you wish to keep your vehicle in peak condition at all times, you may wish to perform some of these procedures even more often. Because frequent maintenance enhances the efficiency, performance and resale value of your car, we encourage you to do so. If you drive in dusty areas, tow a trailer, idle or drive at low speeds for extended periods or drive for short distances (less than four miles) in below freezing temperatures, shorter intervals are also recommended.

When your vehicle is new, follow the maintenance schedule to the letter, record the maintenance performed in your owners manual and keep all receipts to protect the new vehicle warranty. In many cases, the initial maintenance check is done at no cost to the owner.

Every 250 miles or weekly, whichever comes first

Check the engine oil level (Section 4)
Check the engine coolant level (Section 4)
Check the windshield washer fluid level (Section 4)
Check the brake and clutch fluid level (Section 4)
Check the tires and tire pressures (Section 5)

Every 3000 miles or 3 months, whichever comes first

All items listed above plus:
Check the power steering fluid level (Section 6)
Check the automatic transaxle fluid level (Section 7)
Change the engine oil and oil filter (Section 8)

Every 7500 miles or 6 months, whichever comes first

All items listed above plus:
Seat belt check (Section 9)
Inspect and replace, if necessary, the windshield wiper blades (Section 10)
Check and service the battery (Section 11)
Check and adjust, if necessary, the engine drivebelts (Section 12)
Inspect and replace, if necessary, all underhood hoses (Section 13)
Check the cooling system (Section 14)
Rotate the tires (Section 15)

Every 15,000 miles or 12 months, whichever comes first

All items listed above plus:
Inspect the brake system (Section 16)*
Check the manual transaxle lubricant level (Section 17)*

Every 30,000 miles or 24 months, whichever comes first

All items listed above plus:
Replace the air filter (Section 18)*
Replace the spark plugs (four-cylinder models) (Section 19)
Inspect and replace, if necessary, the spark plug wires, distributor cap and rotor (Section 20)
Check and, if necessary, replace the PCV valve (Section 21)
Check and adjust, if necessary, the engine idle speed (1997 and earlier models only) (Section 22)
Check and, if necessary, adjust the ignition timing (1997 and earlier models only) (Section 23)
Service the cooling system (drain, flush and refill) (Section 24)
Replace the brake fluid (Section 25)
Inspect the suspension, steering components and driveaxle boots (Section 26)*
Change the automatic transaxle fluid (Section 27)**
Change the manual transaxle lubricant (Section 28)
Exhaust system check (Section 29)
Inspect the fuel system (Section 30)

Every 60,000 miles or 48 months, whichever comes first

Check and adjust if necessary, the valve clearance (1998 and later models only) (Section 31)
Replace the fuel filter (Section 32)
Replace the spark plugs, V6 models (Section 19)
Replace the timing belt (Chapter 2A and 2B)

**This item is affected by "severe" operating conditions as described below. If your vehicle is operated under "severe" conditions, perform all maintenance indicated with a * at 7500 mile/6 month intervals. Severe conditions are indicated if you mainly operate your vehicle under one or more of the following conditions:*

Operating in dusty areas
Towing a trailer
Idling for extended periods and/or low speed operation
Operating when outside temperatures remain below freezing and when most trips are less than five miles

***If operated under one or more of the following conditions, change the automatic transaxle fluid every 15,000 miles:*

In heavy city traffic where the outside temperature regularly reaches 90-degrees F (32-degrees C) or higher
In hilly or mountainous terrain
Operating in dusty areas
Towing a trailer
Idling for extended periods and/or low speed operation
Operating when outside temperatures remain below freezing and when most trips are less than five miles
In heavy city traffic or where the outside temperature regularly reaches 90-degrees F (32-degrees C) or higher

2 Introduction

This Chapter is designed to help the home mechanic maintain his/her car for peak performance, economy, safety and long life.

The following Sections deal specifically with each item on the maintenance schedule. Visual checks, adjustments, component replacement and other helpful items are included. Refer to the accompanying photos of the engine compartment and the underside of the vehicle for the location of various components.

Servicing your vehicle in accordance with the mileage/time maintenance schedule and the following Sections will provide it with a planned maintenance program that should result in a long and reliable service life. This is a comprehensive plan, so maintaining some items but not others at the specified service intervals will not produce the same results.

As you service your car, you will discover that many of the procedures can - and should - be grouped together because of the nature of the particular procedure you're performing or because of the close proximity of two otherwise unrelated components to one another. For example, if the vehicle is raised for chassis lubrication, you should inspect the exhaust, suspension, steering and fuel systems while you're under the vehicle. When you're rotating the tires, it makes good sense to check the brakes and wheel bearings since the wheels are already removed.

Finally, let's suppose you have to borrow or rent a torque wrench. Even if you only need to tighten the spark plugs, you might as well check the torque of as many critical fasteners as time allows.

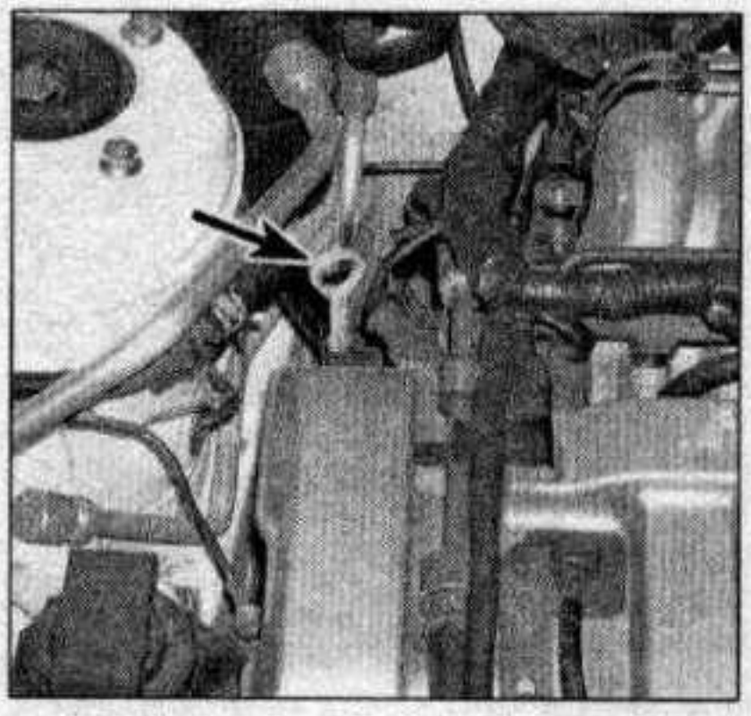
The first step of this maintenance program is to prepare you before the actual work begins. Read through all Sections pertinent to the procedures you're planning to do, then make a list of and gather together all the parts and tools you will need to do the job. If it looks as if you might run into problems during a particular segment of some procedure, seek advice from your local parts man or dealer service department.

3 Tune-up general information

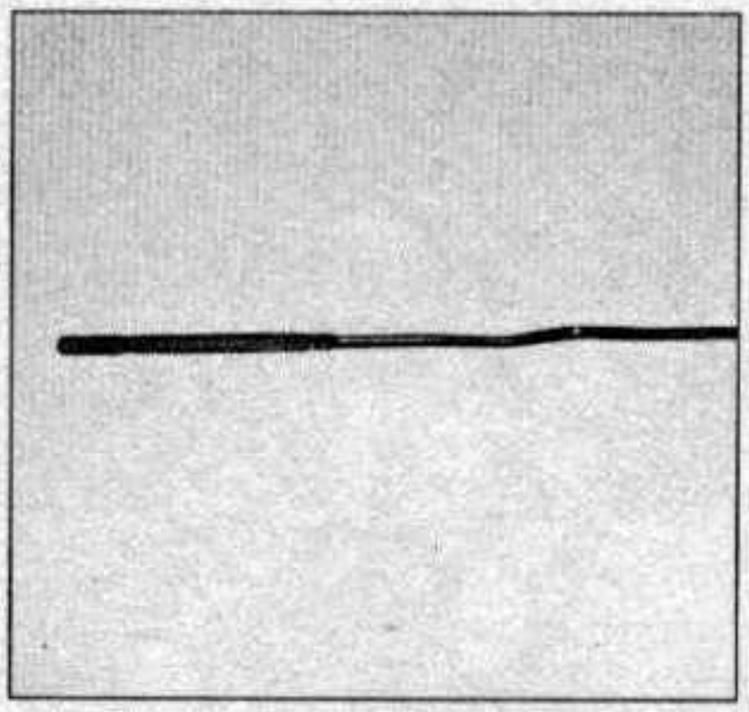
The term tune-up is used in this manual to represent a combination of individual operations rather than one specific procedure.

If, from the time the vehicle is new, the routine maintenance schedule is followed closely and frequent checks are made of fluid levels and high wear items, as suggested throughout this manual, the engine will be kept in relatively good running condition and the need for additional work will be minimized.

More likely than not, however, there will be times when the engine is running poorly due to lack of regular maintenance. This is even more likely if a used vehicle, which has not received regular and frequent maintenance checks, is purchased. In such cases, an engine tune-up will be needed outside of the regular routine maintenance intervals.



4.2 The engine oil dipstick (arrow) is located at the right rear of the engine



4.4 The oil level should be between the two lines on the dipstick - if it isn't, add enough oil to bring the level to or near the upper line (it takes one quart to raise the level from the lower line to the upper line)

The first step in any tune-up or engine diagnosis to help correct a poor running engine would be a cylinder compression check. A check of the engine compression (see Chapter 2 Part C) will give valuable information regarding the overall performance of many internal components and should be used as a basis for tune-up and repair procedures. If, for instance, a compression check indicates serious internal engine wear, a conventional tune-up will not help the running condition of the engine and would be a waste of time and money. Because of its importance, someone should perform compression checking with the proper compression testing gauge and the knowledge to use it properly.

The following series of operations are those most often needed to bring a generally poor running engine back into a proper state of tune.

Minor tune-up

Check all engine related fluids (Section 4)
Clean, inspect and test the battery (Section 11)
Check and adjust the drivebelts (Section 12)
Check all underhood hoses (Section 13)
Check the cooling system (Section 14)
Check the air filter (Section 18)
Inspect the spark plug wires, distributor cap and rotor (Section 20)

Major tune-up

All items listed under minor tune-up, plus . . .
Replace the air filter (Section 18)
Replace the spark plugs (Section 19)
Check the idle speed (Section 22)
Check the ignition timing (Section 23)
Replace the distributor cap and rotor (Section 20)
Replace the spark plug wires (Section 20)
Check the fuel system (Section 30)

4 Fluid level checks (every 250 miles or weekly)

1 Fluids are an essential part of the lubrication, cooling, brake, clutch and other systems. Because these fluids gradually become depleted and/or contaminated during normal operation of the vehicle, they must be periodically replenished. See *Recommended lubricants, fluids and capacities* at the beginning of this Chapter before adding fluid to any of the following components. **Note:** *The vehicle must be on level ground before fluid levels can be checked.*

Engine oil

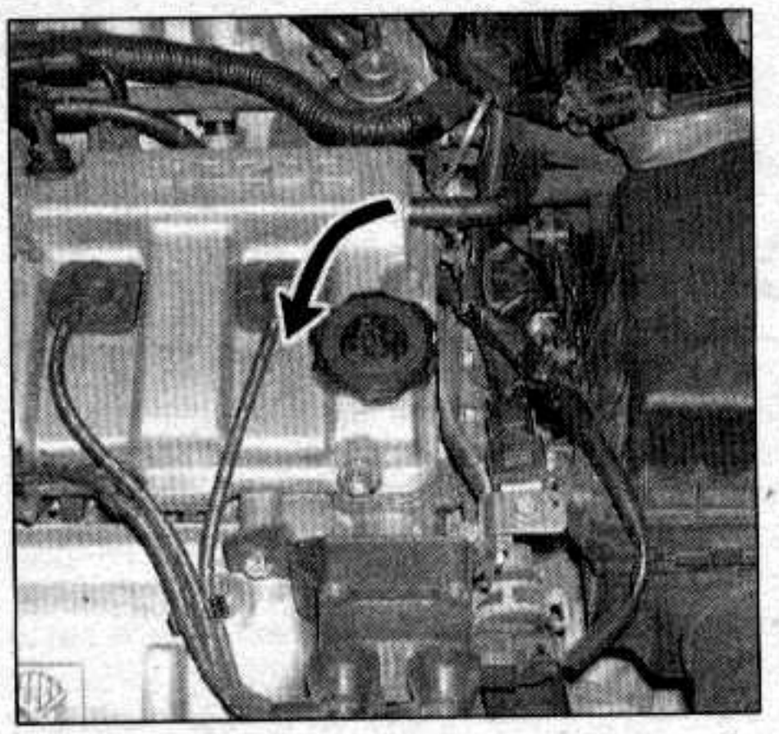
Refer to illustrations 4.2, 4.4 and 4.6

2 The engine oil level is checked with a dipstick located at the right rear of the engine **(see illustration)**. The dipstick extends through a metal tube from which it protrudes down into the engine oil pan.

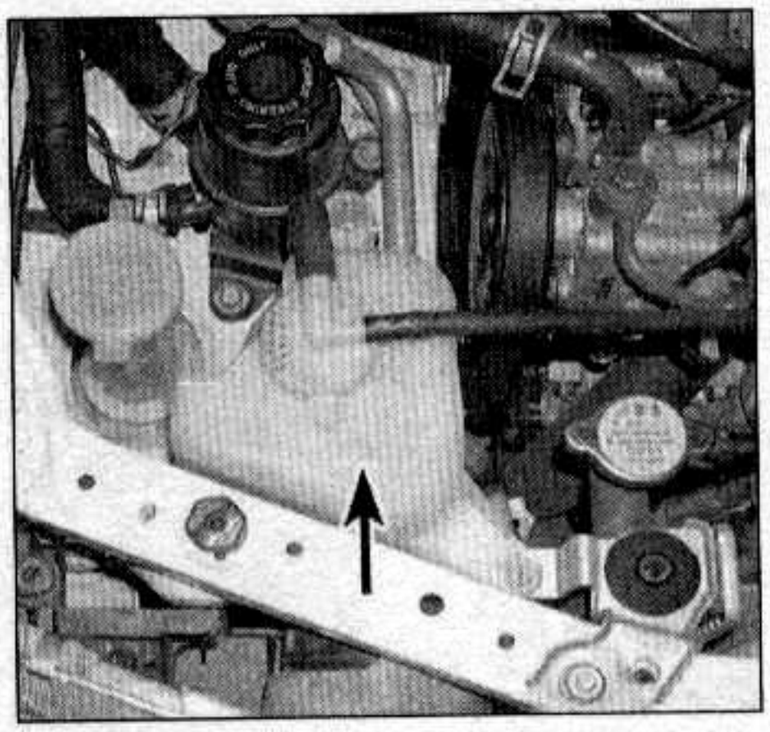
3 The oil level should be checked before the vehicle has been driven, or about 15 minutes after the engine has been shut off. If the oil is checked immediately after driving the vehicle, some of the oil will remain in the upper engine components, producing an inaccurate reading on the dipstick.

4 Pull the dipstick from the tube and wipe all the oil from the end with a clean rag or paper towel. Insert the clean dipstick all the way back into its metal tube and pull it out again. Observe the oil at the end of the dipstick. At its highest point, the level should be between the upper and lower lines **(see illustration)**.

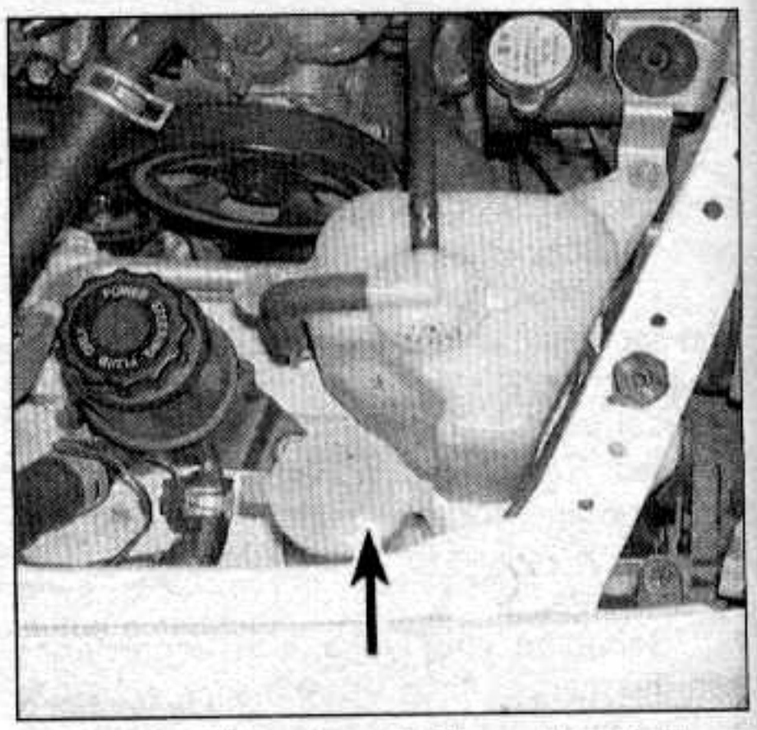
5 It takes one quart of oil to raise the level from the lower line to the upper line on the dipstick. Do not allow the level to drop below the lower line or oil starvation may cause engine damage. Conversely, overfilling the engine (adding oil above the upper line) may cause oil fouled spark plugs, oil leaks or oil seal failures.



4.6 The threaded oil filler cap is located on the valve cover - to prevent dirt from contaminating the engine, always make sure the area around this opening is clean before unscrewing the cap (counterclockwise)



4.9 On 1998 and later models, make sure the coolant level is between the MAX and MIN lines on side of the coolant reservoir (arrow) - if it's below the MIN line, detach the cap and add a sufficient quantity of the specified mixture of antifreeze and water



4.14a The windshield washer fluid reservoir (arrow) is located in front corner of the engine compartment - fluid can be added after removing the cap

4.14b The rear window washer fluid reservoir (arrow) is accessible with the liftgate open - add fluid after lifting up the cap

6 Remove the threaded cap from the valve cover to add oil **(see illustration)**. Use an oil can spout or funnel to prevent spills. After adding the oil, install the filler cap hand tight. Start the engine and look carefully for any small leaks around the oil filter or drain plug. Stop the engine and check the oil level again after it has had sufficient time to drain from the upper block and cylinder head galleys.

7 Checking the oil level is an important preventive maintenance step. A continually dropping oil level indicates oil leakage through damaged seals, from loose connections, or past worn rings or valve guides. If the oil looks milky in color or has water droplets in it, a cylinder head gasket may be blown or the oil cooler could be leaking. The engine should be checked immediately. The condition of the oil should also be checked. Each time you check the oil level, slide your thumb and index finger up the dipstick before wiping off the oil. If you see small dirt or metal particles clinging to the dipstick, the oil should be changed (see Section 8).

Engine coolant

Refer to illustration 4.9

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

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

8 All vehicles covered by this manual are equipped with a pressurized coolant-recovery system. A coolant reservoir located in the front corner of the engine compartment is connected by a hose to the base of the radiator filler neck. If the coolant heats up during engine operation, coolant can escape through the pressurized filler cap, then through the connecting hose into the reservoir. As the engine cools, the coolant is automatically drawn back into the cooling system to maintain the correct level.

9 The coolant level in the reservoir should be checked regularly. On 1997 and earlier models, remove the dipstick from the reservoir and make sure the level is between the F and L marks. On 1998 and later models, the level must be between the MAX and MIN lines on the reservoir tank. The level will vary with the temperature of the engine. When the engine is cold, the coolant level should be at or slightly above the lower mark on the dipstick or tank. Once the engine has warmed up, the level should be at or near the upper mark. If it isn't, allow the fluid in the tank to cool, then remove the dipstick or cap from the reservoir **(see illustration)** and add coolant to bring the level up to the upper line.

Caution: *Use only ethylene glycol type coolant and water in the mixture ratio recommended by your owner's manual. Do not use supplemental inhibitors or additives. If only a small amount of coolant is required to bring the system up to the proper level, water can be used. However, repeated additions of water will dilute the recommended antifreeze and water solution. In order to maintain the proper ratio of antifreeze and water, it is advisable to top up the coolant level with the correct mixture. Refer to your owner's manual for the recommended ratio.*

10 If the coolant level drops within a short time after replenishment, there may be a leak in the system. Inspect the radiator, hoses, engine coolant filler cap, drain plugs and water pump. If no leak is evident, have the radiator cap pressure tested. **Warning:** *Never remove the radiator cap or the coolant recovery reservoir cap when the engine is running or has just been shut down, because the cooling system is hot. Escaping steam and scalding liquid could cause serious injury.*

11 If it is necessary to open the radiator cap, wait until the system has cooled completely, then wrap a thick cloth around the cap and turn it to the first stop. If any steam escapes, wait until the system has cooled further, then remove the cap.

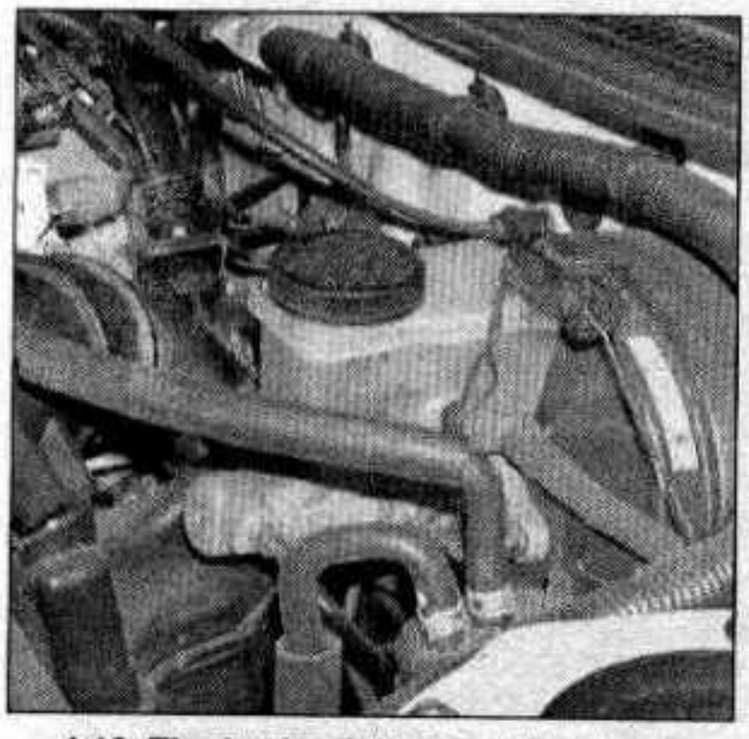
12 When checking the coolant level, always note its condition. It should be relatively clear. If it is brown or rust colored, the system should be drained, flushed and refilled. Even if the coolant appears to be normal, the corrosion inhibitors wear out with use, so it must be replaced at the specified intervals.

13 Do not allow antifreeze to come in contact with your skin or painted surfaces of the vehicle. Flush contacted areas immediately with plenty of water.

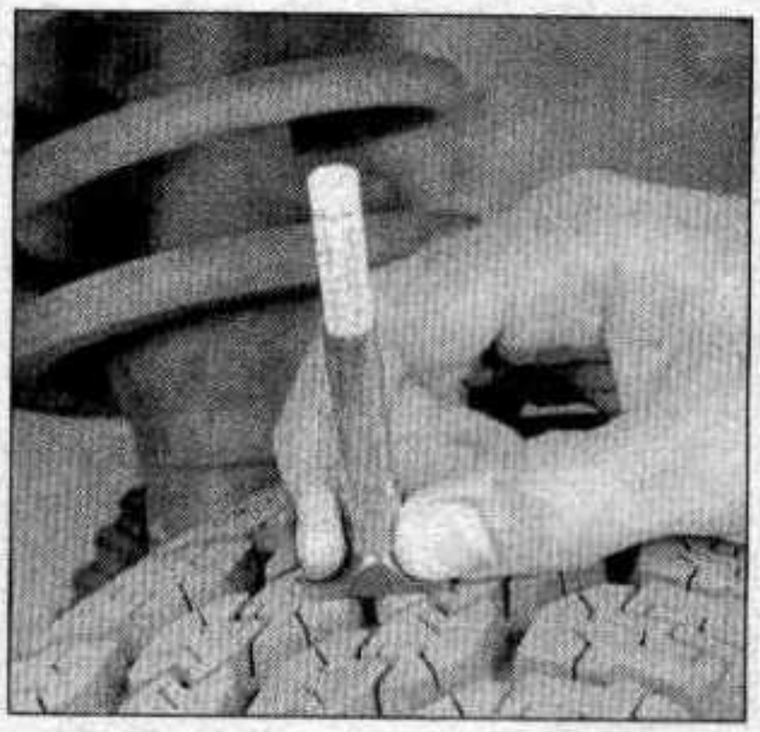
Washer fluid

Refer to illustrations 4.14a and 4.14b

14 Fluid for the windshield washer system is stored in a plastic reservoir, which is located in the front corner of the engine compartment **(see illustration)**. The reservoir on



4.16 The brake fluid should be kept between the MIN and MAX marks on the reservoir - turn and lift up the cap to add fluid



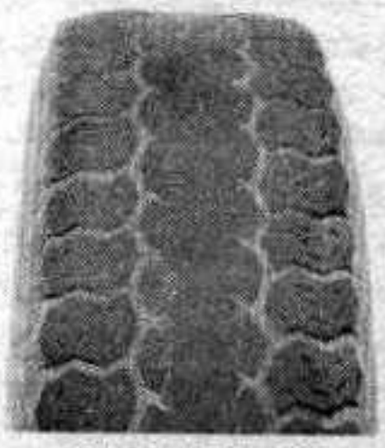
5.2 Use a tire tread depth gauge to monitor tire wear; they are available at auto parts stores and service stations and cost very little

UNDERINFLATION

CUPPING

Cupping may be caused by:

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



OVERINFLATION

INCORRECT TOE-IN OR EXTREME CAMBER

FEATHERING DUE TO MISALIGNMENT

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

models with rear window washers is accessible after opening the liftgate **(see illustration)**. Check the windshield washer float in the reservoir filler neck to make sure it is near the Full mark. Make sure the rear window fluid level is near the top of the filler neck. In milder climates, plain water can be used to top up the reservoir, but the reservoir should be kept no more than 2/3 full to allow for expansion should the water freeze. In colder climates, the use of a specially designed windshield washer fluid, available at your dealer and any auto parts store, will help lower the freezing point of the fluid. Mix the solution with water in accordance with the manufacturer's directions on the container. Do not use regular antifreeze. It will damage the vehicle's paint.

Brake and clutch fluid

Refer to illustration 4.16

15 The brake master cylinder is mounted on the front of the power booster unit and the clutch master cylinder (on manual transmission models) is next to it on the firewall within the engine compartment.

16 To check the fluid level of the brake or clutch master cylinder, simply look at the MAX and MIN marks on the reservoir **(see illustration)**. The level should be between the two marks.

17 If the level is low, wipe the top of the reservoir cover with a clean rag to prevent contamination of the brake system before lifting the cap.

18 Add only the specified brake fluid to the brake or clutch reservoir (refer to *Recommended lubricants and fluids* at the front of this Chapter or to your owner's manual). Mixing different types of brake fluid can damage the system. Fill the brake master cylinder reservoir only to about 3/4-inch below the MAX line - this brings the fluid to the correct level when you put the cap back on. **Warning:** *Use caution when filling the reservoir - brake fluid can harm your eyes and damage painted surfaces. Do not use brake fluid that has been opened for more than one year or has been left open. Brake fluid absorbs moisture from the air. Excess moisture can cause a dangerous loss of braking.*

19 While the reservoir cap is removed, inspect the master cylinder reservoir for contamination. If deposits, dirt particles or water droplets are present, the system should be drained and refilled (see Chapters 8 or 9).

20 After filling the reservoir to the proper level, make sure the lid is properly seated to prevent fluid leakage and/or system pressure loss.

21 The brake fluid in the master cylinder will drop slightly as the brake pads at each wheel wear down during normal operation. If the master cylinder requires repeated replenishing to keep it at the proper level, this is an indication of leakage in the brake system, which should be corrected immediately. Check all brake lines and connections, along with the wheel cylinders and booster (see Section 16 for more information). A drop in the clutch reservoir level indicates a leak in the clutch hydraulic system (see Chapter 8).

22 If, upon checking the brake master cylinder fluid level, you discover an empty or nearly empty reservoir, the brake system should be bled (see Chapter 9).

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

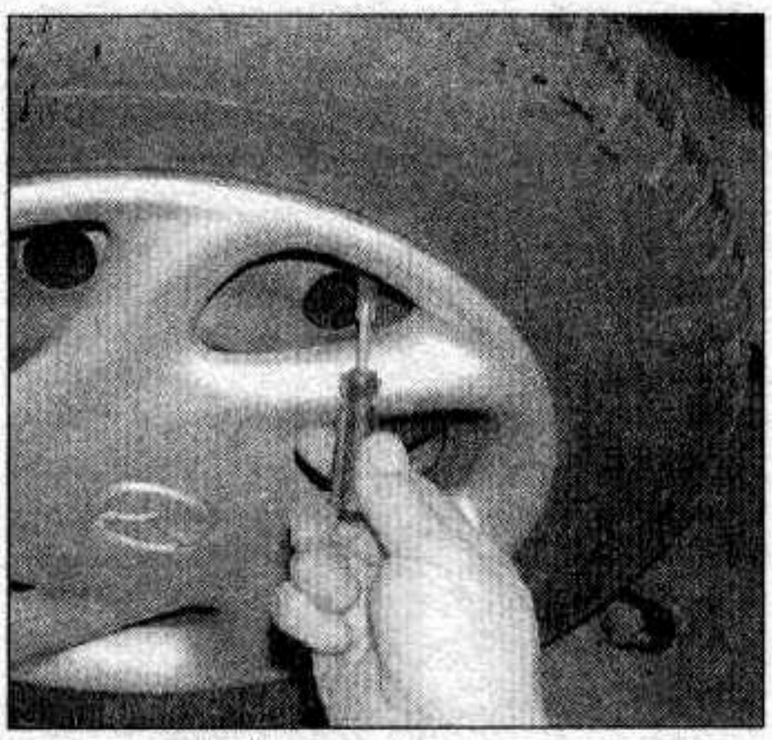
Refer to illustrations 5.2, 5.3, 5.4a, 5.4b and 5.8

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

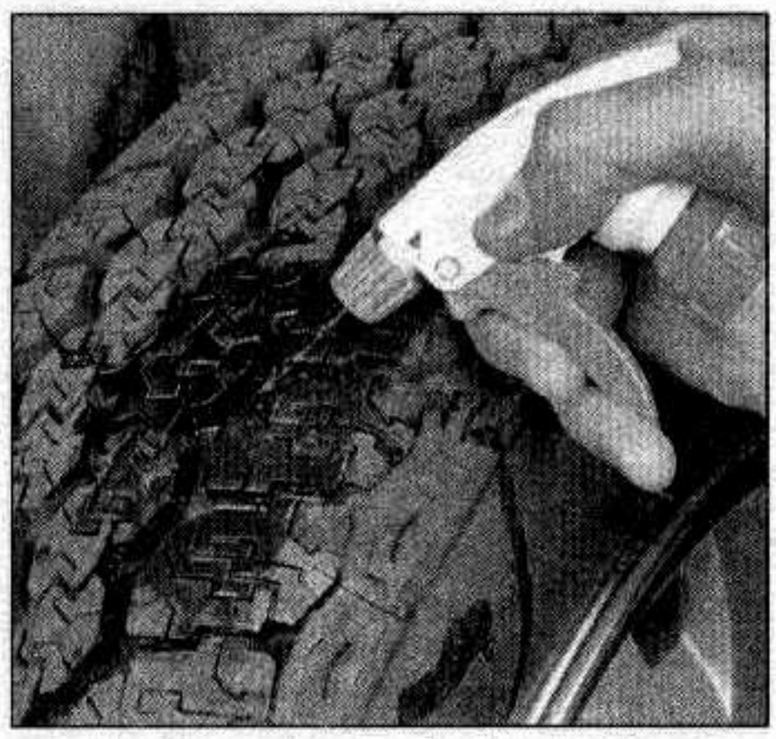
2 Normal tread wear can be monitored with a simple, inexpensive device known as a tread depth indicator **(see illustration)**. When the tread depth reaches the specified minimum, replace the tire(s).

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.

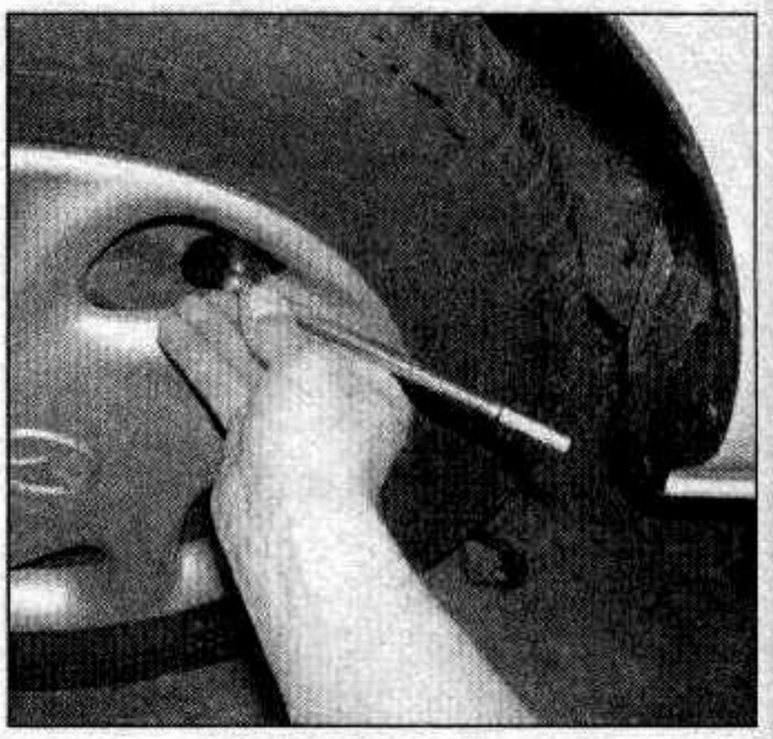
4 Look closely for cuts, punctures and embedded nails or tacks. Sometimes a tire will hold its air pressure for a short time or leak down very slowly even after a nail has



5.4a If a tire loses air on a steady basis, check the valve core first to make sure it's snug (special inexpensive wrenches are commonly available at auto parts stores)



5.4b If the valve core is tight, raise the corner of the vehicle with the low tire and spray a soapy water solution onto the tread as the tire is turned slowly - leaks will cause small bubbles to appear



5.8 To extend the life of the tires, check the air pressure at least once a week with an accurate gauge (don't forget the spare)

embedded itself into the tread. If a slow leak persists, check the valve core to make sure it is tight **(see illustration)**. Examine the tread for an object that may have embedded itself into the tire or for a "plug" that may have begun to leak (radial tire punctures are repaired with a plug that is installed in a puncture). If a puncture is suspected, it can be easily verified by spraying a solution of soapy water onto the puncture area **(see illustration)**. The soapy solution will bubble if there is a leak. Unless the puncture is inordinately large, a tire shop or gas station can usually repair the punctured tire.

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

6 Correct tire 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, particularly if it is a radial. A tire pressure gauge is therefore essential. Keep an accurate gauge in the glovebox. The pressure gauges fitted 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 **(see illustration)**. Note the reading on the gauge and compare this figure to the recommended tire pressure shown on the tire placard on the left door jamb. 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 levels.

9 Don't forget to keep the spare tire inflated to the specified pressure (consult your owner's manual). Note that the air pressure specified for the compact spare is significantly higher than the pressure of the regular tires.

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

Refer to illustrations 6.2 and 6.4

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

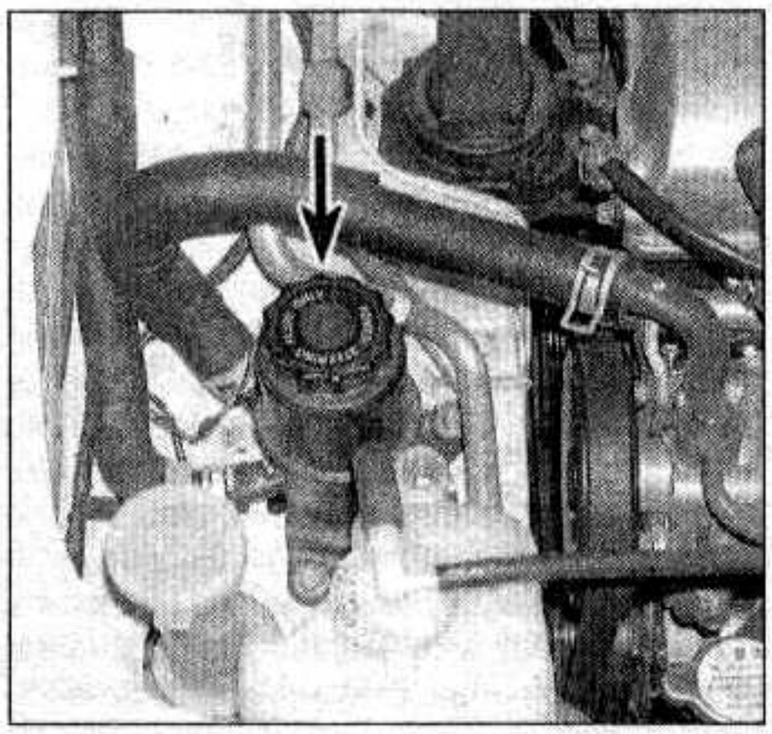
2 The fluid reservoir for the power steering pump is located on the right inner fender panel near the front of the engine compartment **(see illustration)**.

3 For the check, the front wheels should be pointed straight ahead and the engine should be off. The fluid should be cold when checking the level.

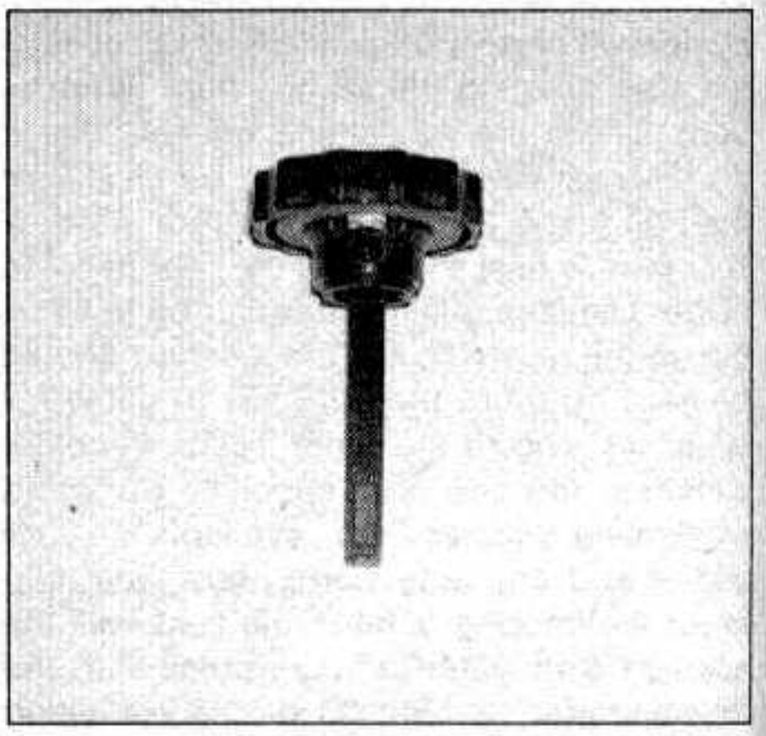
4 Remove the cap and make sure the fluid level is between the High and Low marks on the dipstick **(see illustration)**.

5 If additional fluid is required, pour the specified type directly into the reservoir, using a funnel to prevent spills.

6 If the reservoir requires frequent fluid additions, all power steering hoses, hose connections, the power steering pump and the steering gear should be carefully checked for leaks.



6.2 The power steering fluid reservoir (arrow) is located on the right side of the engine compartment



6.4 The fluid should be near the High mark on the power steering dipstick

7 Automatic transaxle fluid level check (every 3000 miles or 3 months)

Refer to illustrations 7.3 and 7.5

1 The level of the automatic transaxle fluid should be carefully maintained. Low fluid level can lead to slipping or loss of drive, while overfilling can cause foaming, loss of fluid and transaxle damage.

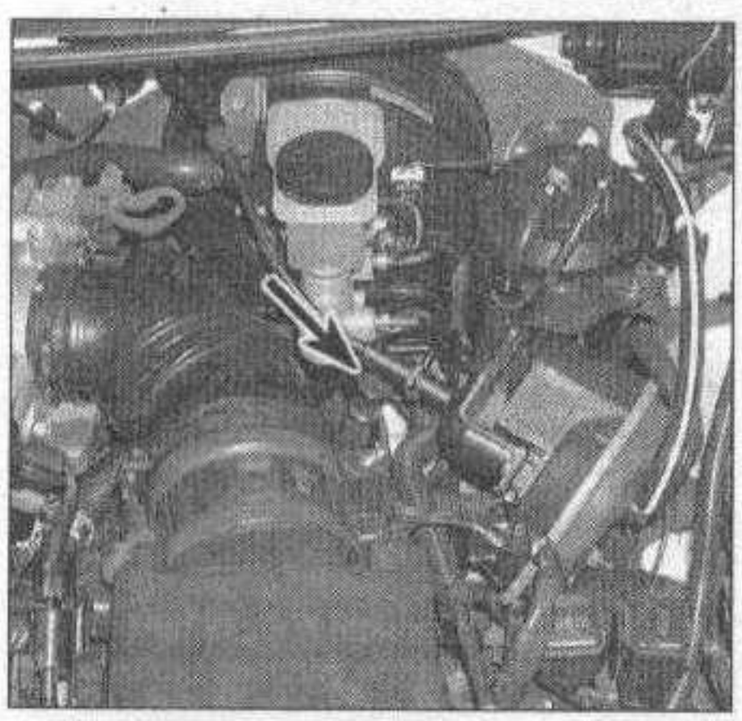
2 The fluid level should only be checked on level ground with the engine idling and the transaxle in Park.

3 Remove the dipstick - it's located below the brake master cylinder **(see illustration)**. Check the level of the fluid on the dipstick and note its condition.

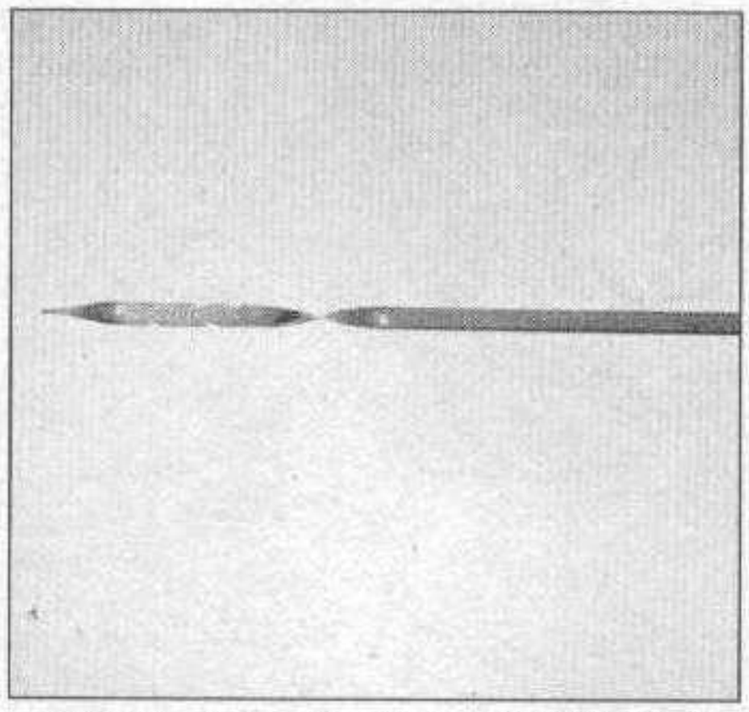
4 Wipe the fluid from the dipstick with a clean rag and reinsert it.

5 Pull the dipstick out again and note the fluid level **(see illustration)**. The level should be between the upper and lower marks on the dipstick. If the level is low, add the specified automatic transmission fluid. Add the fluid through the dipstick opening with a funnel.

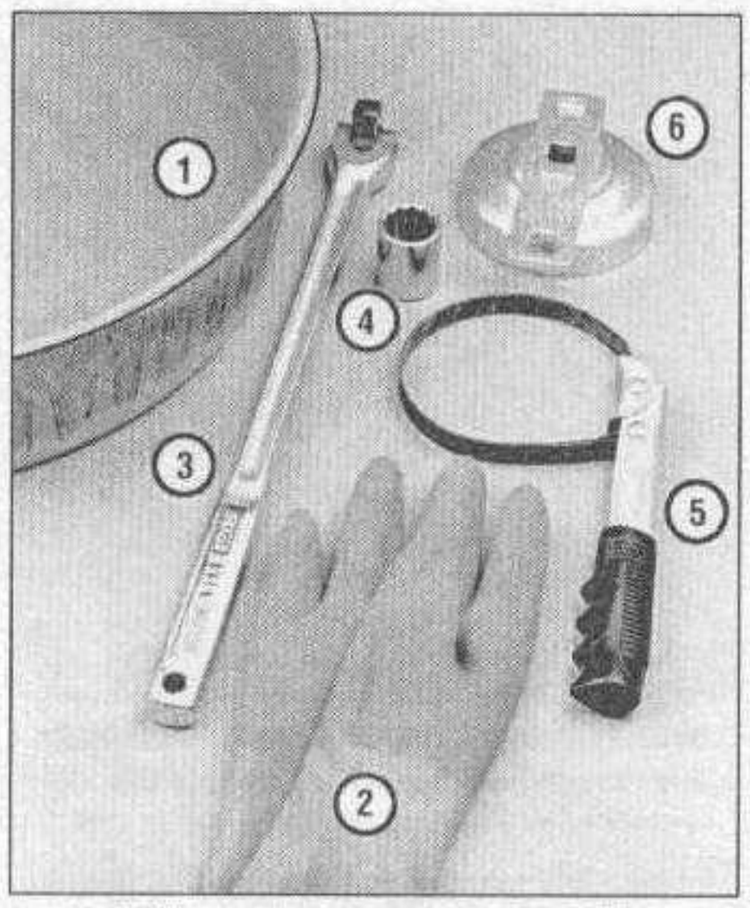
6 Add just enough of the specified fluid to



7.3 The automatic transaxle dipstick (arrow) is located below the brake master cylinder



7.5 The automatic transaxle fluid level should be between the two upper notches on the dipstick



8.2 These tools are required when changing the engine oil and filter

1 ***Drain pan*** *- It should be fairly shallow in depth, but wide to prevent spills*
2 ***Rubber gloves*** *- When removing the drain plug and filter, you will get oil on your hands (the gloves will prevent burns)*
3 ***Breaker bar*** *- Sometimes the oil drain plug is tight, and a long breaker bar is needed to loosen it*
4 ***Socket*** *- To be used with the breaker bar or a ratchet (must be the correct size to fit the drain plug)*
5 ***Filter wrench*** *- This is a metal band-type wrench, which requires clearance around the filter to be effective*
6 ***Filter wrench*** *- This type fits on the bottom of the filter and can be turned with a ratchet or breaker bar (different-size wrenches are available for different types of filters*

fill the transaxle to the proper level. It takes about one pint to raise the level from the lower mark to the upper mark, so add the fluid a little at a time and keep checking the level until it is correct.

7 The condition of the fluid should also be checked along with the level. If the fluid at the end of the dipstick is black or a dark reddish brown color, or if it emits a burned smell, the fluid should be changed (see Section 27). If you are in doubt about the condition of the fluid, purchase some new fluid and compare the two for color and smell.

8 Engine oil and oil filter change (every 3000 miles or 3 months)

Refer to illustrations 8.2, 8.7, 8.12 and 8.14

1 Frequent oil changes are the best preventive maintenance the home mechanic can give the engine, because aging oil becomes diluted and contaminated, which leads to premature engine wear.

2 Make sure you have all the necessary tools before you begin this procedure **(see illustration)**. You should also have plenty of rags or newspapers handy for mopping up any spills.

3 Access to the underside of the vehicle is greatly improved if the vehicle can be lifted on a hoist, driven onto ramps or supported by jackstands. **Warning:** *Do not work under a vehicle which is supported only by a bumper, hydraulic or scissors-type jack.*

4 If this is your first oil change, familiarize yourself with the locations of the oil drain plug and the oil filter. The engine and exhaust components will be warm during the actual work, so try to anticipate any potential problems before the engine and accessories are hot.

5 Park the vehicle on a level spot. Start the engine and allow it to reach its normal operating temperature. Warm oil and sludge will flow out more easily. Turn off the engine when it's warmed up. Remove the filler cap from the valve cover.

6 Raise the vehicle and support it securely on jackstands. **Warning:** *Never get beneath the vehicle when it is supported only by a jack. The jack provided with your vehicle is designed solely for raising the vehicle to remove and replace the wheels. Always use jackstands to support the vehicle when it becomes necessary to place your body underneath the vehicle.*

7 Being careful not to touch the hot exhaust components, place the drain pan under the drain plug in the bottom of the pan and remove the plug **(see illustration)**. You may want to wear gloves while unscrewing the plug the final few turns if the engine is hot.

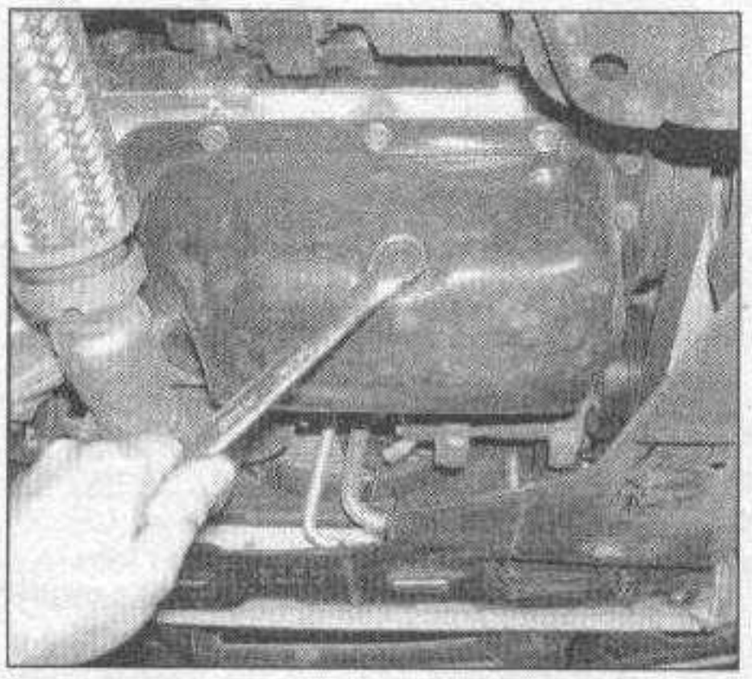
8 Allow the old oil to drain into the pan. It may be necessary to move the pan farther under the engine as the oil flow slows to a trickle. Inspect the old oil for the presence of metal shavings and chips.

9 After all the oil has drained, wipe off the drain plug with a clean rag. Even minute metal particles clinging to the plug would immediately contaminate the new oil.

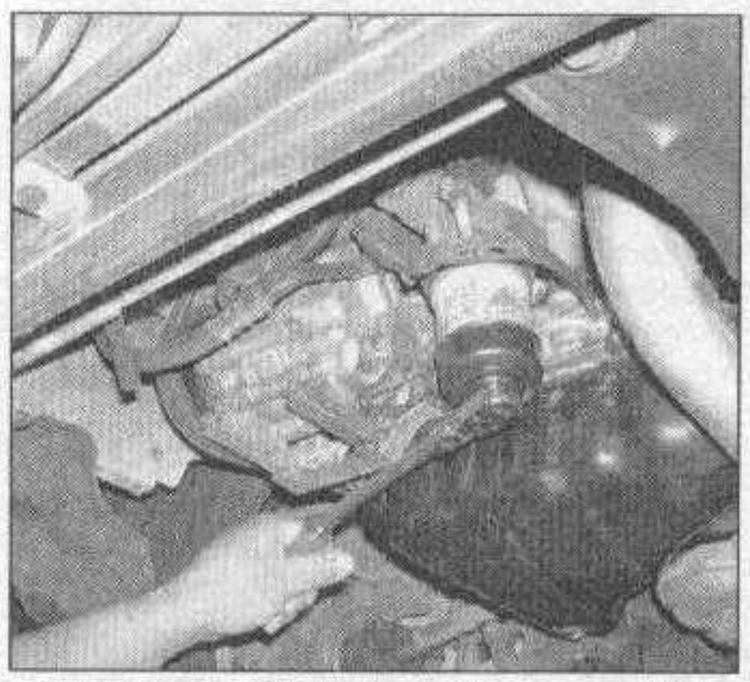
10 Clean the area around the drain plug opening, reinstall the plug and tighten it securely, but do not strip the threads.

11 Move the drain pan into position under the oil filter.

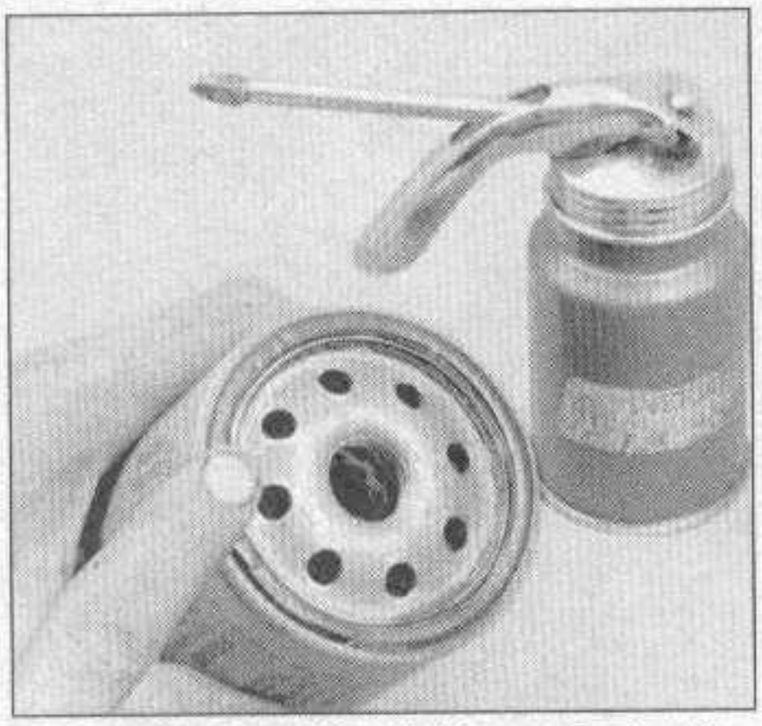
12 Loosen the oil filter **(see illustration)** by turning it counterclockwise with an oil filter wrench. Once the filter is loose, use your hands to unscrew it from the block. Just as the filter is detached from the block, immediately tilt the open end up to prevent the oil



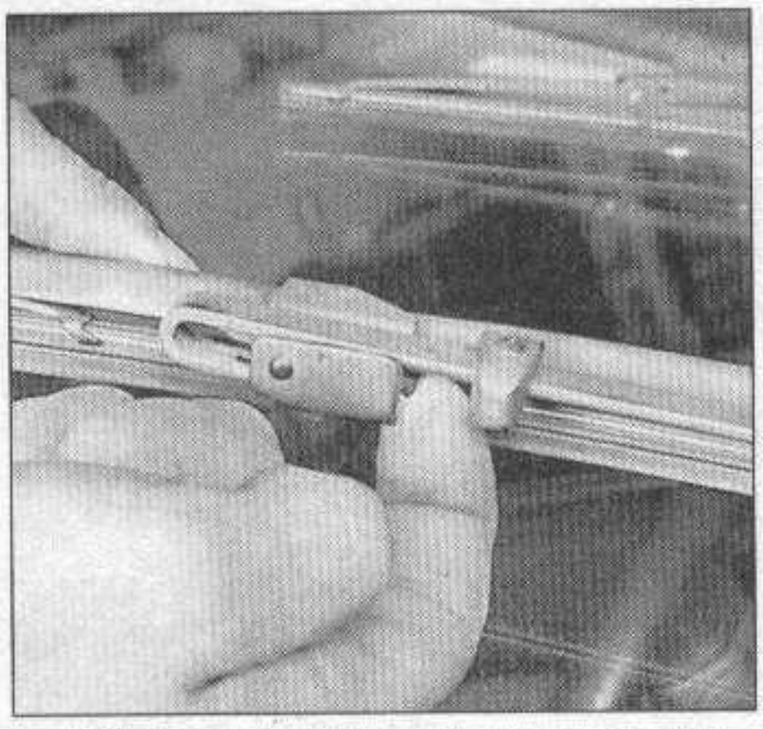
8.7 Use the proper size box-end wrench or socket to remove the oil drain plug without rounding off the corners



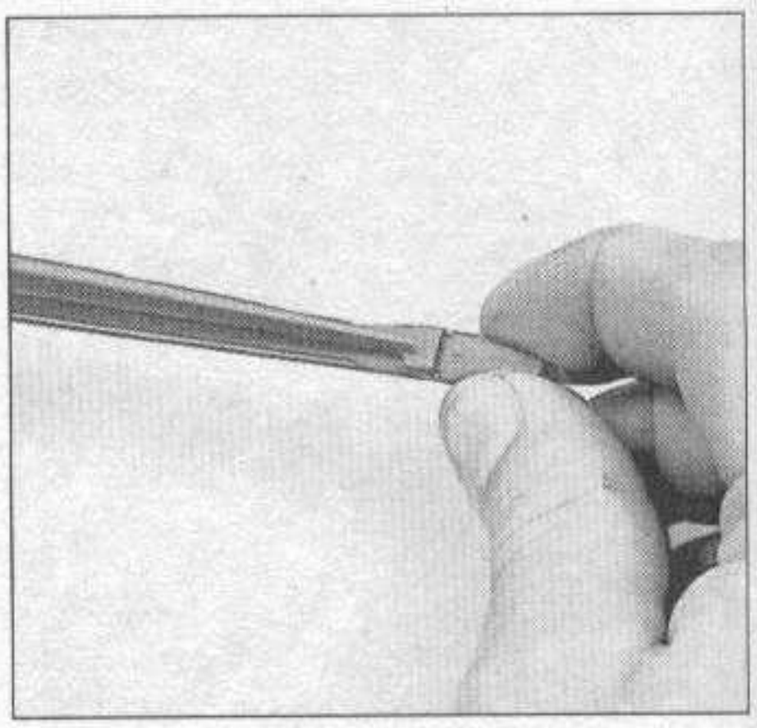
8.12 The oil filter is usually on very tight and will require a special wrench for removal - DO NOT use the wrench to tighten the new filter



8.14 Lubricate the oil filter gasket with clean engine oil before installing the filter on the engine



10.6 Press in on the tab and push the blade assembly out of the hook at the end to remove it



10.7 Squeeze the blade element tabs, then pull the element out of the metal frame and remove it

inside the filter from spilling out. **Warning:** *The exhaust system may still be hot, so be careful.*

13 With a clean rag, wipe off the mounting surface on the block. If a residue of old oil is allowed to remain, it will smoke when the block is heated up. Also make sure that none of the old gasket remains stuck to the mounting surface. It can be removed with a scraper if necessary.

14 Compare the old filter with the new one to make sure they are the same type. Smear some clean engine oil on the rubber gasket of the new filter and screw it into place **(see illustration)**. Because overtightening the filter will damage the gasket, do not use a filter wrench to tighten the filter. Tighten it by hand until the gasket contacts the seating surface. Then seat the filter by giving it an additional 3/4-turn.

15 Remove all tools, rags, etc. from under the vehicle, being careful not to spill the oil in the drain pan, then lower the vehicle.

16 Add new oil to the engine through the oil filler cap in the valve cover. Use a funnel, if necessary, to prevent oil from spilling onto the top of the engine. Pour three quarts of fresh oil into the engine. Wait a few minutes to allow the oil to drain into the pan, then check the level on the oil dipstick (see Section 4 if necessary). If the oil level is at or near the upper hole on the dipstick, install the filler cap hand tight, start the engine and allow the new oil to circulate.

17 Allow the engine to run for about a minute. While the engine is running, look under the vehicle and check for leaks at the oil pan drain plug and around the oil filter. If either is leaking, stop the engine and tighten the plug or filter.

18 Wait a few minutes to allow the oil to trickle down into the pan, then recheck the level on the dipstick and, if necessary, add enough oil to bring the level to the upper hole.

19 During the first few trips after an oil change, make it a point to check frequently for leaks and proper oil level.

20 Used motor oil cannot be re-used in its present state and should be recycled. Oil reclamation centers, auto repair shops and gas stations will normally accept the oil, which can be refined and used again. After the oil has cooled, it can be drained into a suitable container (capped plastic jugs, topped bottles, milk cartons, etc.) for transport to one of these recycling sites. New or used oil should never be allowed to go into street drains or into the ground.

9 Seat belt check (every 15,000 miles or 12 months)

1 Check 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. On passive restraint systems, the shoulder belt should move into position in the A-pillar.

3 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.

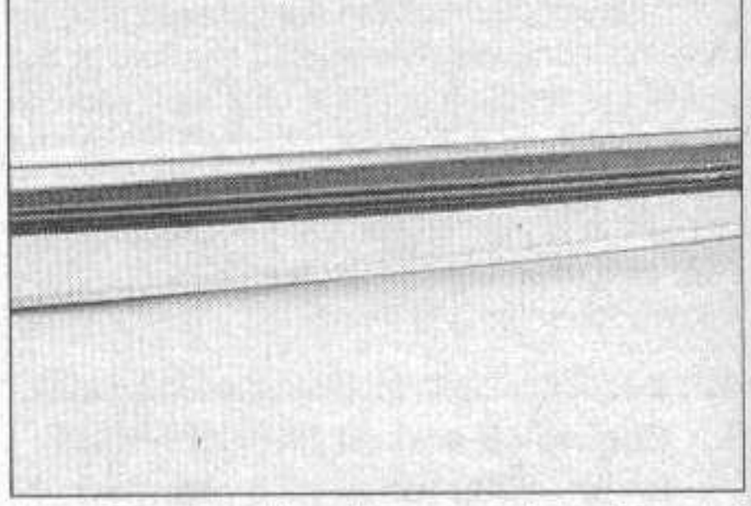
4 If any of the above checks reveal problems with the seat belt system, replace parts as necessary.

10 Windshield wiper blade inspection and replacement (every 7500 miles or 6 months)

Refer to illustrations 10.6, 10.7 and 10.8

1 The windshield wiper and blade assembly 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.



10.8 The metal retainers must be inserted into the slots in the rubber before installation

3 The action of the wiping mechanism can loosen bolts, nuts and fasteners, so they should be checked and tightened, as necessary, at the same time the wiper blades are checked.

4 If the wiper blade elements are cracked, worn or warped, or no longer clean adequately, they should be replaced with new ones.

5 Lift the arm assembly away from the glass for clearance.

6 Press in on the lock tab and push the blade assembly down the wiper arm, out of the hook at the end **(see illustration)**.

7 Squeeze the blade element tabs tightly and pull the element out of the metal frame **(see illustration)**.

8 Remove the metal retainers from the element and install them in the new element **(see illustration)**.

9 Insert the element into the frame and push it until the element tabs lock.

10 Place the metal arm assembly in the hook on the wiper arm and press it into place until the lock tab snaps into place.

11 Battery check, maintenance and charging (every 7500 miles or 6 months)

Warning: *Certain precautions must be followed when checking and servicing the battery. Hydrogen gas, which is highly flammable, is always present in the battery cells, so keep lighted tobacco and all other open flames and sparks away from the battery. The electrolyte inside the battery is actually dilute sulfuric acid, which will cause injury if splashed on your skin or in your eyes. It will also ruin clothes and painted surfaces. When removing the battery cables, always detach the negative cable first and hook it up last!*

Check

Refer to illustrations 11.1 and 11.6

1 A routine preventive maintenance program for the battery in your vehicle is the only way to ensure quick and reliable starts. But before performing any battery maintenance, make sure that you have the proper equipment necessary to work safely around the battery **(see illustration)**.

2 There are also several precautions that should be taken whenever battery maintenance is performed. Before servicing the battery, always turn the engine and all accessories off and disconnect the cable from the negative terminal of the battery.

3 The battery produces hydrogen gas, which is both flammable and explosive. Never create a spark, smoke or light a match around the battery. Always charge the battery in a ventilated area.

4 Electrolyte contains poisonous and corrosive sulfuric acid. Do not allow it to get in your eyes, on your skin on your clothes. Never ingest it. Wear protective safety glasses when working near the battery. Keep children away from the battery.

5 Note the external condition of the battery. If the positive terminal and cable clamp on your vehicle's battery is equipped with a rubber protector, make sure that it's not torn or damaged. It should completely cover the terminal. Look for any corroded or loose connections, cracks in the case or cover or loose hold-down clamps. Also check the entire length of each cable for cracks and frayed conductors.

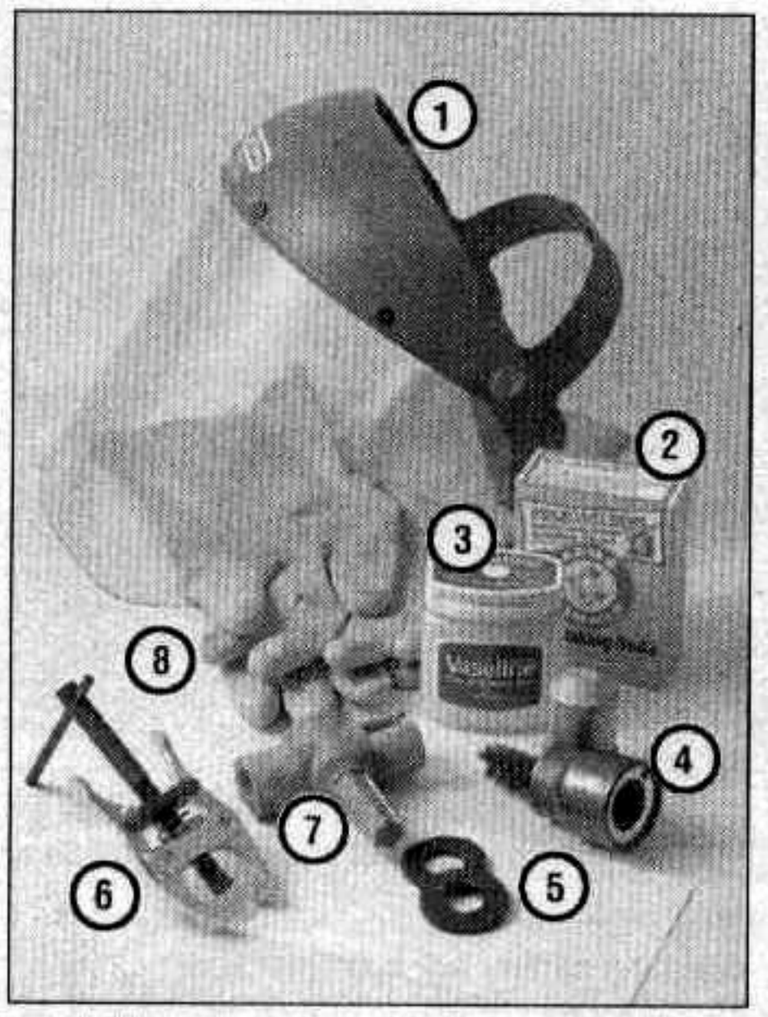
6 Some models with sealed batteries have a battery condition indicator on top of the battery **(see illustration)**. Compare the color showing in the window to the condition color chart on the battery. You may catch a low-charge battery condition before it strands you on the roadside. If the color indicate a low state of charge, charge the battery and examine the charging system (see Chapter 5 and this Section).

Maintenance

Refer to illustrations 11.7a, 11.7b, 11.8a and 11.8b

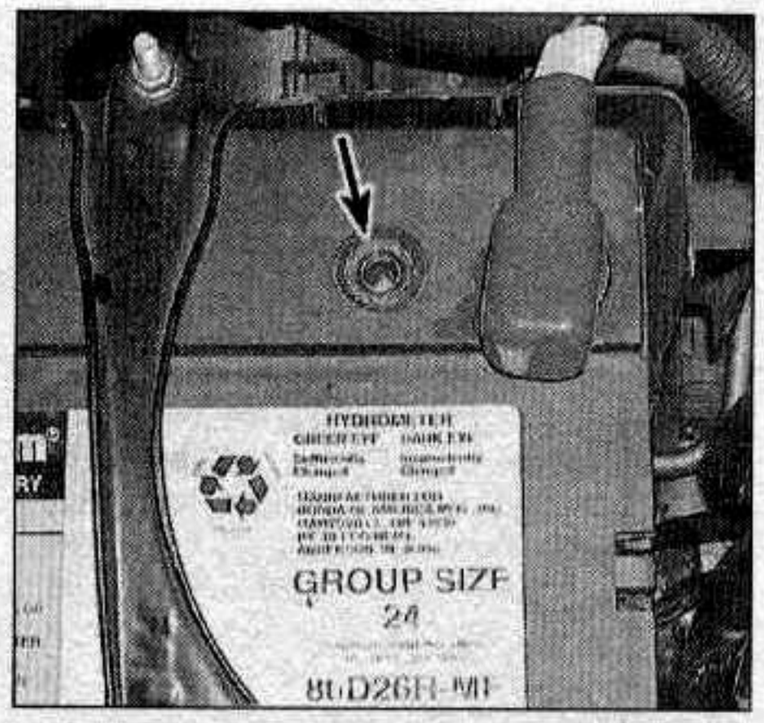
7 If corrosion, which looks like white, fluffy deposits **(see illustration)** is evident, particularly around the terminals, the battery should be removed for cleaning. Loosen the cable clamp bolts with a wrench, being careful to remove the ground cable first, and slide them off the terminals **(see illustration)**. Then disconnect the hold-down clamp bolt and nut, remove the clamp and lift the battery from the engine compartment.

8 Clean the cable clamps thoroughly with a battery brush or a terminal cleaner and a solution of warm water and baking soda **(see illustration)**. Wash the terminals and the top of the battery case with the same solution but make sure that the solution doesn't get into the battery. When cleaning the cables, terminals and battery top, wear safety goggles and

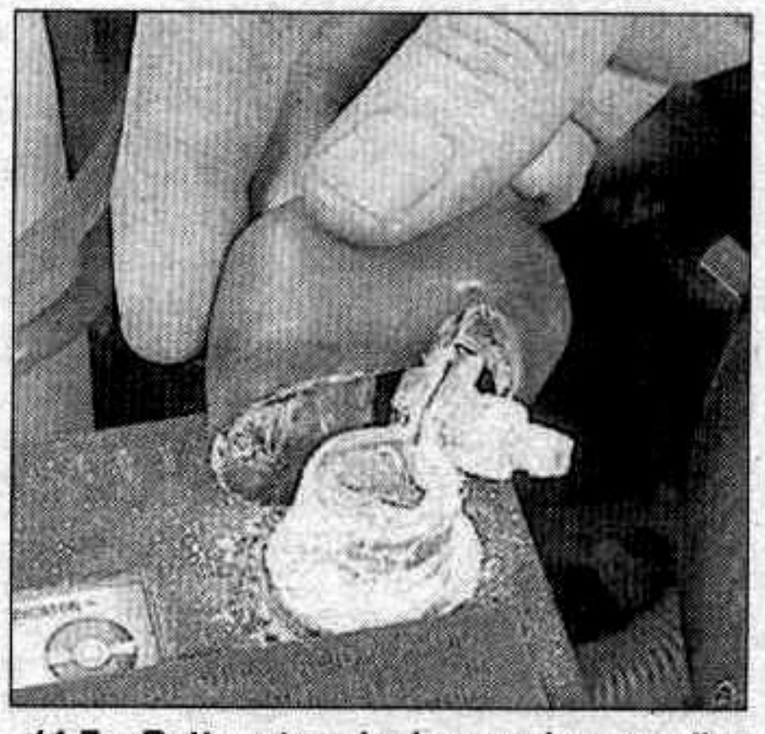


11.1 Tools and materials required for battery maintenance

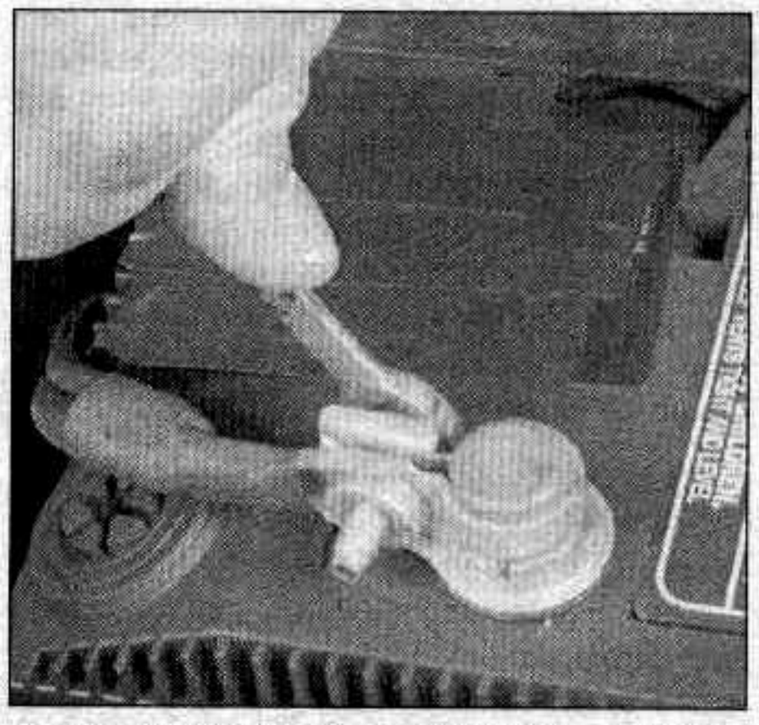
1 ***Face shield/safety goggles*** *- When removing corrosion with a brush, the acidic particles can easily fly up into your eyes*
2 ***Baking soda*** *- A solution of baking soda and water can be used to neutralize corrosion*
3 ***Petroleum jelly*** *- A layer of this on the battery posts will help prevent corrosion*
4 ***Battery post/cable cleaner*** *- This wire brush cleaning tool will remove all traces of corrosion from the battery posts and cable clamps*
5 ***Treated felt washers*** *- Placing one of these on each post, directly under the cable clamps, will help prevent corrosion*
6 ***Puller*** *- Sometimes the cable clamps are very difficult to pull off the posts, even after the nut/bolt has been completely loosened. This tool pulls the clamp straight up and off the post without damage*
7 ***Battery post/cable cleaner*** *- Here is another cleaning tool which is a slightly different version of Number 4 above, but it does the same thing*
8 ***Rubber gloves*** *- Another safety item to consider when servicing the battery; remember that's acid inside the battery!*



11.6 Compare the color showing in your battery's indicator window (arrow) with the color chart decal on the battery



11.7a Battery terminal corrosion usually appears as light, fluffy powder



11.7b Removing the cable from a battery post with a wrench - sometimes special battery pliers are required for this procedure if corrosion has caused deterioration of the nut hex (always remove the ground cable first and hook it up last!)

rubber gloves to prevent any solution from coming in contact with your eyes or hands. Wear old clothes too - even diluted, sulfuric acid splashed onto clothes will burn holes in them. If the terminals have been extensively corroded, clean them up with a terminal cleaner **(see illustration)**. Thoroughly wash all cleaned areas with plain water.

9 Whenever the battery is removed for cleaning or charging, inspect the battery carrier before reinstalling the battery in the engine compartment. If the carrier is dirty or covered with corrosion, clean it in the same solution of warm water and baking soda. Inspect the metal brackets that support the carrier to make sure that they are not covered with corrosion. If they are, wash them off. If corrosion is extensive, sand the brackets down to bare metal and spray them with a zinc-based primer (available in spray cans at auto paint and body supply stores).

10 Reinstall the battery back into the engine compartment. Make sure that no parts or wires are laying on the carrier during installation of the battery. Information on removing and installing the battery can be found in Chapter 5. Information on jump starting can be found at the front of this manual. For more detailed battery checking procedures, refer to the *Haynes Automotive Electrical Manual*.

11 Install a pair of specially-treated felt washers around the terminals (available at auto parts stores), then coat the terminals and the cable clamps with petroleum jelly or grease to prevent further corrosion. Install the cable clamps and tighten the nuts, being careful to install the negative cable last.

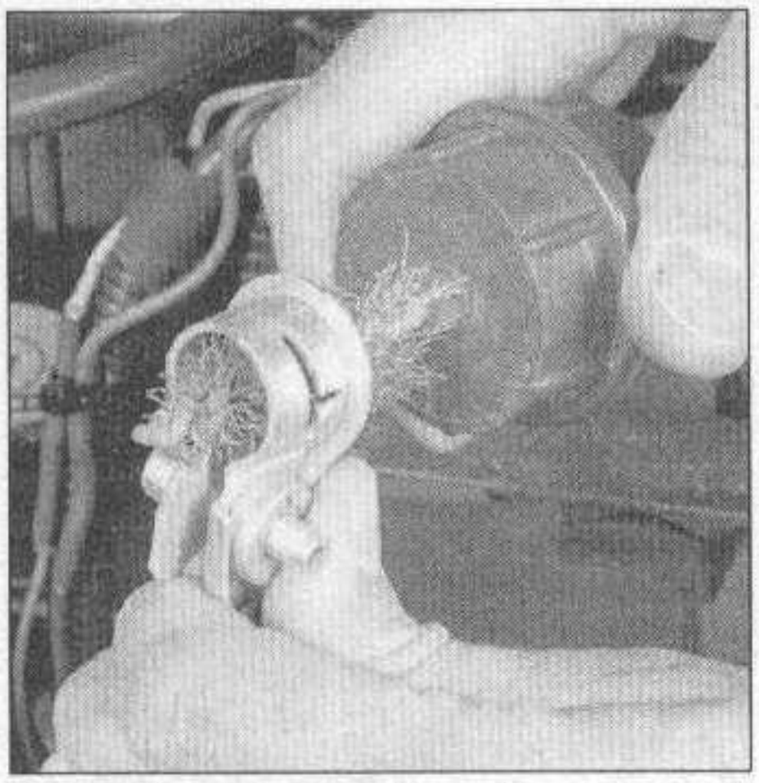
12 Install the hold-down clamp and nuts. Tighten the nuts only enough to hold the battery firmly in place. Overtightening these nuts can crack the battery case.

13 Make sure that the battery tray is in good condition and the hold-down clamp bolts are tight. If the battery is removed from the tray, make sure no parts remain in the bottom of the tray when the battery is reinstalled. When reinstalling the hold-down clamp bolts, do not overtighten them.

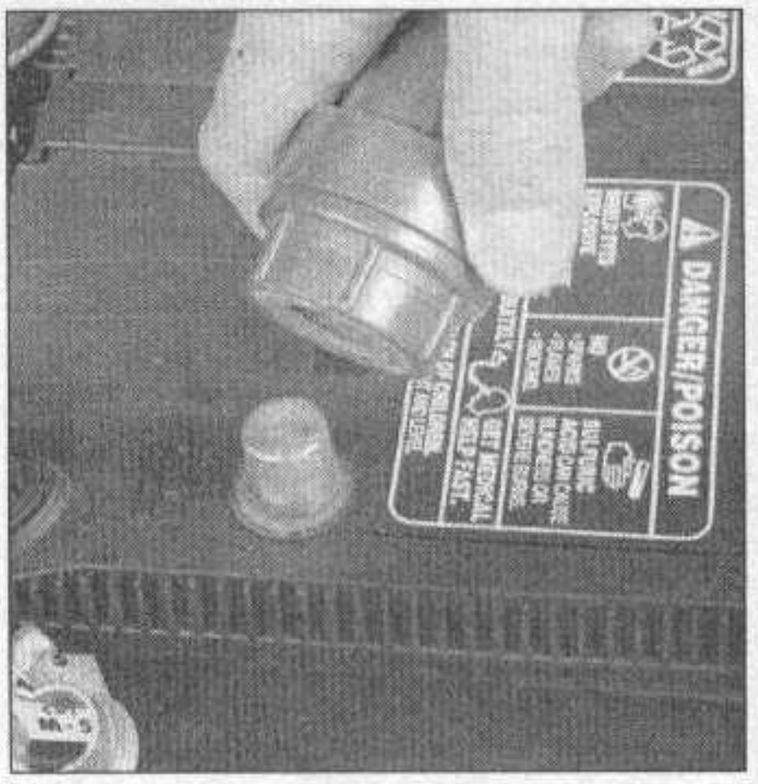
Charging

Warning: *When batteries are being charged, hydrogen gas, which is very explosive and flammable, is produced. Do not smoke or allow open flames near a charging or a recently charged battery. Wear eye protection when near the battery during charging. Also, make sure the charger is unplugged before connecting or disconnecting the battery from the charger.*

14 Slow-rate charging is the best way to restore a battery that's discharged to the point where it will not start the engine. It's also a good way to maintain the battery charge in a vehicle that's only driven a few miles between starts. Maintaining the battery charge is particularly important in the winter when the battery must work harder to start the engine and electrical accessories that drain the battery are in greater use.



11.8a When cleaning the cable clamps, all corrosion must be removed



11.8b Regardless of the type of tool used on the battery posts, a clean, shiny surface should be the result (the inside of the clamp is tapered to match the taper on the post, so don't remove too much material)

15 It's best to use a one or two-amp battery charger (sometimes called a "trickle" charger). They are the safest and put the least strain on the battery. They are also the least expensive. For a faster charge, you can use a higher amperage charger, but don't use one rated more than 1/10th the amp/hour rating of the battery. Rapid boost charges that claim to restore the power of the battery in one to two hours are hardest on the battery and can damage batteries not in good condition. This type of charging should only be used in emergency situations.

16 The average time necessary to charge a battery should be listed in the instructions that come with the charger. As a general rule, a trickle charger will charge a battery in 12 to 16 hours.

12 Drivebelt check, adjustment and replacement (every 7500 miles or 6 months)

Check

Refer to illustrations 12.3 and 12.4

1 The drivebelts are located at the front of the engine and play an important role in the overall operation of the vehicle and its components. Due to their function and material make-up, the belts are prone to failure after a period of time and should be inspected and adjusted periodically to prevent major engine damage.

2 The number of belts used on a particular vehicle depends on the accessories installed. Drivebelts are used to turn the alternator, power steering pump, water pump and air conditioning compressor. Depending on the pulley arrangement, more than one of these components may be driven by a single belt.

3 With the engine off, open the hood and locate the various belts at the front of the engine. Using your fingers (and a flashlight, if necessary), move along the belts checking for cracks and separation of the belt plies. Also check for fraying and glazing, which gives the belt a shiny appearance **(see illustration)**. Both sides of each belt should be inspected, which means you will have to twist the belt to check the underside.

4 The tension of each belt is checked by pushing on the belt at a distance halfway between the pulleys. Push firmly with your thumb and see how much the belt moves (deflects) **(see illustration)**. As rule of thumb, if the distance from pulley center-to-pulley center is between 7 and 11 inches, the belt should deflect 1/4-inch. If the belt travels between pulleys spaced 12 to 16 inches apart, the belt should deflect 1/2-inch.

Adjustment

Refer to illustrations 12.5a, 12.5b and 12.7

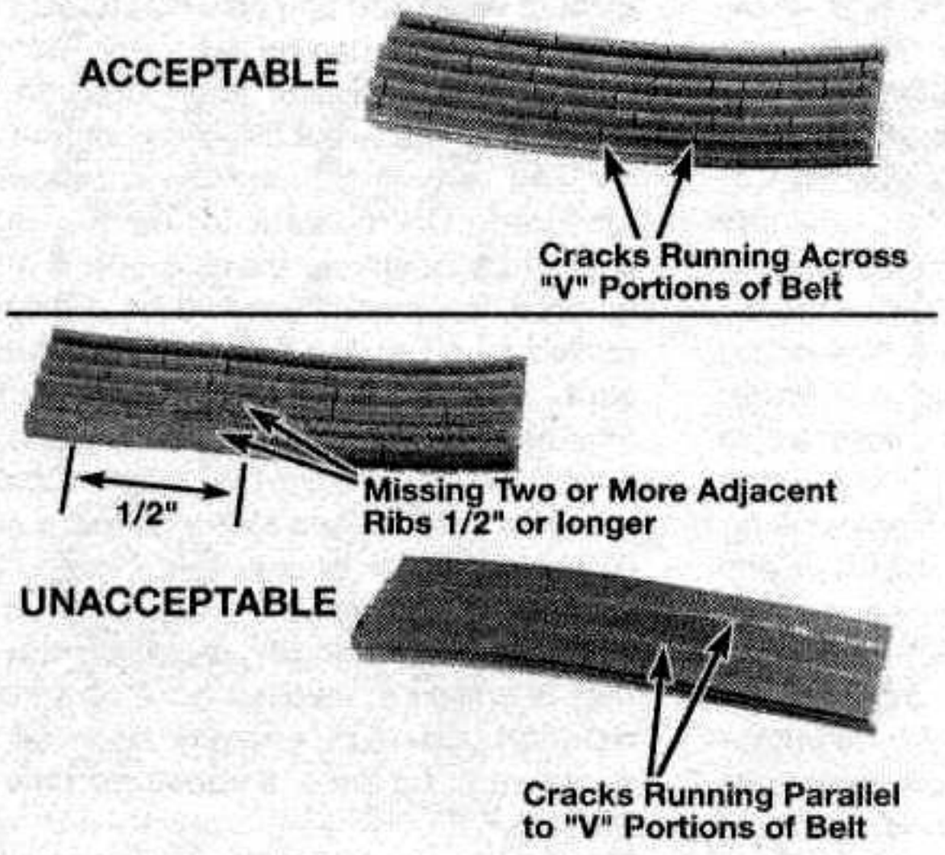
5 The power steering pump and the air conditioner compressor belt tension on four-cylinder models is adjusted by loosening the power steering pump through-bolt and adjuster lock bolt, then turning the adjusting bolt to loosen or tighten the belt. The four-cylinder water pump and alternator belt tension is adjusted by loosening the alternator mounting bolts and turning the adjuster locknut. The V6 model alternator and air conditioner compressor belt tension is adjusted by loosening the upper tensioner locknut and turning the adjusting bolt **(see illustration)**. The V6 model power steering pump and water pump belt tension is adjusted by loosening the lower tensioner locknut, then turning the adjusting bolt **(see illustration)**.

6 After the belts have been adjusted, measure the belt tension in accordance with one of the above methods. Repeat the adjustment procedure until the drivebelt is tensioned properly.

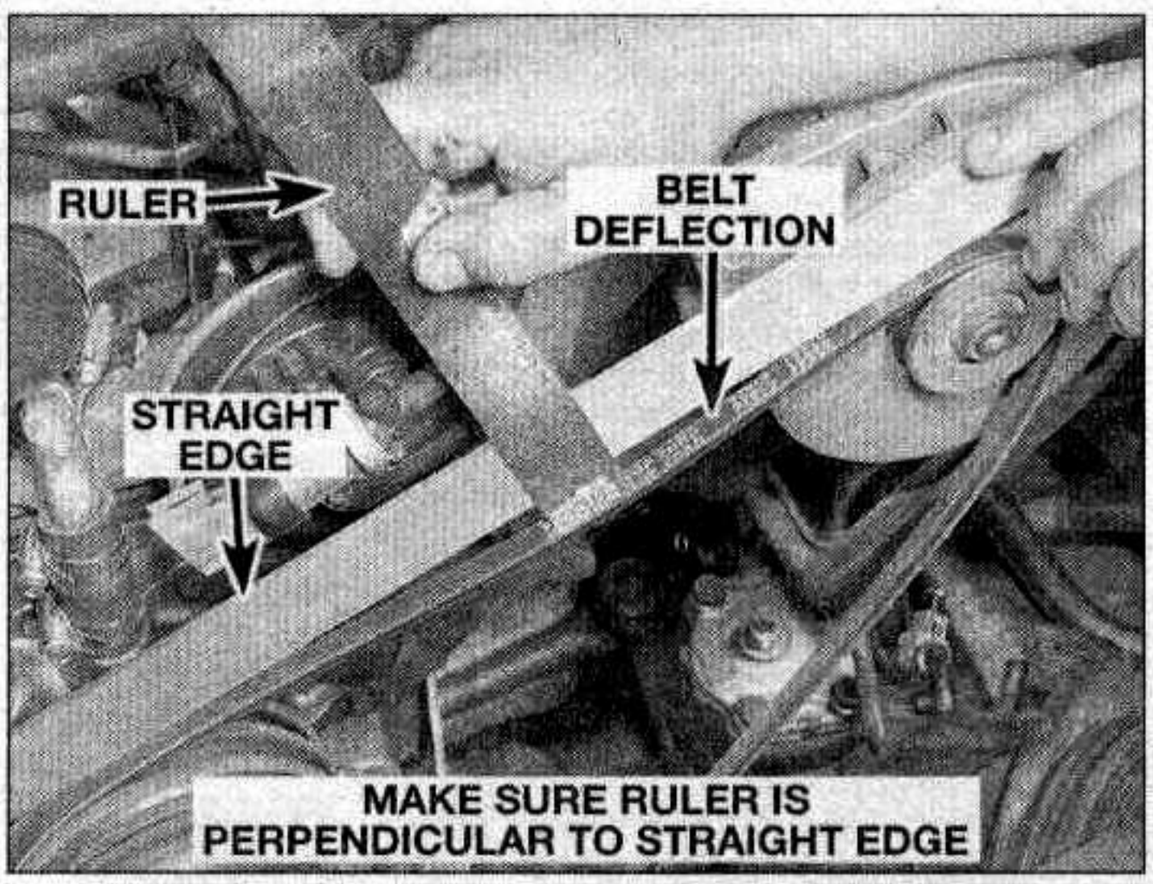
Replacement

Refer to illustration 12.7

7 Follow the above adjustment proce-



12.3 Check the belts for signs of wear like these - if the belt looks worn, replace it



12.4 Measuring drivebelt deflection with a straightedge and ruler

dures to loosen the belt, slip the belt off the pulleys and remove it. Since belts tend to wear out more or less at the same time, it's a good idea to replace all of them at the same time. Most models have a belt-routing diagram on a decal in the engine compartment or on the underside of the hood **(see illustration)**.

8 Take the old belts with you when purchasing new ones in order to make a direct comparison for length, width and design. Keep in mind that your old belt may have stretched, and the correct new belt may be slightly shorter. When installing a new ribbed belt, make sure it is centered on its drive pulley.

9 Install the belt by reversing the removal procedures. When installing a ribbed belt, make sure it is centered on the pulleys, it must not overlap either edge of the pulleys. Adjust the belt as described earlier in this Section.

13 Underhood hose check and replacement (every 7500 miles or 6 months)

Caution: *Replacement of air conditioning hoses must be left to a dealer service department or air conditioning shop that has the equipment to evacuate the system safely. Never remove air conditioning components or hoses until the system has been evacuated and the refrigerant recovered by an air conditioning shop.*

General

1 High temperatures in the engine compartment can cause the deterioration of the rubber and plastic hoses used for engine, accessory and emission systems operation. Periodic inspection should be made for cracks, loose clamps, material hardening and leaks.

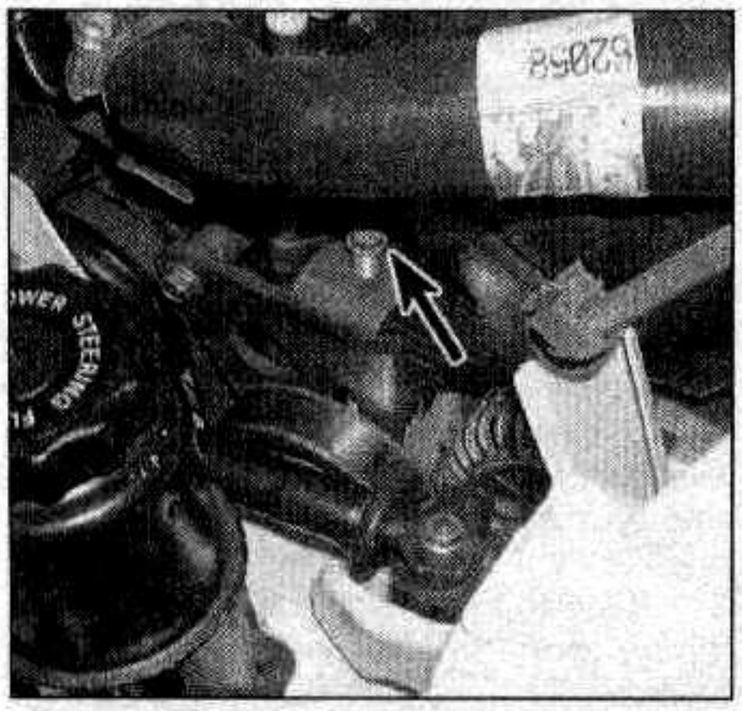
2 Information specific to the cooling system hoses can be found in Section 14.

3 Some, but not all, hoses are secured to the fittings with clamps. Where clamps are used, check to be sure they haven't lost their tension, allowing the hose to leak. If clamps aren't used, make sure the hose has not expanded and/or hardened where it slips over the fitting, allowing it to leak.

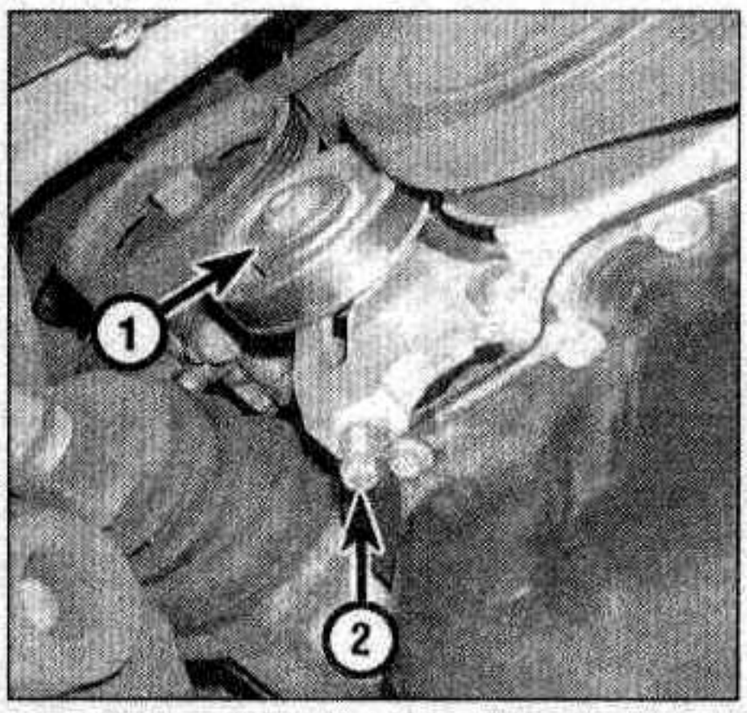
Vacuum hoses

4 It's quite common for vacuum hoses, especially those in the emissions system, to be color coded or identified by colored stripes molded into them. Various systems require hoses with different wall thickness, collapse resistance and temperature resistance. When replacing hoses, be sure the new ones are made of the same material.

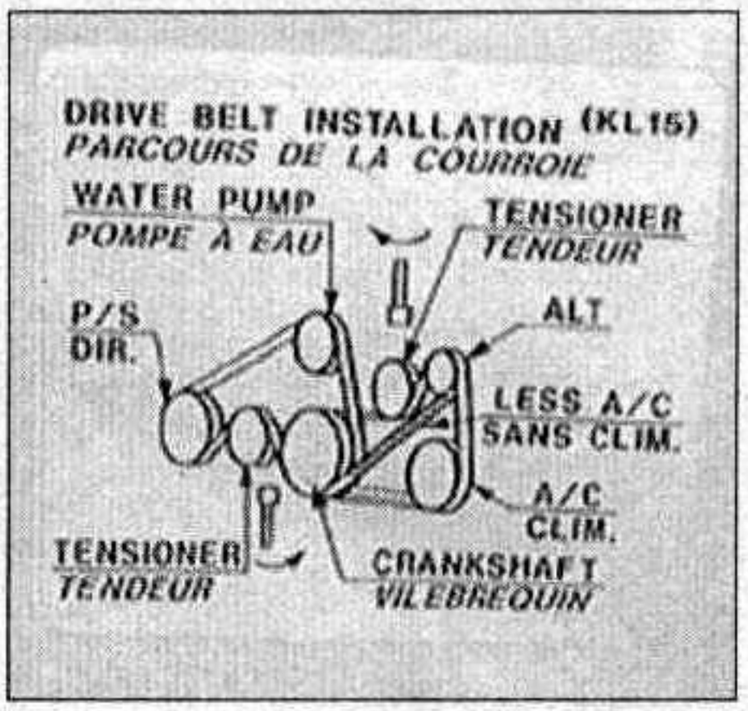
5 Often the only effective way to check a hose is to remove it completely from the vehicle. If more than one hose is removed, be sure to label the hoses and fittings to ensure correct installation.



12.5a On V6 models, loosen the tensioner locknut (in the center of the adjuster pulley) and turn the adjuster bolt (arrow) to adjust the alternator and air conditioning compressor belt tension



12.5b To adjust the power steering and water pump belt tension on V6 models, loosen the tensioner locknut (1), then turn the adjustment bolt (2) clockwise to tighten the belt, or counterclockwise to loosen the belt



12.7 Check the underside of the hood for a drivebelt routing diagram for your vehicle

6 When checking vacuum hoses, be sure to include any plastic T-fittings in the check. Inspect the fittings for cracks and the hose where it fits over the fitting for distortion, which could cause leakage.

7 A small piece of vacuum hose (1/4-inch inside diameter) can be used as a stethoscope to detect vacuum leaks. Hold one end of the hose to your ear and probe around vacuum hoses and fittings, listening for the "hissing" sound characteristic of a vacuum leak. **Warning:** *When probing with the vacuum hose stethoscope, be very careful not to come into contact with moving engine components such as the drivebelts, cooling fan, etc.*

Fuel hose

Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or clothes dryer) with a pilot light is present. Since gasoline is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. The fuel system is under constant pressure, so, if any fuel lines are to be disconnected, the fuel pressure in the system must be relieved first (see Chapter 4 for more information). When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand.*

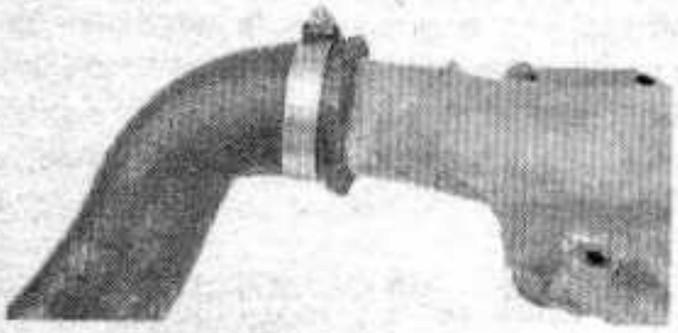
8 Check all rubber fuel lines for deterioration and chafing. Check especially for cracks in areas where the hose bends and just before fittings, such as where a hose attaches to the fuel filter.

9 When replacing hose, use only hose that is specifically designed for your fuel injection system.

Check for a chafed area that could fail prematurely.

Check for a soft area indicating the hose has deteriorated inside.

Overtightening the clamp on a hardened hose will damage the hose and cause a leak.



Check each hose for swelling and oil-soaked ends. Cracks and breaks can be located by squeezing the hose.

14.4 Hoses, like drivebelts, have a habit of failing at the worst possible time - to prevent the inconvenience of a blown radiator or heater hose, inspect them carefully as shown here

Metal lines

10 Sections of metal line are often used for fuel line between the fuel pump and fuel injection system. Check carefully to be sure the line has not been bent or crimped and that cracks have not started in the line.

11 If a section of metal fuel line must be replaced, only seamless steel tubing should be used, since copper and aluminum tubing don't have the strength necessary to withstand normal engine vibration.

12 Check the metal brake lines where they enter the master cylinder and brake proportioning unit (if used) for cracks in the lines or loose fittings. Any sign of brake fluid leakage calls for an immediate, thorough inspection of the brake system.

14 Cooling system check (every 7500 miles or 6 months)

Refer to illustration 14.4

1 Many major engine failures can be attributed to a faulty cooling system. If the vehicle is equipped with an automatic transaxle, the cooling system also cools the transmission fluid and thus plays an important role in prolonging transaxle life.

2 The cooling system should be checked with the engine cold. Do this before the vehicle is driven for the day or after the engine has been shut off for at least three hours.

3 Remove the radiator cap (four-cylinder models) or coolant filler cap (V6 models) by turning it to the left until it reaches a stop. Refer to the underhood photographs at the front of this Chapter to locate the radiator cap. Note that on V6 models the cap is located on top of drivebelt end of the engine. If you hear a hissing sound (indicating there is still pressure in the system), wait until it stops. Now press down on the cap with the palm of your hand and continue turning to the left until the cap can be removed. Thoroughly clean the cap, inside and out, with clean water. Also clean the filler neck on the radiator. All traces of corrosion should be removed. The coolant inside the radiator should be relatively transparent. If it's rust colored, the system should be drained and refilled (see Section 24). If the coolant level isn't up to the top, add additional antifreeze/coolant mixture (see Section 4).

4 Carefully check the large upper and lower radiator hoses along with the smaller diameter heater hoses which run from the engine to the firewall. Inspect each hose along its entire length, replacing any hose that is cracked, swollen or shows signs of deterioration. Cracks may become more apparent if the hose is squeezed **(see illustration)**.

5 Make sure that all hose connections are tight. A leak in the cooling system will usually show up as white or rust colored deposits on the areas adjoining the leak. If wire-type clamps are used at the ends of the hoses, it may be a good idea to replace them with more secure screw-type clamps.

6 Use compressed air or a soft brush to remove bugs, leaves, etc. from the front of the radiator or air conditioning condenser. Be careful not to damage the delicate cooling fins or cut yourself on them.

7 Every other inspection, or at the first indication of cooling system problems, have the cap and system pressure tested. If you don't have a pressure tester, most gas stations and repair shops will do this for a minimal charge.

15 Tire rotation (every 7500 miles or 6 months)

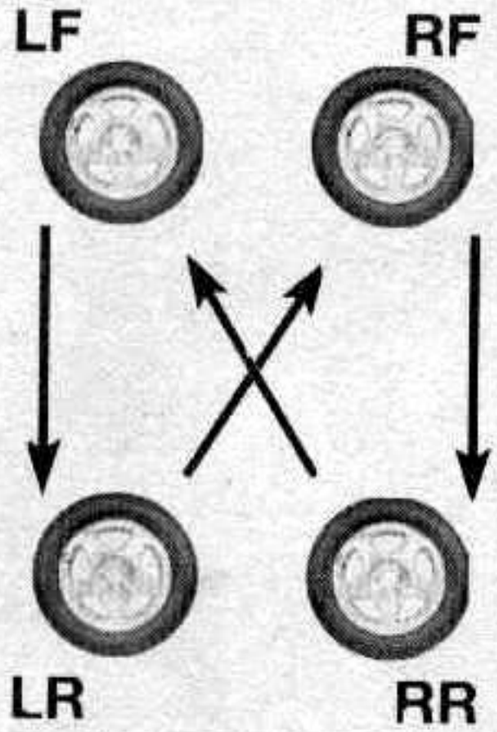
Refer to illustrations 15.2a and 15.2b

1 The tires should be rotated at the specified intervals and whenever uneven wear is noticed. Since the vehicle will be raised and the tires removed anyway, check the brakes (see Section 16) at this time.

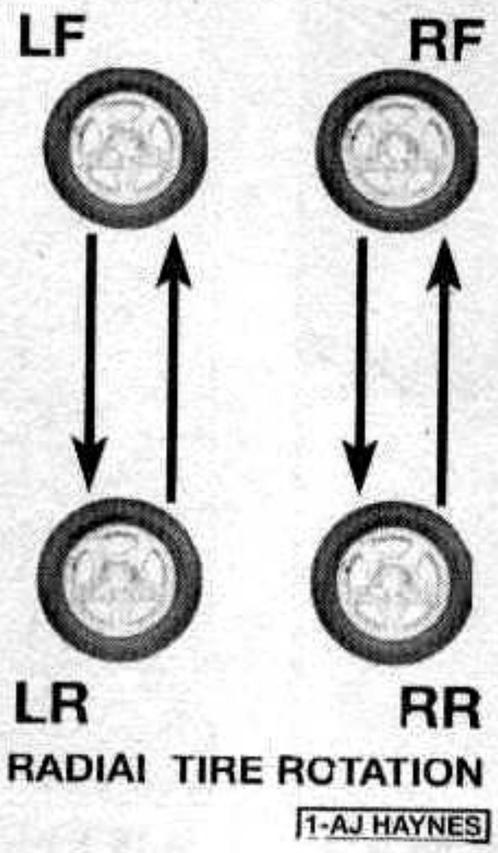
2 Radial tires must be rotated in a specific pattern **(see illustrations)**. Most models are equipped with non-directional tires, but some models have directional tires, which have a different rotation pattern. When choosing replacement tires, examine the sidewalls. Directional tires have arrows on the sidewall that indicate the direction they must turn, and a set of these tires includes two left-side tires and two right-side tires. The left and right side tires must not be rotated to the other side.

3 Refer to the information in *Jacking and towing* at the front of this manual for the proper procedures to follow when raising the vehicle and changing a tire. If the brakes are to be checked, do not apply the parking brake as stated. Make sure the tires are blocked to prevent the vehicle from rolling.

4 Preferably, the entire vehicle should be raised at the same time. This can be done on



15.2a Recommended radial tire rotation pattern for models with NON-DIRECTIONAL tires



15.2b Recommended radial tire rotation pattern for models with DIRECTIONAL tires

a hoist or by jacking up each corner and then lowering the vehicle onto jackstands placed under the frame rails. Always use four jackstands and make sure the vehicle is firmly supported.

5 After rotation, check and adjust the tire pressures as necessary and be sure to check the lug nut tightness. Ideally, lug nuts should be torqued to Specifications with a torque wrench, and rechecked after 25 miles of driving.

6 For further information on the wheels and tires, refer to Chapter 10.

16 Brake system check (every 7500 miles or 6 months)

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

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

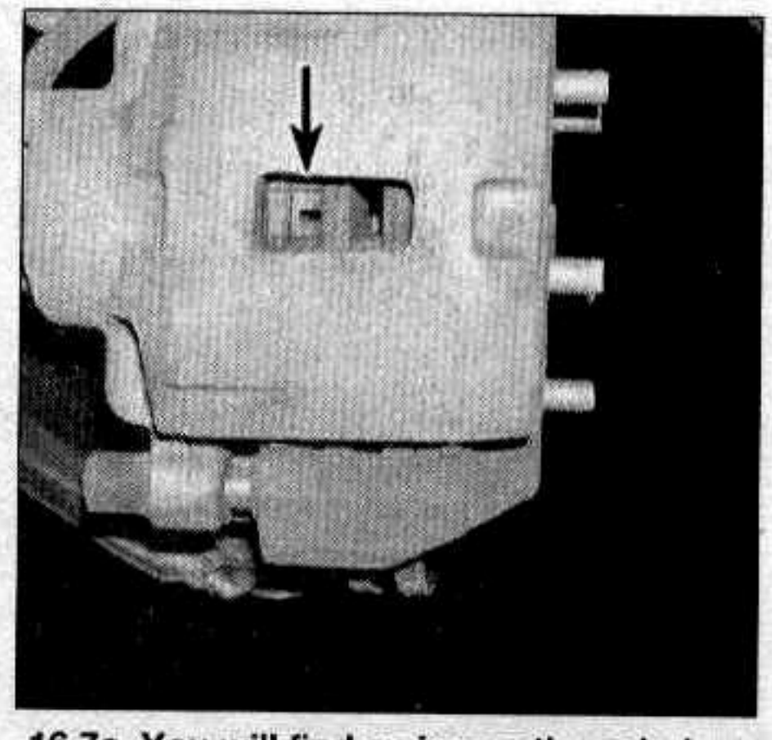
1 In addition to the specified intervals, the brakes should be inspected every time the wheels are removed or whenever a defect is suspected.

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

3 Loosen the wheel lug nuts.

4 Raise the vehicle and place it securely on jackstands.

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



16.7a You will find an inspection window (arrow) in each caliper - the inner brake pad lining thickness can be determined by looking through this window

Front and rear disc brakes

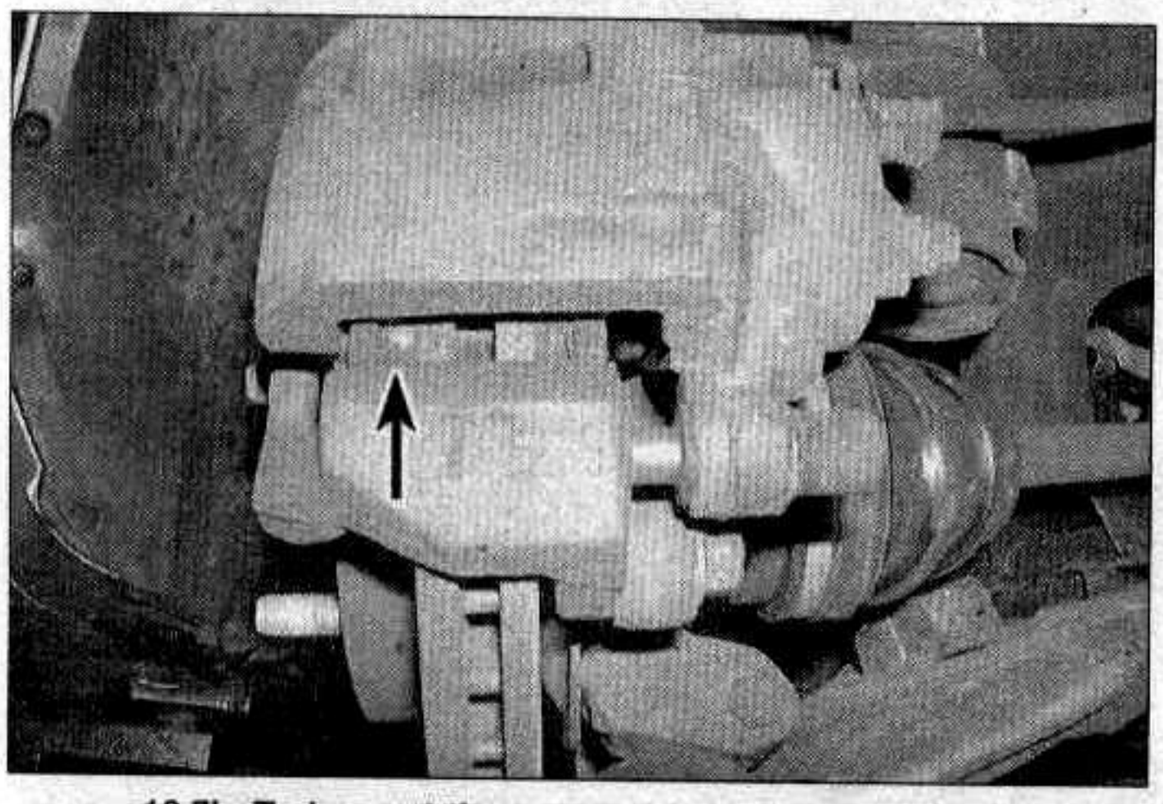
Refer to illustrations 16.7a, 16.7b, 16.9 and 16.11

6 There are two pads (an outer and an inner) in each caliper. The pads are visible with the wheels removed.

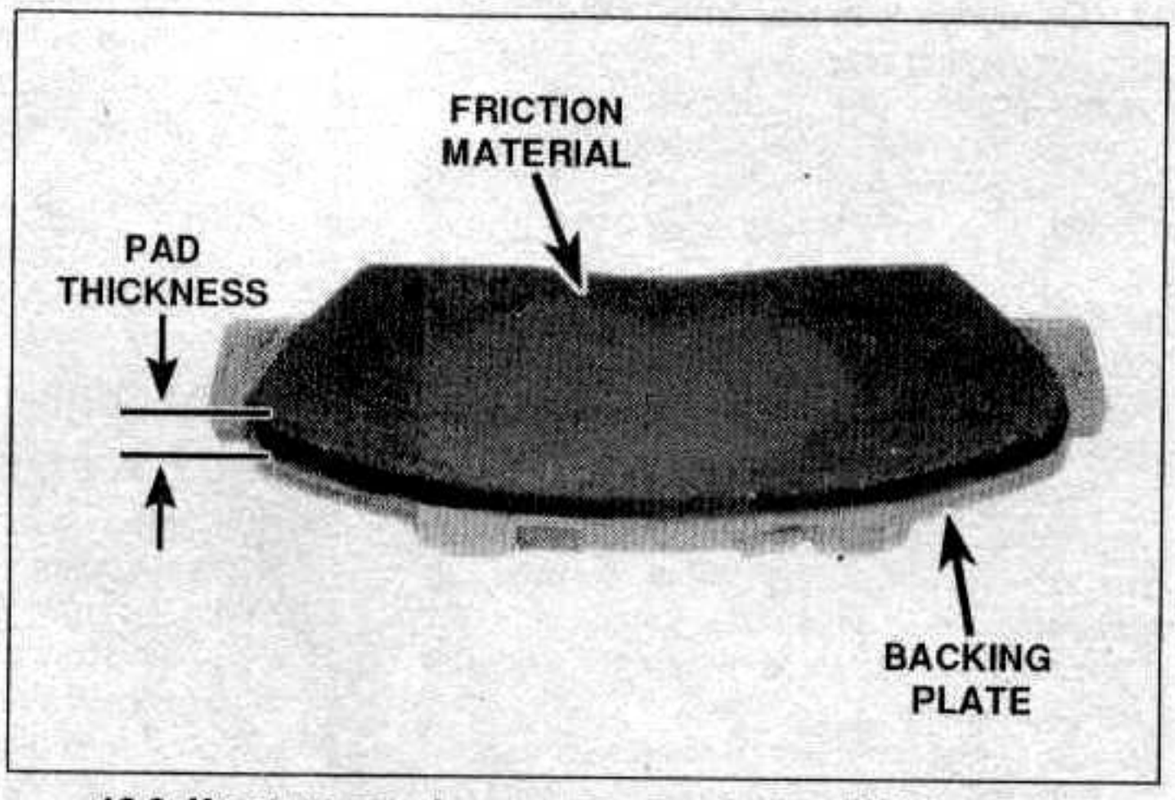
7 Check the pad thickness by looking at each end of the caliper and through the inspection window in the caliper body **(see illustrations)**. If the lining material is less than the thickness listed in this Chapter's Specifications, replace the pads. **Note:** *Keep in mind that the lining material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

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

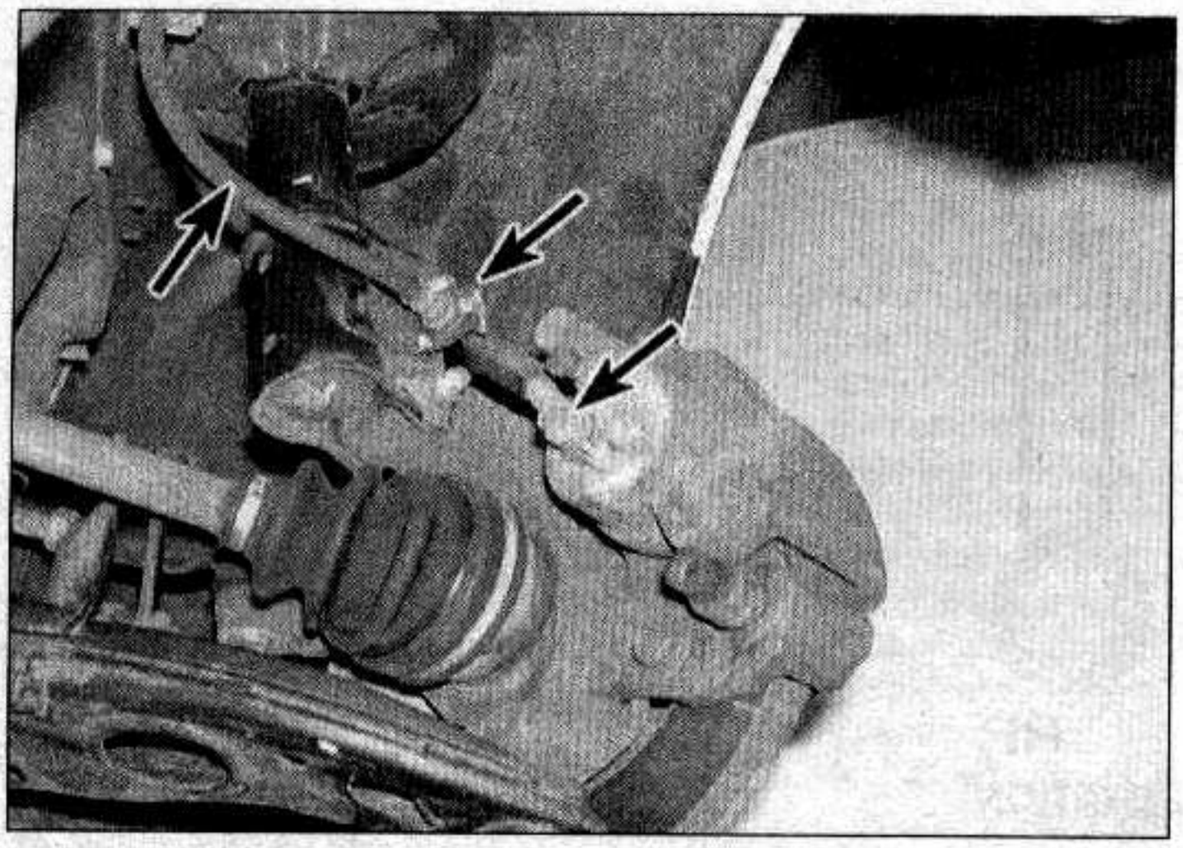
9 Once the pads are removed from the calipers, clean them with brake cleaner and re-measure them with a ruler or a vernier caliper **(see illustration)**.



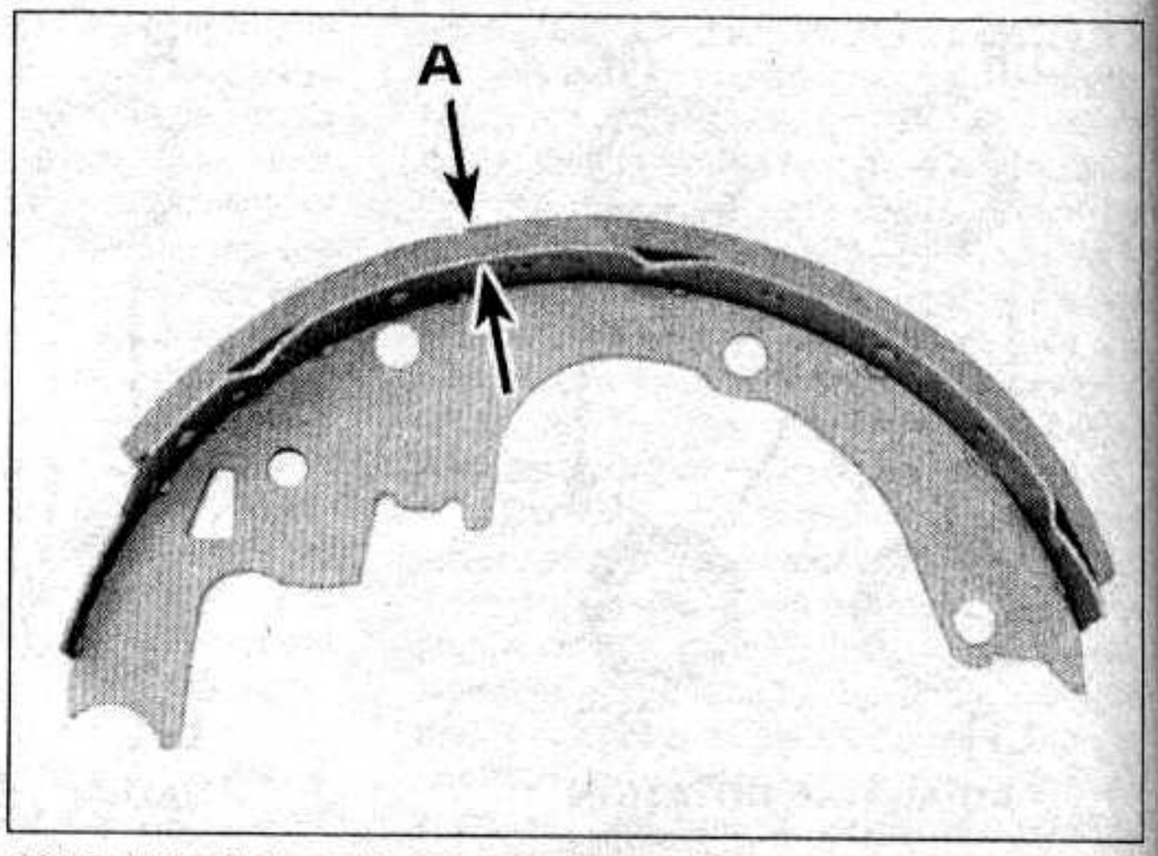
16.7b To inspect the outer pad thickness (arrow), look at the end of the pad



16.9 If a more precise measurement of pad thickness is necessary, remove the pads and measure the remaining friction material



16.11 Check along the brake hoses and at each fitting (arrows) for deterioration and cracks



16.15 If the lining is bonded to the brake shoe, measure the lining thickness from the outer surface to the metal shoe, as shown here; if the lining is riveted to the shoe, measure from the lining outer surface to the rivet head

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

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

Rear drum brakes

Refer to illustrations 16.15 and 16.17

12 On models with rear drum brakes, make sure the parking brake is off. Remove the two screws around the center of the drum (if installed), then tap on the outside of the drum with a rubber mallet to loosen it.

13 Remove the brake drums. If the drums do not pull off easily, apply some penetrating oil to the center of the hub, allow it to soak in, then tap around the center of the drum with a hammer. If it is still on solidly, tap around the outside edge of the drum from the backside.

14 With the drums removed, carefully clean the brake assembly with brake system cleaner. **Warning:** *Don't blow the dust out with compressed air and don't inhale any of it (it may contain asbestos, which is harmful to your health).*

15 Note the thickness of the lining material on both front and rear brake shoes. If the material has worn away to within 1/16-inch of the recessed rivets or 1/8-inch of the metal backing on bonded type shoes, the shoes should be replaced **(see illustration)**. The shoes should also be replaced if they're cracked, glazed (shiny areas), or covered with brake fluid.

16 Make sure all the brake assembly springs are connected and in good condition, referring to the photographs in Chapter 9, if necessary.

17 Check the brake components for signs of fluid leakage. With your finger or a small screwdriver, carefully pry back the rubber cups on the wheel cylinder located at the top of the brake shoes **(see illustration)**. Any leakage here is an indication that the wheel cylinders should be replaced immediately (see Chapter 9). Also, check all hoses and connections for signs of leakage.

18 Wipe the inside of the drum with a clean rag and denatured alcohol or brake cleaner. Again, be careful not to breathe the dangerous asbestos dust.

19 Check the inside of the drum for cracks, score marks, deep scratches and "hard spots" which will appear as small discolored areas. If imperfections cannot be removed with fine emery cloth, the drum must be taken to an automotive machine shop for resurfacing.

20 Repeat the procedure for the remaining wheel. If the inspection reveals that all parts are in good condition, reinstall the brake drums, install the wheels and lower the vehicle to the ground.

Brake booster check

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

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

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

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

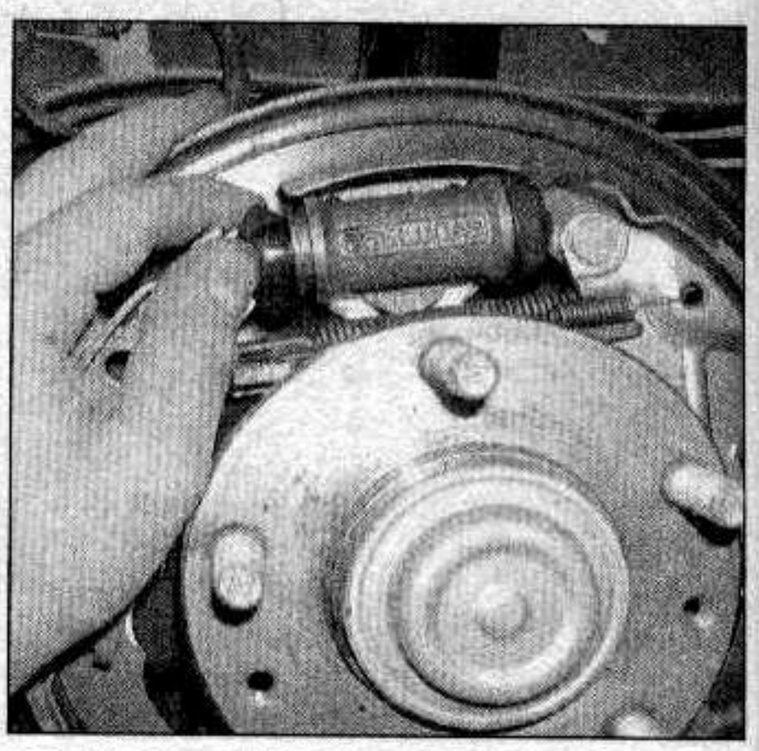
25 Restart the engine, run it for about a minute and turn it off. Then firmly depress the brake several times - the pedal travel should decrease with each application.

26 If your brakes do not operate as described, the brake booster has failed. Refer to Chapter 9 for the replacement procedure.

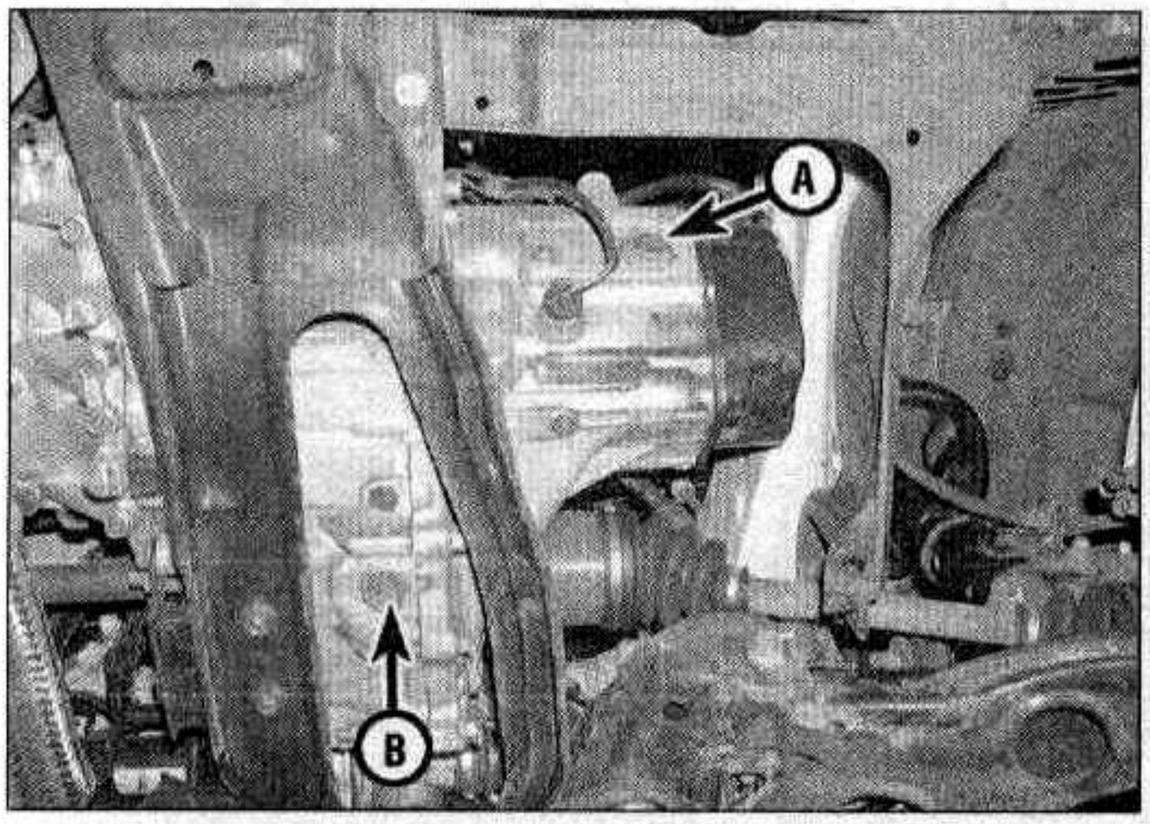
Parking brake

27 Slowly pull up on the parking brake and count the number of clicks you hear until the handle is up as far as it will go. The adjustment is correct if you hear the specified number of clicks (see this Chapter's Specifications). If you hear more or fewer clicks, it's time to adjust the parking brake (see Chapter 9).

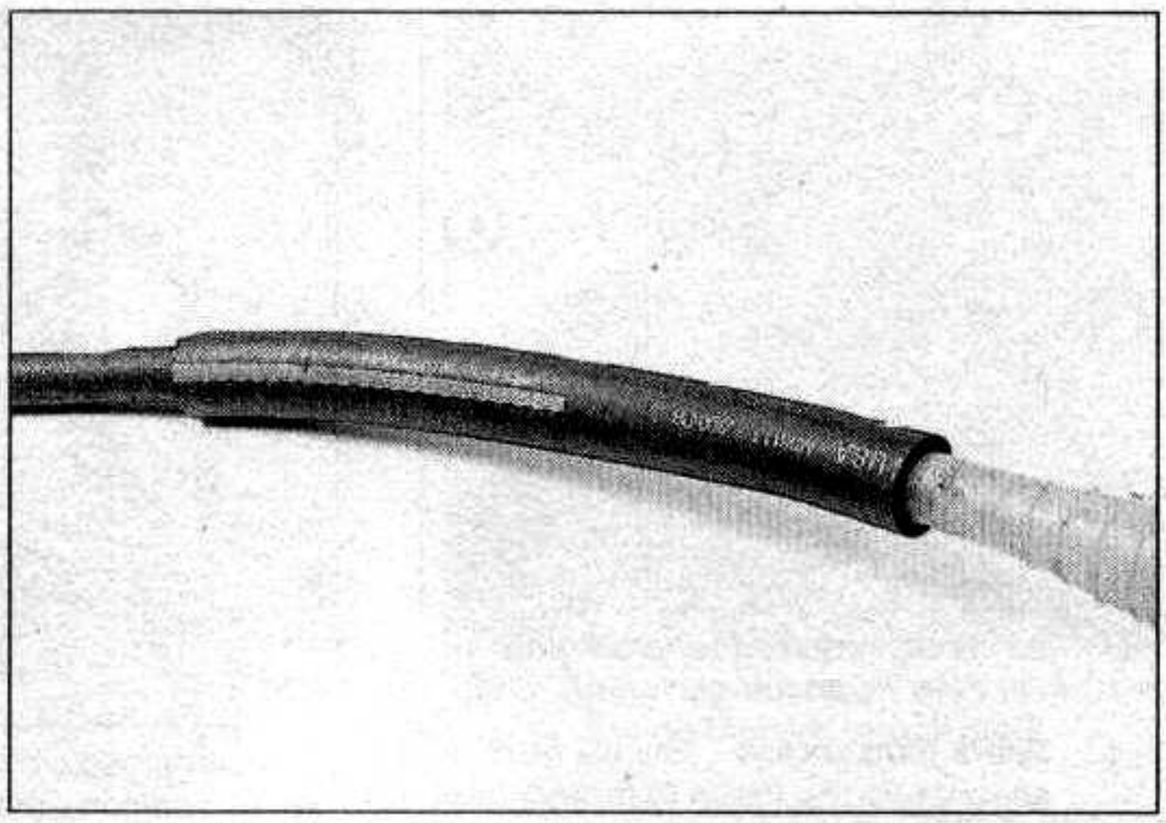
28 An alternative method of checking the parking brake is to park the vehicle on a steep hill with the parking brake set and the transaxle in Neutral. If the parking brake cannot prevent the vehicle from rolling, it is in need of adjustment (see Chapter 9).



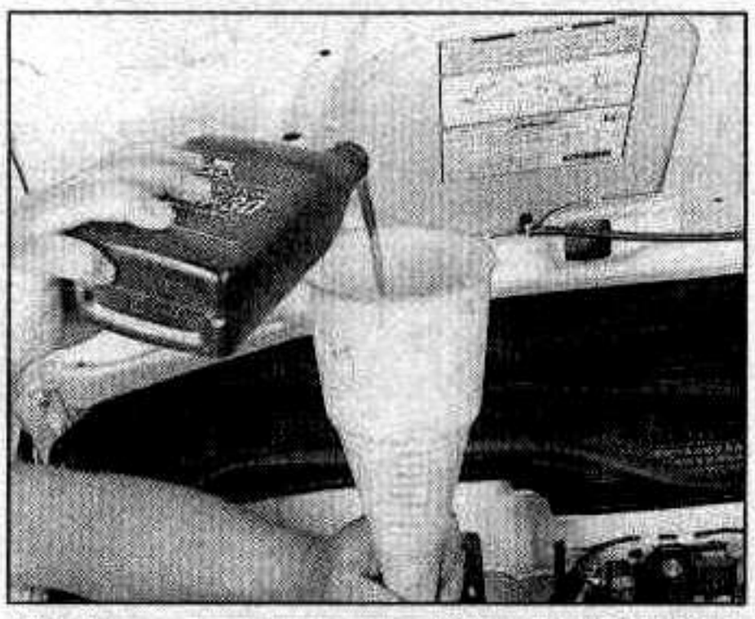
16.17 Check the wheel cylinder boots for leaking fluid indicating that the cylinder must be replaced or rebuilt



17.1 The manual transaxle check/fill (A) and drain (B) plugs



17.2a Use two different size pieces of hose to make an adapter on the funnel . . .



17.2b . . . so you can easily add lubricant to the transaxle from above

17 Manual transaxle lubricant level check (every 15,000 miles or 12 months)

Refer to illustrations 17.1, 17.2a and 17.2b

1 The manual transaxle does not have a dipstick. To check the fluid level, raise the vehicle and support it securely on jackstands. The vehicle must be level. The check/fill plug is on the side of the transaxle, and the drain plug is on the bottom **(see illustration)**. Remove the check/fill plug with a socket or box-end wrench. If the lubricant level is correct, it should be up to the lower edge of the hole. Often, lubricant will leak out when the plug is removed, indicating the level is correct. If lubricant does not leak out when the plug is removed, use your finger as a dipstick to check that it is up to the level of the hole.

2 If the transaxle needs more lubricant (if the level is not up to the hole), use a funnel to add more **(see illustrations)**. Handy lubricant containers with built-in pumps are available from auto parts stores; these provide a still easier method for a moderate extra expense. Stop filling the transaxle when the lubricant begins to run out the hole.

3 Install the plug and tighten it securely. Drive the vehicle a short distance, then check for leaks.

18 Air filter replacement (every 30,000 miles or 24 months)

Refer to illustrations 18.2 and 18.4

1 At the specified intervals, the air filter should be replaced with a new one.

2 Release the air cleaner cover clips **(see illustration)**.

3 Lift the cover up.

4 Lift the air filter element out of the housing and wipe out the inside of the air cleaner housing with a clean rag **(see illustration)**.

5 While the air cleaner cover is off, be careful not to drop anything down into the air cleaner assembly.

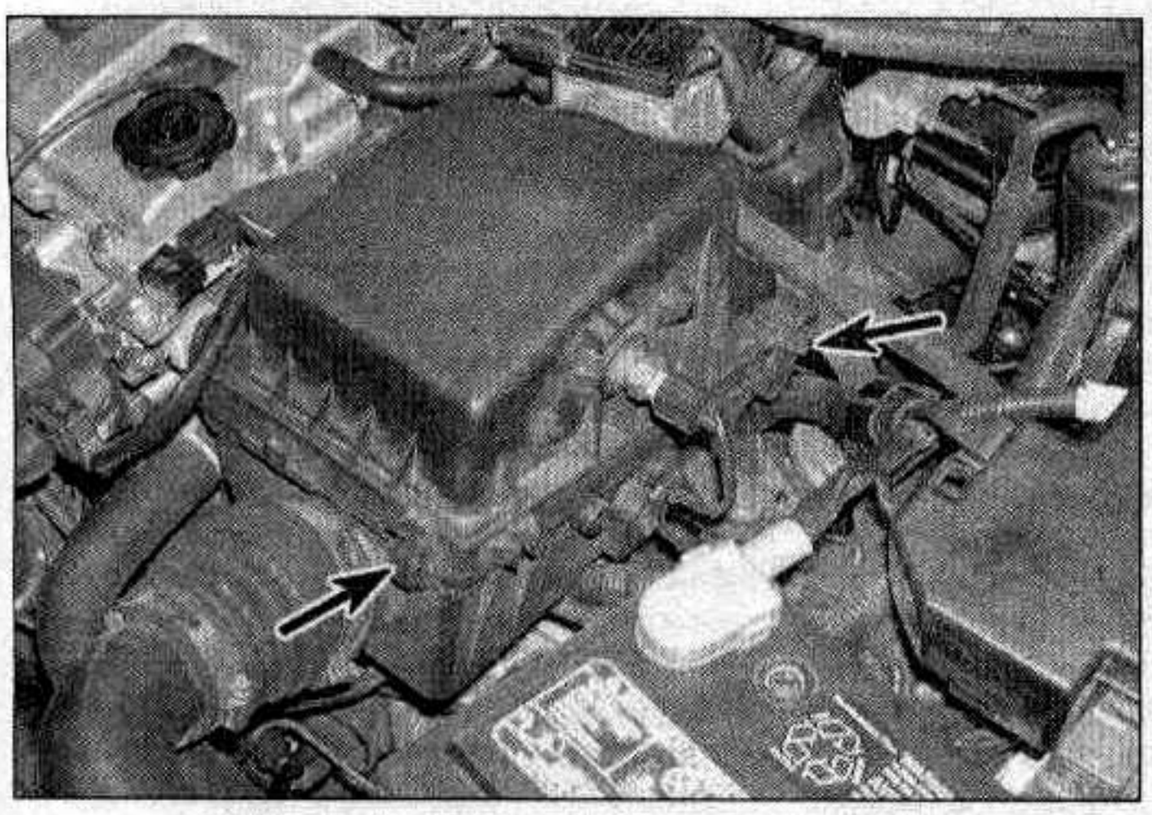
6 Place the new filter in the air cleaner housing. Make sure it seats properly in the lower half of the housing.

7 Install the air cleaner cover and tighten the screws securely.

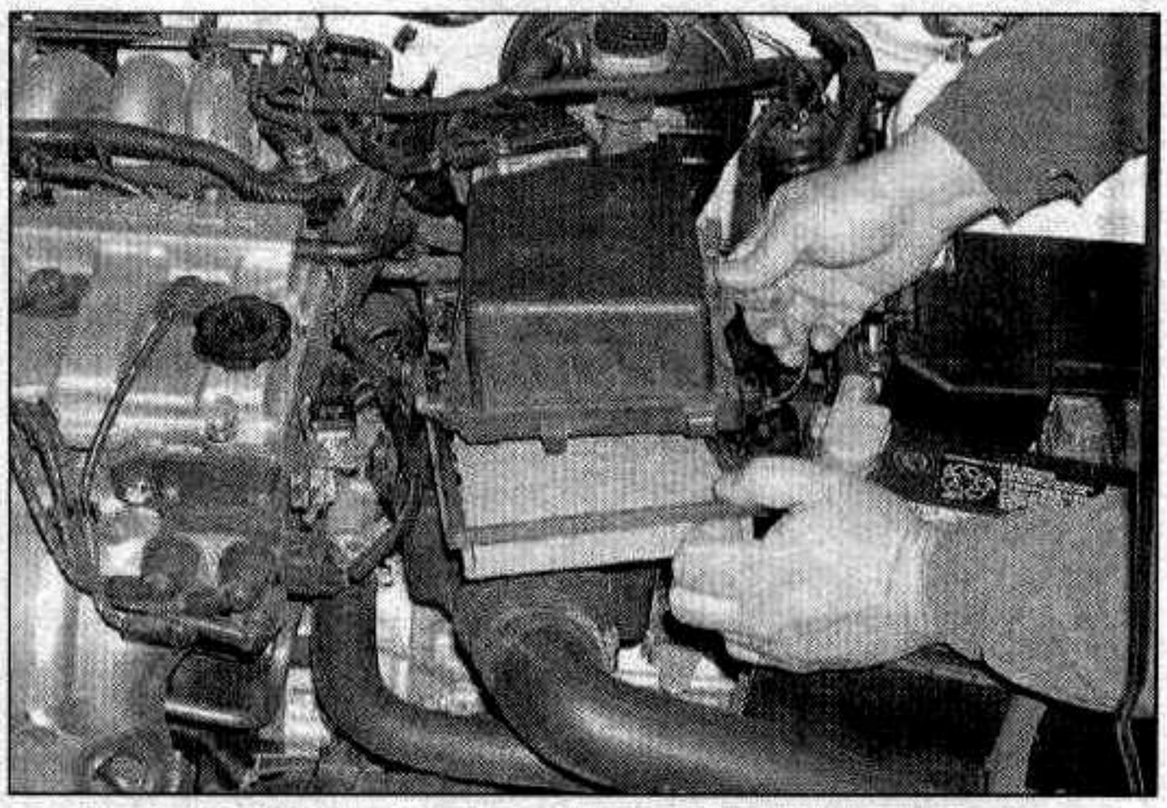
19 Spark plug check and replacement (see maintenance schedule)

Refer to illustrations 19.2, 19.5a, 19.5b, 19.8, 19.9 and 19.10

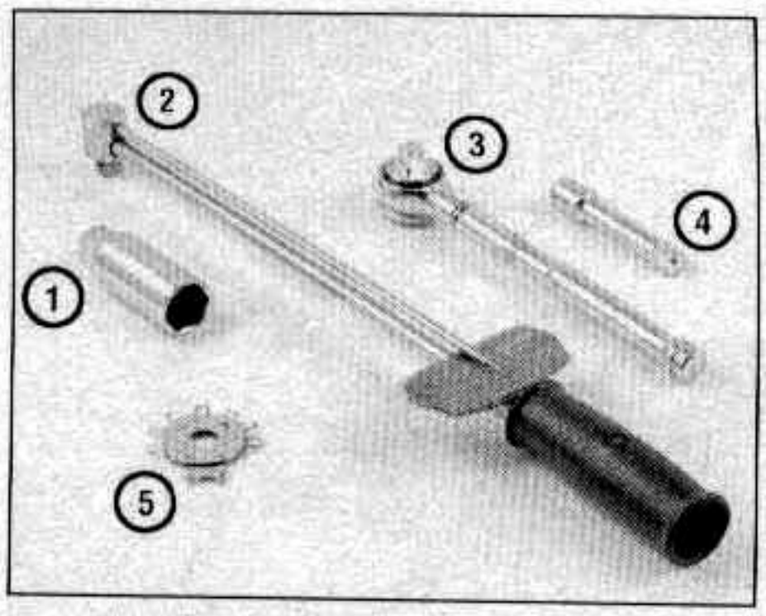
1 The spark plug wires should be checked whenever new spark plugs are installed (see the next Section).



18.2 Release all the air cleaner cover clips



18.4 Lift up the cover and remove the filter element



19.2 Tools required for changing spark plugs

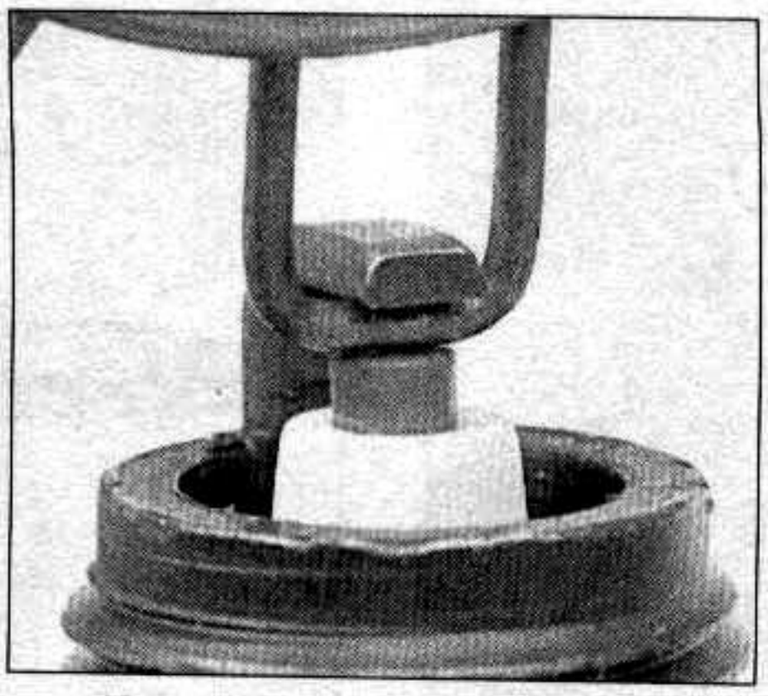
1 ***Spark plug socket*** *- This will have special padding inside to protect the spark plug's porcelain insulator*
2 ***Torque wrench*** *- Although not mandatory, using this tool is the best way to ensure the plugs are tightened properly*
3 ***Ratchet*** *- Standard hand tool to fit the spark plug socket*
4 ***Extension*** *- Depending on model and accessories, you may need special extensions and universal joints to reach one or more of the plugs*
5 ***Spark plug gap gauge*** *- This gauge for checking the gap comes in a variety of styles. Make sure the gap for your engine is included*

2 In most cases, the tools necessary for spark plug replacement include a spark plug socket which fits onto a ratchet (spark plug sockets are padded inside to prevent damage to the porcelain insulators on the new plugs), various extensions and a gap gauge to check and adjust the gap on the new plugs **(see illustration)**. A special plug wire removal tool is available for separating the wire boots from the spark plugs, and is a good idea on these models because the boots fit very tightly. A torque wrench should be used to tighten the new plugs. It is a good idea to allow the engine to cool before removing or installing the spark plugs.

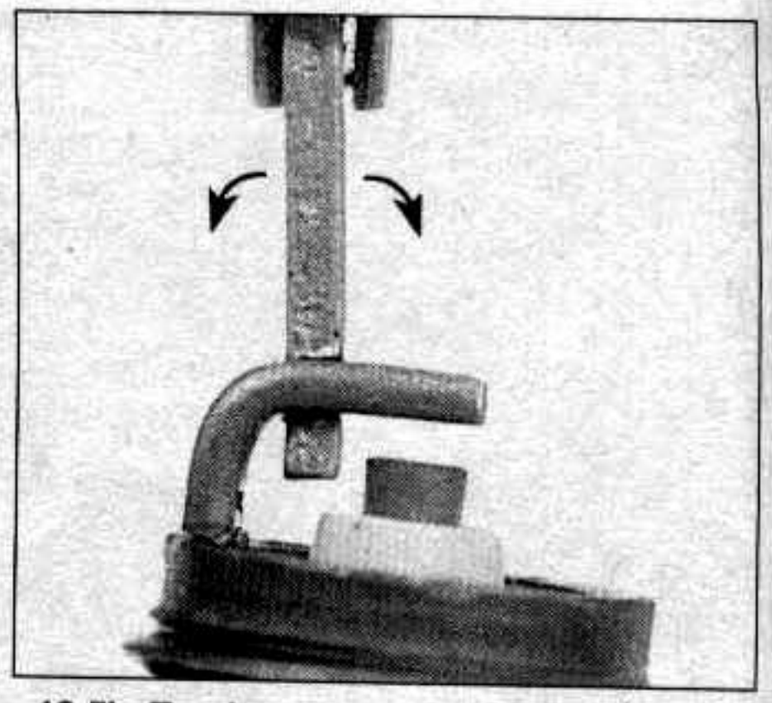
3 The best approach when replacing the spark plugs is to purchase the new ones in advance, adjust them to the proper gap and replace the plugs one at a time. When buying the new spark plugs, be sure to obtain the correct plug type for your particular engine. The plug type can be found in the Specifications at the front of this Chapter and on the Emission Control Information label located under the hood. If these two sources list different plug types, consider the emission control label correct.

4 Allow the engine to cool completely before attempting to remove any of the plugs. While you are waiting for the engine to cool, check the new plugs for defects and adjust the gap.

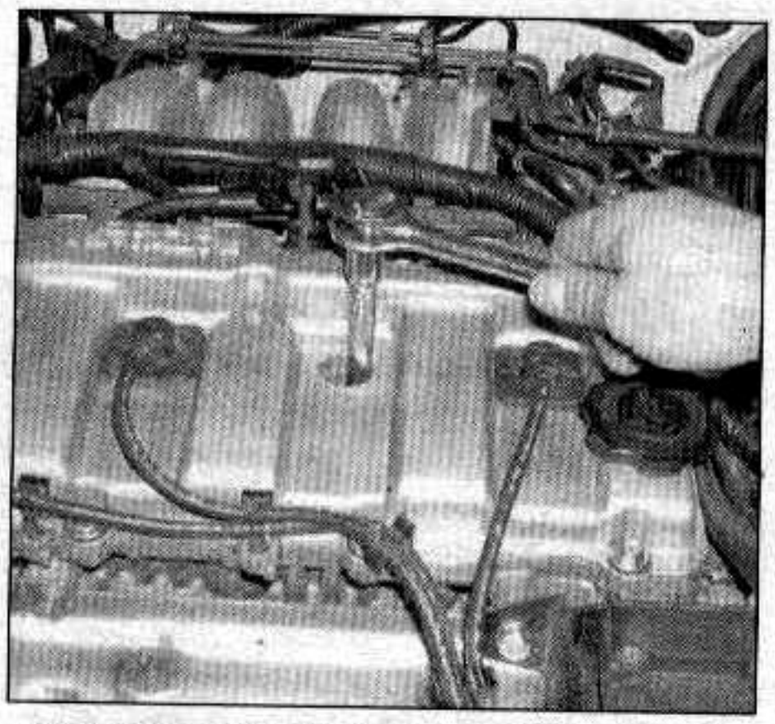
5 Check the gap by inserting the proper thickness gauge between the electrodes at the tip of the plug **(see illustration)**. The gap



19.5a Spark plug manufacturers recommend using a wire-type gauge when checking the gap - if the wire does not slide between the electrodes with a slight drag, adjustment is required



19.5b To change the gap, bend the side electrode only, as indicated by the arrows, and be very careful not to crack or chip the porcelain insulator surrounding the center electrode



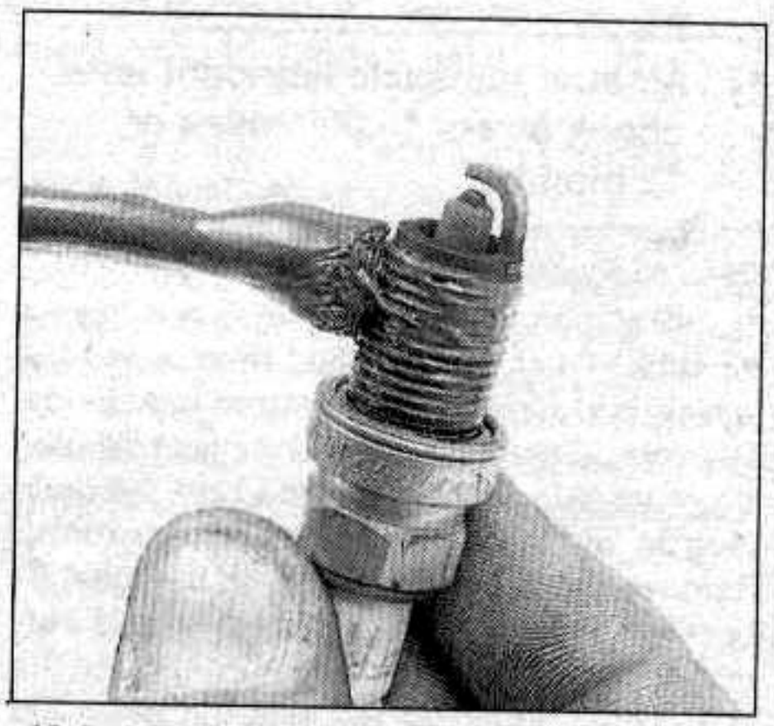
19.8 Because they are deeply recessed, an extension will be required when removing or installing the spark plugs

between the electrodes should be the same as the one specified on the Emissions Control Information label or in Chapter 5. The wire should slide between the electrodes with a slight amount of drag. If the gap is incorrect, use the adjuster on the gauge body to bend the curved side electrode slightly until the proper gap is obtained **(see illustration)**. If the side electrode is not exactly over the center electrode, bend it with the adjuster until it is. Check for cracks in the porcelain insulator (if any are found, the plug should not be used).

6 With the engine cool, remove the spark plug wire as described in the next Section from one spark plug. Pull only on the boot at the end of the wire - do not pull on the wire. A plug wire removal tool should be used if available.

7 If compressed air is available, use it to blow any dirt or foreign material away from the spark plug hole. A common bicycle pump will also work. The idea here is to eliminate the possibility of debris falling into the cylinder as the spark plug is removed.

8 The spark plugs on these models are difficult to reach, so an extension is needed to reach into the deep spark plug recesses.



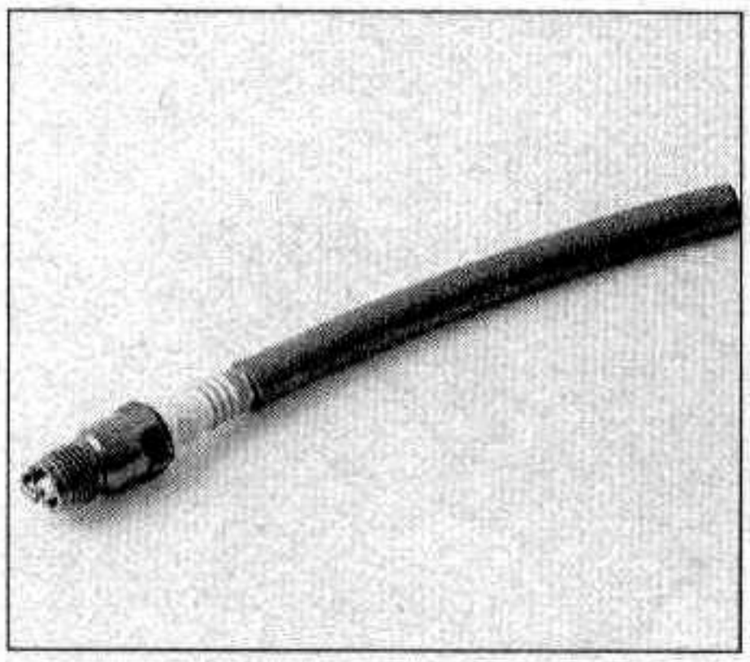
19.9 A light coat of anti-seize compound applied to the threads of the spark plugs will keep the threads in the cylinder head from being damaged the next time the plugs are removed

Place the spark plug socket over the plug and remove it from the engine by turning it in a counterclockwise direction **(see illustration)**. The rear plugs on V6 models are very deeply recessed: they will require a very long (about 10-inch) extension and possibly a swivel joint.

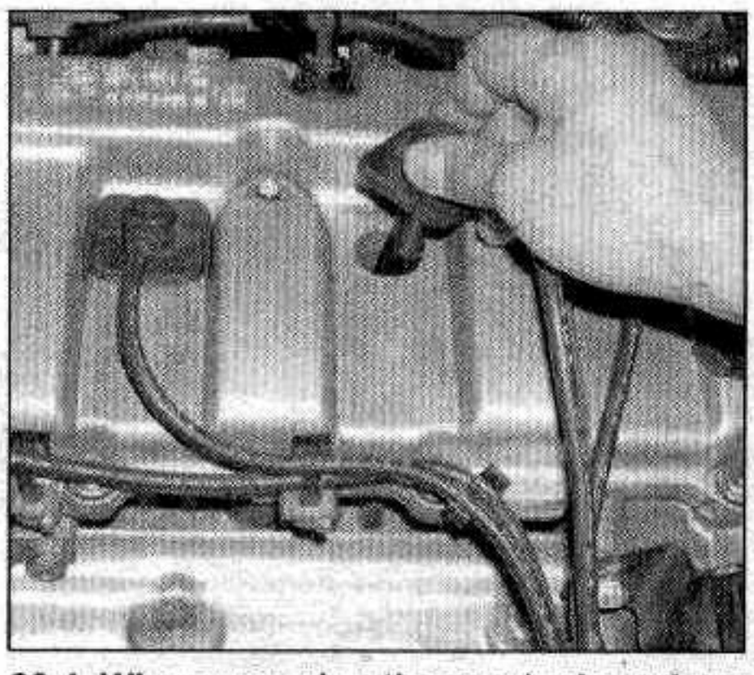
9 Compare the spark plug with the chart shown on the inside back cover of this manual to get an indication of the general running condition of the engine. Before installing the new plugs, it is a good idea to apply a thin coat of anti-seize compound to the threads **(see illustration)**.

10 Thread one of the new plugs into the hole until you can no longer turn it with your fingers, then tighten it with a torque wrench (if available) or the ratchet. It's a good idea to slip a short length of rubber hose over the end of the plug to use as a tool to thread it into place **(see illustration)**. The hose will grip the plug well enough to turn it, but will start to slip if the plug begins to cross-thread in the hole - this will prevent damaged threads and the accompanying repair costs.

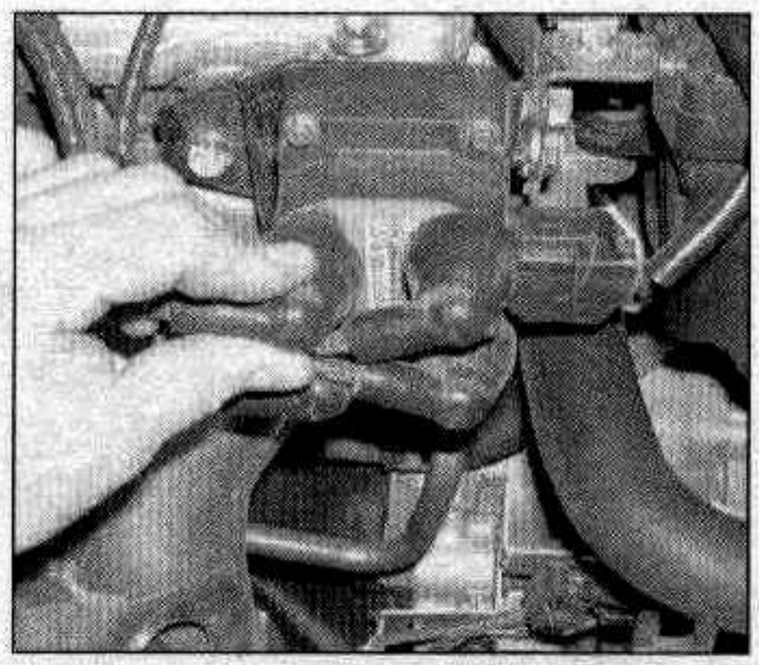
11 Before pushing the spark plug wire onto



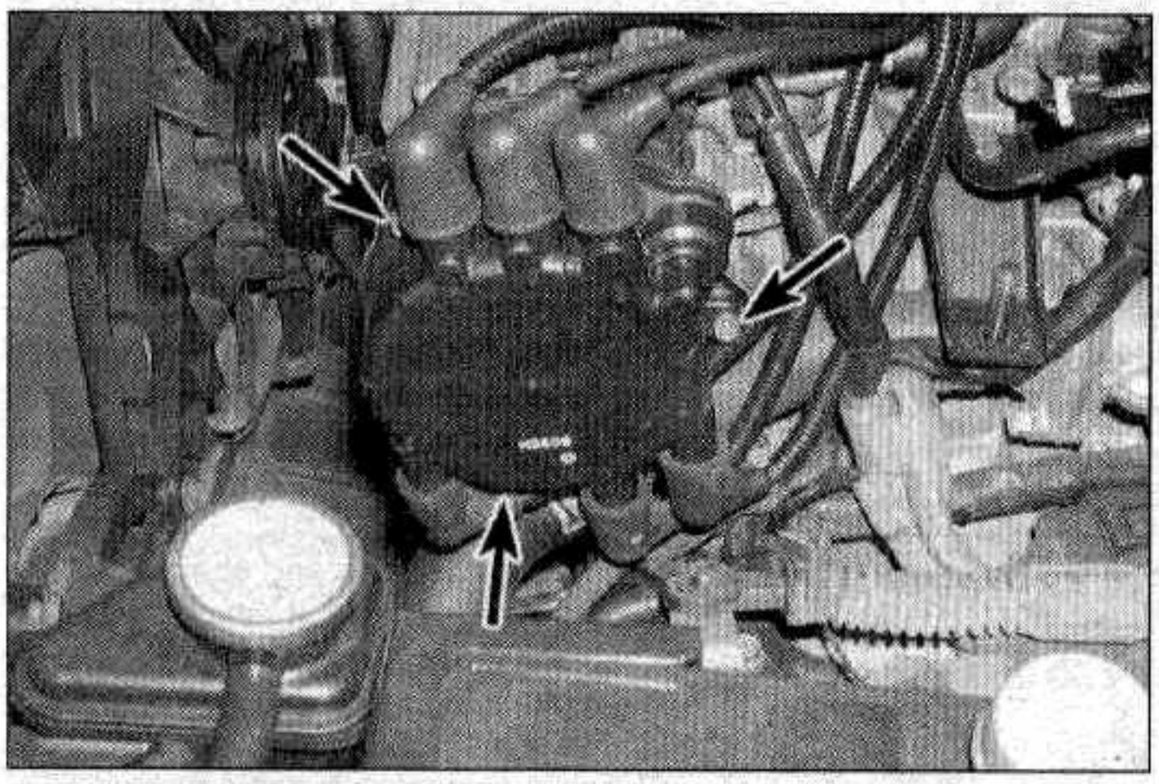
19.10 A piece of rubber hose will aid in getting the spark plug started in the hole



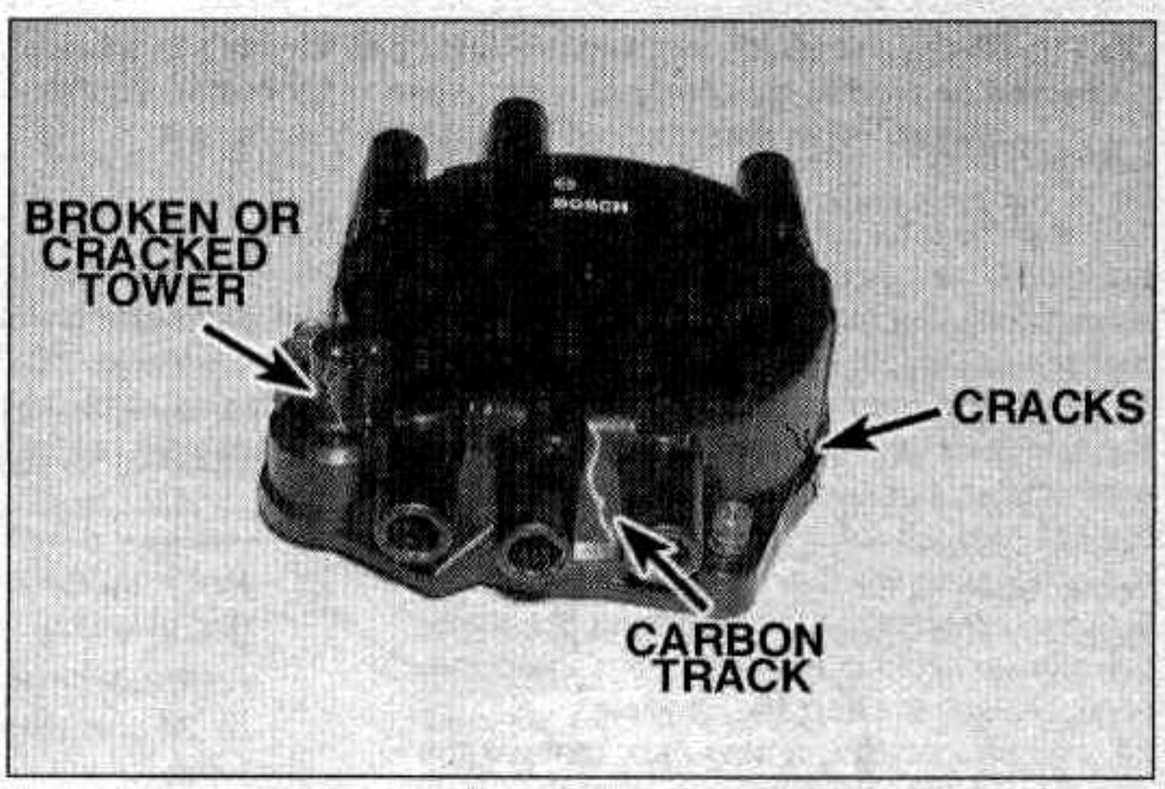
20.4 When removing the spark plug wires, pull only on the boot using a twisting/pulling motion



20.8 Remove each spark plug wire from the distributor or coil pack



20.11a Loosen the distributor cap retaining screw (arrows)



20.11b Check the outside of the distributor cap for cracks, a broken tower or carbon tracks

the end of the plug, inspect the wire following the procedures outlined in the next Section.

12 Attach the plug wire to the new spark plug, again using a twisting motion on the boot until it's seated on the spark plug.

13 Repeat the procedure for the remaining spark plugs, replacing them one at a time to prevent mixing up the spark plug wires.

20 Ignition system component check and replacement (30,000 miles or 24 months)

Spark plug wires

Refer to illustrations 20.4 and 20.8

1 The spark plug wires should be checked whenever new spark plugs are installed.

2 Begin this procedure by making a visual check of the spark plug wires while the engine is running. In a darkened garage (make sure there is adequate ventilation) start the engine and observe each plug wire. Be careful not to come into contact with any moving engine parts. If there is a break in the wire, you will see arcing or a small spark at the damaged area. If arcing is noticed, make a note to obtain new wires, then allow the engine to cool and check the distributor cap and rotor.

3 The spark plug wires should be inspected one at a time to prevent mixing up the order, which is essential for proper engine operation. Each original plug wire should be numbered to help identify its location. If the number is illegible, a piece of tape can be marked with the correct number and wrapped around the plug wire.

4 Disconnect the plug wire from the spark plug. A removal tool can be used for this purpose or you can grasp the rubber boot, twist the boot half a turn and pull the boot free **(see illustration)**. Do not pull on the wire itself. On V6 models, the rear spark plug wires are particularly difficult to pull out of their recesses, so a special plier-type removal tool may be necessary.

5 Check inside the boot for corrosion, which will look like a white crusty powder. Light corrosion can be removed with a small wire brush, but replace the wires if corrosion is heavy.

6 Push the wire and boot back onto the end of the spark plug. It should fit tightly onto the end of the plug. If it doesn't, remove the wire and use pliers to carefully crimp the metal connector inside the wire boot until the fit is snug.

7 Using a clean rag, wipe the entire length of the wire to remove built-up dirt and grease. Once the wire is clean, check for burns, cracks and other damage. Do not bend the wire sharply, because the conductor might break.

8 Disconnect the wire from the distributor or ignition coil pack (on models without a distributor) **(see illustration)**. Again, pull only on the rubber boot. Check for corrosion and a tight fit. Replace the wire in the distributor or coil pack.

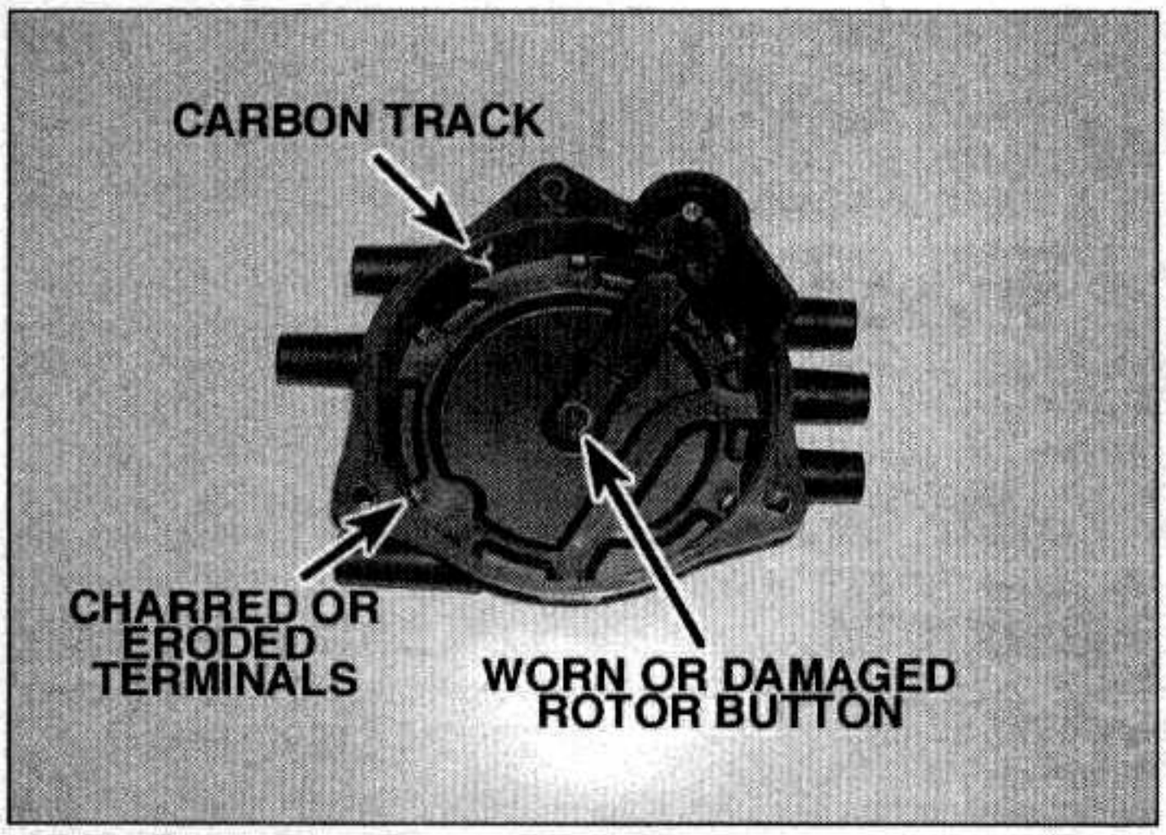
9 Inspect the remaining spark plug wires, making sure that each one is securely fastened at the distributor or coil pack and spark plug when the check is complete.

10 If new spark plug wires are required, purchase a set for your specific engine model. Remove and replace the wires one at a time to avoid mix-ups in the firing order.

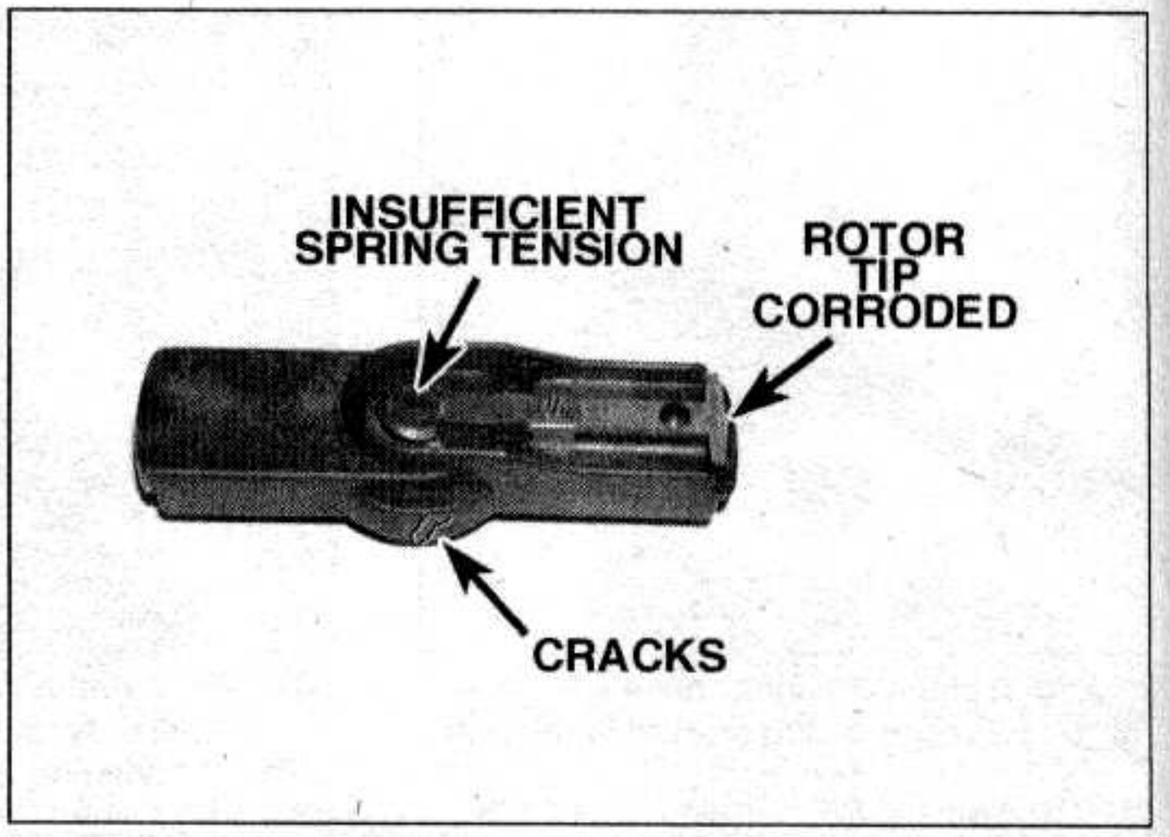
Distributor cap and rotor (models so equipped)

Refer to illustrations 20.11a, 20.11b, 20.11c and 20.12

11 Detach the distributor cap by loosening the cap retaining screws **(see illustration)**. Check the distributor cap for cracks, carbon tracks and worn, burned or loose contacts **(see illustrations)**.



20.11c Check the inside of the distributor cap for carbon tracks, charred or eroded terminals or a damaged rotor button (in the center) - if in doubt about its condition, replace it



20.12 Check the distributor rotor for cracks, a corroded rotor tip and insufficient spring tension (if in doubt about its condition, buy a new one)

12 Pull the rotor off the distributor shaft and examine it for cracks and carbon tracks **(see illustration)**. Replace the cap and rotor if any damage or defects are noted.

13 It is common practice to install a new cap and rotor whenever new spark plug wires are installed, but if you wish to continue using the old cap, check the resistance between the spark plug wires and the cap first. If the indicated resistance is more than the maximum value listed in this Chapter's Specifications, replace the cap and/or wires.

14 When installing a new cap, remove the wires from the old cap one at a time and attach them to the new cap in the exact same location **Note:** *If an accidental mix-up occurs, refer to the firing order Specifications at the beginning of this Chapter. On most models, the location of the number one plug wire tower is marked on the distributor cap.*

Ignition coil pack (models with distributorless ignition)

Refer to illustration 20.16

15 Clean the coil pack(s) with a dampened cloth and dry them with a dampened cloth thoroughly.

16 Inspect each coil pack for cracks, damage and carbon tracking **(see illustration)**. Carbon tracks can usually be removed. If damage exists, refer to Chapter 5 for the replacement procedure.

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

Refer to illustrations 21.2 and 21.4.

1 The Positive Crankcase Ventilation (PCV) system directs blowby gases from the crankcase through the PCV valve and hose back into the intake manifold so they can be burned in the engine. The system consists of a hose leading from the valve cover to the intake manifold and a fresh air hose between the air cleaner assembly and the rocker arm cover.

2 The PCV valve and hose is located in the valve cover **(see illustration)**.

3 With the engine idling at normal operating temperature, pull the valve (with hose attached) from the valve cover.

4 Place your finger over the valve opening or hose **(see illustration)**. If there's no vacuum, check for a plugged hose, manifold port, or the valve itself. Replace any plugged or deteriorated hoses.

5 Turn off the engine and shake the PCV valve, listening for a rattle. If the valve doesn't rattle, replace it with a new one.

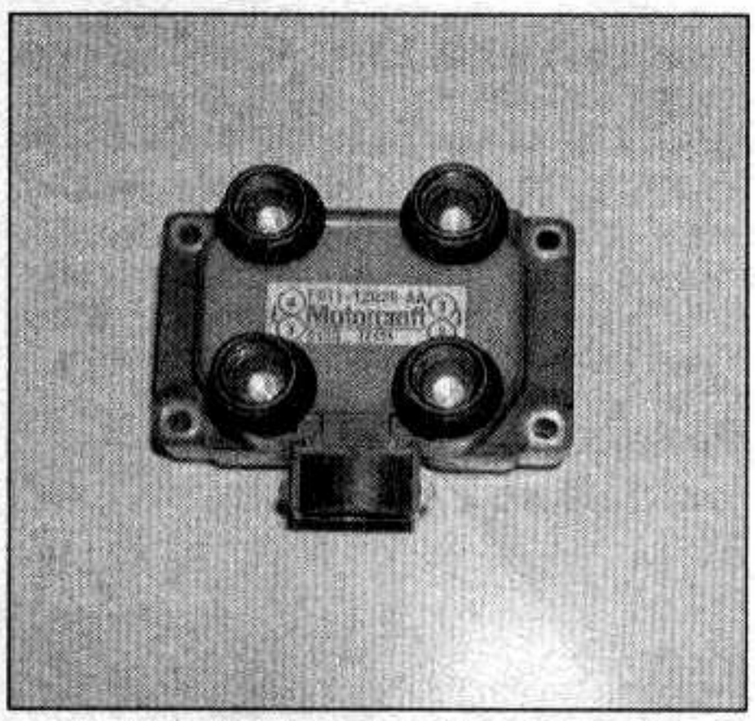
6 To replace the valve, pull it from the end of the hose, noting its installed position.

7 When purchasing a replacement PCV valve, make sure it's for your particular vehicle and engine size. Compare the old valve with the new one to make sure they're the same.

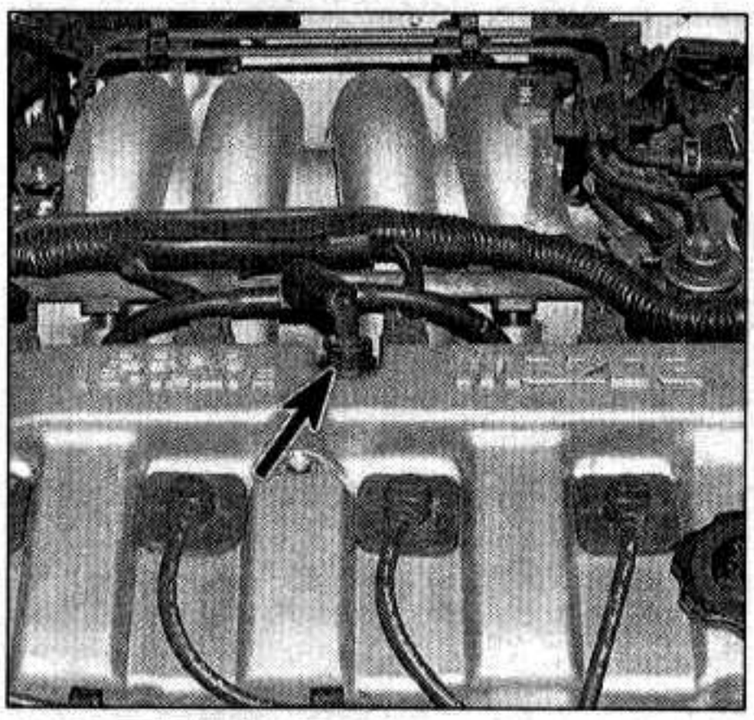
8 Push the valve into the end of the hose until it's seated.

9 Inspect all rubber hoses and grommets for damage and hardening. Replace them, if necessary.

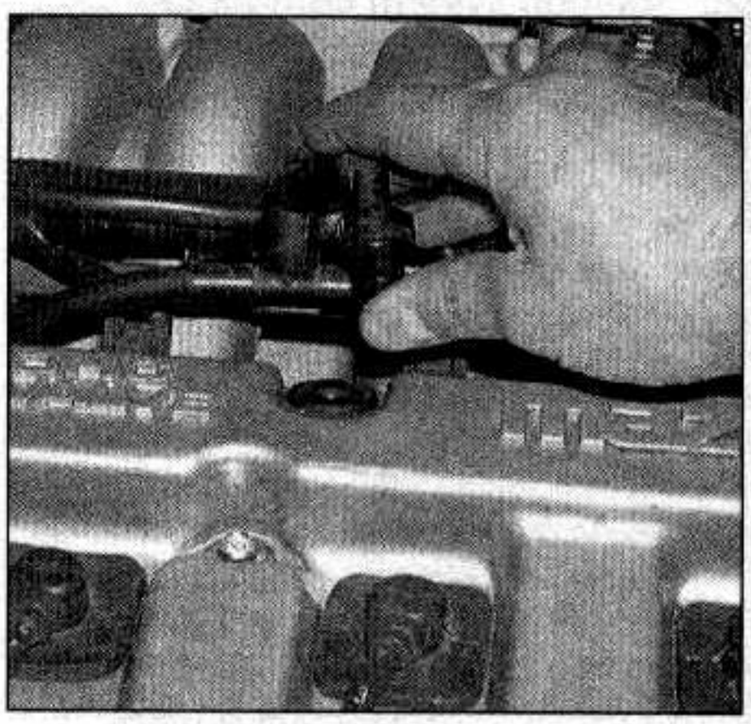
10 Press the PCV valve and hose securely into position. For further information on the PCV system refer to Chapter 6.



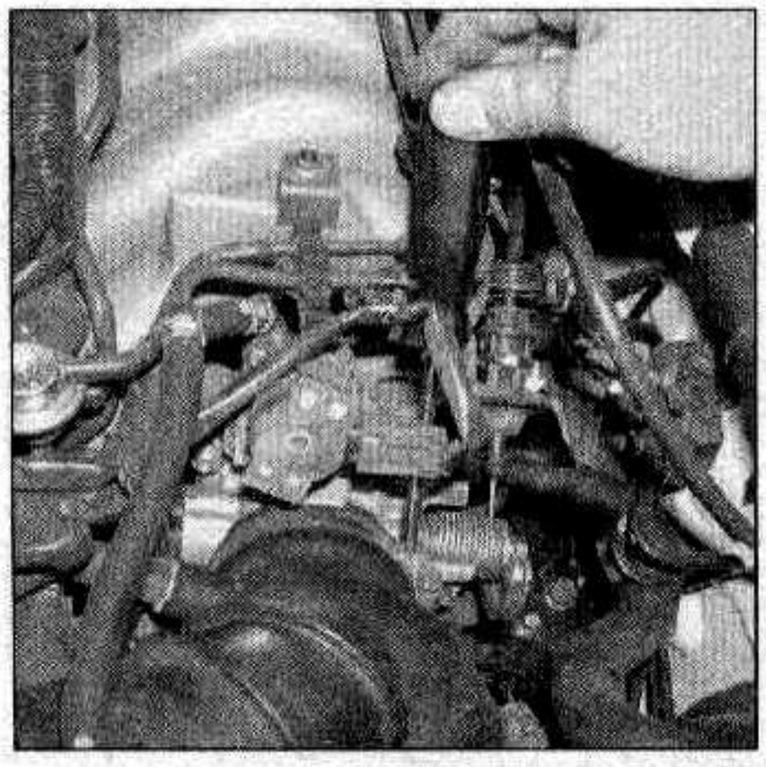
20.16 Check the ignition coil pack for cracks and carbon tracking between the towers



21.2 PCV valve location on four-cylinder models (the V6 PCV valve is also in the valve cover, on the left side)



21.4 With the engine running at idle, remove the PCV valve and verify that vacuum can be felt at the end of the valve



22.7 The idle speed screw is located on the throttle body; use a screwdriver to turn the adjusting screw until the idle speed is correct (V6 shown, four-cylinder similar)

22 Idle speed check and adjustment (1997 and earlier models) (every 30,000 miles or 24 months)

Refer to illustration 22.7

1 Engine idle speed is the speed at which the engine operates when no accelerator pedal pressure is applied, as when stopped at a traffic light. The speed is critical to the performance of the engine itself, as well as many subsystems.

2 Set the parking brake firmly and block the wheels to prevent the vehicle from rolling. Place the transaxle in Neutral (manual transaxle) or Park (automatic transaxle). Make sure all accessories are turned off.

3 Start the engine and warm it up to normal operating temperature, then turn the engine off.

4 Connect a tachometer in accordance with the tool manufacturer's instructions.

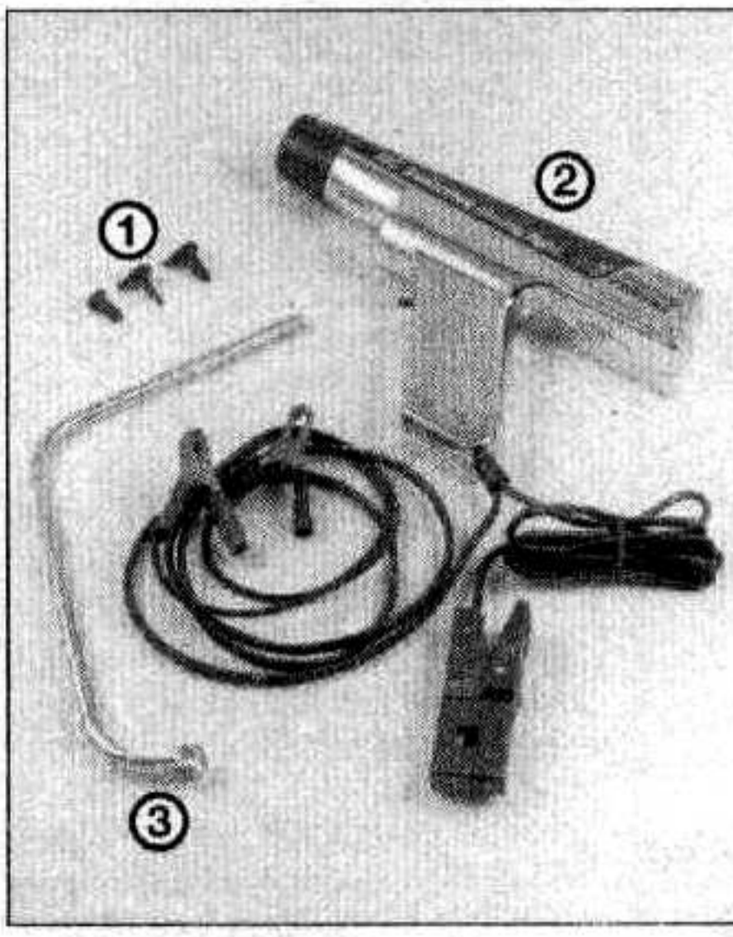
5 Refer to Section 23 and remove the shorting bar from the SPOUT connector or connect a jumper wire between the TEN and GND terminals of the data link connector, as applicable.

6 Start the engine and note the idle speed on the tachometer. Compare it to that listed on the VECI label or in this Chapter's Specifications. **Note:** *If the idle speed listed on the VECI label is different than that listed in this Chapter's Specifications, use the specification shown on the VECI label.*

7 If the idle speed is too low or too high, turn the idle speed adjusting screw to obtain the specified idle speed **(see illustration)**. Make changes only in quarter-turn increments. Allow the idle to stabilize for one minute and recheck the idle speed. When adjusting the idle speed, make sure the engine cooling fan is off.

8 Check the ignition timing (see Section 23), adjust the timing, if necessary and readjust the idle speed, if necessary.

9 Turn off the engine and disconnect the tachometer. Remove the jumper wire from the data link connector or install the shorting bar in the SPOUT connector.



23.5 Tools needed to check and adjust the ignition timing

1 ***Vacuum plugs*** *- Vacuum hoses will, in some cases, have to be disconnected and plugged. Molded plugs in various shapes and sizes are available for this*

2 ***Inductive pick-up timing light*** *- Flashes a bright, concentrated beam of light when the number one spark plug fires. Connect the leads according to the instructions supplied with the light*

3 ***Distributor wrench*** *- On some models, the hold-down bolt for the distributor is difficult to reach and turn with conventional wrenches or sockets. A special wrench like this must be used*

23 Ignition timing (1997 and earlier models) - check and adjustment (every 30,000 miles or 24 months)

Refer to illustrations 23.5 and 23.10

1 At the specified intervals or when the distributor has been removed, the ignition timing should be checked and adjusted.

2 Set the parking brake firmly and block the wheels to prevent the vehicle from rolling. Place the transaxle in Neutral (manual transaxle) or Park (automatic transaxle).

3 Locate the VECI label under the hood for information concerning ignition timing. If no VECI label is found, refer to the specifications section at the beginning of this Chapter.

4 Start the engine and warm it up to normal operating temperature (the cooling fan comes on), then turn the engine off.

5 Before attempting to check the ignition timing some special tools will be needed for this procedure **(see illustration)**.

6 Connect a tachometer and a timing light in accordance with the tool manufacturer's instructions. Connect the timing light inductive pick-up to the number 1 spark plug wire (refer to the cylinder location diagram at the beginning of this Chapter).

7 Locate the timing scale on the timing belt cover at the drivebelt end of the engine adjacent to the crankshaft pulley. Clean it with solvent, if necessary to read the small markings.

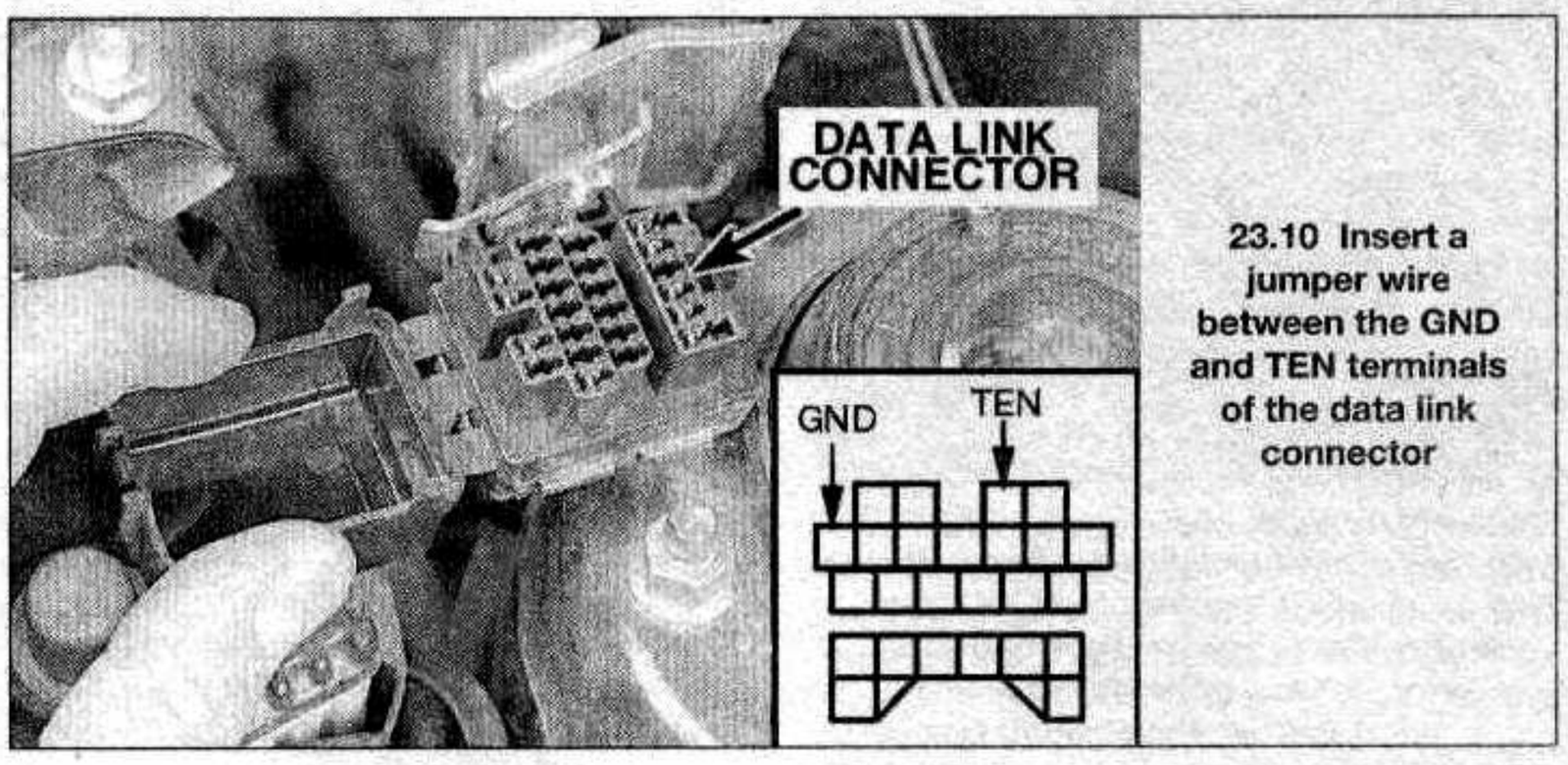
8 Check that the wiring for the tachometer and timing light are clear of all moving parts.

9 On all Ford four-cylinder models and Mazda four-cylinder models with an automatic transaxle, disconnect the shorting bar from the two-wire SPOUT connector located between the battery and the data link connector.

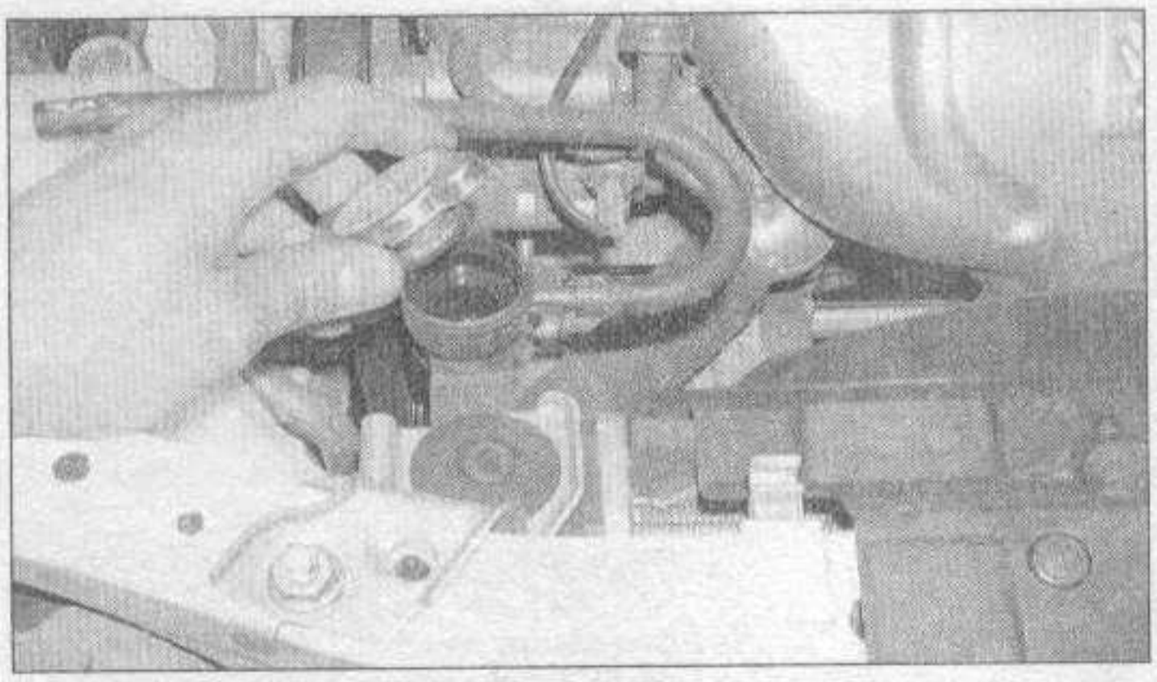
10 On Mazda four-cylinder models with a manual transaxle and all V6 models, connect a jumper wire between the GND and TEN terminals of the data link connector **(see illustration)**.

11 Start the engine and check the engine idle speed (see Section 22). If the engine idle speed is incorrect, adjust the engine idle speed to specifications before proceeding with the timing check.

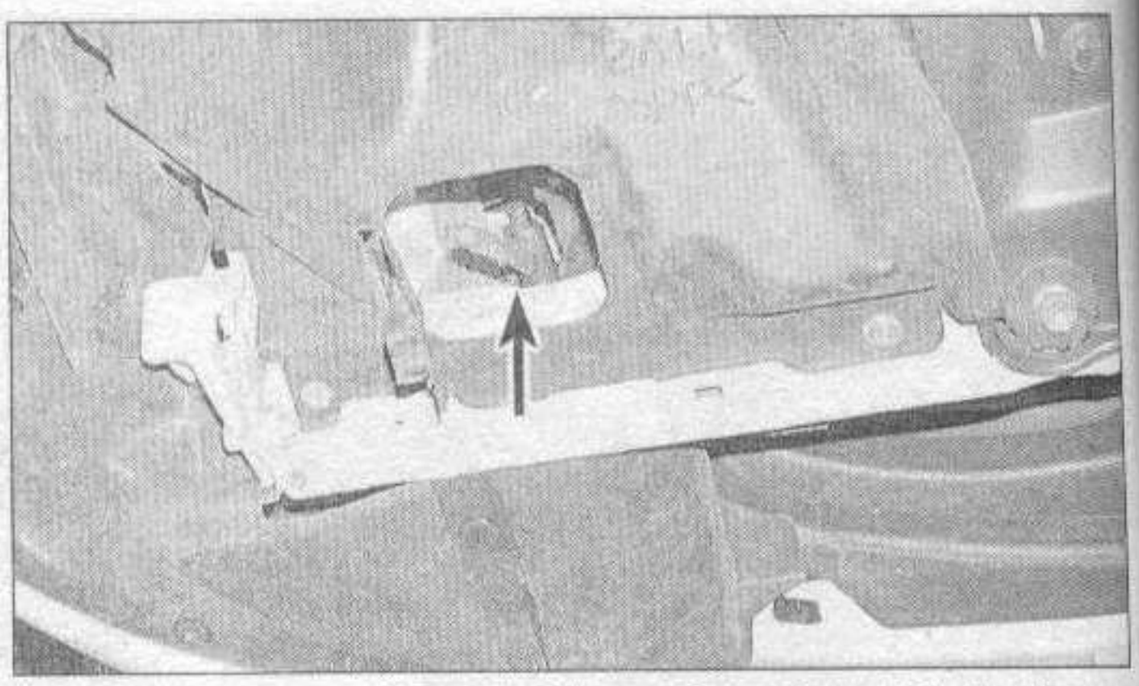
12 Aim the flashing timing light at the timing scale and the crankshaft pulley. If the yellow mark on the crankshaft pulley isn't aligned with the specified mark on the timing scale,



23.10 Insert a jumper wire between the GND and TEN terminals of the data link connector



24.5 Push down on the radiator cap and rotate it counterclockwise - never remove it when the engine is hot!



24.6 The radiator drain plug (arrow) is located at the bottom corner of the radiator

loosen the distributor hold-down bolt and turn the distributor until the marks align.

13 Tighten the bolt and re-check the timing and idle speed, readjust if necessary.

14 When the timing and idle speed are correct turn the engine off and remove the tachometer and timing light. Remove the jumper wire from the data link connector or plug the shorting bar back into the SPOUT connector.

24 Cooling system servicing (draining, flushing and refilling) (every 30,000 miles or 24 months)

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

1 Periodically, the cooling system should be drained, flushed and refilled to replenish the antifreeze mixture and prevent formation of rust and corrosion, which can impair the performance of the cooling system and cause engine damage.

2 At the same time the cooling system is serviced, all hoses and the radiator cap should be inspected and replaced if defective (see Section 13).

3 Since antifreeze is a corrosive and poisonous solution, be careful not to spill any of the coolant mixture on the vehicle's paint or your skin. If this happens, rinse it off immediately with plenty of clean water. Consult local authorities about where to recycle or dispose of antifreeze before draining the cooling system. In many areas, reclamation centers have been set up to collect automobile oil and drained antifreeze/water mixtures, rather than allowing them to be added to the sewage system.

Draining

Refer to illustrations 24.5 and 24.6

4 Apply the parking brake and block the wheels. If the vehicle has just been driven, wait several hours to allow the engine to cool down before beginning this procedure.

5 Once the engine is completely cool, remove the radiator cap (four-cylinder models) **(see illustration)** or the filler cap on the engine (V6 models). Also remove the coolant reservoir cap.

6 Drain the radiator by opening the drain plug at the bottom of the radiator **(see illustration)**. If the drain plug is corroded and can't be turned easily, or if the radiator isn't equipped with a plug, disconnect the lower radiator hose to allow the coolant to drain. Be careful not to get antifreeze on your skin or in your eyes.

7 After the coolant stops flowing out of the radiator, disconnect the lower radiator hose from the radiator and allow the remaining coolant in the engine block to drain.

8 While the coolant is draining from the engine block, disconnect the hose from the coolant reservoir and remove the reservoir (see Chapter 3 if necessary). Flush the reservoir out with water until it's clean, and, if necessary, wash the inside with soapy water and a brush to make reading the fluid level easier.

9 While the coolant is draining, check the condition of the radiator hoses, heater hoses and clamps (refer to Section 13 if necessary).

10 Replace any damaged clamps or hoses (refer to Chapter 3 for detailed replacement procedures).

Flushing

11 Once the system is completely drained, remove the thermostat from the engine (see Chapter 3). Then reinstall the thermostat housing without the thermostat. This will allow the system to be thoroughly flushed.

12 Re-connect the lower radiator hose and tighten the radiator drain plug. Turn your heating system controls to Hot, so that the heater core will be flushed at the same time as the rest of the cooling system.

13 Disconnect the upper radiator hose, then place a garden hose in the upper radiator inlet and flush the system until the water runs clear at the upper radiator hose.

14 In severe cases of contamination or clogging of the radiator, remove the radiator (see Chapter 3) and have a radiator repair facility clean and repair it if necessary.

15 Many deposits can be removed by the chemical action of a cleaner available at auto parts stores. Follow the procedure outlined in the manufacturer's instructions. **Note:** *When the coolant is regularly drained and the system refilled with the correct antifreeze/water mixture, there should be no need to use chemical cleaners or descalers.*

Refilling

16 To refill the system, install the thermostat, reconnect any radiator hoses and install the reservoir and the overflow hose.

17 Place the heater temperature control in the maximum heat position.

18 Make sure to use the proper coolant listed in this Chapter's Specifications. Slowly fill the radiator with the recommended mixture of antifreeze and water to the base of the filler neck. Then add coolant to the reservoir until it reaches the F mark on the dipstick. Wait five minutes and recheck the coolant level in the radiator, adding if necessary.

19 Leave the radiator cap (four-cylinder) or filler cap (V6) off and run the engine in a well-ventilated area until the thermostat opens (coolant will begin flowing through the radiator and the upper radiator hose will become hot).

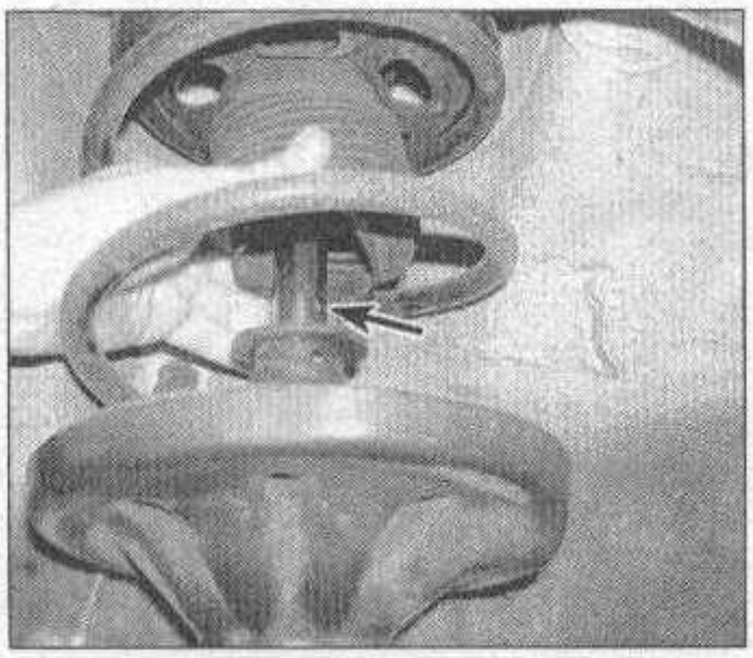
20 Turn the engine off and let it cool. Add more coolant mixture to bring the level back up to the base of the filler neck.

21 Squeeze the upper radiator hose to expel air, then add more coolant mixture if necessary. Replace the radiator cap.

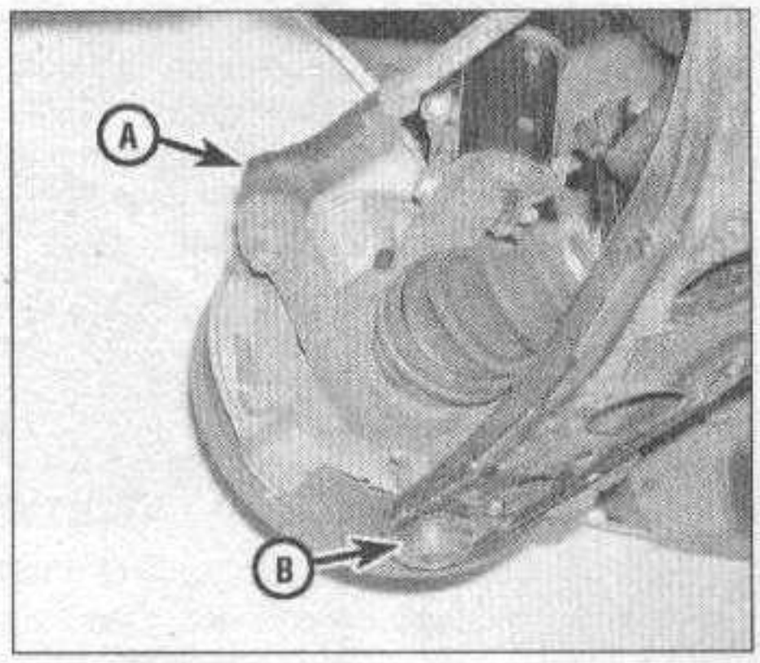
22 Place the heater temperature control and the blower motor speed control to their maximum setting.

23 Start the engine, allow it to reach normal operating temperature and check for leaks.

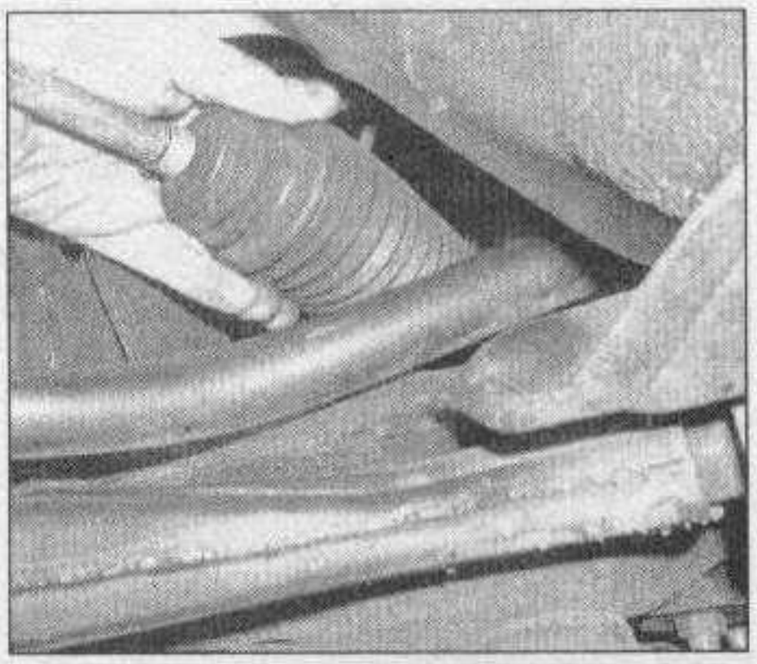
24 If the coolant temperature rises above normal, there is air trapped in the cooling system. Shut off the engine and allow it to cool completely; the system will automatically vent the trapped air. Repeat the procedure until the engine temperature stays at the normal position on the gauge.



26.6 Check the front and rear shock absorbers for leakage where the rod enters the tube (arrow)



26.9a Inspect the tie rod ends (A) and the balljoints (B) for torn grease seals



26.9b Check the steering gear boots for cracks and leaking steering fluid

25 Brake fluid change (every 30,000 miles or 24 months)

Warning: *Brake fluid can harm your eyes and damage painted surfaces, so use extreme caution when handling or pouring it. Do not use brake fluid that has been standing open or is more than one year old. Brake fluid absorbs moisture from the air. Excess moisture can cause a dangerous loss of braking effectiveness.*

1 At the specified intervals, the brake fluid should be drained and replaced. Since the brake fluid may drip or splash when pouring it, place plenty of rags around the master cylinder to protect any surrounding painted surfaces.

2 Before beginning work, purchase the specified brake fluid (see *Recommended lubricants and fluids* at the beginning of this Chapter).

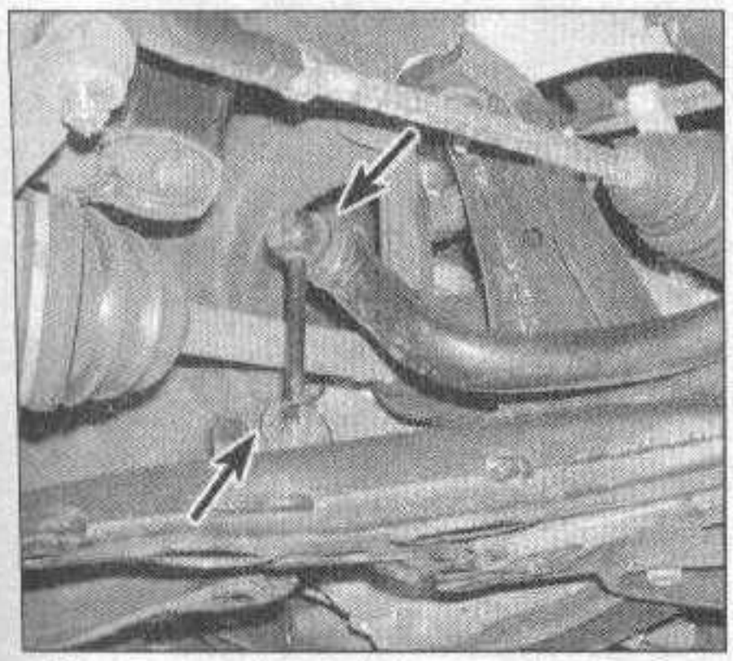
3 Remove the cap from the master cylinder reservoir.

4 Using a hand suction pump or similar device, withdraw the fluid from the master cylinder reservoir.

5 Add new fluid to the master cylinder until it rises to the base of the filler neck.

6 Bleed the brake system as described in Chapter 9 at all four brakes until new and uncontaminated fluid is expelled from the bleeder screw. Be sure to maintain the fluid level in the master cylinder as you perform the bleeding process. If you allow the master cylinder to run dry, air will enter the system.

7 Refill the master cylinder with fluid and check the operation of the brakes. The pedal should feel solid when depressed, with no sponginess. **Warning:** *Do not operate the vehicle if you are in doubt about the effectiveness of the brake system.*



26.9c Check the stabilizer bar bushings (arrows) for deterioration at the front and rear of the vehicle

26 Steering and suspension check (every 30,000 or 24 months)

Refer to illustrations 26.6, 26.9a, 26.9b, 26.9c, 26.11 and 26.14

Note: *The steering linkage and suspension components should be checked periodically. Worn or damaged suspension and steering linkage components can result in excessive and abnormal tire wear, poor ride quality and vehicle handling and reduced fuel economy. For detailed illustrations of the steering and suspension components, refer to Chapter 10.*

Shock absorber check

1 Park the vehicle on level ground, turn the engine off and set the parking brake. Check the tire pressures.

2 Push down at one corner of the vehicle, then release it while noting the movement of the body. It should stop moving and come to rest in a level position within one or two bounces.

3 If the vehicle continues to move up-and-down or if it fails to return to its original position, a worn or weak shock absorber (which is part of the strut assembly) is probably the reason.

4 Repeat the above check at each of the three remaining corners of the vehicle.

5 Raise the vehicle and support it securely on jackstands.

6 Check the shock absorbers for evidence of fluid leakage **(see illustration)**. A light film of fluid is no cause for concern. Make sure that any fluid noted is from the shocks and not from some other source. If leakage is noted, replace the shocks as a set.

7 Check the shocks to be sure that they are securely mounted and undamaged. Check the upper mounts for damage and wear. If damage or wear is noted, replace the shocks as a set (front or rear).

8 If the shocks must be replaced, refer to Chapter 10 for the procedure.

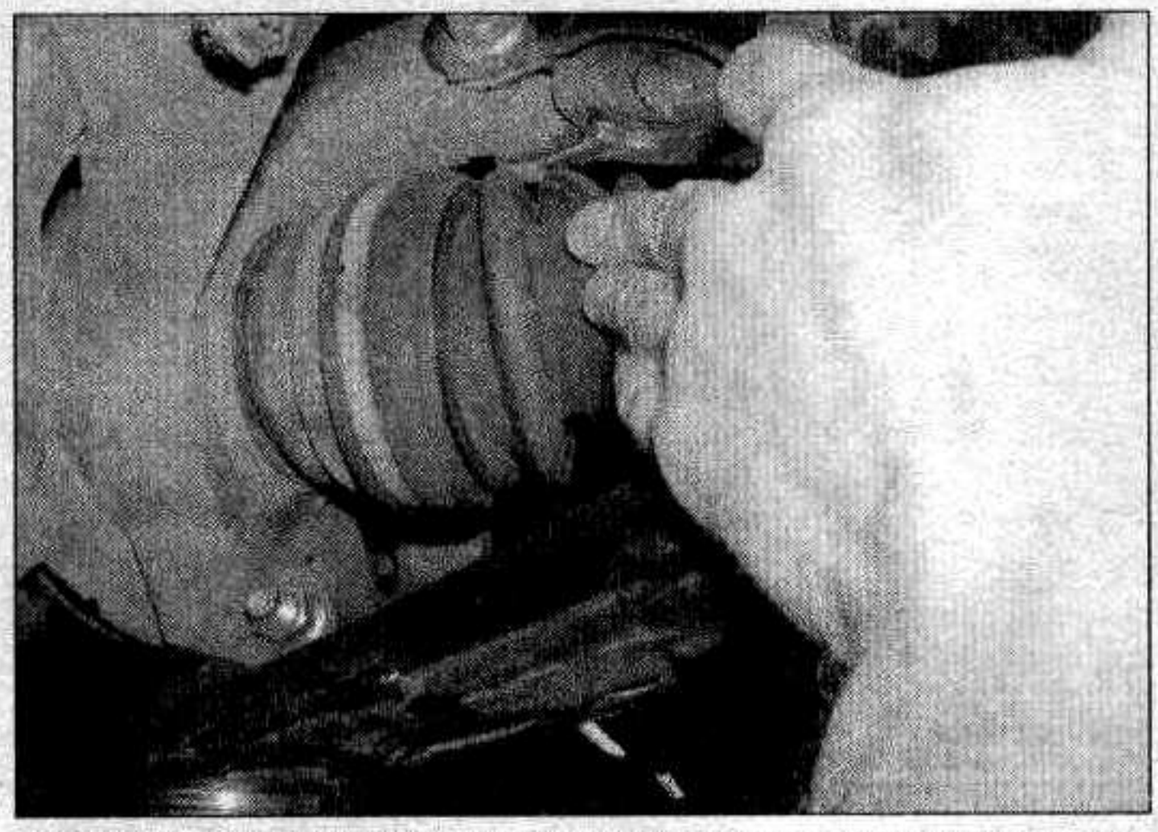
9 Visually inspect the steering and suspension components (front and rear) for damage and distortion. Look for damaged seals, boots and bushings and leaks of any kind. Examine the bushings where the lower control arm meets the chassis and on the stabilizer bar connections **(see illustrations)**.

10 Clean the lower end of the steering knuckle. Have an assistant grasp the lower edge of the tire and move the wheel in-and-out while you look for movement at the steering knuckle-to-control arm balljoint. If there is any movement, the suspension balljoint(s) must be replaced.

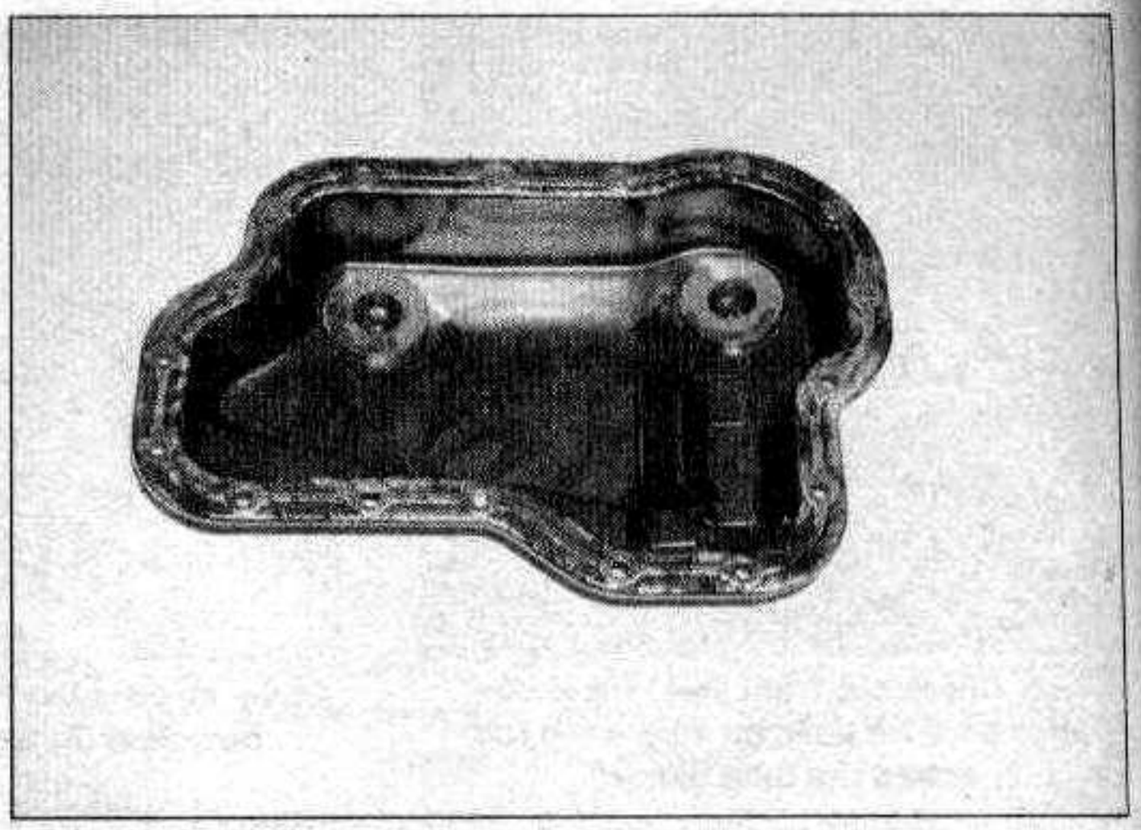
11 Grasp each front tire at the front and rear edges, push in at the front, pull out at the rear and feel for play in the steering system components. If any freeplay is noted, check the idler arm and the tie-rod ends for looseness **(see illustration)**.

12 Additional steering and suspension system information and illustrations can be found in Chapter 10.

26.11 With the steering wheel in the lock position and the vehicle raised, grasp the front tire as shown and try to move it back-and-forth - if any play is noted, check the steering gear mounts and tie-rod ends for looseness



26.14 Flex the inner and outer driveaxle boots by hand to check for cracks and/or tears



27.12 After cleaning the pan, be sure to install the magnets in their original positions

Driveaxle boot check

13 The driveaxle boots are very important because they prevent dirt, water and foreign material from entering and damaging the constant velocity (CV) joints. Oil and grease can cause the boot material to deteriorate prematurely, so it's a good idea to wash the boots with soap and water. Because it constantly pivots back and forth following the steering action of the front hub, the outer CV boot wears out sooner and should be inspected regularly.

14 Inspect the boots for tears and cracks as well as loose clamps **(see illustration)**. If there is any evidence of cracks or leaking lubricant, they must be replaced as described in Chapter 8.

27 Automatic transaxle fluid change (every 30,000 miles or 24 months)

Refer to illustrations 27.12, 27.13 and 27.14

1 At the specified time intervals, the automatic transaxle fluid should be drained and replaced.

2 Before beginning work, purchase the specified transmission fluid (*see Recommended lubricants and fluids* at the front of this Chapter).

3 Other tools necessary for this job include jackstands to support the vehicle in a raised position, 3/8-inch drive ratchet, a drain pan capable of holding least six quarts, newspapers and clean rags.

4 The fluid should be drained immediately after the vehicle has been driven. Hot fluid is more effective than cold fluid at removing built-up sediment. **Warning:** *Fluid temperature can exceed 350-degrees F in a hot transaxle. Wear protective gloves.*

5 After the vehicle has been driven to warm up the fluid, raise it and place it on jackstands for access to the transaxle drain plug.

6 Move the necessary equipment under the vehicle, being careful not to touch any of the hot exhaust components.

7 Place the drain pan under the transaxle and remove the drain plug (refer to the component locator photographs at the front of this Chapter). Be sure the drain pan is in position, as fluid will come out with some force. Once the fluid has drained, clean the drain plug and reinstall it securely.

Ford CD4E and Mazda LA4A-EL transaxles

8 Lower the vehicle and go to step 17 for the transaxle refilling procedure.

Ford 4EAT and Mazda GF4A-EL transaxles

9 Remove the transaxle pan bolts.

10 Carefully pry the transaxle pan loose with a screwdriver. Don't damage the pan or transaxle gasket surface or leaks could develop.

11 Remove the pan and gasket. Carefully clean the gasket surface of the transaxle to remove all traces of the old gasket and sealant.

12 Drain any remaining fluid from the transaxle pan, clean it with solvent and dry it thoroughly. Make sure to install the magnets in their original positions **(see illustration)**.

13 Remove the old filter from the transaxle **(see illustration)**.

14 Install a new O-ring on the filter **(see illustration)**, then install the filter and tighten the bolts.

15 Make sure the gasket surface on the transaxle pan is clean, then install a new gasket. Put the pan in place against the transaxle and install the bolts. Working around the pan, tighten each bolt a little at a time until the final torque figure listed in this Chapter's Specifications is reached. Don't overtighten the bolts!

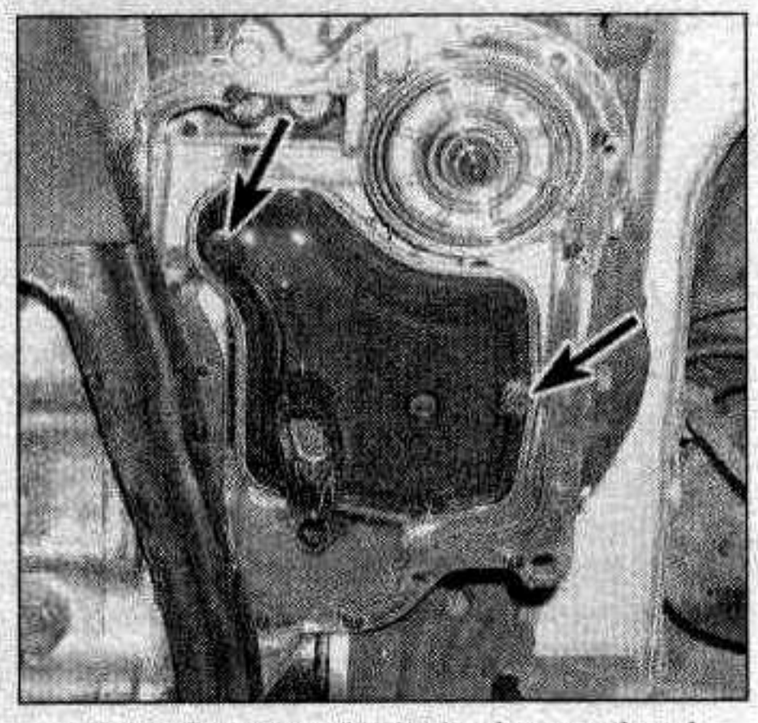
16 Lower the vehicle.

All models

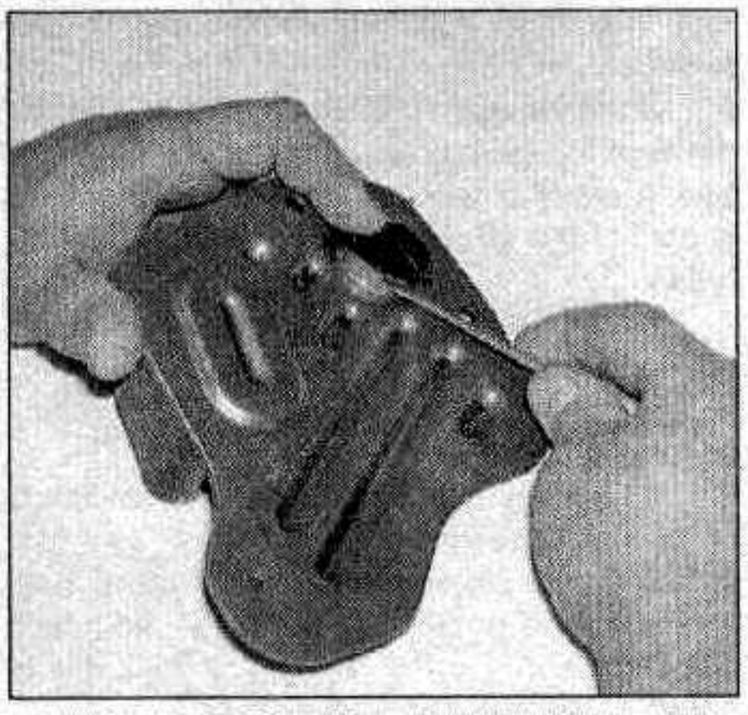
17 Pull out the dipstick and add new fluid to the transaxle through the dipstick tube (see *Recommended lubricants and fluids* for the recommended fluid type and capacity). Use a funnel to prevent spills. It is best to add a little fluid at a time, continually checking the level with the dipstick (see Section 7). Allow the fluid time to drain into the pan.

18 Install the dipstick.

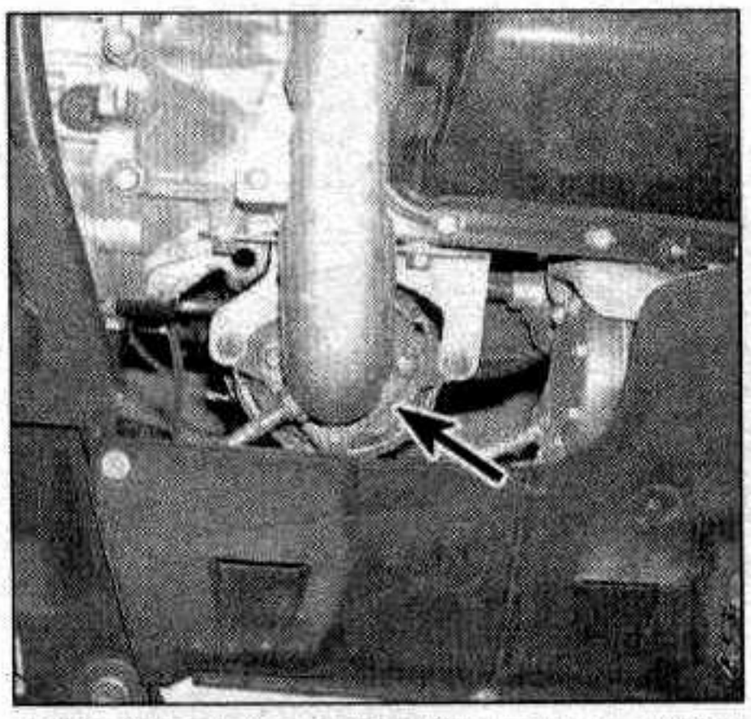
19 Start the engine and shift the selector



27.13 Remove the bolts (arrows)and detach the fluid filter



27.14 Use a small screwdriver to install the O-ring on the new filter



29.2a Check the exhaust pipe-to manifold flange (arrow) for signs of leakage

into all positions from P through 2, then shift into P and apply the parking brake.

20 Turn off the engine and check the fluid level. Add fluid to bring the level into the notched area on the dipstick.

28 Manual transaxle lubricant change - (every 30,000 or 24 months)

1 At the specified time intervals, the manual transaxle lubricant should be drained and replaced.

2 Before beginning work, purchase the specified transaxle lubricant (see *Recommended lubricants and fluids* and *Capacities* at the beginning of this Chapter).

3 Other tools necessary for this job include jackstands to support the vehicle in a raised position, 3/8-inch drive ratchet, a drain pan capable of holding at least four quarts, newspapers and clean rags.

4 After the vehicle has been driven to warm up the fluid, raise it and place it on jackstands for access to the transaxle drain plug. Place the drain pan under the transaxle, remove the drain plug and allow the old oil to drain into the pan (see Section 17).

5 Reinstall the drain plug securely.

6 Add new fluid through the filler hole until it begins to run out of the filler hole (see Section 17). Install the check/fill plug and tighten it securely.

29 Exhaust system check (every 30,000 miles or 24 months)

Refer to illustrations 29.2a, 29.2b and 29.2c

1 With the engine cold (at least three hours after the vehicle has been driven), check the complete exhaust system from the engine to the end of the tailpipe. Ideally, the inspection should be done with the vehicle on a hoist to permit unrestricted access. If a hoist isn't available, raise the vehicle and support it securely on jackstands.

2 Check the exhaust pipes and connections for evidence of leaks, severe corrosion and damage. Make sure that all brackets and hangers are in good condition and tight **(see illustrations)**.

3 At the same time, inspect the underside of the body for holes, corrosion, open seams, etc. which may allow exhaust gases to enter the passenger compartment. Seal all body openings with silicone or body putty.

4 Rattles and other noises can often be traced to the exhaust system, especially the mounts and hangers. Try to move the pipes, muffler and catalytic converter. If the components can come in contact with the body or suspension parts, secure the exhaust system with new mounts.

5 Check the running condition of the engine by inspecting inside the end of the tailpipe. The exhaust deposits here are an indication of engine state-of-tune. If the pipe is black and sooty or coated with white deposits, the engine may need a tune-up, including a thorough fuel system inspection and adjustment.

30 Fuel system check (every 30,000 miles or 24 months)

Refer to illustrations 30.6 and 30.9

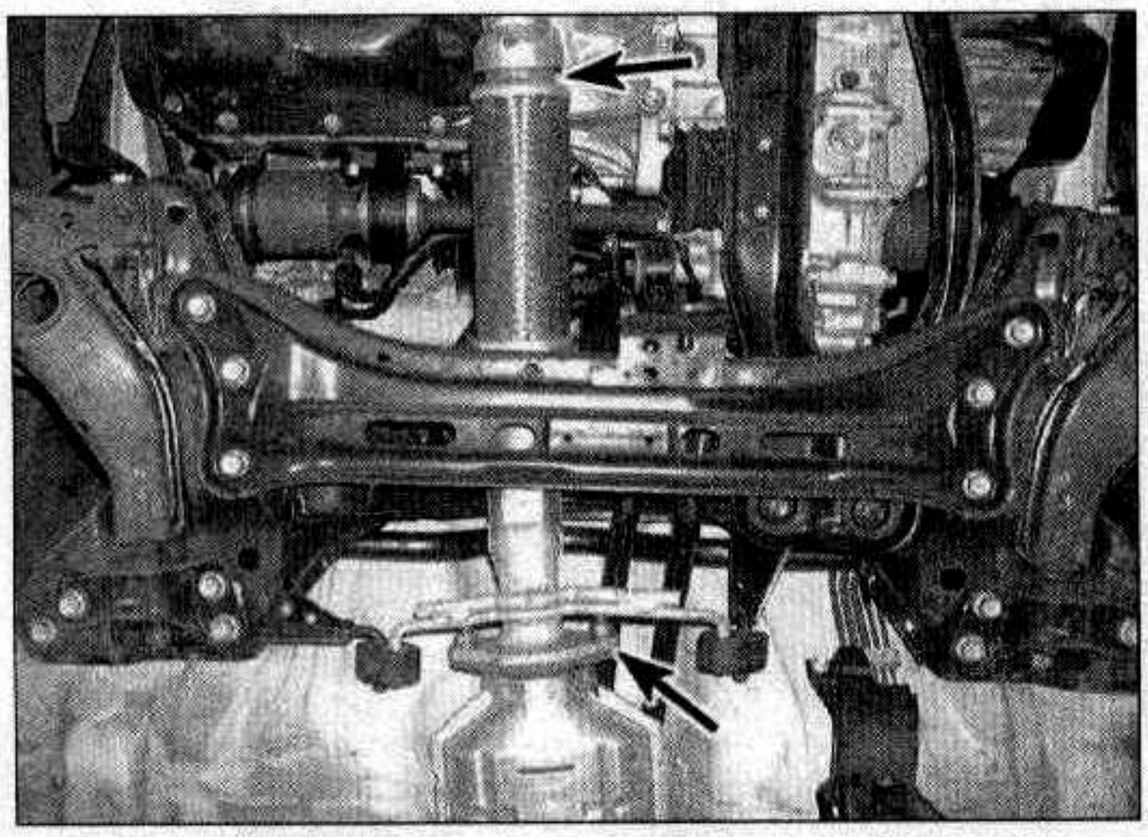
Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or clothes dryer) with a pilot light is present. Since gasoline is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand. The fuel system is under constant pressure, so, before any lines are disconnected, the fuel system pressure must be relieved (see Chapter 4).*

1 If you smell gasoline while driving or after the vehicle has been sitting in the sun, inspect the fuel system immediately.

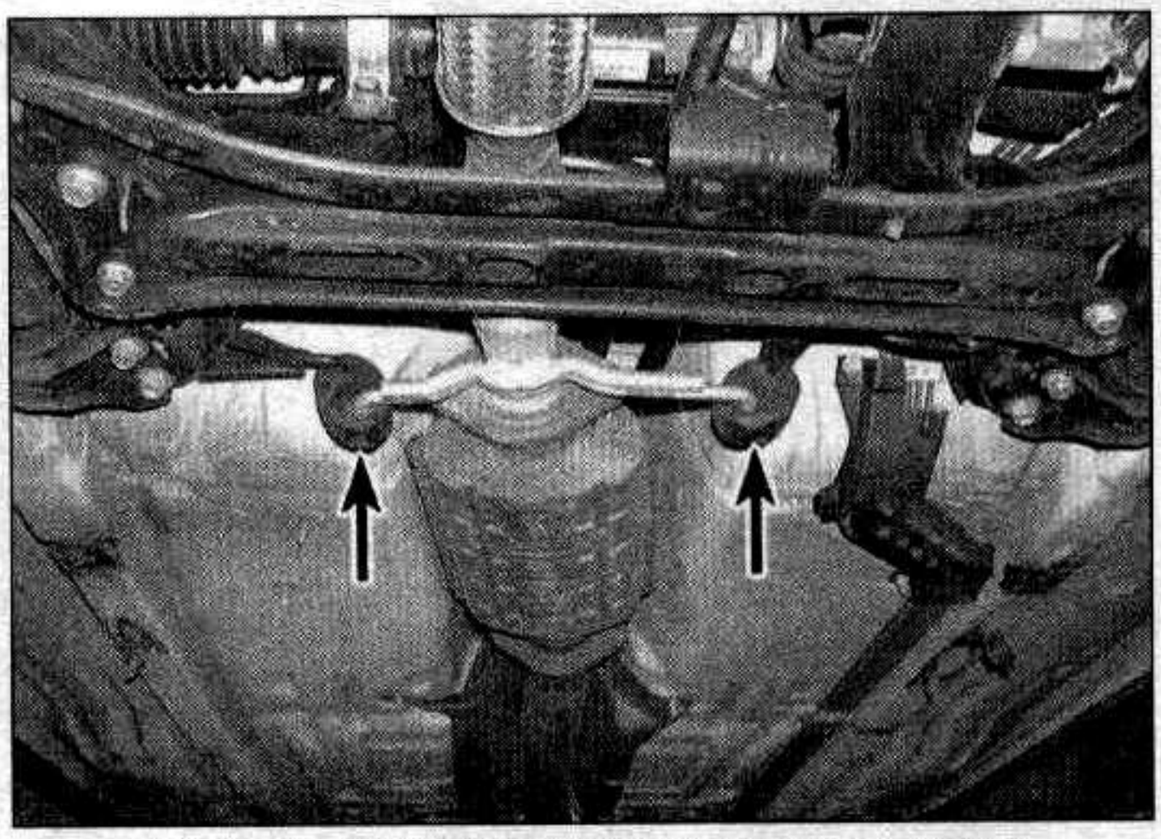
2 Remove the gas filler cap and inspect if for damage and corrosion. The gasket should have an unbroken sealing imprint. If the gasket is damaged or corroded, install a new cap.

3 Inspect the fuel feed and return lines for cracks. Make sure that the connections between the fuel lines and the fuel injection system and between the fuel lines and the in-line fuel filter are tight. **Warning:** *Your vehicle is fuel injected, so you must relieve the fuel system pressure before servicing fuel system components. The fuel system pressure-relief procedure is outlined in Chapter 4.*

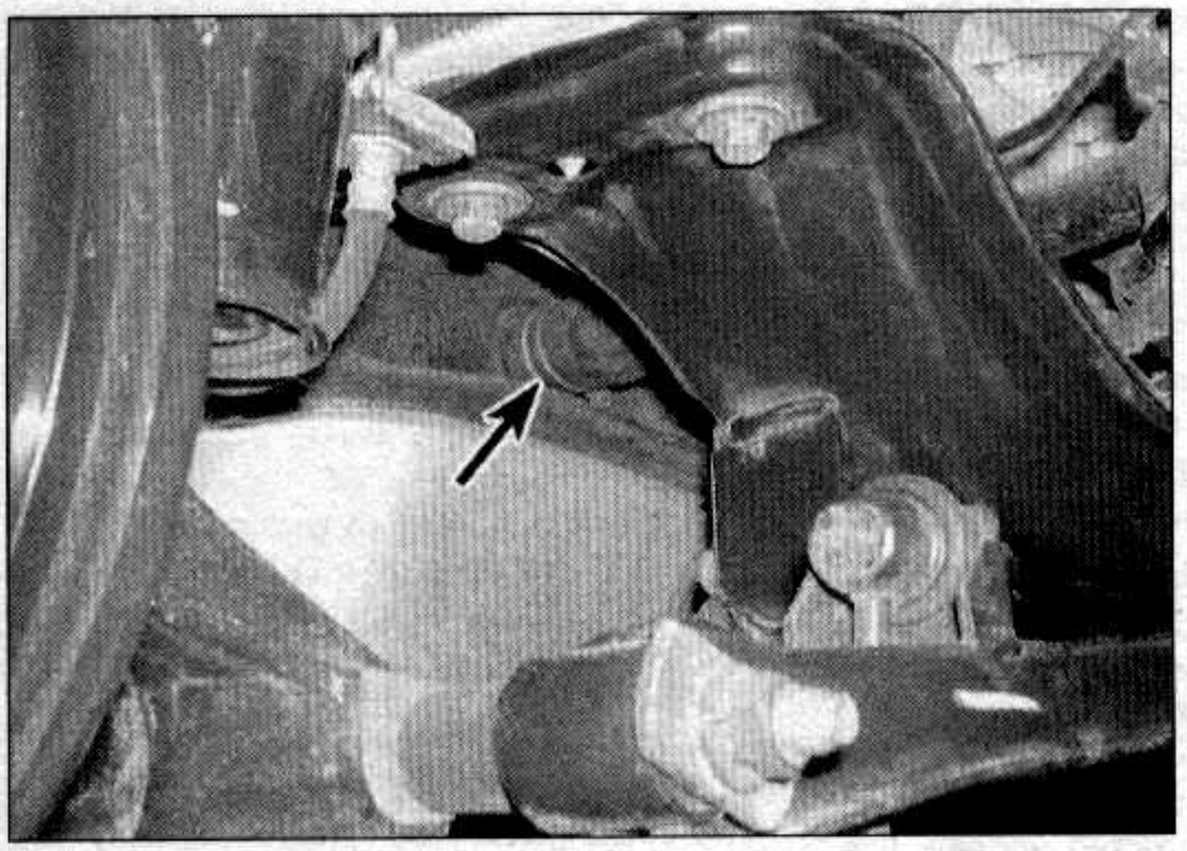
4 If the fuel injectors are visible, look for signs of fuel leakage (wet spots) around any of the injectors, they may need new O-rings (see Chapter 4).



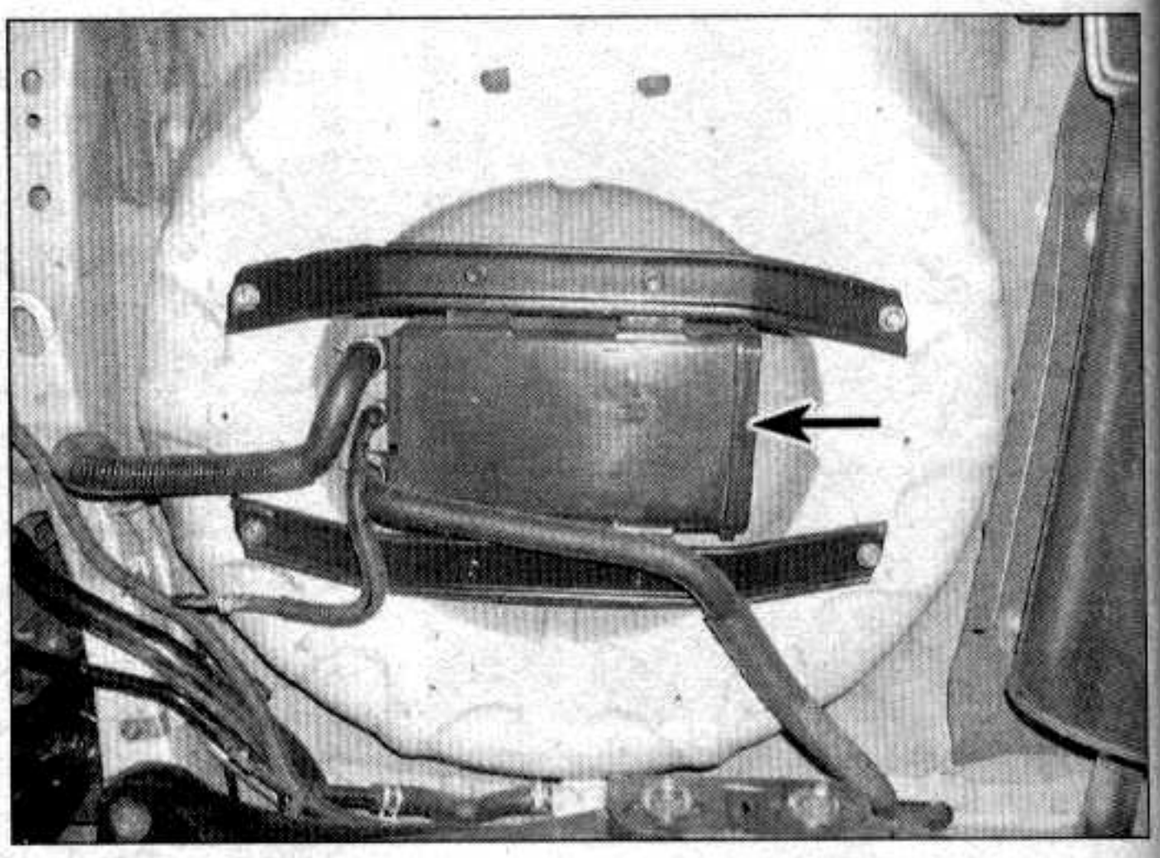
29.2b Check all of the flanged and slip-jointed exhaust connections (arrows) - look for stains that indicate exhaust leakage



29.2c Check the exhaust system hangers (arrows) for damage and cracks



30.6 Inspect the fuel filler hoses for cracks and make sure the clamps (arrow) are tight



30.9 The charcoal canister (arrow) is located underneath the rear of the vehicle under a cover on 1998 Mazda 626 models

5 Since some components of the fuel system - the fuel tank and part of the fuel feed and return lines, for example - are underneath the vehicle, they can be inspected more easily with the vehicle raised on a hoist. If that's not possible, raise the vehicle and support it on jackstands.

6 With the vehicle raised and safely supported, inspect the gas tank and filler neck for punctures, cracks and other damage. The connection between the filler neck and the tank is particularly critical. Sometimes a rubber filler neck will leak because of loose clamps or deteriorated rubber **(see illustration)**. Inspect all fuel tank mounting brackets and straps to be sure that the tank is securely attached to the vehicle. **Warning:** *Do not, under any circumstances, try to repair a fuel tank (except rubber components). A welding torch or any open flame can easily cause fuel vapors inside the tank to explode.*

7 Carefully check all rubber hoses and metal lines leading away from the fuel tank. Check for loose connections, deteriorated hoses, crimped lines and other damage. Repair or replace damaged sections as necessary (see Chapter 4).

8 The evaporative emissions control system can also be a source of fuel odors. The function of the system is to store fuel vapors from the fuel tank in a charcoal canister until they can be routed to the intake manifold where they mix with incoming air before being burned in the combustion chambers.

9 The most common symptom of a faulty evaporative emissions system is a strong odor of fuel in the engine compartment. If a fuel odor has been detected, and you have already checked the areas described above, check the charcoal canister, located behind the left front suspension tower on earlier models or under the rear of the vehicle on 1998 and later models, and the hoses connected to it **(see illustration)**.

31 Valve clearance check and adjustment (1998 and later models) (every 60,000 miles or 48 months)

Refer to illustrations 31.7a, 31.7b, 31.7c, 31.8 and 31.17

Note: *With the camshafts installed, it is not possible to adjust the valves without a unique special tool set that, at the time this manual was written, was available only from the manufacturer. Aftermarket valve adjustment tools we tried in our shop did not work because of the tight clearances around the lifters on these engines. However, since the recommended replacement interval for the timing belt is the same as for valve adjustment, the do-it-yourselfer can carry out routine valve adjustment without special tools by removing the camshafts while the timing belt is off.*

1 Disconnect the negative cable from the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 On four-cylinder models, remove any components that will interfere with valve cover removal (see Chapter 2A).

3 On V6 engines, remove the air intake assembly and any other components that will interfere with valve cover removal (see Chapter 2B).

4 Blow compressed air, if available, around the valve covers to remove any debris that might fall into the cylinders, then remove the spark plugs (see Section 19).

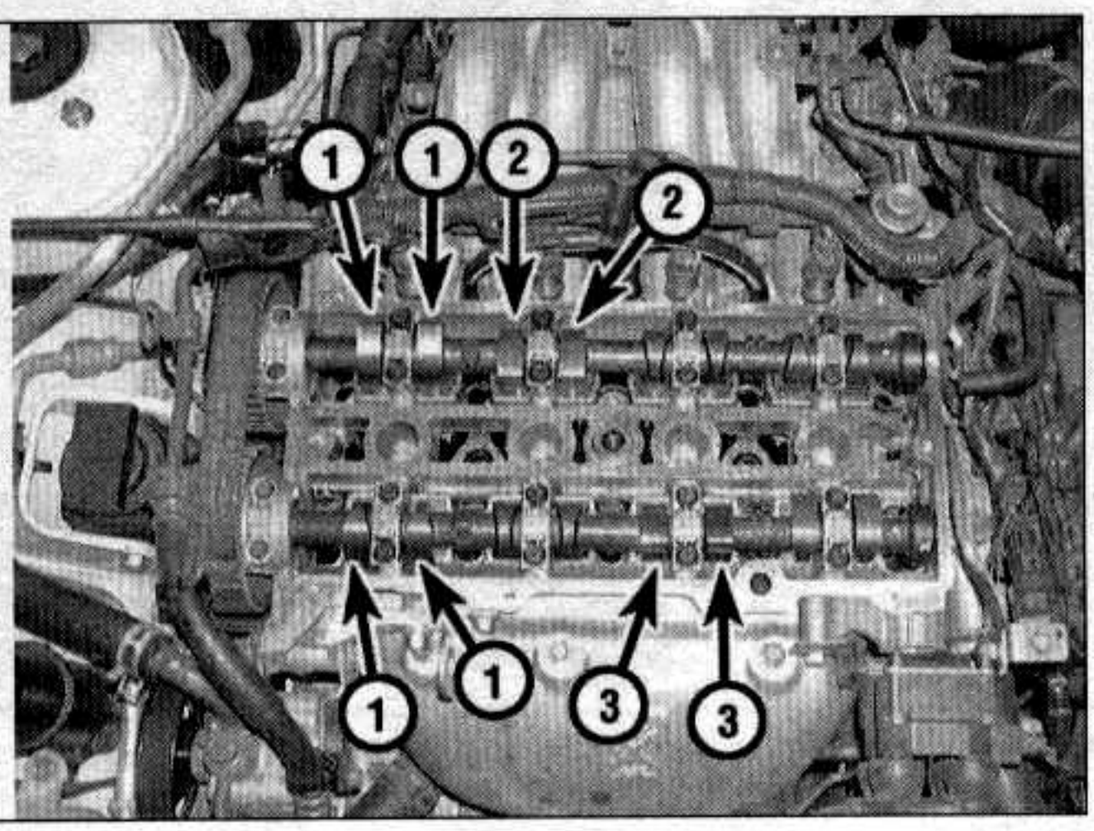
5 Remove the valve cover(s) (refer to Chapter 2).

6 Refer to Chapter 2 and position the number 1 piston at TDC on the compression stroke.

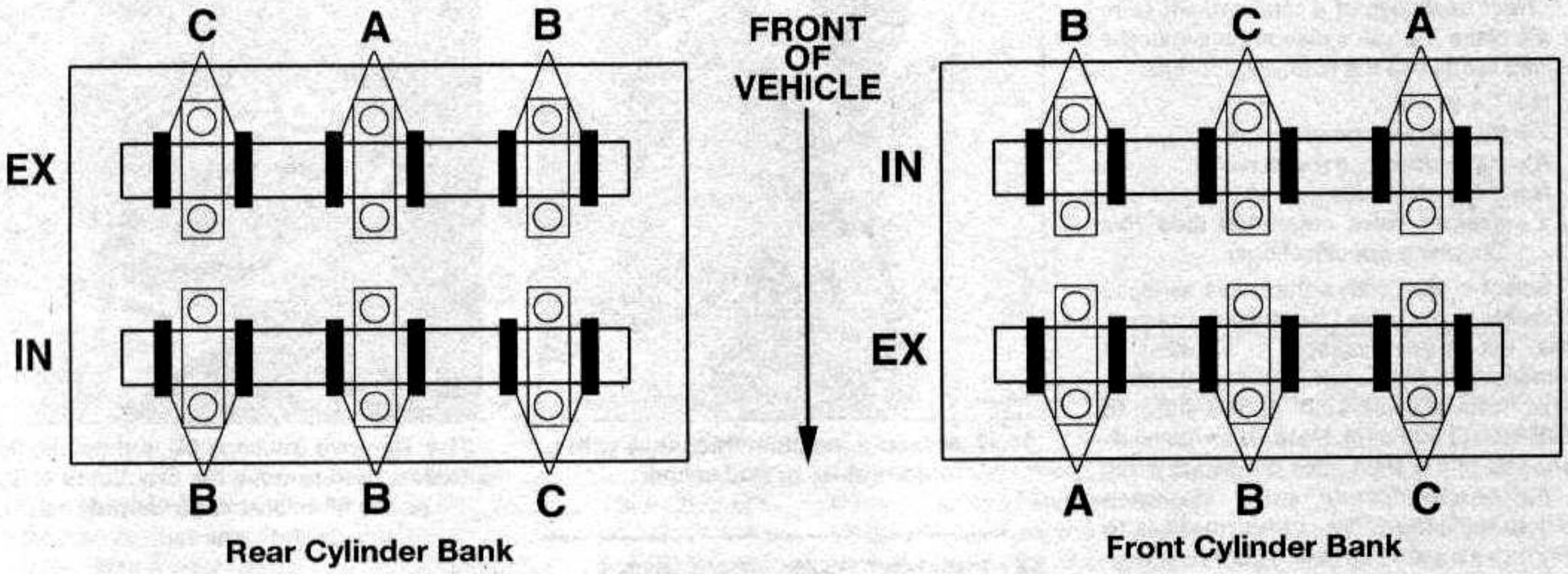
7 Measure the clearance of the indicated valves with a feeler gauge of the specified thickness **(see illustrations)**. Record the measurements that are out of specification. They will be used later to determine the required replacement shims.

8 On four-cylinder engines, turn the crankshaft one complete revolution and realign the timing marks. Measure the remaining valves **(see illustration)**.

9 On V6 engines, turn the crankshaft 2/3-turn (240-degrees) clockwise. Measure the valve clearance on the valves indicated B in **illustration 31.7b**. Rotate the crankshaft a further 2/3-turn and measure the clearance on the valves indicated C in **illustration 31.7b**.



31.7a On four-cylinder engines, when the no. 1 piston is at TDC, measure the clearance on the indicated valves



31.7b On V6 engines, when the no. 1 piston is at TDC on the compression stroke, measure the valves indicated A, rotate the engine 240-degrees clockwise, measure at B, then rotate another 240-degrees and measure at C

10 If the valve clearances are all OK, reassemble the engine. If any valves need adjustment, it is easiest for the do-it-yourselfer to adjust the valve clearances while the timing belt is off (as a part of the timing belt replacement procedure). However, if the timing belt is in good shape, the procedure using the special tools is also described here.

Procedure with timing belt removed

11 Remove the timing belt and camshafts, as described in Chapter 2A or 2B.

12 Remove each shim from each lifter with an incorrect clearance, one at a time. Measure the shims and calculate replacement shims, as described in Steps 17 and 18.

13 Install the replacement shims, then install the camshafts and bearing caps, torquing the bolts to the Specification in Chapter 2A or 2B.

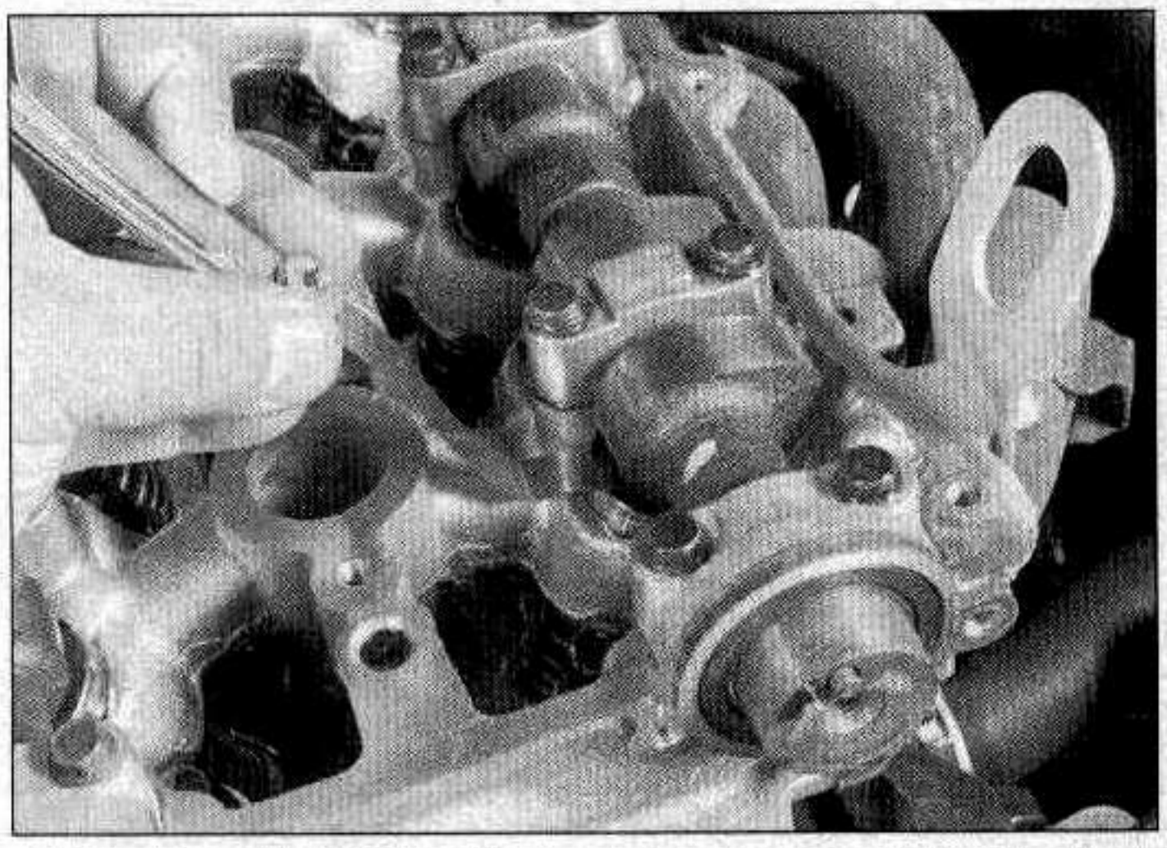
14 Re-check the valve clearances, as described in Steps 6 through 10. If the clearances are correct, install the new timing belt and finish assembling the engine (reverse the removal procedures). If the clearances are still not correct, remove the camshafts and repeat Steps 12 and 13.

Procedure with timing belt installed

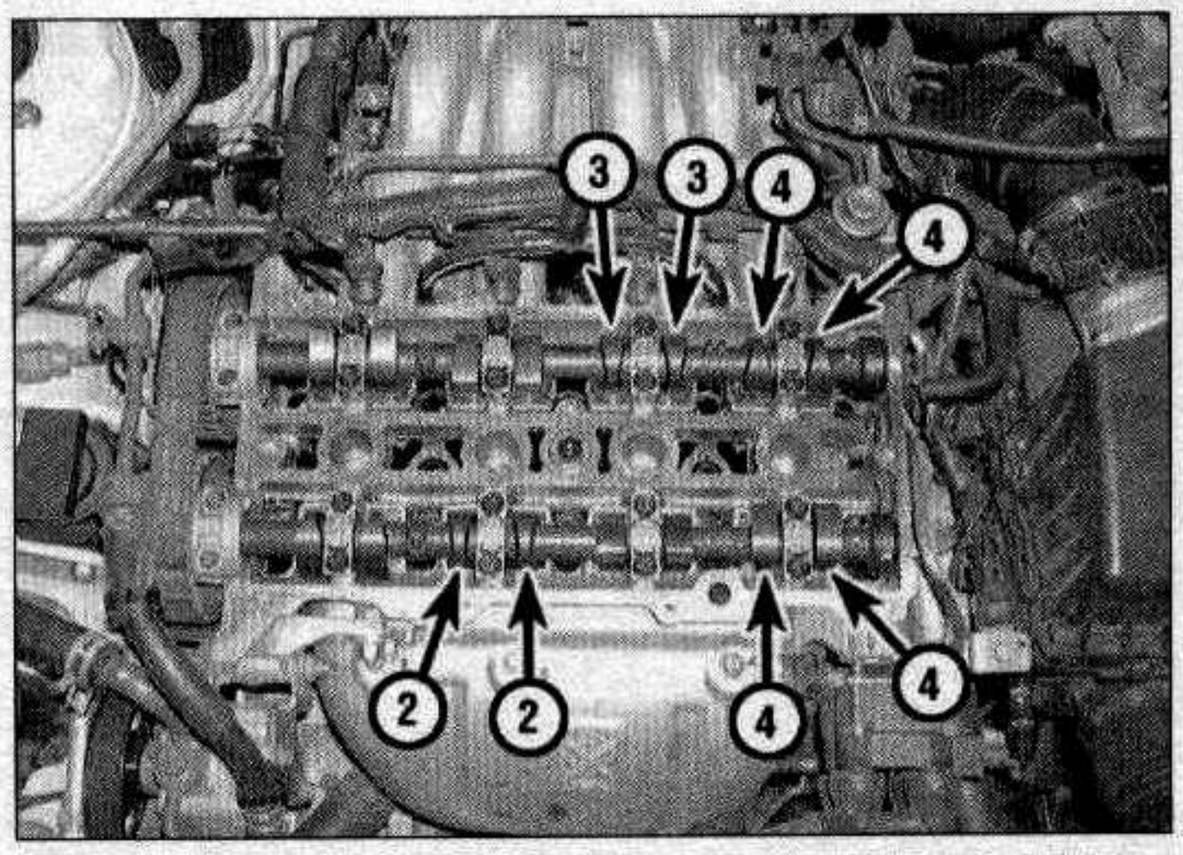
Note: *This procedure requires special tools.*

15 Turn the crankshaft pulley until the camshaft lobe above the first valve that you intend to adjust is pointing upward, away from the shim.

16 Position the notch in the lifter toward the spark plug. Then depress the lifter with the special lifter tools. The tools consist of a bar-type tool (that attaches to two of the camshaft bearing caps) and a clamp that is positioned on the bar. On V6 engines, remove the inner bolts from the end bearing caps (excluding the larger thrust bearing cap). On four-cylinder engines, remove the inner bolts from the bearing caps that will provide the best access to the valve being worked on. Using extra-long bolts, attach the tool to the bearing caps with the clamp positioned over the valve to be adjusted. Tighten the clamp to depress the lifter, then slide the adjusting shim out, toward the spark plug side, with a small screwdriver and a magnet or a pair of tweezers.



31.7c Measure the lifter-to-cam lobe clearance for each valve with a feeler gauge of the specified thickness - if the clearance is correct, you should feel a slight drag on the gauge as you pull it out



31.8 On four-cylinder engines, when the no. 4 piston is at TDC on the compression stroke, the valve clearance for the no. 2 and no. 4 exhaust valves and the no. 3 and no. 4 intake valves can be measured

17 Measure the thickness of the shim with a micrometer **(see illustration)**. To calculate the correct thickness of a replacement shim that will place the valve clearance within the specified value, use the following formula:

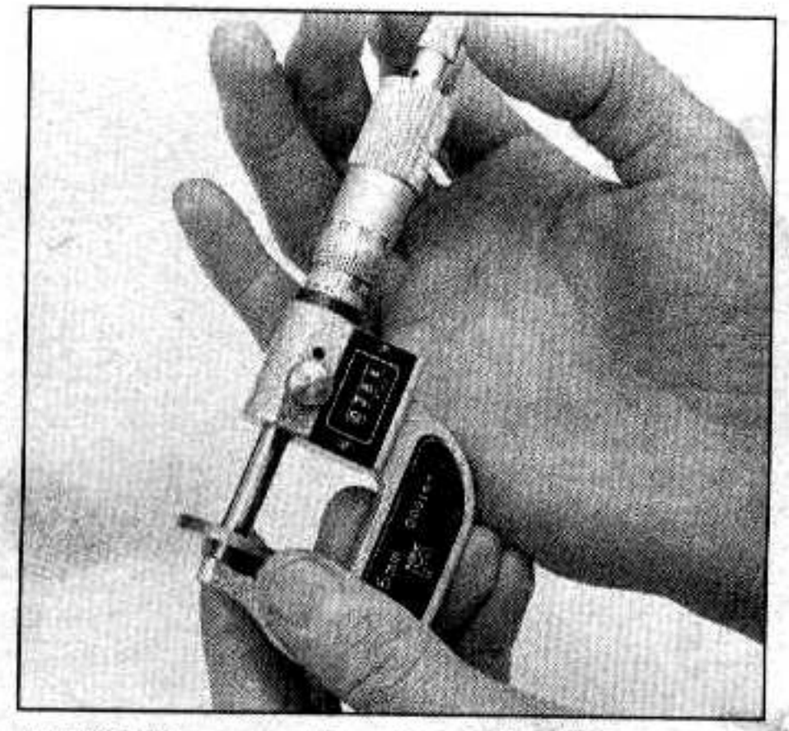
N = T + (A - V)
T = thickness of the old shim
A = valve clearance measured
N = thickness of the new shim
V = desired valve clearance (see this Chapter's Specifications)

18 Select a shim with a thickness as close as possible to the valve clearance calculated. Shims, which are available in 17 sizes in increments of 0.0020-inch (0.050 mm), range in size from 0.0984-inch (2.500 mm) to 0.1299-inch (3.300 mm). **Note:** *Through careful analysis of the shim sizes needed to bring the out-of-specification valve clearance within specification, it is often possible to simply move a shim that has to come out anyway to another lifter requiring a shim of that particular size, thereby reducing the number of new shims that must be purchased.*

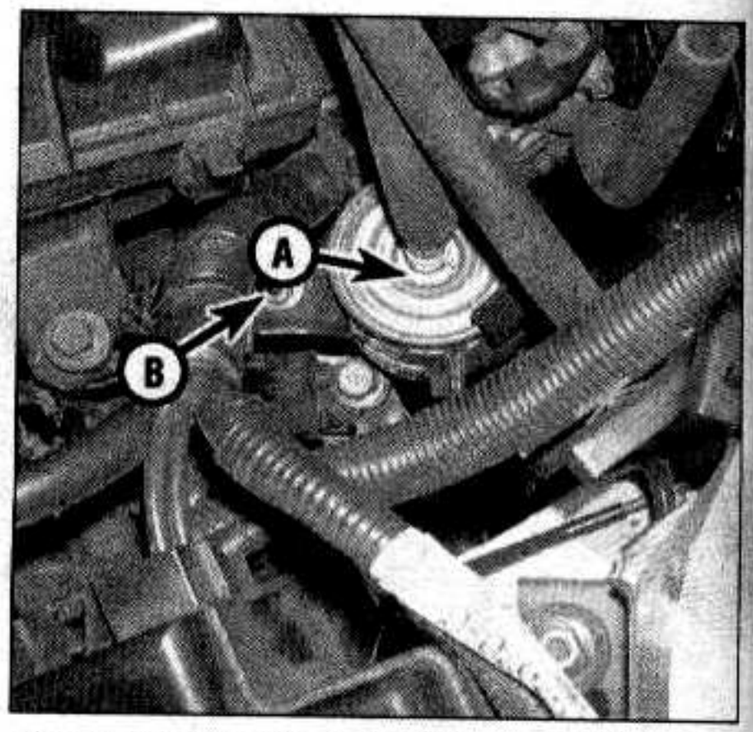
19 Use the special tools to depress the lifter and install the new shim. Measure the clearance with a feeler gauge to make sure that your calculations are correct.

20 Repeat this procedure until all the valves which are out of clearance have been corrected.

21 Installation of the spark plugs, valve cover, spark plug wires and boots, accelerator cable bracket, etc. is the reverse of removal.



31.17 Measure the shim thickness with a micrometer or dial caliper



31.4 Remove the clips (A) and detach the hoses, then remove the bracket nuts (B) so the filter/bracket assembly can be removed

32 Fuel filter replacement (every 60,000 miles or 48 months)

Refer to illustration 32.4

1 Disconnect the negative battery cable. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 If necessary for access, remove the air cleaner assembly (see Chapter 4).

3 Refer to Chapter 4 and relieve the fuel system pressure.

4 Remove the clips and detach the hoses from the fuel filter, then remove the filter bracket nuts and lift the assembly out of the engine compartment **(see illustration)**.

6 Note the direction that the inlet and outlet pipes are facing. Make sure the new filter is installed so that it's facing the proper direction as noted above. Install the inlet and outlet hoses and secure them with clamps.

7 The remainder of installation is the reverse of the removal procedure.

Chapter 2 Part A
Four-cylinder engine

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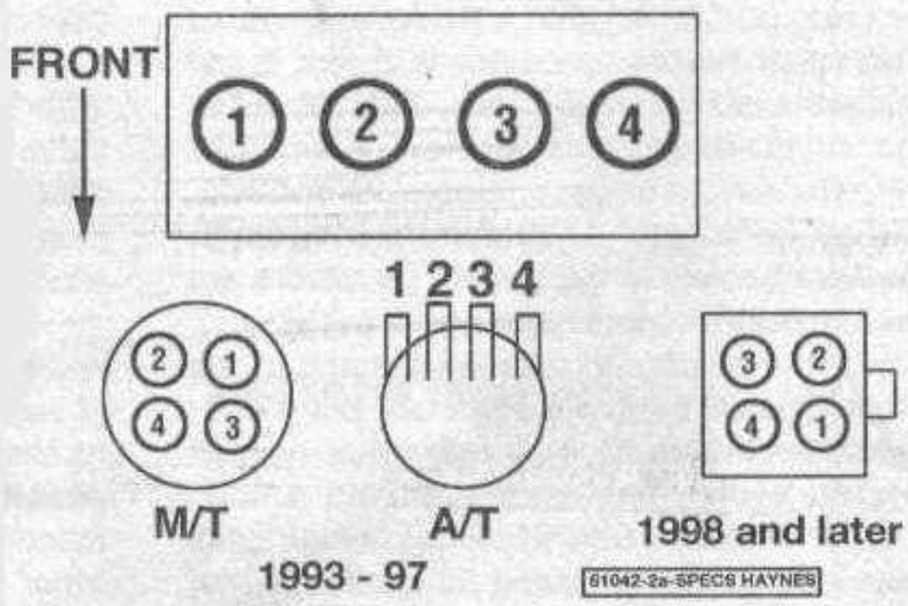
Specifications

General

Bore	3.27 inches
Stroke	3.62 inches
Displacement	121.5 cubic inches (2.0 liters)
Cylinder numbers (timing belt end to transaxle end)	1-2-3-4
Firing order	1-3-4-2
Intake/exhaust manifold warpage limit	0.006 inch

Oil pump

Driven rotor-to-housing clearance	0.083 inch maximum
Drive rotor-to-driven rotor clearance	0.0079 inch maximum
Rotor-to-housing clearance (endplay)	0.0047 inch maximum
Oil pump relief valve spring free length	1.842 inches minimum



Cylinder numbering and distributor cap or coil pack terminal locations

Torque specifications

	Ft-lbs (unless otherwise indicated)
Timing belt tensioner bolt	27 to 38
Timing belt idler pulley bolt	27 to 38
Timing belt cover bolts	71 to 88 in-lbs
Valve cover bolts	43 to 78 in-lbs
Camshaft bearing cap and thrust plate bolts	
Step 1	35 in-lbs
Step 2	71 in-lbs
Step 3	100 to 126 in-lbs
Camshaft sprocket bolts	36 to 45
Crankshaft pulley bolt	116 to 123
Crankshaft rear main seal plate bolts	71 to 88 in-lbs
Crossmember bolts	68 to 96
Cylinder head bolts	
Step 1	13 to 16
Step 2	Tighten an additional 90-degrees
Step 3	Tighten an additional 90-degrees
Engine mounts	
Right mount throughbolt	63 to 86
Right mount nuts	55 to 75
Front and rear mount bolts/nuts	50 to 68
Left mount bolt/nuts	50 to 68
Left mount throughbolt	63 to 86
Lower mount bolts (transaxle)	41 to 59
Engine hanger bracket bolts	27 to 38
Exhaust manifold bolts	12 to 17
Exhaust manifold nuts	14 to 21
Exhaust manifold heat shield bolts/nuts	71 to 88 in-lbs
Exhaust pipe to catalytic converter nuts	27 to 38
Flywheel/driveplate bolts	70 to 75
Intake manifold bolts	14 to 18
Intake manifold bracket bolts	28 to 38
Oil pan-to-engine bolts	14 to 18
Oil pump bolts	14 to 18
Oil pump strainer	71 to 88 in-lbs
Rear main seal retainer plate bolts	71 to 88 in-lbs
Water pump pulley	71 to 88 in-lbs

1 General information

This Part of Chapter 2 is devoted to in-vehicle repair procedures for the four-cylinder engine. All information concerning engine removal and installation and engine block and cylinder head overhaul can be found in Part C of this Chapter.

The following repair procedures are based on the assumption that the engine is installed in the vehicle. If the engine has been removed from the vehicle and mounted on a stand, many of the Steps outlined in this Part of Chapter 2 will not apply.

The Specifications included in this Part of Chapter 2 apply only to the procedures contained in this Part. Part C of Chapter 2 contains the Specifications necessary for cylinder head and engine block rebuilding.

Caution: *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery in any of the following procedures.*

2 Repair operations possible with the engine in the vehicle

Many major repair operations can be accomplished without removing the engine from the vehicle.

Clean the engine compartment and the exterior of the engine with some type of degreaser before any work is done. It will make the job easier and help keep dirt out of the internal areas of the engine.

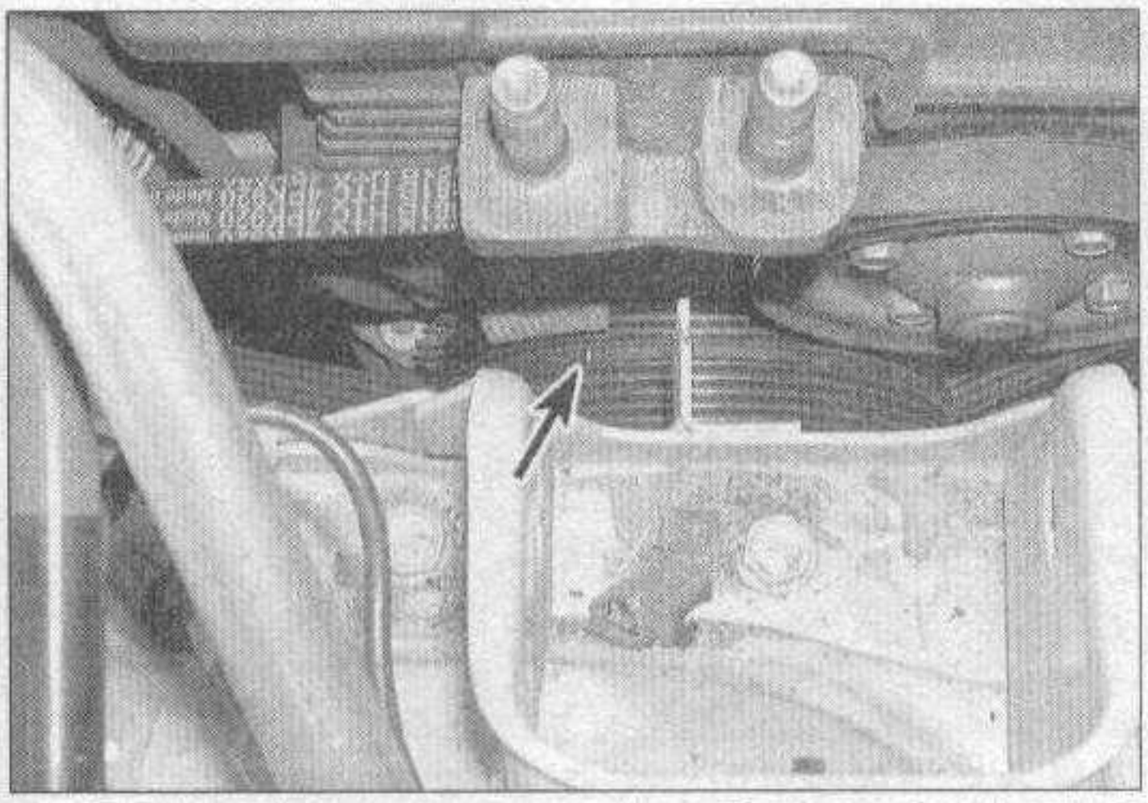
Depending on the components involved, it may be helpful to remove the hood to improve access to the engine as repairs are performed (refer to Chapter 11 if necessary). Cover the fenders to prevent damage to the paint. Special pads are available, but a substitute such as a thick bedspread or blanket will also work.

If vacuum, exhaust, oil or coolant leaks develop, indicating a need for gasket or seal replacement, the repairs can generally be made with the engine in the vehicle. The intake and exhaust manifold gaskets, oil pan gasket, crankshaft oil seals and cylinder head gasket are all accessible with the engine in place.

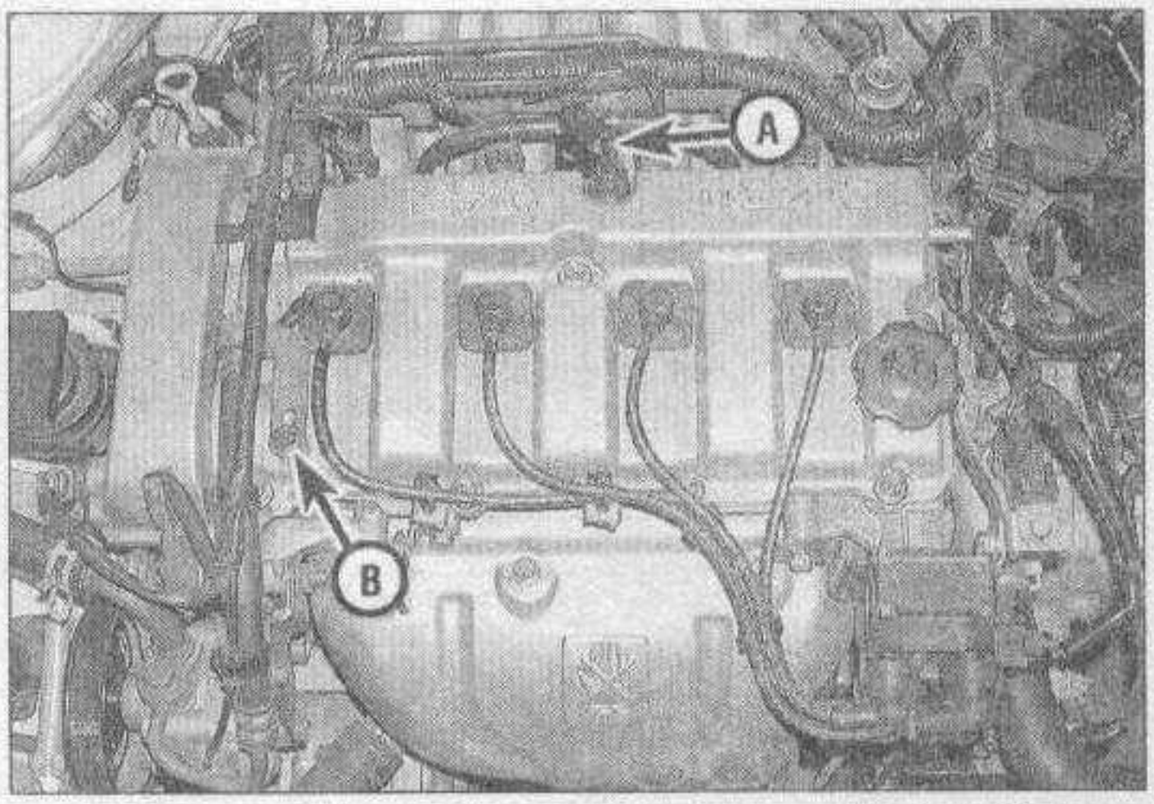
Exterior engine components, such as the intake and exhaust manifolds, the oil pan, the oil pump, the water pump, the starter motor, the alternator, and the fuel system components can be removed for repair with the engine in place.

Since the cylinder head can be removed without pulling the engine, camshaft and valve component servicing can also be accomplished with the engine in the vehicle. Replacement of the timing belt and sprockets is also possible with the engine in the vehicle.

In extreme cases caused by a lack of necessary equipment, repair or replacement of piston rings, pistons, connecting rods and rod bearings is possible with the engine in the vehicle. However, this practice is not recommended because of the engine cleaning and other preparation work, such as driveshaft, steering, stabilizer bar, and engine mount members that may require partial disassembly or removal for access to the engine.



3.8 To bring the number one piston to TDC, align the timing notch on the edge of the crankshaft pulley with the TDC mark on the timing indicator scale



4.4 Disconnect the PCV hose (A) and remove the bolt at the power steering hose bracket (B) - push aside the wiring harness and power steering hose to clear the valve cover

3 Top Dead Center (TDC) - locating

Refer to illustration 3.8

Note: *The following procedure is based on the assumption that the spark plug wires and distributor are correctly installed. If you are trying to locate TDC to install the distributor correctly, piston position must be determined by the method described for (distributorless) 1998 and later models.*

1 Top Dead Center (TDC) is the highest point in the cylinder that each piston reaches traveling up and down as the crankshaft turns. Each piston reaches TDC on the compression stroke and again on the exhaust stroke, but TDC generally refers to piston position on the compression stroke.

2 Positioning the piston(s) at TDC is an essential part of many procedures such as camshaft and timing belt/sprocket removal.

3 Before beginning this procedure, be sure to place the transmission in Neutral and apply the parking brake or block the rear wheels. Also, disable the ignition system by detaching the primary (low voltage) wires from the ignition coil (see Chapter 5). Remove the spark plugs (see Chapter 1) and disable the fuel system (see Chapter 4).

4 In order to bring any piston to TDC, the crankshaft must be turned using one of the methods outlined below. When looking at the front of the engine, normal crankshaft rotation is clockwise.

a) *The preferred method is to turn the crankshaft with a socket and ratchet attached to the bolt threaded into the front of the crankshaft.*
b) *A remote starter switch, which may save some time, can also be used. Follow the instructions included with the switch. Once the piston is close to TDC, use a socket and ratchet as described in the previous paragraph.*
c) *If an assistant is available to turn the ignition switch to the Start position in short bursts, you can get the piston close to TDC without a remote starter switch. Make sure your assistant is out of the vehicle, away from the ignition switch, then use a socket and ratchet as described in Paragraph a) to complete the procedure.*

1997 and earlier models

5 Note the position of the terminal for the number one spark plug wire on the distributor cap. If the terminal isn't marked, follow the plug wire from the number one cylinder spark plug to the cap.

6 Detach the cap from the distributor and set it aside (see Chapter 1 if necessary).

7 Mark the distributor directly under the rotor terminal for the number 1 cylinder.

8 Turn the crankshaft clockwise (see Paragraph 3 above) until the notch on the crankshaft pulley is aligned with the TDC mark on the timing indicator **(see illustration)**.

9 Look at the distributor rotor - it should be pointing directly at the mark you made on the distributor body (cover). If the rotor is pointing at the mark, go to Step 12. If it isn't, go to Step 10.

10 If the rotor is 180-degrees off, the number one piston is at TDC on the exhaust stroke.

11 To get the piston to TDC on the compression stroke, turn the crankshaft one complete turn (360-degrees) clockwise. The rotor should now be pointing at the mark on the distributor. When the rotor is pointing at the number one spark plug wire terminal in the distributor cap and the crankshaft pulley timing marks are aligned, the number one piston is at TDC on the compression stroke.

1998 and later models

12 1998 and later models are equipped with a distributorless ignition system (see Chapter 5). To locate TDC, remove the no. 1 cylinder spark plug and install a compression gauge in the no. 1 spark plug hole (see the cylinder numbering diagram at the beginning of this Chapter).

13 Rotate the crankshaft (see Step 4 above). As the no. 1 piston nears TDC on the compression stroke, compression pressure will be indicated on the gauge. Continue turning the crankshaft until the notch in the crankshaft sprocket is aligned with the TDC mark on the timing indicator **(see illustration 3.8)**. When compression is indicated, do not rotate the crankshaft any farther than necessary to align the marks.

14 It may require at least two complete revolutions of the crankshaft to bring the no. 1 piston up on the compression stroke. If compression pressure was not indicated on the gauge during the first revolution, continue rotating the crankshaft. When compression is indicated at the no. 1 cylinder and the marks are aligned, the no. 1 piston is at TDC.

All models

15 After the number one piston has been positioned at TDC on the compression stroke, TDC for any of the remaining pistons can be located by turning the crankshaft in 90-degree increments and following the firing order (i.e. 90-degrees of crankshaft rotation past no. 1 TDC will position no. 3 at TDC).

4 Valve cover - removal and installation

Removal

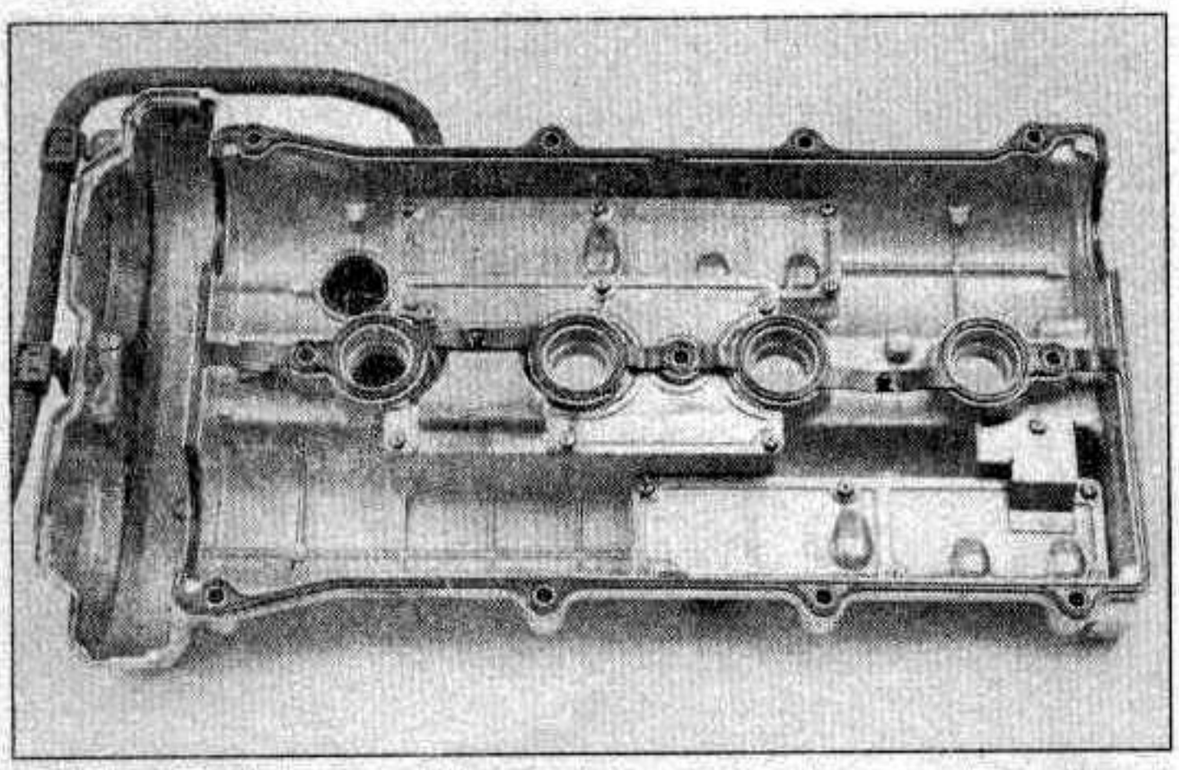
Refer to illustrations 4.4 and 4.6

1 Disconnect the negative cable from the battery. **Caution:** *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

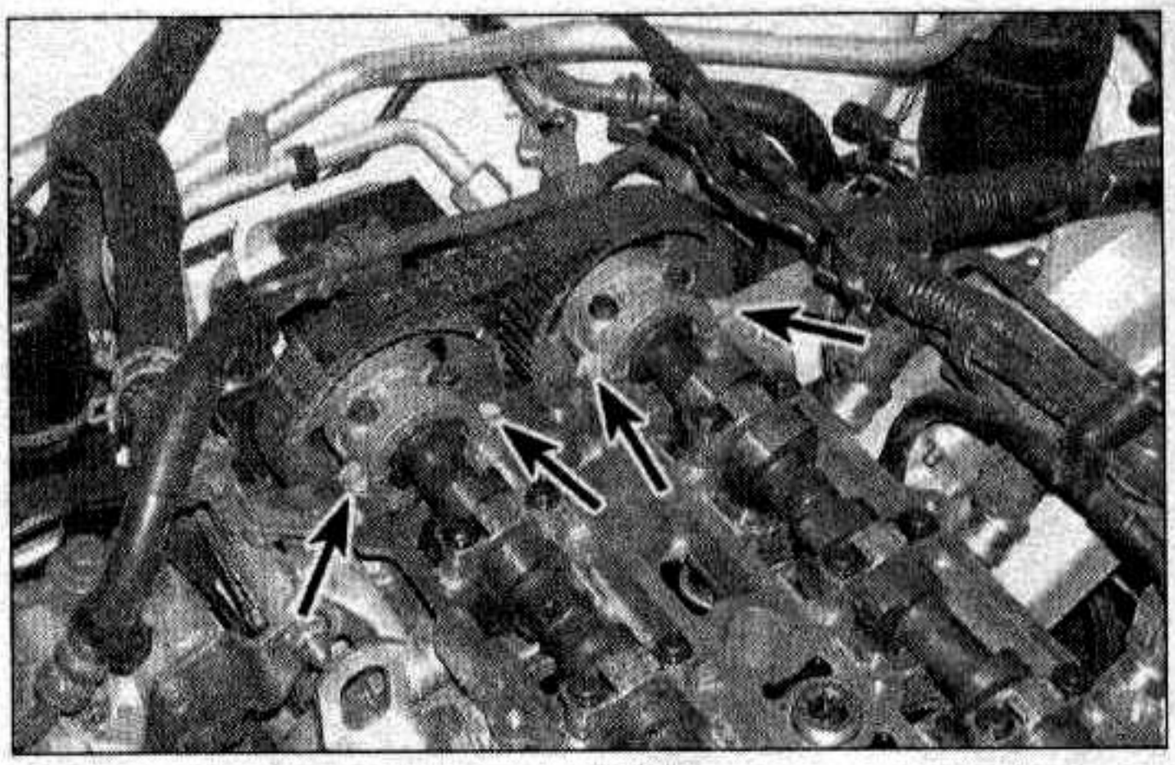
2 Detach the PCV (Positive Crankcase Ventilation) valve and breather hoses from the valve cover.

3 Label the spark plug cables, then remove them from the spark plugs.

4 Remove the bolts at the power steering hose bracket **(see illustration)**.



4.10 Apply RTV sealant to one side of the valve cover gasket and position it on the valve cover



4.11 Apply a bead of RTV sealant to the corners where the front camshaft bearing caps meet the cylinder head (arrows)

5 On 1996 and later models, disconnect the crankshaft position sensor (see Chapter 6).

6 Remove the bolts attaching the valve cover to the cylinder head in the reverse order of the tightening sequence **(see illustration 4.13)**.

7 Disconnect any tubing or other connected components and move them out of the way, and remove the valve cover. If the cover sticks, knock it loose with a rubber mallet or a hammer and a block of wood. Do not pry between the sealing surfaces.

Installation

Refer to illustrations 4.10, 4.11 and 4.13

8 The mating surfaces of the cylinder head must be clean when the cover is installed. Carefully use a gasket scraper to remove all traces of sealant and old gasket material - be careful to not gouge the gasket surfaces when cleaning. Then clean the mating surfaces with a rag soaked with lacquer thinner or acetone. If there is residue or oil on the mating surfaces when the cover is installed, oil leaks may develop.

9 Remove the gasket from the valve cover and clean the sealing surface as described above.

10 Apply RTV sealant to one side of the valve cover gasket and reinstall the gasket on the valve cover **(see illustration)**.

11 Apply a bead of RTV sealant on the cylinder head in the areas shown **(see illustration)**.

12 Position the valve cover in place and insert the bolts by hand, starting the threads several turns before using a wrench.

13 Following the recommended tightening sequence **(see illustration)**, tighten the bolts in two or three steps to the torque listed in this Chapter's Specifications.

14 Reinstallation of the remaining parts is the reverse of removal.

15 Run the engine and check for oil leaks.

5 Valve springs, retainers and seals - replacement

Refer to illustrations 5.4, 5.7, 5.9, 5.11, 5.12 and 5.13

Note 1: *Broken valve springs and defective valve stem seals can be replaced without removing the cylinder head. Several 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.*

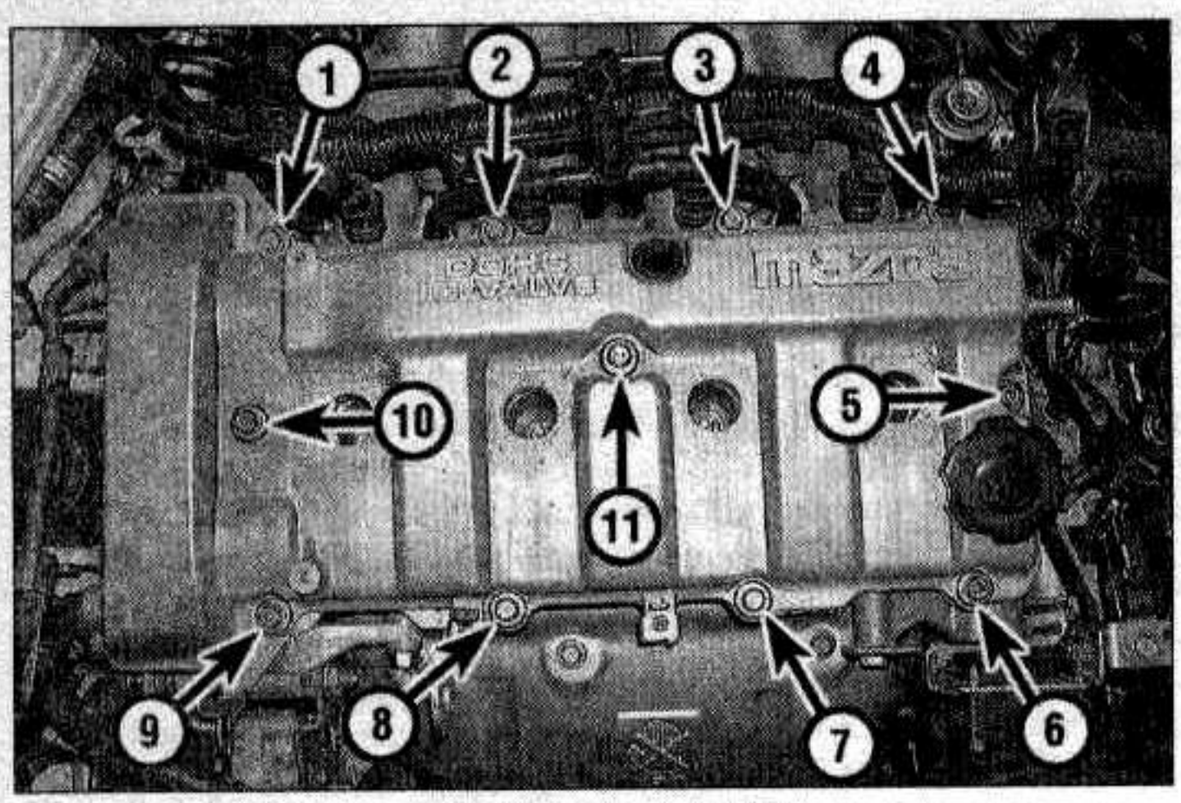
Note 2: *On 1998 and later models, check the valve clearance (see Chapter 1) before beginning this procedure. Any valves in need of adjustment can be corrected during this procedure.*

1 Refer to Section 7 and remove the camshaft. Remove the valve lifters from the defective valves. Keep the lifters in order so they may be reinstalled in their original location.

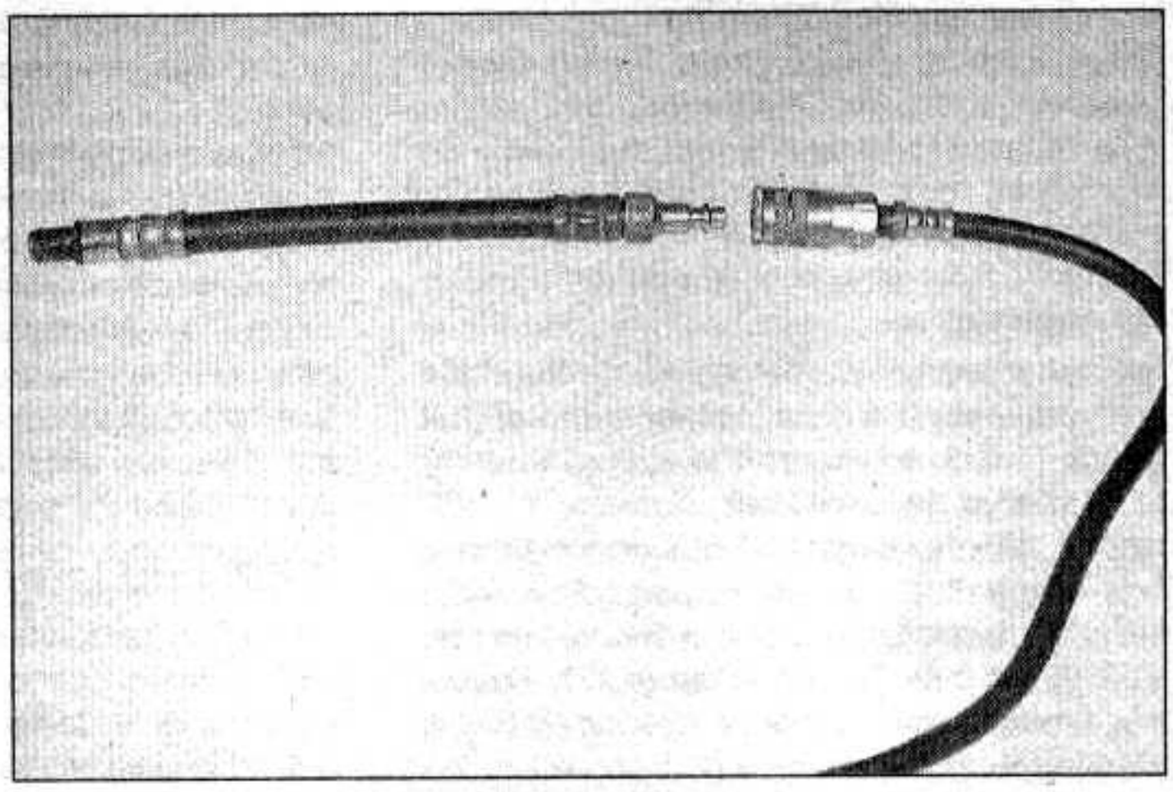
2 Remove the spark plug from the cylinder which has the defective component. If all of the valve stem seals are being replaced, all of the spark plugs should be removed.

3 Turn the crankshaft until the piston in the affected cylinder is at Top Dead Center (TDC) on the compression stroke (refer to Section 3). If you are 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).

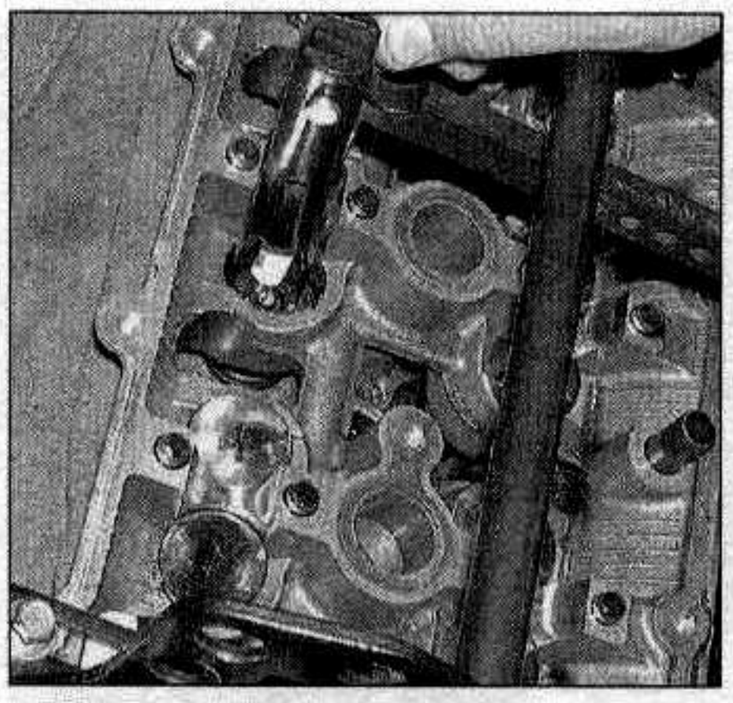
4 Thread a long adapter into the spark plug hole and connect an air hose from a compressed air source to it **(see illustration)**. Most auto parts stores can supply the air



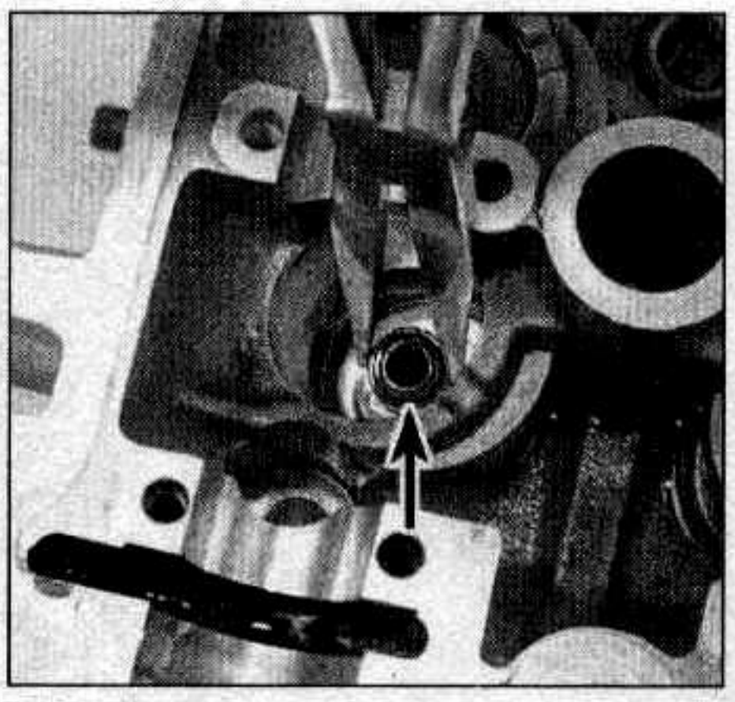
4.13 Valve cover bolt TIGHTENING sequence



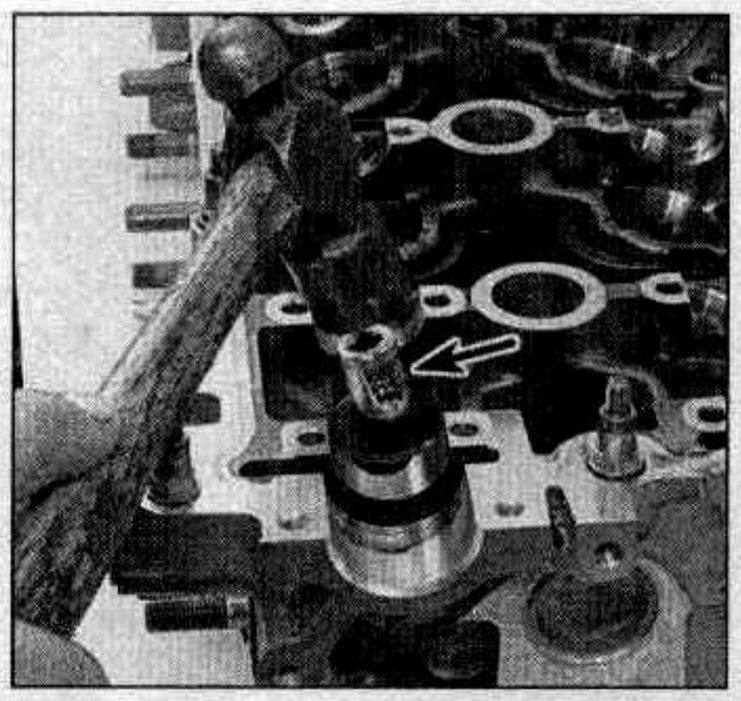
5.4 You'll need an air adapter this long to reach down into the spark plug tubes - they are commonly available from auto parts stores



5.7 A special valve spring compressor, that bolts to each end of the cylinder head, is needed to compress the springs - remove the valve stem locks from the valve stem with a magnet or small needle-nose pliers



5.9 Remove the valve stem seal with an oil seal removal tool or a pair of pliers



5.11 Gently tap the seal into place with a hammer and a seal installer or deep socket

hose adapter. **Note:** *Because of the length of the spark plug tubes, it will be necessary to use a long spark plug adapter with a length of hose attached (as used on many cylinder compression gauges) utilizing a quick-disconnect fitting to hook to your air source.*

5 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 pulley end, damage or injury could occur if the crankshaft moves.*

6 Stuff clean shop rags into any cylinder head holes around the valves to prevent parts and tools from falling into the engine.

7 Using a valve spring compressor, compress the valve spring and remove the valve stem locks with small needle-nose pliers or a magnet **(see illustration)**. **Note:** *A special valve spring compressor capable of compressing the valve springs with the cylinder head in place will be needed. Because the valves are recessed into the cylinder head, a special adapter is also necessary.*

8 Remove the spring retainer, valve spring and spring seat. Mark or store the components in an organized manner so they can be reinstalled in their original locations. **Note:** *If using air pressure fails to hold the valve in the closed position during this operation, the valve face and/or seat is probably damaged. If so, the cylinder head will have to be removed.*

9 Note the installed depth of the valve seal. Measure the installed depth, if necessary. Remove the valve stem seal **(see illustration)**.

10 Inspect the valve spring for cracks or damage and check that the free length is as listed in the Specifications for Chapter 2, Part C.

11 Lubricate the valve stem with engine oil and install a new oil seal using an oil seal installer tool or deep socket **(see illustration)**, measuring the installed depth as necessary. Install the oil seal to the same depth as the original. **Caution:** *The intake and exhaust valve stem seals are different. The exhaust stem seals are identified with ridges on top of the seal. Be sure to install the correct seal in each location.*

12 Install the valve spring seat and spring in position over the valve **(see illustration)**. Be sure the spring is installed with the closely wound coils toward the cylinder head.

13 Install the valve spring retainer. Compress the valve spring and carefully position the valve stem locks in the groove. Apply a small dab of grease to the inside of each valve stem lock to hold it in place if necessary **(see illustration)**.

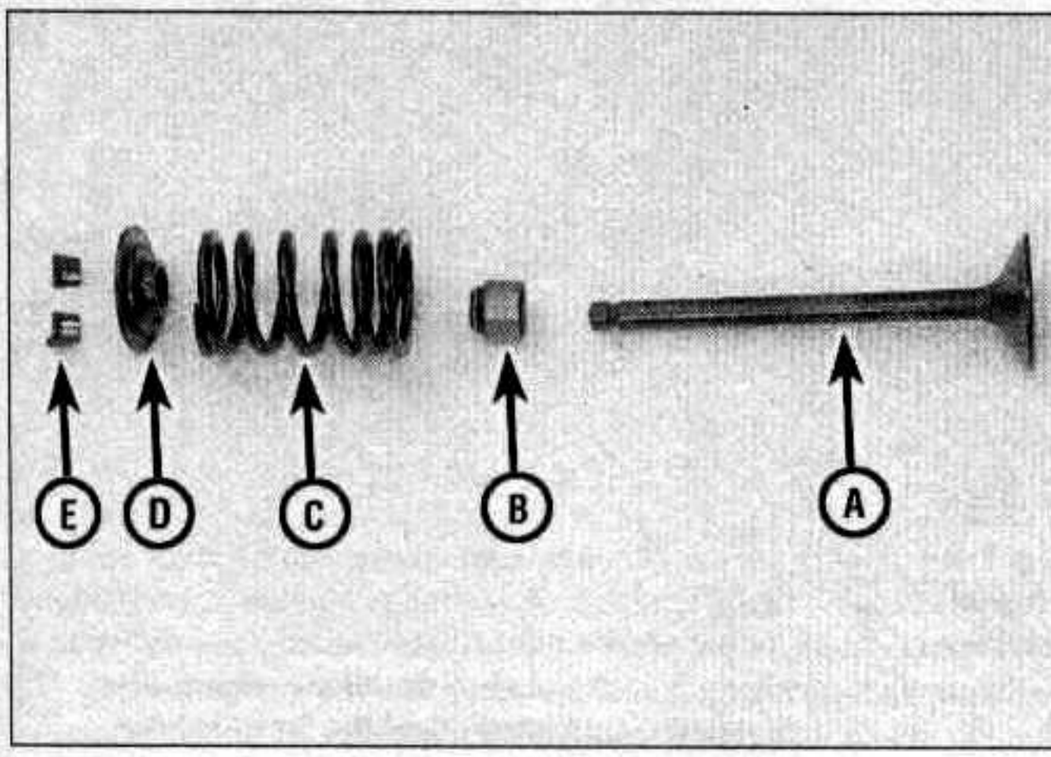
14 Remove the pressure from the spring tool and make sure the valve stem locks are seated.

15 Disconnect the compressed air hose and remove the adapter from the spark plug hole.

16 Refer to Section 7 and install the lifters and camshaft.

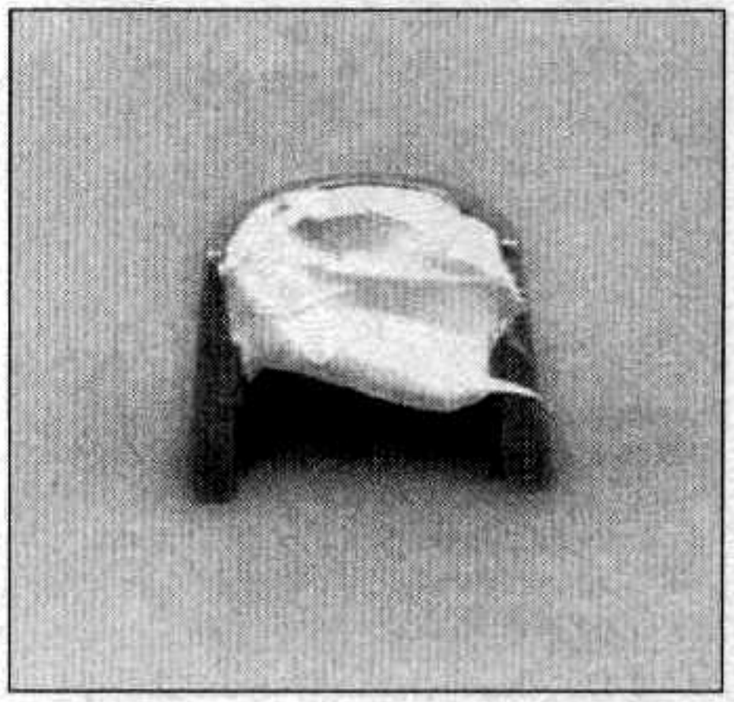
17 Install the remainder of the components in the reverse order of the removal procedure.

18 Start and run the engine, then check for oil leaks and unusual sounds coming from the valve cover area. **Note:** *On 1997 and earlier models, may exhibit be some initial noise from the hydraulic lash adjusters until full oiling is achieved.*

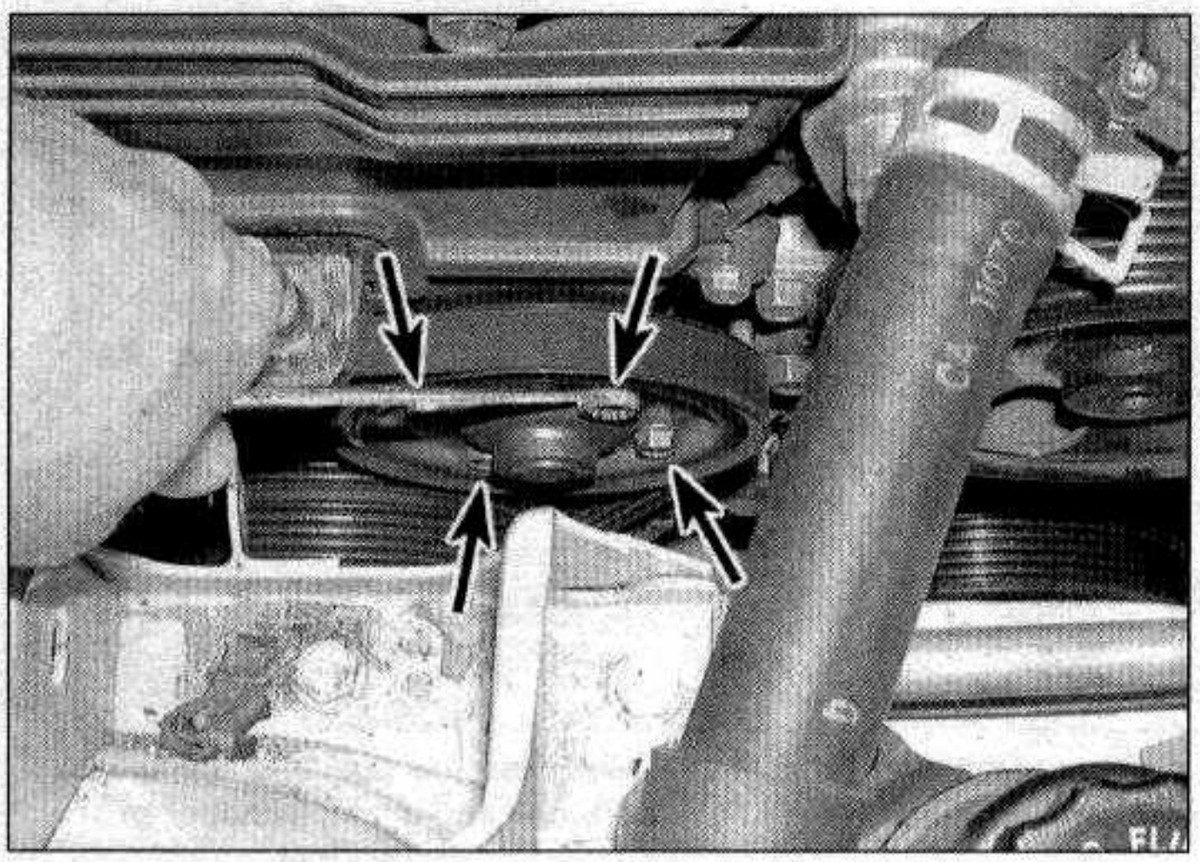


5.12 Arrangement of valve components

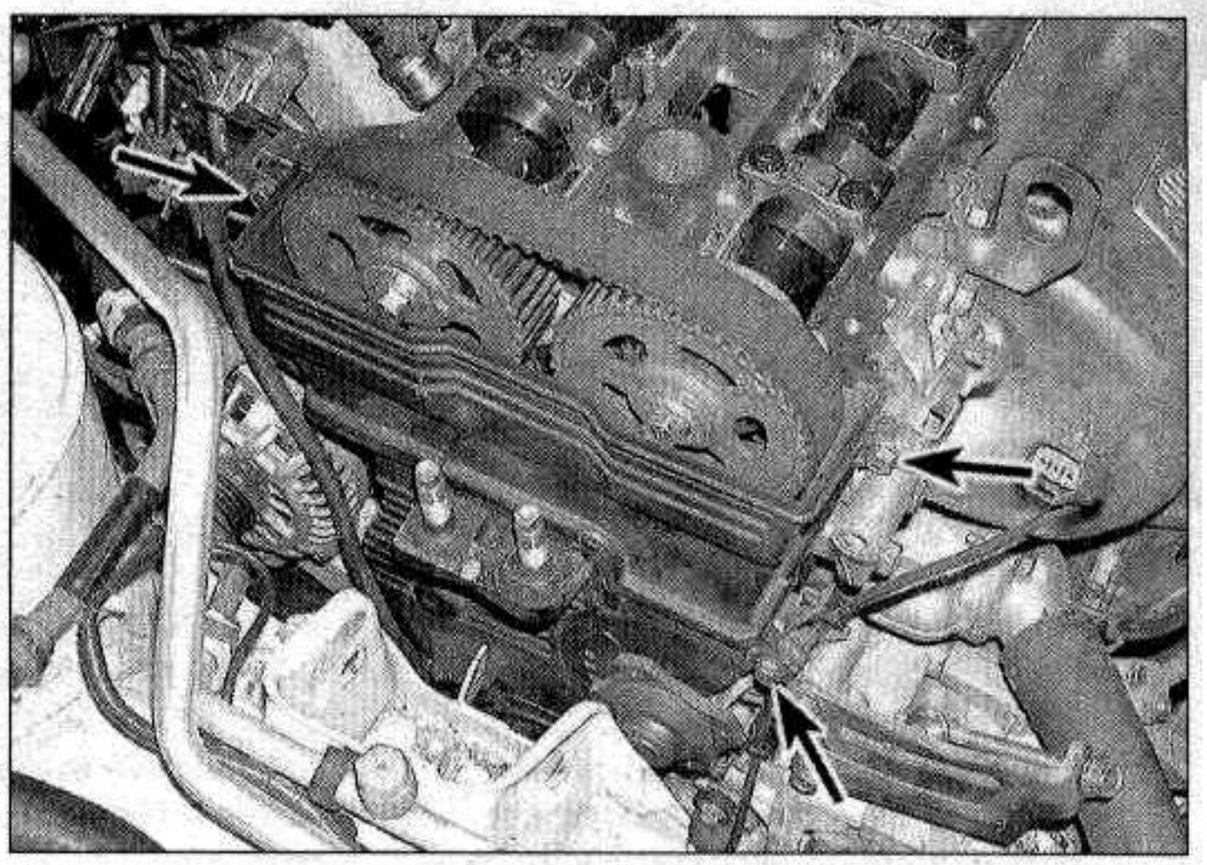
A Valve
B Valve stem seal
C Valve spring
D Retainer
E Valve stem locks



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



6.4 Loosen the water pump pulley bolts (arrows) - remove the bolts and pulley after the drivebelts are removed



6.10 Remove the upper timing belt cover bolts (arrows) - remove the cover and the oil dipstick tube

6 Timing belt and sprockets - removal, inspection and installation

Removal

Refer to illustrations 6.4, 6.10, 6.11, 6.12a, 6.12b, 6.12c, 6.13, 6.15 and 6.18

1 Disconnect the negative cable from the battery. **Caution:** *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Remove the valve cover (see Section 4).

3 Remove the spark plugs from all cylinders (see Chapter 1).

4 With the drivebelts still in place, loosen the bolts on the water pump pulley **(see illustration)**. Remove the power steering/air conditioning and alternator drivebelts (see Chapter 1). Remove the water pump pulley.

5 Apply the parking brake, and block the rear wheels. Raise the front of the vehicle and support it securely on jackstands.

6 Remove the right front wheel.

7 Remove the right front inner fender splash shield.

8 Remove the crankshaft pulley (refer to Section 11).

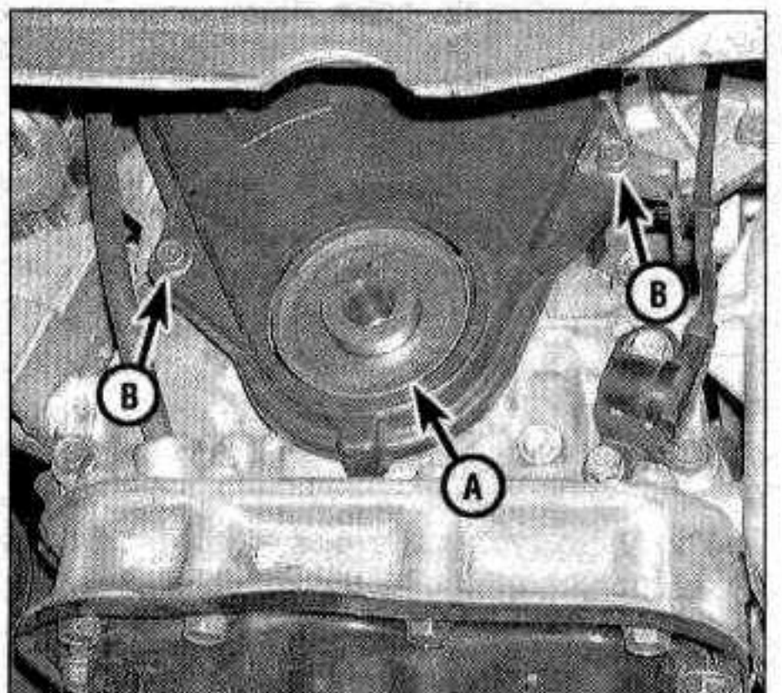
9 Support the engine with a jack from underneath. Place a wood block on the jack head to protect the oil pan. Raise the engine just enough to support the weight and remove the right engine mount (see Section 16). **Caution:** *The engine must remain supported during the remainder of this procedure. Use the proper equipment and make sure the engine is securely supported.*

10 Remove the upper timing belt cover bolts and remove the upper cover and the oil dipstick tube **(see illustration)**.

11 Remove the lower timing belt cover **(see illustration)**.

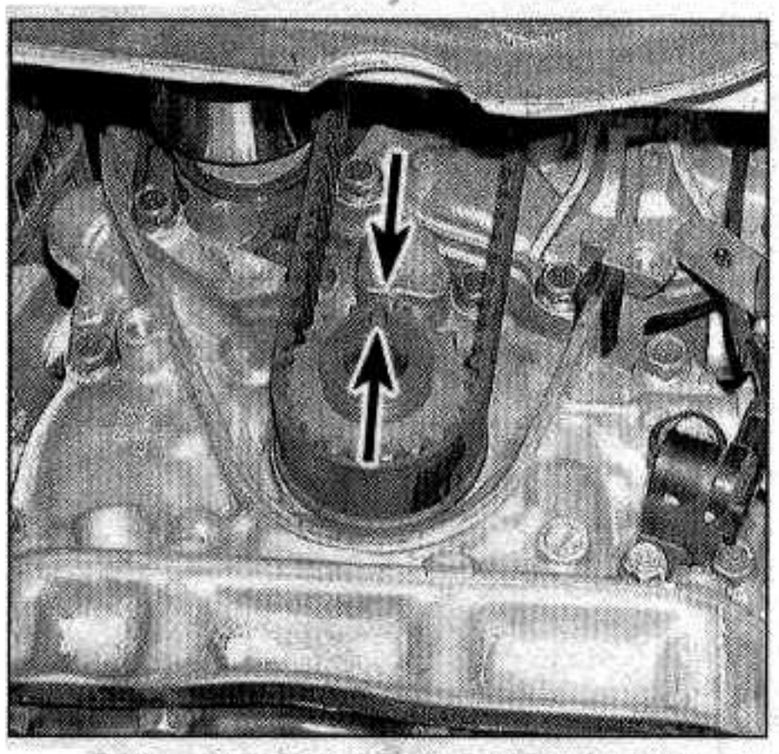
12 Temporarily install the crankshaft pulley bolt, and use a socket and breaker bar to rotate the crankshaft to align the crankshaft and camshaft sprocket timing marks **(see illustrations)**.

13 If reusing the timing belt, paint match marks on the pulley and belt and an arrow indicating direction of travel on the belt **(see illustration)**.

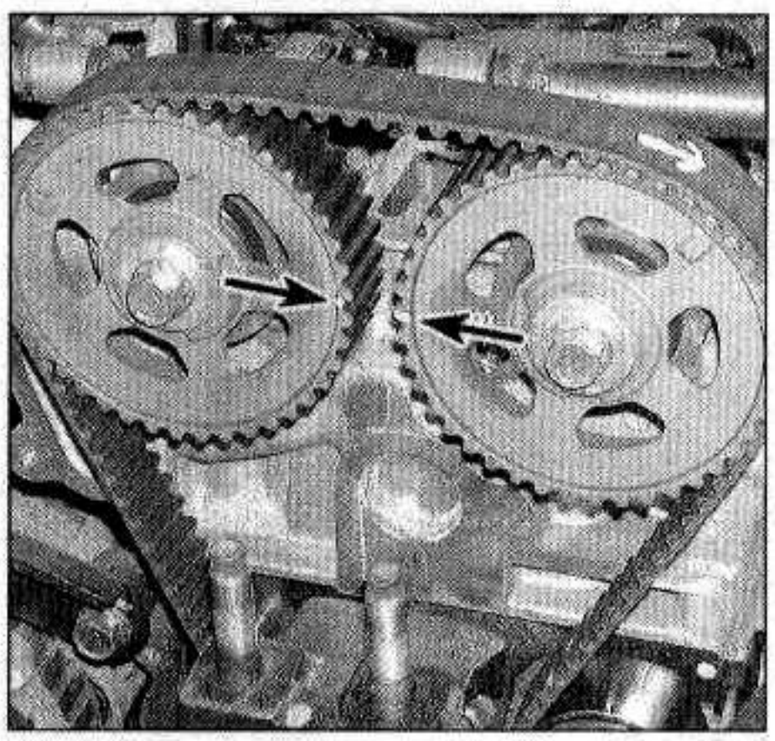


6.11 Remove the timing belt outer guide (A) and the lower timing belt cover bolts (B)

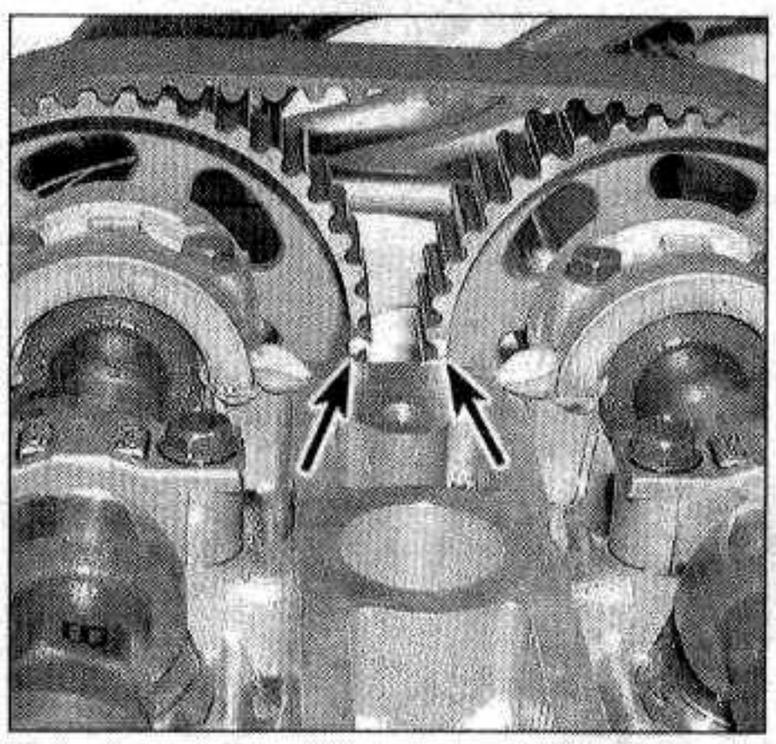
14 A special tool is available that fits between the camshaft sprockets and locks



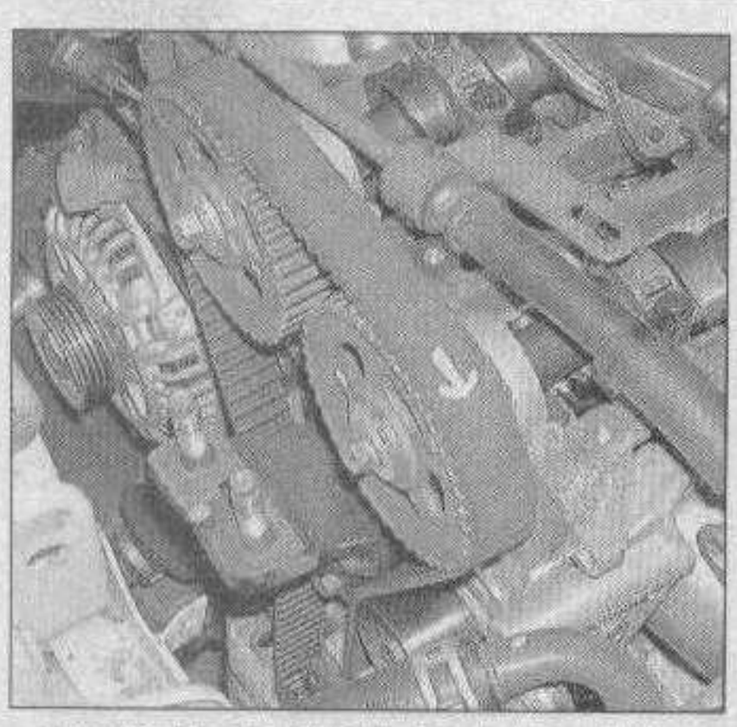
6.12a Crankshaft sprocket timing marks (arrows) aligned at TDC



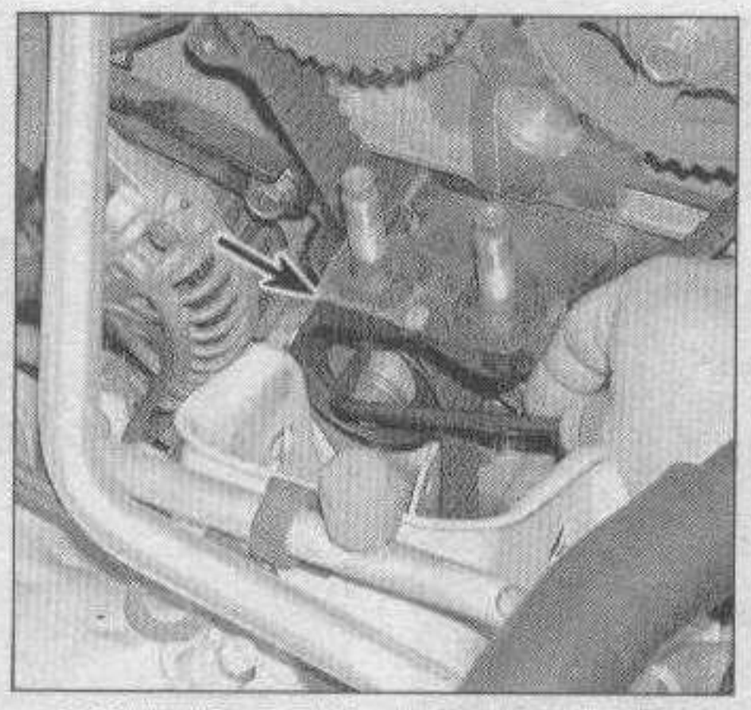
6.12b At TDC, both camshaft sprocket marks (arrows) are aligned with the surface of the cylinder head



6.12c The rear of the camshaft sprockets have timing marks also (arrows) - align them with the surface of the cylinder head as a double-check to the alignment of the front marks



6.13 If reusing the timing belt, make a paint mark to indicate the direction of rotation



6.15 Using an Allen wrench in the hex hole provided in the tensioner pulley, lever the tensioner enough to remove the tensioner spring (arrow), then slowly release the tensioner

their teeth together in the center. This simplifies the timing belt procedure, because it keeps the camshafts from turning due to valve spring pressure. **Note:** *The procedure can be done without the tool, but it means that you may have to turn each camshaft sprocket somewhat to align the timing marks as the belt is installed, and it may become a two-person job.*

15 Release the tension on the timing belt **(see illustration)**.

16 Remove the timing belt.

17 If necessary, remove the crankshaft sprocket using two prybars or screwdrivers placed behind the sprocket to apply even pressure on the sprocket to slide it off the crankshaft. On models so equipped, remove the bolt and the crankshaft position sensor before removing the crankshaft sprocket.

18 If necessary, remove the camshaft sprocket bolts and remove the sprockets from the camshafts. Prevent the camshaft from turning by placing a wrench on the hex surface on the shaft **(see illustration)**. The sprockets are marked on the front with an "I" for intake and "E" for exhaust.

Inspection

Refer to illustration 6.21

Caution: *Do not bend, twist or turn the timing belt inside out. Do not allow it to come in contact with oil, coolant or fuel. Do not use timing belt tension to keep the camshaft or crankshaft from turning when installing the sprocket bolts. Do not turn the crankshaft or camshaft more than a few degrees (necessary for timing mark alignment) while the timing belt is removed.*

19 Check the tensioner and idler pulley bearings for smooth operation and excessive play. Inspect the tensioner spring for damage. Replace the components, if necessary.

20 If the timing belt was broken during engine operation, the belt may have been fouled by debris or may have been damaged by a defective component in the area of the timing belt; check for belt material in the teeth of the sprockets. Any defective parts or debris in the sprockets must be cleaned out of all the sprockets before installing the new belt or the belt will not mesh properly when installed.

21 If the belt teeth are cracked or pulled off **(see illustration)**, water pump, oil pump or camshaft(s) may have seized.

22 If there is noticeable wear or cracks in the belt, check to see if there are nicks or burrs on the sprockets.

23 If there is wear or damage on only one side of the belt, check the belt guide and the alignment of all sprockets. Also check the oil seals at the front of the engine and replace them if they are leaking. Refer to Section 11 for the crankshaft oil seal and Section 7 for camshaft seals.

24 Replace the timing belt with a new one if obvious wear or damage is noted or if it is the least bit questionable. Correct any problems which contributed to belt failure prior to belt installation. **Note:** *We recommend replacing the belt whenever it is removed, since belt failure can lead to expensive engine damage.*

Installation

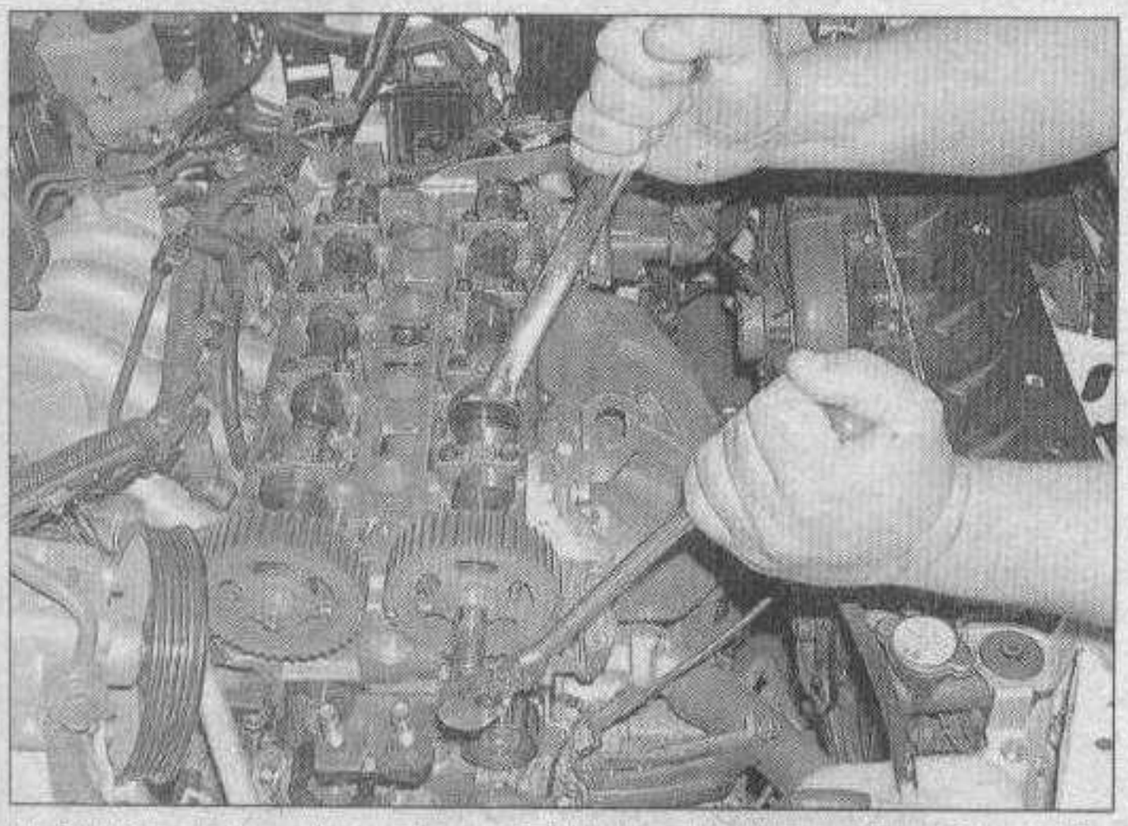
25 Remove all dirt and oil from the timing belt area at the front of the engine.

26 If they were removed, install the tensioner and idler pulley.

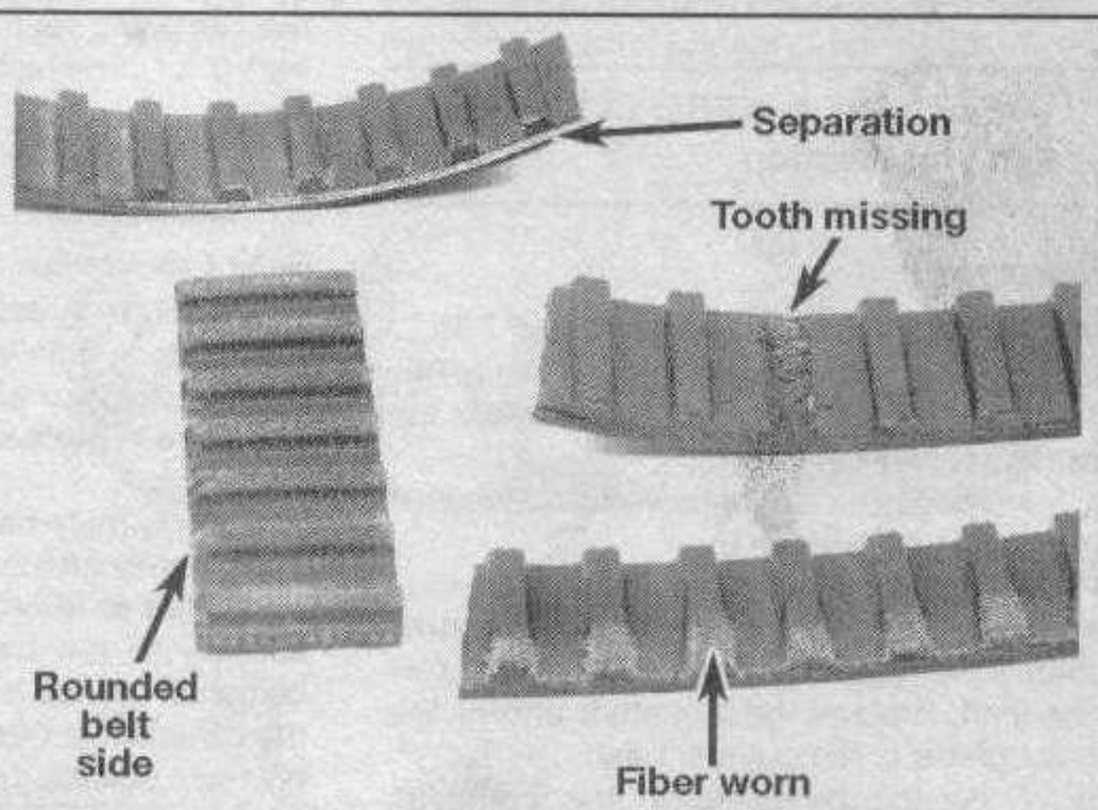
27 If they were removed, install the camshaft and crankshaft sprockets. Make sure the crankshaft sprocket Woodruff key is installed with the tapered side toward the oil pump body. Tighten the camshaft sprocket bolts to the torque listed in this Chapter's Specifications, referring to Step 18 above.

28 Align the camshaft sprocket and crankshaft sprocket timing marks **(see illustrations 6.12a, 6.12b and 6.12c)**. The notch on the rear flange of the crankshaft sprocket is aligned with the mark on the oil pump body. The "I" and "E" marks on the camshaft sprockets are aligned with the flat surface at the top of the cylinder head. **Note:** *If necessary, rotate the crankshaft and camshaft sprockets slightly to achieve proper alignment.*

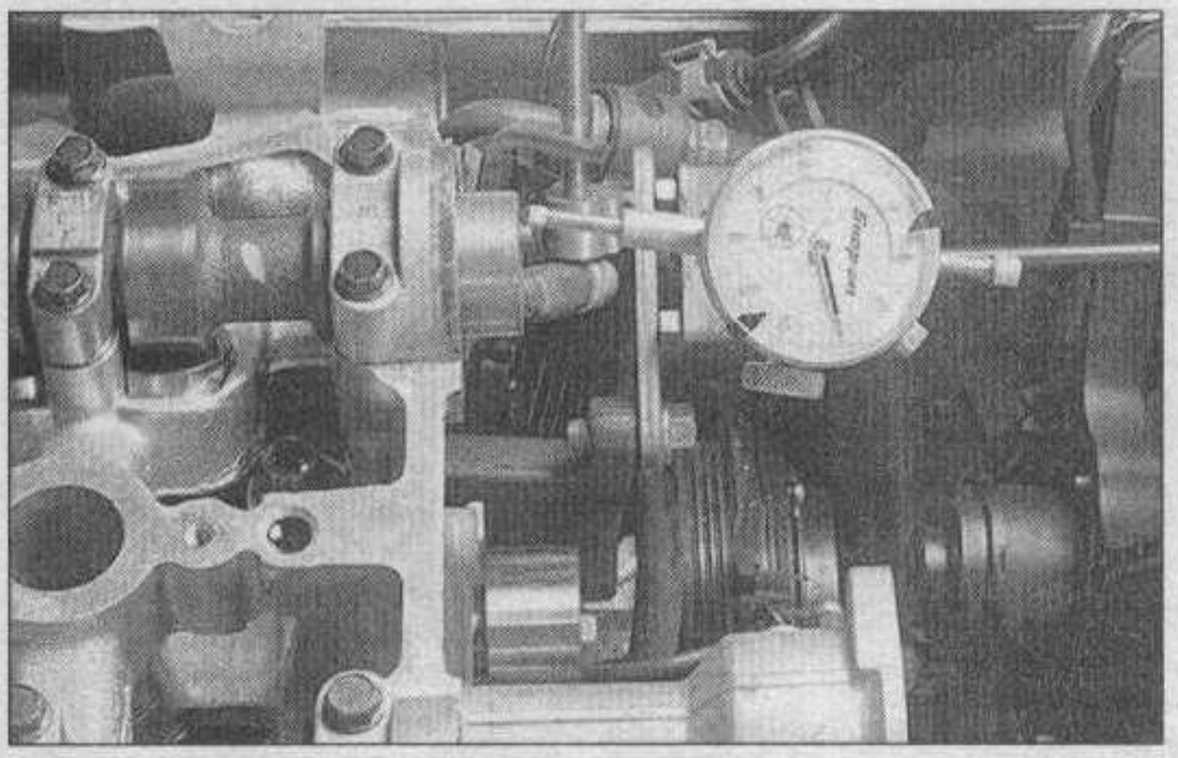
29 Slip the timing belt over the crankshaft sprocket and camshaft sprockets, and position the belt so it's tight on the side opposite the tensioner pulley and between the



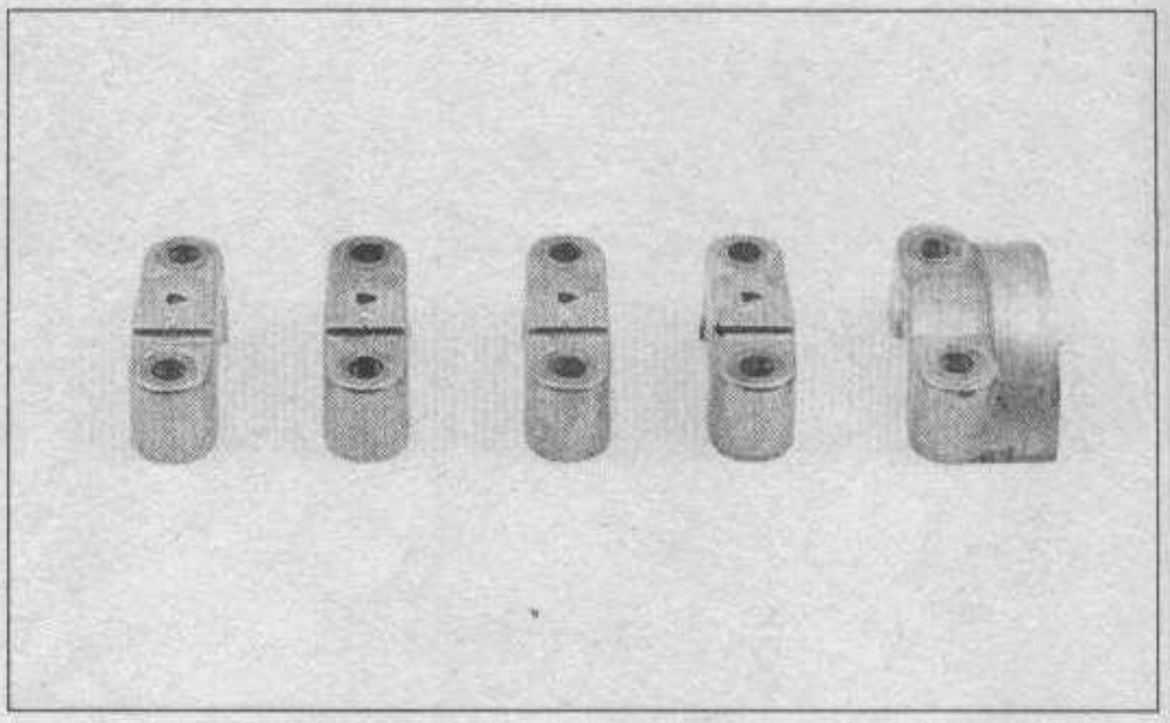
6.18 Use a large wrench to hold the hex portion of the camshaft while removing the sprocket bolt



6.21 Inspect the timing belt for signs of wear or damage



7.4 Before removing a camshaft, measure the endplay with a dial indicator



7.6 Camshaft caps must be kept in order - they should be numbered and marked I for Intake and E for Exhaust - the larger thrust cap (at right here) is for the timing-belt end of the head

camshaft sprockets. If the original belt is being reinstalled, align the marks made during removal with the marks on the sprockets, and be sure to install the timing belt so that it will rotate in the same direction as removed (the direction of rotation was marked during removal). If the camshaft sprocket-holding tool was used, remove it now.

30 Refer to Step 15 and rotate the tensioner until the spring can be replaced, then slowly release the tensioner.

31 Rotate the crankshaft two full turns clockwise and check the alignment of the camshaft and crankshaft sprockets **(see illustrations 6.12a, 6.12b and 6.12c)**. **Caution:** *If you feel resistance while rotating the engine by hand, do not continue. The valves may be contacting the pistons due to incorrect valve timing. Recheck the camshaft and crankshaft sprockets to be sure they are correctly aligned with their marks.*

32 Reinstall the remaining parts in the reverse order of removal. Run the engine and check for proper operation. **Caution:** *DO NOT start the engine until you are absolutely certain that the timing belt is installed correctly. Serious and costly engine damage could occur if the belt is improperly installed.*

7 Camshafts and lifters - removal and installation

Removal

Refer to illustrations 7.4, 7.6, 7.8a and 7.8b

1 Remove the valve cover (see Section 4).

2 On 1997 and earlier models, remove the distributor (see Chapter 5).

3 Remove the timing belt and camshaft sprockets (see Section 6).

4 Measure the camshaft thrust clearance (endplay) with a dial indicator **(see illustration)**. If the clearance is greater than the service limit, replace the camshaft and/or the thrust plates or the cylinder head.

5 Following the reverse of the tightening sequence **(see illustration 7.14)**, loosen the bearing cap bolts in 1/4-turn increments until they can be removed by hand. **Caution:** *As the center bearing cap bolts are being loosened, make sure the camshaft is moving up evenly. If one end or the other stops moving and the cam gets cocked, start over by reinstalling the bearing caps and turning the camshaft. DO NOT try to pry or force the camshaft out.*

6 When all the caps are loosened in sequence, remove the caps and keep them in order. They should be stamped with a number on top **(see illustration)**.

7 Lift the camshaft straight up and out of the head.

8 1997 and earlier models utilize hydraulic lifters, while 1998 and later models use an adjustable shim-and-bucket style lifter. In either type, the lifters can be removed by pulling them straight out of their bores with a magnet **(see illustration)**. Keep the shims with their lifters and store all types so that they can be later reinstalled in their own specific bores **(see illustration)**. **Caution:** *Hydraulic lifters should be stored in clean engine oil with their camshaft surfaces down (i.e. upside down to their normal orientation in the engine).*

9 Clean the camshafts thoroughly, remove the camshaft seals, and refer to Chapter 2, Part C for camshaft and lifter inspection procedures.

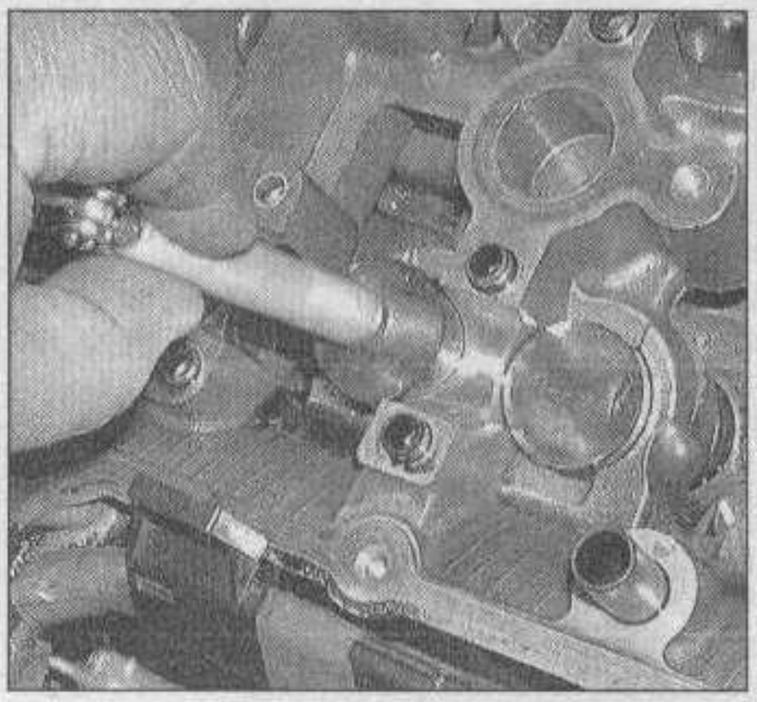
Installation

Refer to illustration 7.14

10 Apply moly-based engine assembly lube to the lifters, then install them in their original locations. Make sure the valve adjustment shims are in place in the lifters (1998 and later models).

11 Apply moly-based engine assembly lube to the camshaft lobes and bearing journals.

12 The camshafts must be installed horizontally to the head to avoid nicking the camshaft journal bores with the journals. As the camshaft is installed, turn it such that the pressure against the lifters is as even as possible front-to-rear. Put the caps in position in order and just start the bolts by hand.



7.8a Pull the lifters out of their bores, using a magnet if necessary

13 Before installing the front cap, apply a thin coat of RTV sealant to the outer edge of the front bearing-cap-to-cylinder-head mating surface. **Note:** *The cap must be installed immediately or the sealer will dry prematurely.*

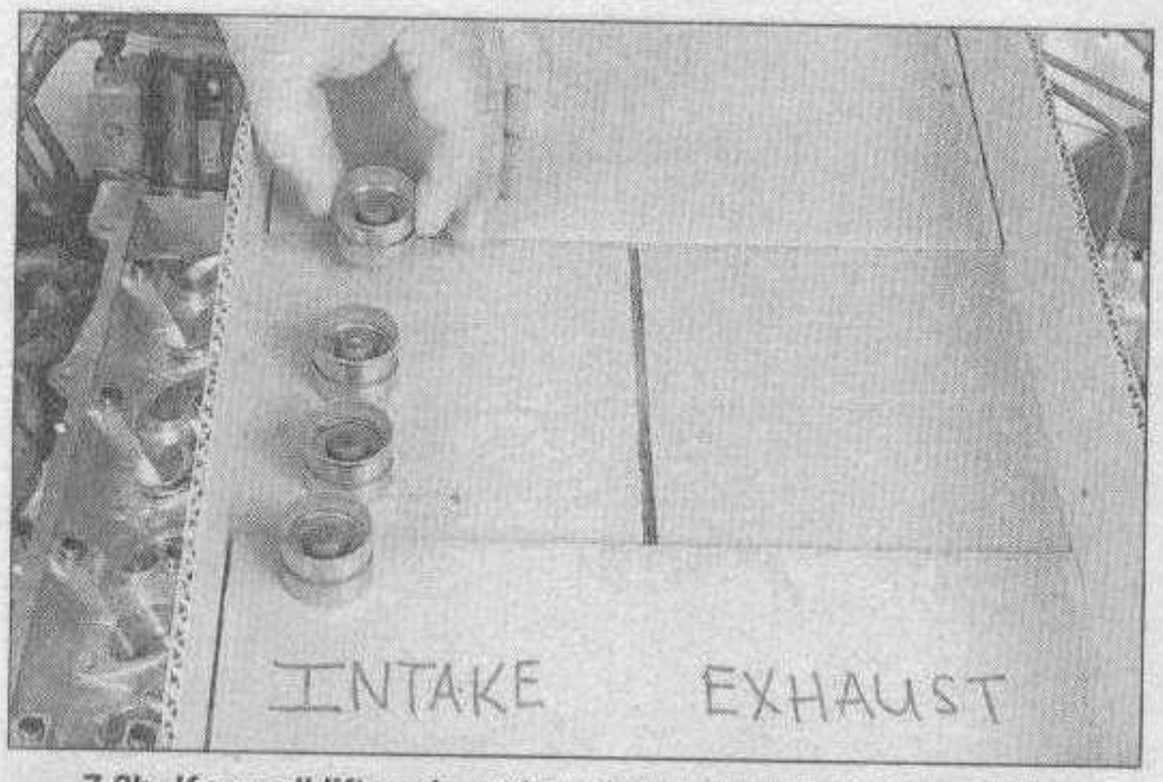
14 Following the recommended tightening sequence **(see illustration)**, tighten the bearing cap bolts in 1/4-turn increments to the torque listed in this Chapter's Specifications.

15 Apply some clean engine oil to the lip of the new camshaft oil seal. Push the seal in slightly by hand.

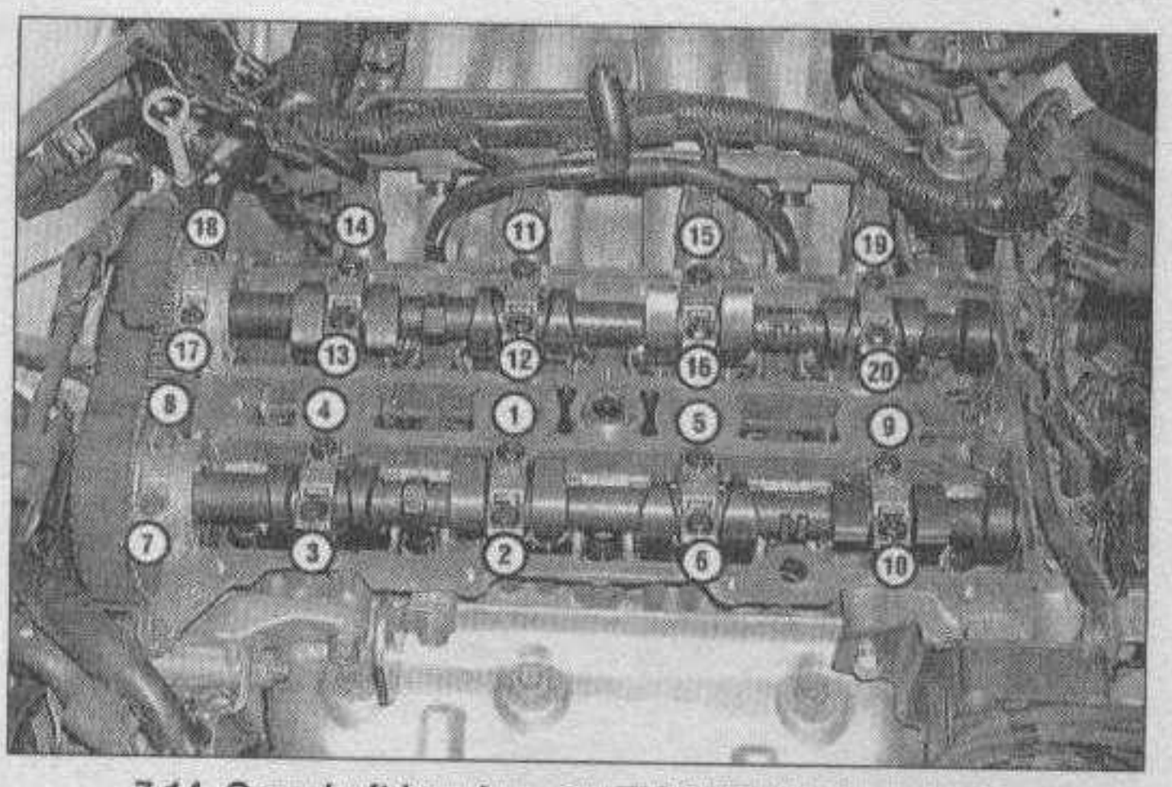
16 Using a seal installer (or short section of pipe or socket sized to fit against the seal), lightly tap the seal in, flush to the edge of the camshaft cap or to the depth of the original seal.

17 Reinstall the remaining parts in the reverse order of removal.

18 Run the engine and check for proper operation. **Note:** *Excessive noise from the hydraulic lifters may occur in some models with 50,000 or more miles. If the lifters pass the inspection procedures in Chapter 2, Part C, the problem may lie with the oil pump. Apparently, the pump may admit some air, even though oil doesn't leak outwardly. The air finds it way to the hydraulic lifters, displaces oil and causes the clattering. If the clattering doesn't go away after the engine is*



7.8b Keep all lifters in order when removing them - store hydraulic lifters upside down in oil, using a plastic or metal tray



7.14 Camshaft bearing cap TIGHTENING sequence

warmed up, you may need a new oil pump. Replacement lifters are expensive, so if yours clatter, see you dealer for an improved replacement oil pump.

8 Intake manifold - removal and installation

Removal

Refer to illustrations 8.8 and 8.9

1 Relieve the fuel system pressure (see Chapter 4).

2 Disconnect the negative cable from the battery. **Caution:** *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

3 Drain the cooling system (see Chapter 1).

4 Remove the air intake duct assembly. Disconnect the accelerator cable, hoses and electrical connectors at the throttle body (see Chapter 4). The throttle body can remain in place on the intake manifold during manifold removal.

5 Label and detach all wire harness, control cables and hoses connected to the intake manifold.

6 Disconnect the electrical connectors from the fuel injectors. Disconnect the fuel supply/return lines from the fuel rail (see Chapter 4). The intake manifold can be removed with the injectors and fuel rail in place.

7 Refer to Chapter 4 and disconnect the EGR tube and EGR vacuum valve.

8 Remove the intake manifold brace from under the intake manifold **(see illustration)**.

9 Remove the intake manifold mounting bolts/nuts, while supporting the intake manifold from above **(see illustration)**.

10 Remove the intake manifold.

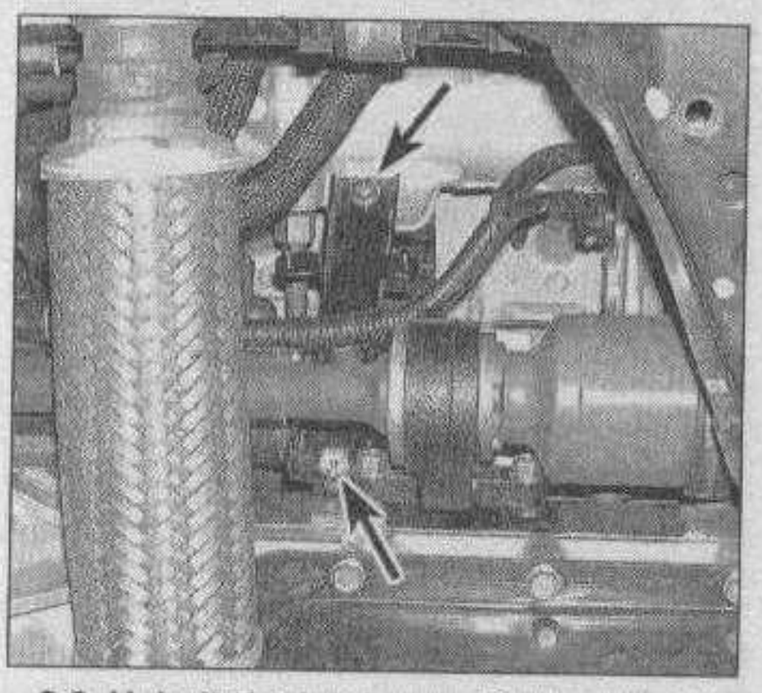
Installation

Refer to illustration 8.13

11 Carefully use a gasket scraper to remove all traces of old gasket material and any sealant from the manifold and cylinder head, then clean the mating surfaces with gasket cleaner or solvent - be careful to not gouge the gasket surfaces when cleaning. If the gasket was leaking, have the manifold checked for warpage at an automotive machine shop and resurfaced if necessary.

12 Install a new gasket, then position the manifold on the head and install the nuts/bolts.

13 Tighten the nuts/bolts, in sequence, in three or four equal steps to the torque listed in this Chapter's Specifications **(see illustration)**.



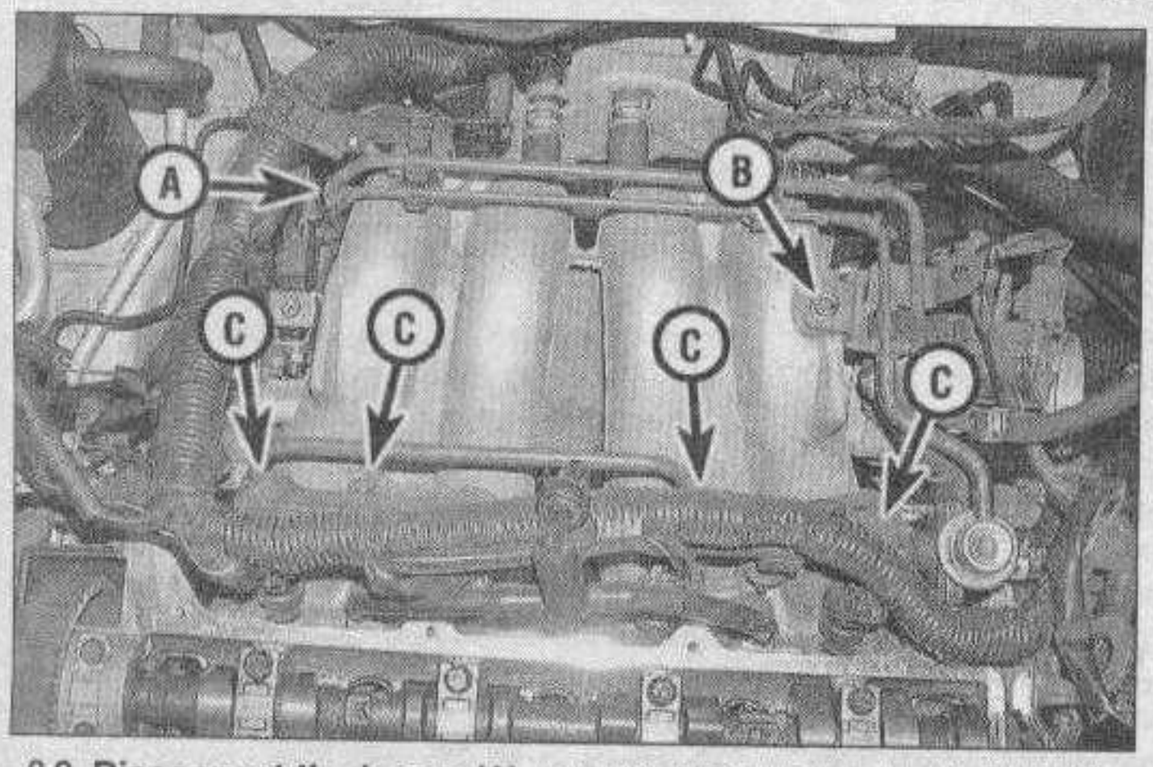
8.8 Unbolt the intake manifold support brace at the top and bottom (arrows)

14 Reinstall the remaining parts in the reverse order of removal.

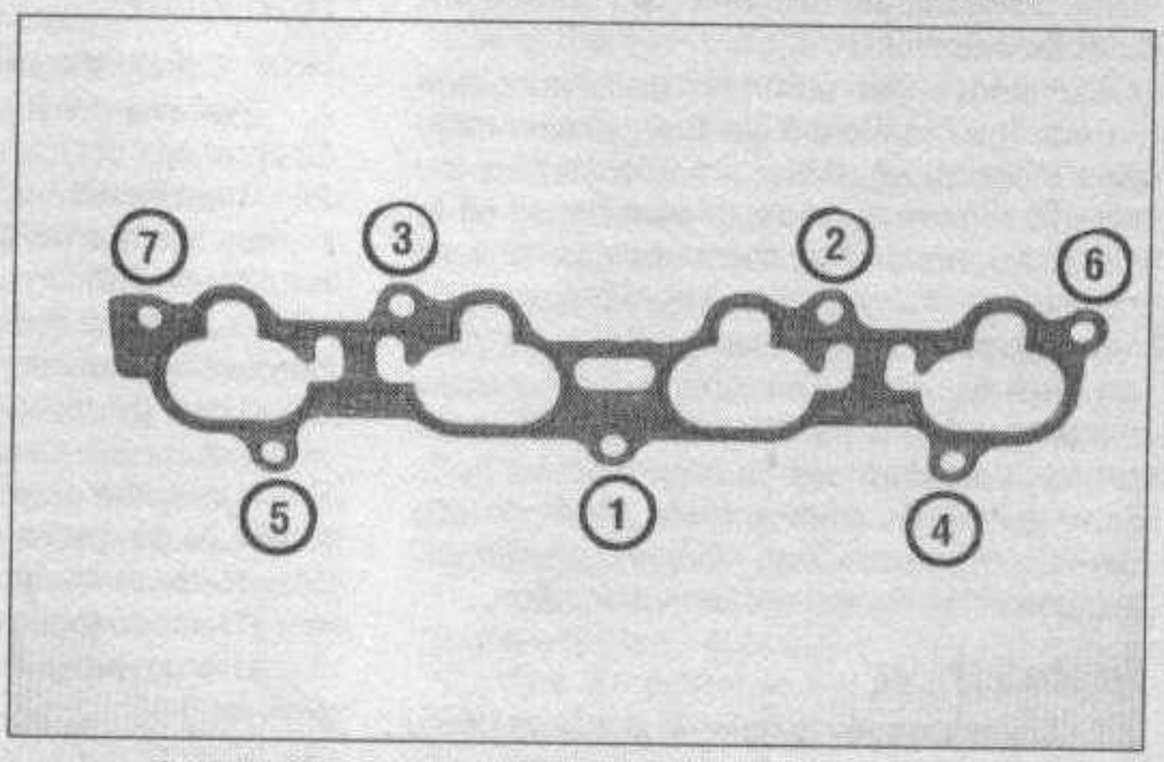
15 Before starting the engine, check the throttle linkage for smooth operation.

16 Check coolant level. Run the engine and check for coolant and vacuum leaks.

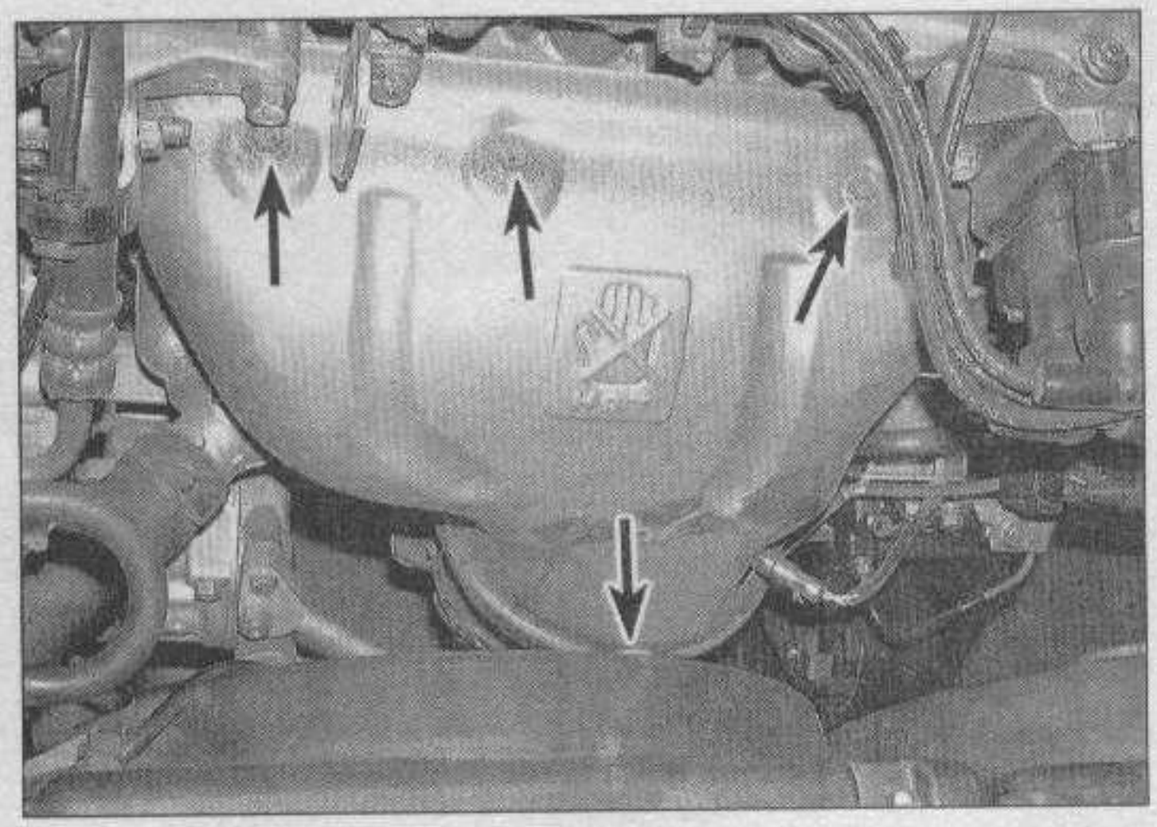
17 Road test the vehicle and check for proper operation of all accessories, including the cruise control system (if equipped).



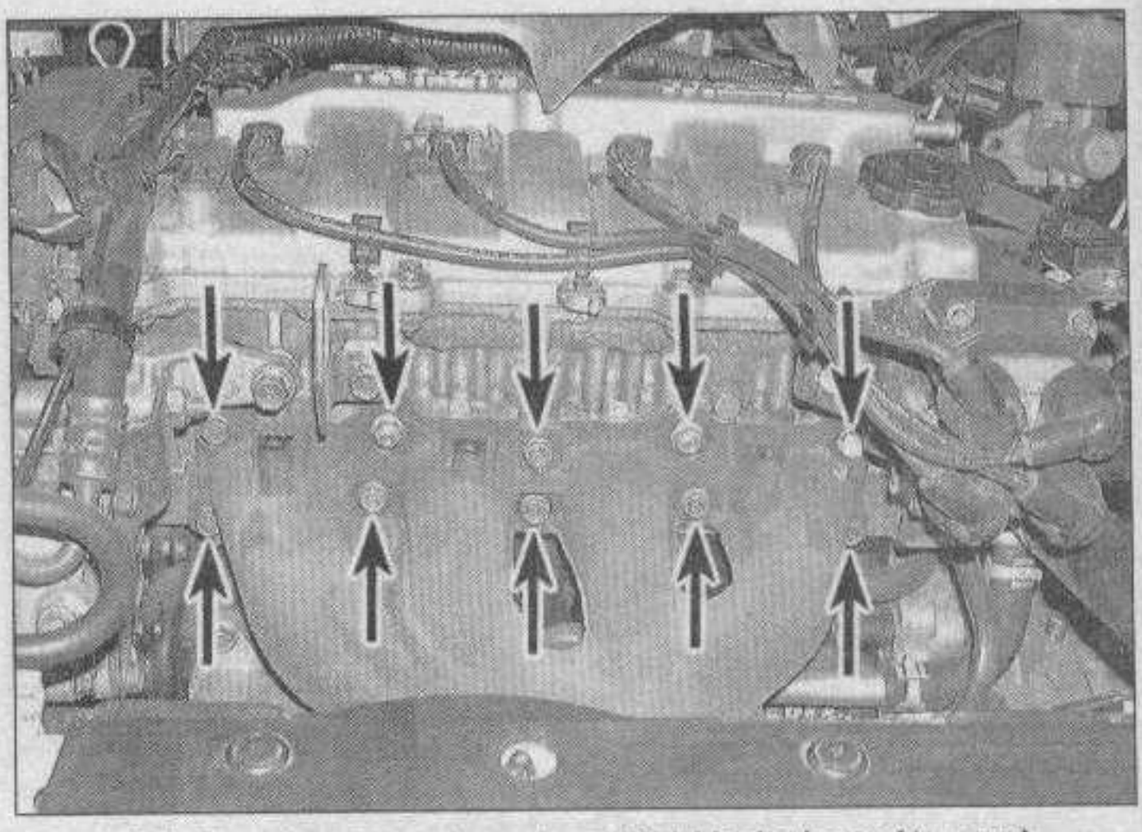
8.9 Disconnect the hoses (A), remove the hose bracket bolt (B), then remove the intake manifold mounting nuts/bolts (C)



8.13 Intake manifold bolt TIGHTENING sequence



9.3 Remove the exhaust manifold heat shield bolts (arrows)



9.7 Remove the exhaust manifold bolts/nuts (arrows)

9 Exhaust manifold - removal and installation

Warning: *The engine must be completely cool before beginning this procedure.*

Removal

Refer to illustrations 9.3 and 9.7

1 Disconnect the negative cable from the battery. **Caution:** *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Disconnect the electrical connector from the oxygen sensor. If you are installing a new manifold, remove the sensor (see Chapter 6).

3 Remove the heat shield bolts and remove the heat shield from the manifold **(see illustration)**.

4 Apply penetrating oil to the exhaust manifold mounting bolts/nuts, to the EGR pipe and to the manifold-to-catalytic converter nuts.

5 Raise the vehicle and support it securely on jackstands (see Chapter 1).

6 Remove the bolts retaining the exhaust pipe brace to the engine, then lower the catalytic converter and exhaust pipe down away from the manifold.

7 Remove the manifold bolts/nuts and detach the manifold from the cylinder head **(see illustration)**. **Note:** *If any bolts/nuts are difficult to remove, reapply penetrating oil to the bolts/nuts and let them soak for at least 15 minutes. If any bolts or studs break during removal, you may be able to use locking pliers after the manifold is removed to unscrew the broken bolt/stud. If unable to remove the broken bolt/stud, see your automotive parts store for stud removal tools. Replace any damaged parts with parts specifically designed for exhaust system application.*

Installation

8 Use a scraper to remove all traces of old gasket material and carbon deposits from the manifold and cylinder head mating surfaces. If the gasket was leaking, have the manifold checked for warpage at an automotive machine shop and resurfaced if necessary. **Caution:** *When scraping, be very careful not to gouge or scratch the delicate aluminum cylinder head manifold mounting surface.*

9 Position a new exhaust manifold gasket over the studs on the cylinder head.

10 Install the manifold and thread the mounting bolts/nuts into place.

11 Working from the center out, tighten the bolts/nuts to the torque listed in this Chapter's Specifications in several equal steps.

12 Reinstall the remaining parts in the reverse order of removal. If reinstalling the oxygen sensor, use a special anti-seize thread lubricant available at your automotive parts store.

13 Run the engine and check for exhaust leaks.

10 Cylinder head - removal and installation

Caution: *The engine must be completely cool before beginning this procedure.*

Removal

Refer to illustration 10.15

1 Relieve the fuel system pressure (see Chapter 4).

2 Disconnect the negative cable from the battery. **Caution:** *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

3 Drain the coolant from the engine block and radiator (see Chapter 1).

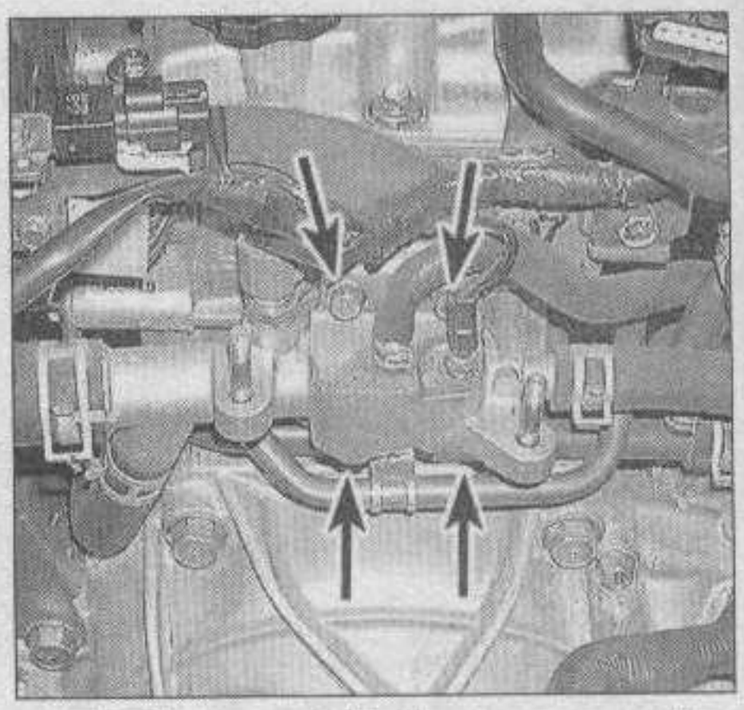
4 Drain the engine oil and remove the oil filter (see Chapter 1).

5 Remove the air intake duct assembly.

6 Remove the spark plugs.

7 Remove the intake manifold (see Section 8).

8 Remove the exhaust manifold (see Section 9).



10.15 Disconnect the hoses, remove the four bolts (arrows) and remove the coolant transfer pipe from the cylinder head

9 Remove the valve cover (see Section 4).

10 Remove the timing belt covers and the timing belt (see Section 6).

11 Remove the power steering pump and alternator drive belt(s) (see Chapter 1).

12 Remove the alternator bracket.

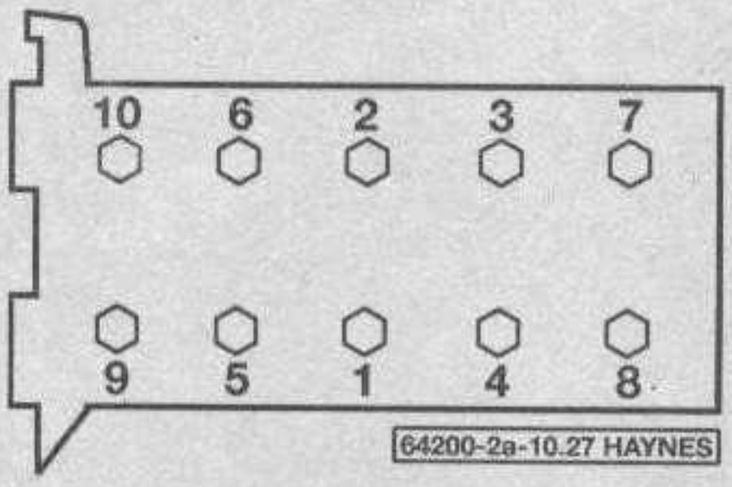
13 Remove the crank angle sensor and distributor or coilpack (see Chapter 5).

14 Unbolt the power steering pump, as applicable, and lay it to the side without disconnecting the hoses (see Chapter 10). Label and detach any remaining hoses, ground wires or electrical connectors that would interfere with cylinder head removal.

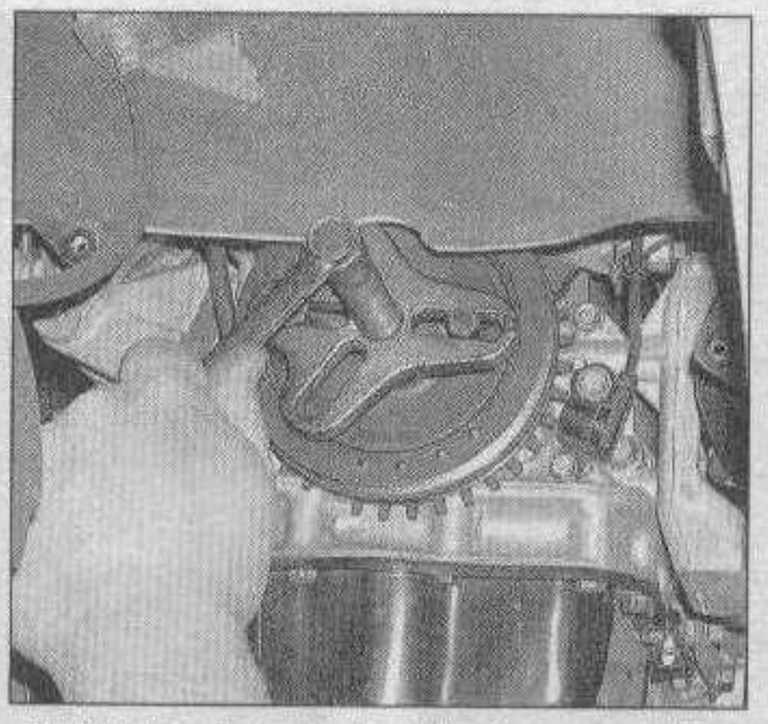
15 Unbolt the coolant transfer pipe at the transaxle end of the engine (**see illustration**).

16 Refer to Section 7 and remove both camshafts and the lifters. Store the lifters in an organized manner, so they can be returned to their original bores upon reassembly.

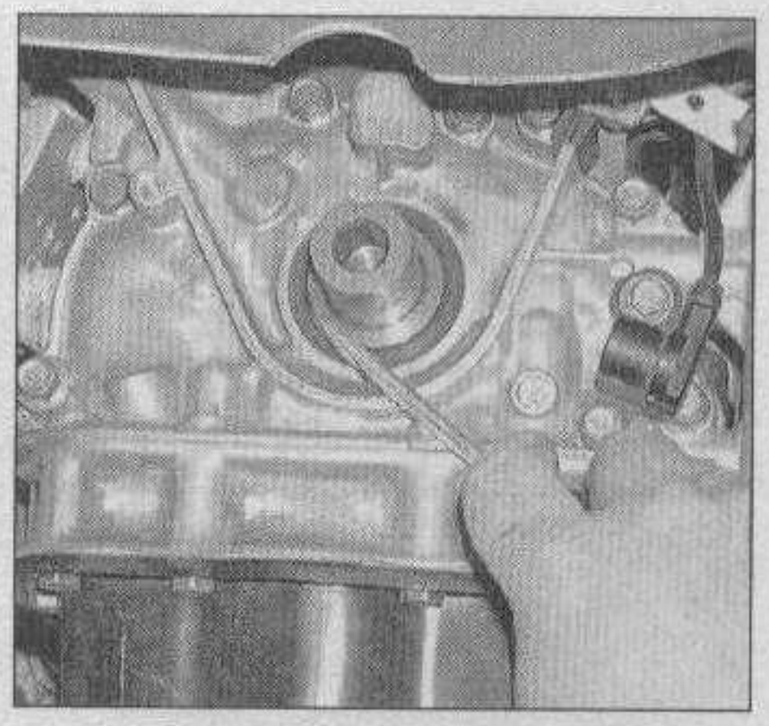
17 Using a breaker bar and the appropriate hex-bit driver or socket, loosen the cylinder head bolts in 1/4-turn increments, loosening in the reverse of the tightening sequence **(see illustration 10.27)** until they can be removed by hand. Discard the cylinder head bolts (but



10.27 Cylinder head bolt TIGHTENING sequence



11.5 Use a two-bolt puller to remove the crankshaft pulley



11.8 Pry out the old seal with a seal removal tool

save the washers, if equipped, for use on the new bolts) and obtain new bolts for reassembly.

18 Lift the cylinder head off the engine block. If it is stuck, very carefully pry up at the transmission end, away from the head gasket surface.

19 Remove all external components from the head to allow for thorough cleaning and inspection. See Chapter 2, Part C, for cylinder head servicing procedures.

Installation

Refer to illustration 10.27

20 The mating surfaces of the cylinder head and block must be perfectly clean when the head is installed.

21 Use a gasket scraper to remove all traces of carbon and old gasket material, then clean the mating surfaces with lacquer thinner or acetone. If any oil residue is on the mating surfaces when the head is installed, the gasket may not seal correctly and leaks could develop. When working on the engine block, stuff the cylinders with clean shop rags to prevent the entry of debris. Use a vacuum cleaner to remove material that falls into the cylinders. **Caution:** *Be careful not to gouge the soft aluminum of the cylinder head.*

22 Check the engine block and cylinder head mating surfaces for nicks, deep scratches and other damage. If damage is slight, it can be removed with a file; if it's excessive, machining may be the only alternative.

23 Use a tap of the correct thread size to chase the threads in the head bolt holes, then clean the holes with compressed air. **Caution:** *Always wear eye protection when using compressed air!* Make sure that no residue such as dirt, corrosion, and sealant remains in the holes and the threads are not damaged as this will affect torque readings, which affects the quality of the cylinder head installation job. **Warning:** *Wear eye protection when using compressed air!*

24 Install the components that were removed from the cylinder head.

25 Position the new gasket over the dowel pins in the engine block, paying attention to any markings on the gasket, such as TOP or FRONT. Carefully set the cylinder head on the engine block without disturbing the gasket.

26 Apply a small amount of clean engine oil to the threads of the *new* head bolts and install the bolts finger-tight.

27 Tighten the bolts following the recommended sequence in several steps to the torque listed in this Chapter's Specifications **(see illustration)**.

28 The remaining installation steps are the reverse of removal.

29 Refill the cooling system, install a new oil filter and add oil to the engine (see Chapter 1).

30 Run the engine and check for leaks. Check the ignition timing (see Chapter 5) and road test the vehicle.

31 Frequently recheck coolant level for the first few hundred miles to be sure that no leakage exists.

11 Crankshaft front oil seal - replacement

Refer to illustrations 11.5, 11.8 and 11.10

1 Disconnect the negative battery cable. **Caution:** *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

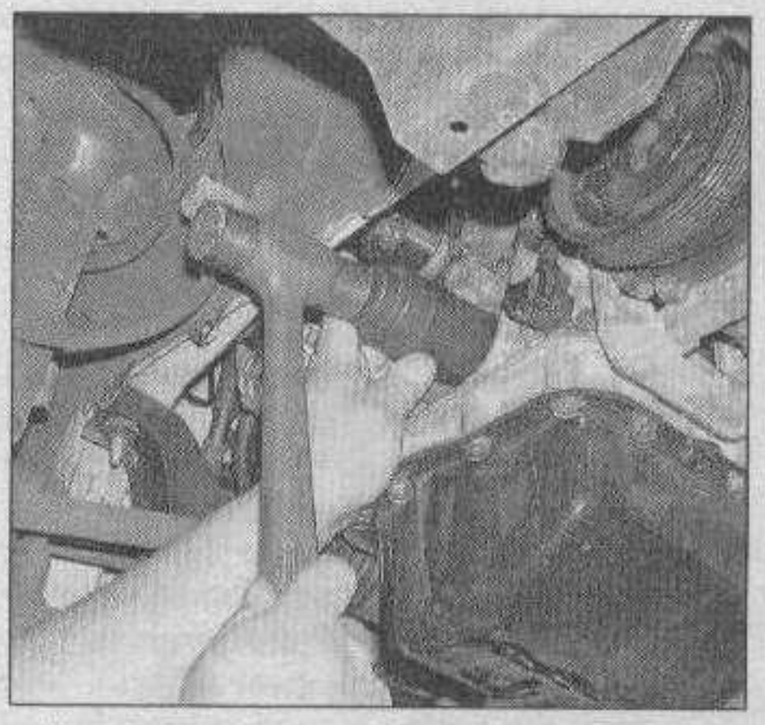
2 Remove the engine splash shield.

3 Securely support the front of the vehicle on jackstands, and remove the front passenger side tire for access.

4 Use a strap wrench or two-bolt holding tool to keep the crankshaft from turning while you remove the crankshaft pulley bolt with a breaker bar and socket.

5 Remove the vibration damper with a bolt-type puller **(see illustration)**. **Caution:** *Don't use a gear-type puller, as it will damage the damper. Use a puller with bolts that thread into the pulley, they are available at most auto parts stores.*

6 Refer to Section 6 and remove the timing belt and crankshaft sprocket.



11.10 Drive the new oil seal in squarely with the correct size seal driver

7 Unbolt the crankshaft position sensor and move it out of the way.

8 Note how far the seal is seated in the bore and the direction the oil seal lip faces (the oil seal should be flush with the face of the oil pump body. Remove the front oil seal with a seal remover tool or a screwdriver with the tip wrapped with tape to protect the crankshaft surface **(see illustration)**.

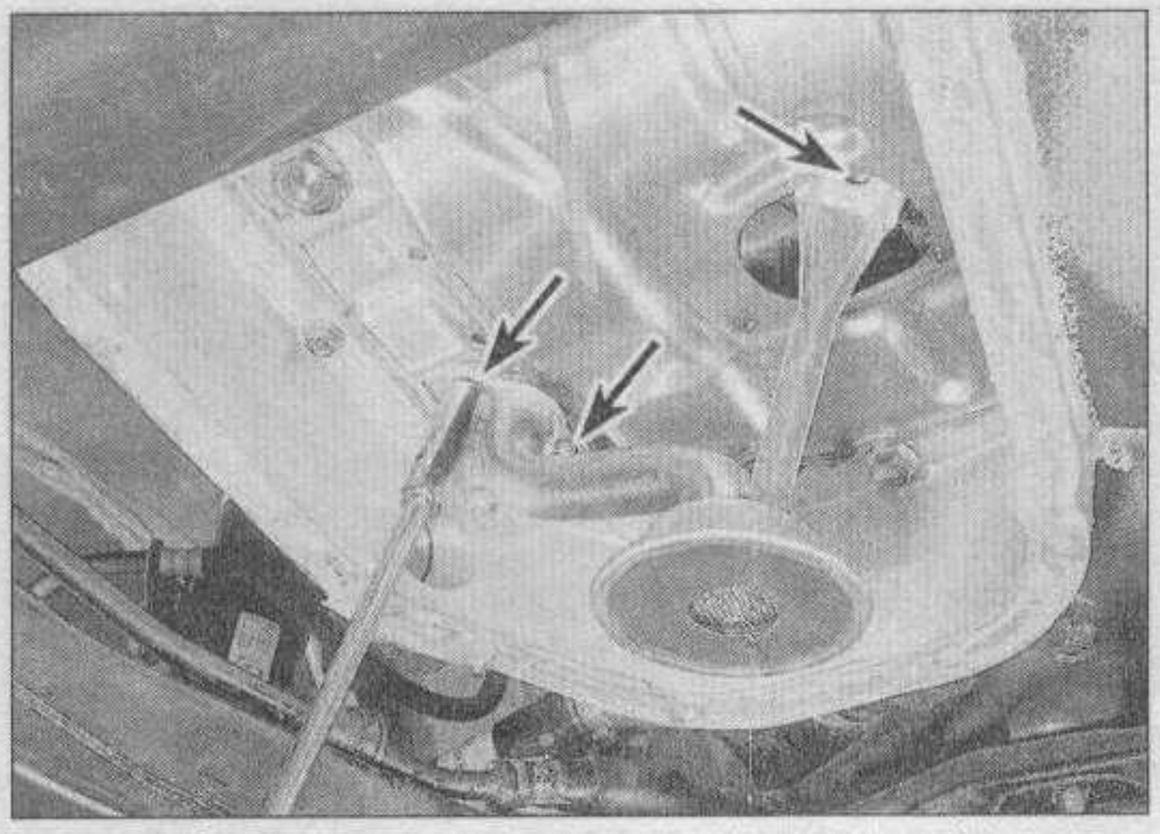
9 Clean the bore in the engine block and clean the crankshaft surface. Coat the outside of the new front oil seal with engine oil. Apply engine assembly lubricant or clean engine oil to the seal lip.

10 Press the oil seal in slightly by hand, with the oil seal lip facing the same direction as removed. Using a seal driver, section of pipe or a socket with an outside diameter slightly smaller than the outside diameter of the front oil seal, carefully tap the new seal into place with a hammer until the oil seal is flush with the face of the oil pump body **(see illustration)**. Make sure the oil seal is installed squarely in the bore.

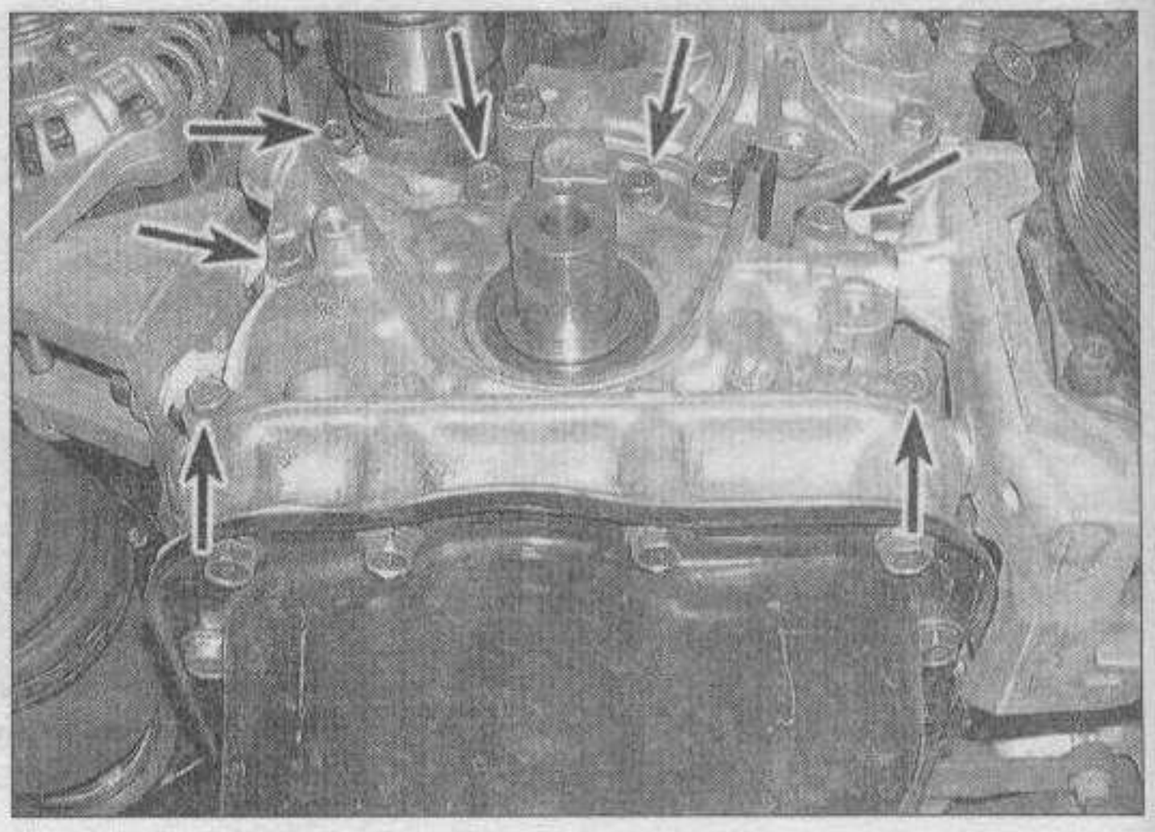
11 Reinstall the crankshaft sprocket and timing belt (see Section 7).

12 The remainder of the installation is the reverse of the removal procedure.

13 Run the engine and check for oil leaks at the front oil seal.



13.5 Remove the three fasteners (arrows) and the oil pump pickup tube/strainer



13.7 Remove the oil pump mounting bolts (arrows)

12 Oil pan - removal and installation

Removal

1 Disconnect the negative cable from the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Raise the vehicle and support it securely on jackstands.

3 Remove the engine splash shield.

4 Drain the engine oil and remove the oil filter (see Chapter 1).

5 Remove the oil dipstick (see Section 6).

6 Disconnect the electrical connector from the oxygen sensor. Detach the exhaust pipe from the exhaust manifold and lower the exhaust pipe and catalytic converter. Support the exhaust pipe at the catalytic converter.

7 Remove the bolts and detach the oil pan. If it's stuck, pry it loose very carefully with a small screwdriver or putty knife. Don't damage the mating surfaces of the pan and block or oil leaks could develop.

Installation

8 Use a scraper to remove all traces of old gasket material and sealant from the block and oil pan. Clean the mating surfaces with lacquer thinner or acetone.

9 Make sure the threaded bolt holes in the block are clean.

10 Check the oil pan flange for distortion, particularly around the bolt holes. If necessary, place the pan on a block of wood and use a hammer to flatten and restore the gasket surface.

11 Inspect the oil pump pick-up tube assembly for cracks and a blocked strainer **(see Section 13)**. If the pick-up was removed, clean it thoroughly and install it now, using a new O-ring or gasket. Tighten the nuts/bolts to the torque listed in this Chapter's Specifications.

12 Apply a 5 mm wide bead of RTV sealant to the oil pan flange. **Note:** *The oil pan must be installed within 5 minutes once the sealer has been applied.*

13 Carefully position the oil pan on the engine block and install the bolts. Working from the center out, tighten them to the torque listed in this Chapter's Specifications in three or four steps.

14 The remainder of installation is the reverse of removal. Be sure to add oil and install a new oil filter. Use new gaskets on each end of the front exhaust pipe.

15 Run the engine and check that the engine has proper oil pressure and no leaks.

13 Oil pump - removal, inspection and installation

Removal

Refer to illustrations 13.5 and 13.7

1 Disconnect the negative battery cable. **Caution:** *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Remove the engine splash shield. Remove the drivebelts (see Chapter 1).

3 Remove the alternator (see Chapter 5). Remove the air conditioning compressor (without disconnecting the hoses) and secure it aside (see Chapter 3).

4 Remove the timing belt and the crankshaft sprocket (see Section 6).

5 Remove the oil pan (see Section 12). Remove the oil pump strainer **(see illustration)**.

6 Loosen the bolts in the reverse order of the tightening sequence **(see illustration 13.23)** and remove the lower engine block reinforcement section. **Note:** *1998 and later Mazda models have a different bolt arrangement at the transaxle end, including bolts that connect to the bellhousing.*

7 Remove the oil pump bolts/nuts from the engine block and separate the oil pump from the engine block **(see illustration)**. You may have to pry carefully between the front main bearing cap and the pump housing with a screwdriver.

Inspection

Refer to illustrations 13.11a, 13.11b and 13.11c

8 Place the oil pump on a workbench. Note how far the oil seal is seated in the bore. Using a seal removal tool or a screwdriver taped or wrapped with a rag to protect the pump bore, remove the oil seal from the housing. **Caution:** *Do not scratch the housing bore.*

9 Remove the screws retaining the oil pump cover to the housing and remove the cover. Inspect the oil pump cover for distortion or damage.

10 Remove the oil pressure relief valve. Note or mark the direction of the components as installed, then remove the oil pump inner and outer rotors from the housing. Thoroughly clean all of the components in clean solvent.

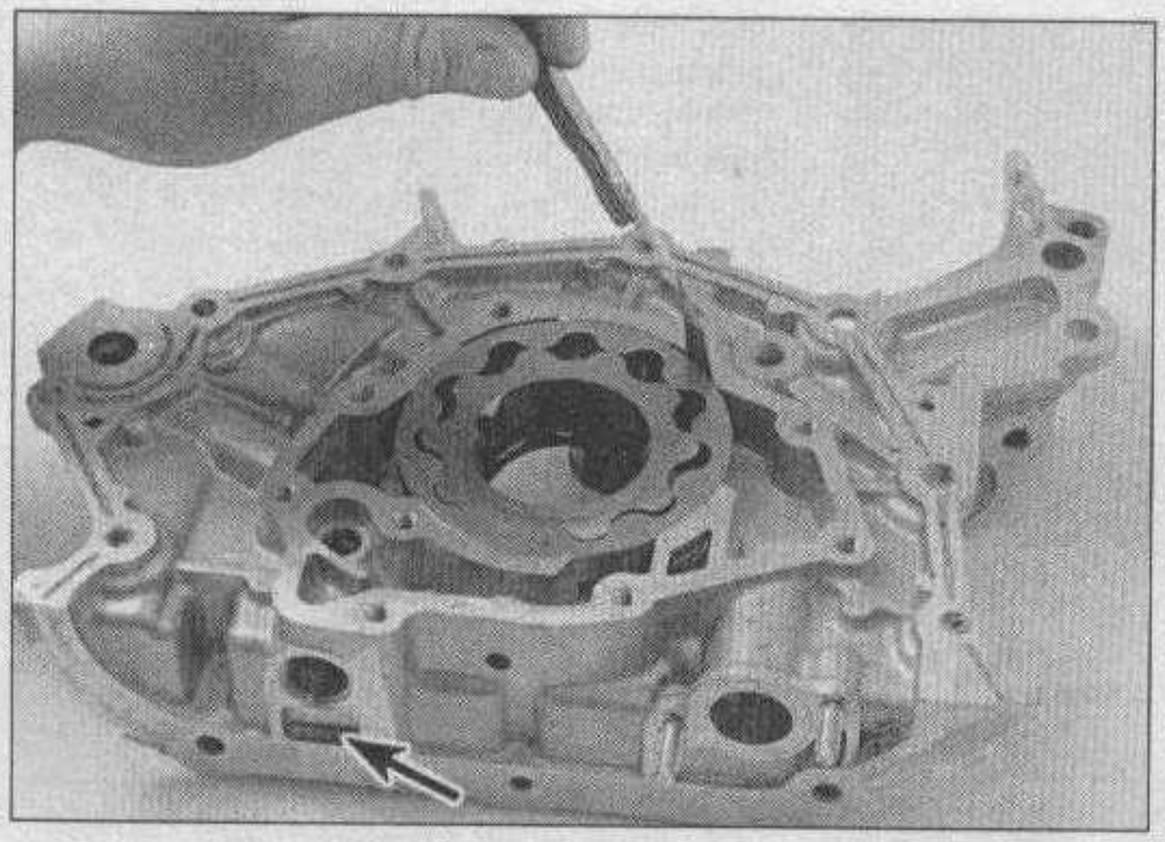
11 Reinstall the oil pump inner and outer rotors into the oil pump housing and measure the following clearance and compare your measurements to the clearance listed in this Chapter's Specifications. **(see illustrations)**:

a) *The driven rotor-to-pump housing.*
b) *The drive rotor-to-driven rotor tips.*
c) *The rotor set-to-oil pump housing end-play.*

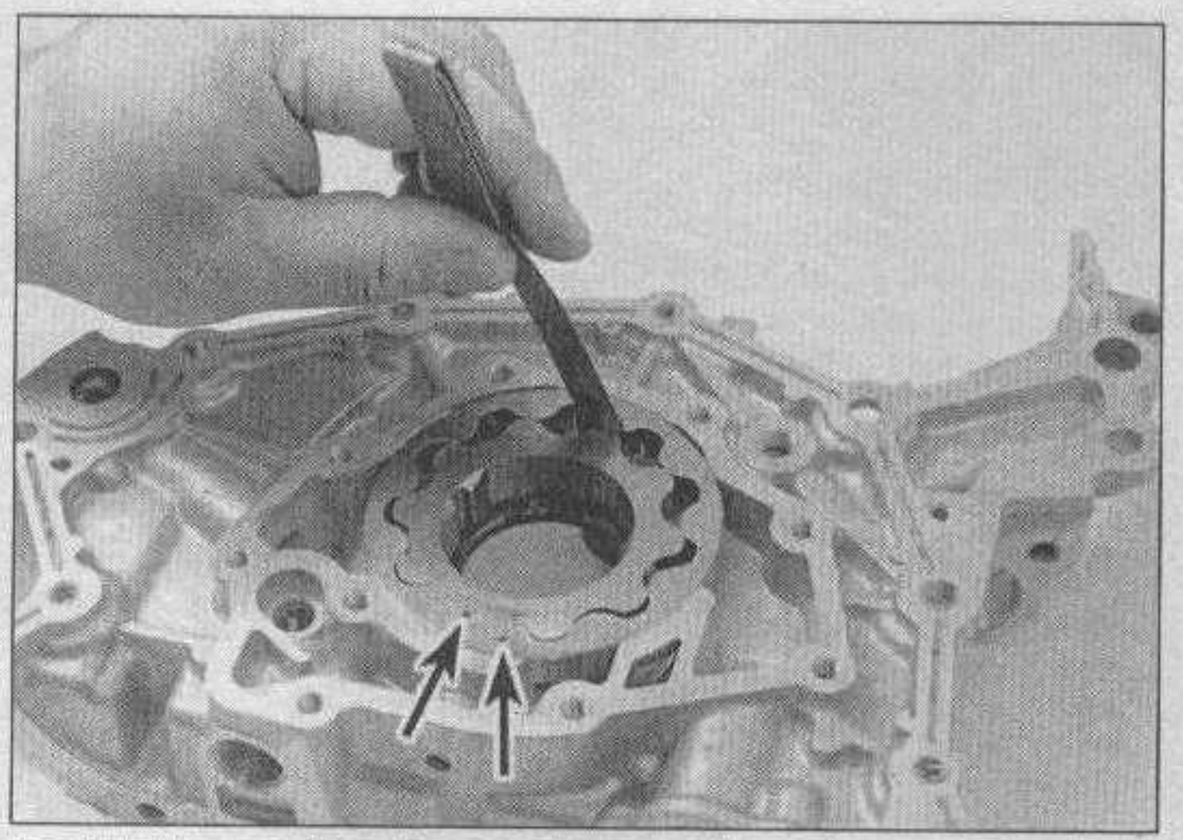
12 Check the length of the oil pressure relief spring when removed from the oil pump. Compare the length measured with the free length listed in this Chapter's Specifications. Replace the spring if necessary.

13 Be sure the surfaces of the pump housing are clean and dry before reassembly.

14 Lightly coat the outer edge of a new oil seal with engine assembly lubricant or clean engine oil. Using a socket with an outside diameter slightly smaller than the outside



13.11a Measure the clearance between the oil pump driven rotor and the pump housing (arrow indicates location of oil pressure relief valve)



13.11b Measure the clearance between the drive and driven rotor tips (arrows indicate dots for aligning the two rotors)

diameter of the seal, carefully drive the new seal into place with a hammer. Make sure it's installed squarely and driven in to the same depth as the original. If a socket is not available, a short section of large diameter pipe will also work. Apply engine assembly lubricant to the seal lip surface that contacts the crankshaft.

15 Lubricate the oil pressure relief valve piston with clean engine oil and reinstall the valve components into the pump case and secure them with the snap ring.

16 Lubricate the rotor set with clean engine oil. Reinstall the rotors.

17 Pack the pump cavities with petroleum jelly (this will prime the pump and ensure good suction when the engine is started).

18 Install the cover, apply thread locking compound to the screw threads and tighten the screws securely.

19 Inspect the screen at the end of the oil pick-up tube for any debris that might plug it. Either clean the tube and screen completely or replace it with a new one at this time.

Installation

Refer to illustration 13.23

20 Use a scraper to remove all traces of gasket and sealant from the engine block, then clean the mating surfaces with lacquer thinner or acetone.

21 Install a new gasket with a thin coat of silicone sealant on the oil pump gasket surface. Reinstall the oil pump to the engine block, turning the pump if necessary to align the oil pump drive with the crankshaft. **Note:** *Be sure the sealant doesn't plug or cover any oil passages. Some pumps may have an O-ring seal on one portion of the pump, replace the O-ring if one was used.*

22 Install the bolts and tighten them to the torque listed in this Chapter's Specifications.

23 Clean the bottom of the engine block and the mating surface of the engine block reinforcement. Apply a bead of RTV sealant to the perimeter of the reinforcement, and at the cap-mating surface around the four rearmost reinforcement-to-main-cap bolt holes, then install the reinforcement within five minutes. Tighten the reinforcement bolts in sequence in several steps to the torque listed in this Chapter's Specifications **(see illustration)**.

24 The remainder of installation is the reverse of the removal procedure.

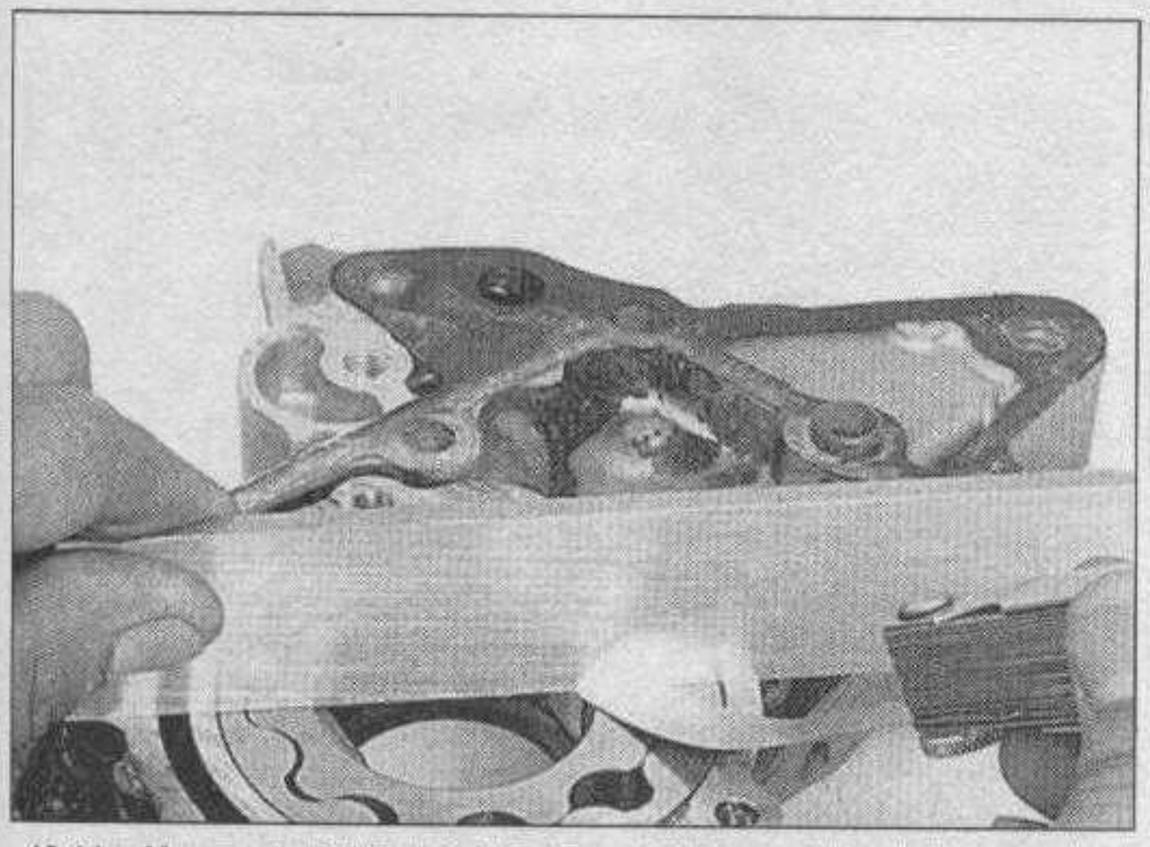
14 Flywheel/driveplate - removal and installation

Refer to illustration 14.3

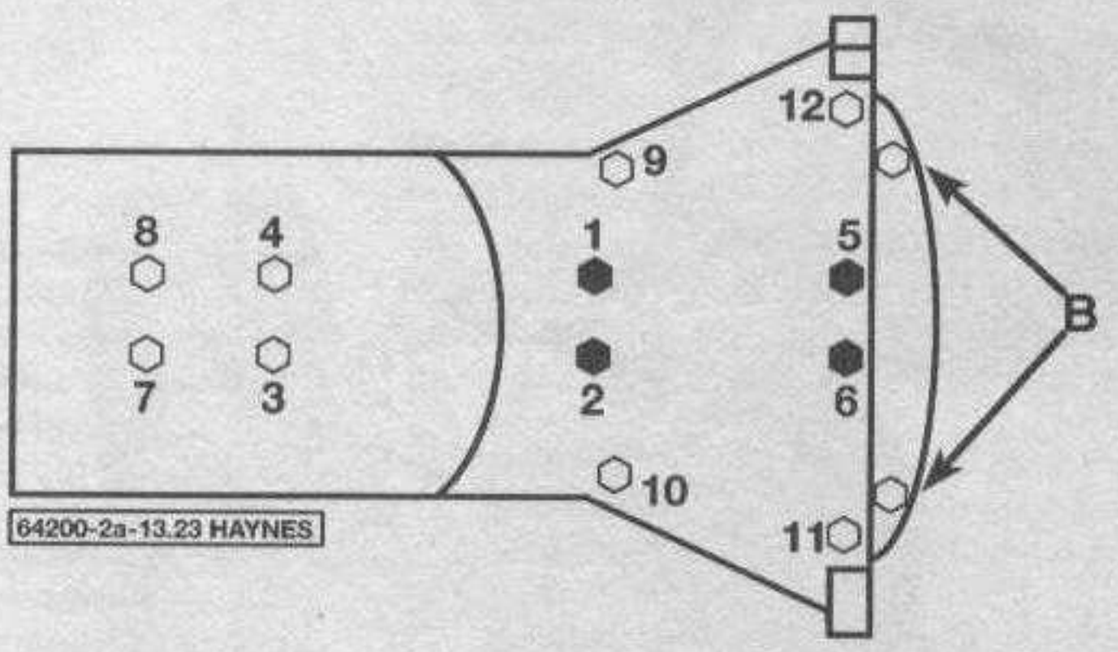
Removal

1 Raise the vehicle and support it securely on jackstands, then refer to Chapter 7 and remove the transaxle.

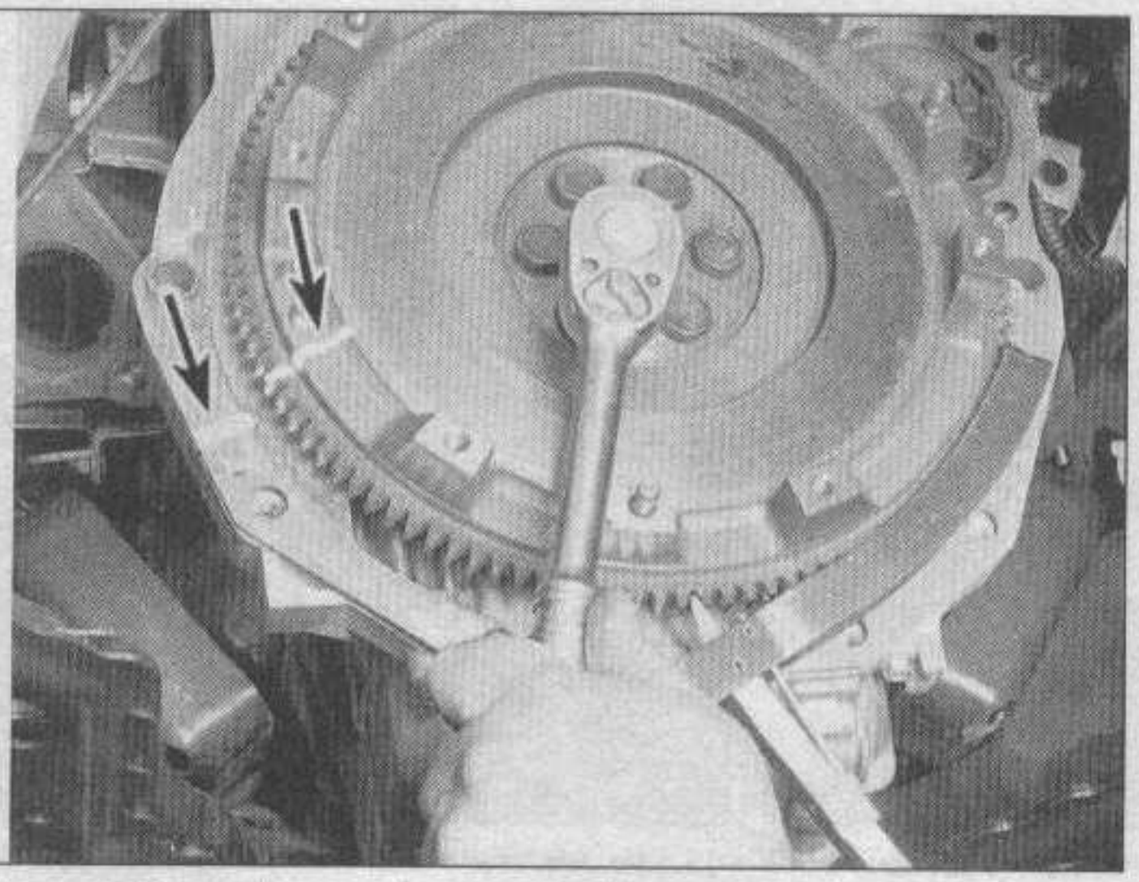
2 If you're working on a model with a manual transaxle, remove the clutch cover and clutch disc (see Chapter 8). Now is a good time to check/replace the clutch components and pilot bearing.



13.11c Use a straightedge to measure the endplay between the rotors and the pump housing



13.23 Bolt TIGHTENING sequence for the lower engine block reinforcement section; B indicates the two bolts that must be tightened to the rear oil seal plate, but are not part of the sequence - apply RTV around the engine block-side of the holes with the darkened bolt heads in this illustration



14.3 Marking the flywheel/driveplate and the rear plate (arrows) will preserve the alignment of the flywheel and crankshaft as long as the crankshaft isn't turned; if you're going to turn the crankshaft, mark the flywheel and crankshaft near one of the bolt holes

3 Use a center-punch or paint to make alignment marks on the flywheel/driveplate and engine rear plate to ensure correct reinstallation alignment later **(see illustration)**.

4 Remove the bolts that secure the flywheel/driveplate to the crankshaft **(see illustration 14.3)**. If the crankshaft turns, wedge a screwdriver in the ring gear teeth to jam the flywheel. **Note:** *Don't turn the crankshaft with the flywheel/driveplate removed, or you'll lose the alignment of flywheel to crankshaft. If you must turn the crankshaft (or if you're going to remove it), punch alignment marks on the flywheel and the rear end of the crankshaft near one of the bolt holes after removing the flywheel. This will allow the flywheel/driveplate to be realigned with the crankshaft.*

5 Remove the flywheel/driveplate from the crankshaft. On the automatic transaxle models, also remove the driveplate backing plate and adapter, taking note which sides of the driveplate the adapter plates are mounted on for correct reinstallation later. Since the flywheel is fairly heavy, be sure to support it while removing the last bolt. **Warning:** *The ring gear teeth may be sharp, wear gloves to protect your hands.*

6 Clean the flywheel to remove grease and oil. Inspect the surface for cracks, rivet grooves, burned areas and score marks. Light scoring can be removed with emery cloth. Check for cracked and broken ring gear teeth. Lay the flywheel on a flat surface and use a straightedge to check for warpage. If necessary, take the flywheel to an automotive machine shop to have it resurfaced.

7 Clean and inspect the mating surfaces of the flywheel/driveplate and the crankshaft. If the crankshaft rear seal is leaking, replace it before reinstalling the flywheel/driveplate (see Section 15).

Installation

8 Remove any thread sealant from the crankshaft flywheel bolt holes and bolts. **Caution:** *If all the thread sealant can't be removed from a bolt, replace that bolt. Do not apply new sealant when installing a new bolt.*

9 For manual transaxle vehicles, position the flywheel at the crankshaft. For automatic transaxle vehicles, position the adapter, driveplate, and backing plate at the crankshaft. Be sure to align the marks made during removal. Before installing the bolts, apply thread sealant to the threads of any reused bolts, but not to new bolts (they are precoated).

10 Wedge a screwdriver in the ring gear teeth to keep the flywheel/driveplate from turning as you tighten the bolts to the torque listed in this Chapter's Specifications. Follow a criss-cross pattern and work up to the final torque in three or four steps.

11 The remainder of installation is the reverse of the removal procedure.

15 Rear main oil seal - replacement

Refer to illustrations 15.5 and 15.6

1 The transaxle must be removed from the vehicle for this procedure (see Chapter 7).

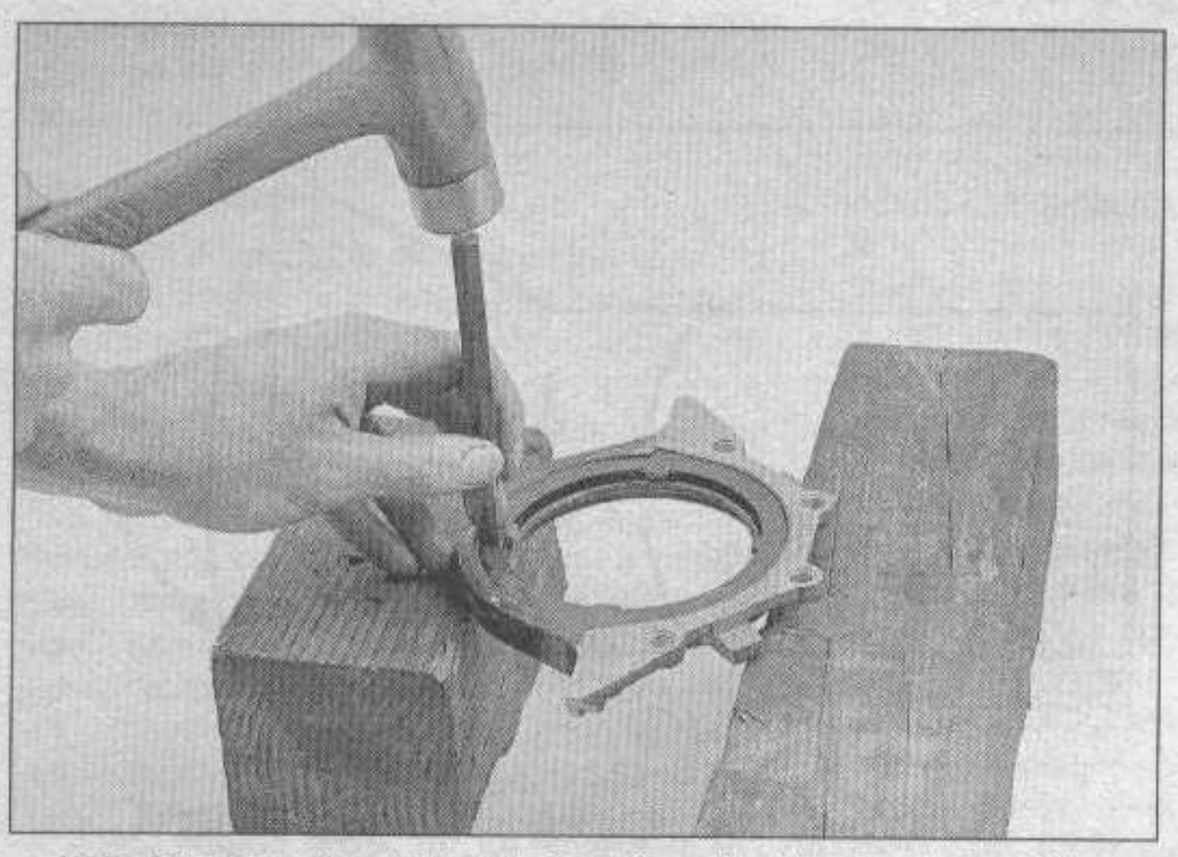
2 Remove the flywheel/driveplate (see Section 14).

3 The oil seal can be removed by prying the seal out with a screwdriver or seal removal tool, or by removing the seal retainer plate. There is less potential damage to the crankshaft sealing surface with the latter method.

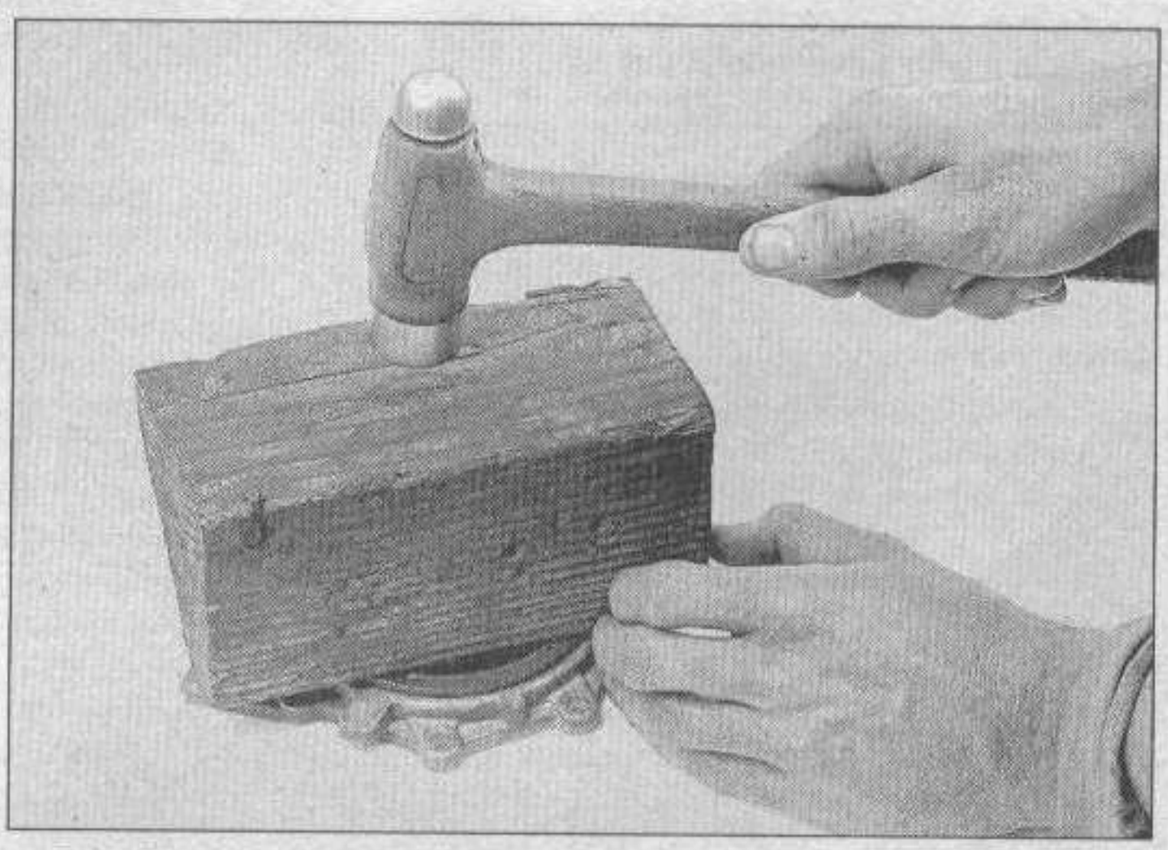
4 Unbolt the seal retainer plate, noting that there are two bolts that come up into the plate from below, through the block reinforcement.

5 Remove the plate and support it on wood blocks. Note the depth of the old seal, then drive the old seal out with a punch and hammer **(see illustration)**.

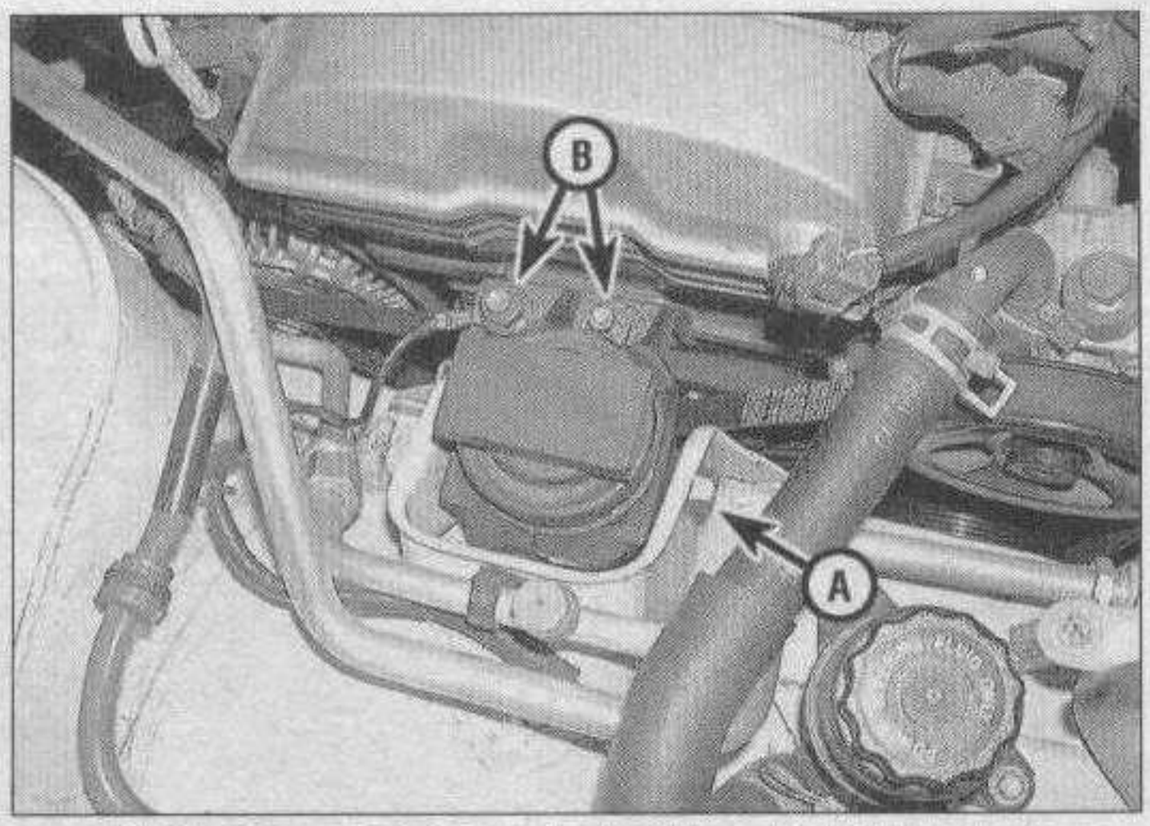
6 Clean the seal bore in the plate with lacquer thinner. Lay the plate on a hard, flat surface and tap the seal into the bore of the plate, using a block of wood and a hammer **(see illustration)**.



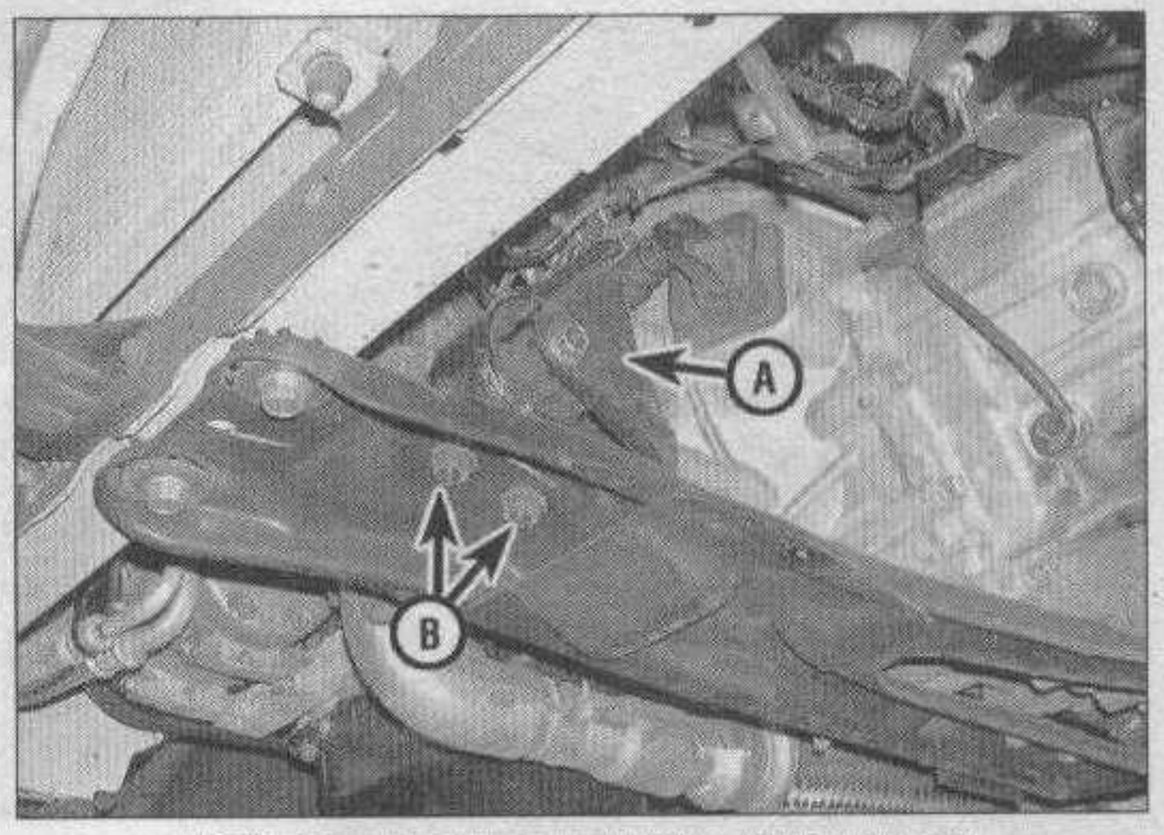
15.5 After removing the retainer from the block, support it on wood blocks and drive out the old seal with a punch or screwdriver and hammer



15.6 With the oil seal lips facing the correct direction as when removed, press the oil seal partially into place by hand. Using a large block of wood, tap the seal into the bore until it is flush with the face of the seal retainer - the seal lip is stiff and can be easily damaged during installation if you're not careful



16.8 Remove the throughbolt (A) from the right mount, then remove the nuts (B) and the insulator



16.10 Front engine mount throughbolt (A) and insulator mounting nuts (B)

7 Apply a new gasket or a bead of RTV sealant to the block side of the plate. Apply clean engine oil to the lip of the seal and install the plate. Work it slowly onto the crankshaft to keep the seal edge from rolling, then tighten the bolts evenly to the torque listed in this Chapter's Specifications.

16 Engine mounts - check and replacement

Check

1 During the check, the engine must be raised slightly to remove the weight from the mounts.

2 Raise the vehicle and support it securely on jackstands, then position a jack under the engine oil pan. Place a large block of wood between the jack head and the oil pan, then carefully raise the engine just enough to take the weight off the mounts. **Warning:** *DO NOT place any part of your body under the engine when it's supported only by a jack!*

3 Check the mounts to see if the rubber is cracked, hardened or separated from the metal plates. Sometimes the rubber will split right down the center.

4 Check for relative movement between the mount plates and the engine or frame (use a large screwdriver or prybar to attempt to move the mounts). If movement is noted, lower the engine and tighten the mount fasteners.

5 Rubber preservative should be applied to the mounts to slow deterioration.

6 Disconnect the negative battery cable from the battery, then set the parking brake, block the rear wheels, raise the front of the vehicle and support it securely on jackstands (if not already done). **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

Replacement

Right (passenger-side) mount

Refer to illustration 16.8

7 The mount supporting the timing-belt end of the powertrain is attached to the chassis, and to a bracket mounted to the block. Perform the procedures of Step 6, then use an engine support fixture attached to the engine lifting eyes from above or floorjack under the oil pan to take the weight from the mount. Use a block of wood on the jack to protect the oil pan.

8 Remove the throughbolt from the mount, then the mount-to-chassis bolts and remove the rubber insulator **(see illustration)**.

9 Installation is the reverse of removal. **Note:** *Tighten the bolts to Specifications only after the powertrain weight is back onto the mounts and the jack is removed. If more than one mount has been replaced, see Final tightening below.*

Front mount

Refer to illustration 16.10

10 The front mount is located between the engine and radiator **(see illustration)**.

11 Perform Steps 7 through 9 to remove the front mount.

12 Installation is the reverse of removal. **Note:** *Tighten the bolts to Specifications only after the powertrain weight is back onto the mounts and the jack is removed. If more than one mount has been replaced, see Final tightening below.*

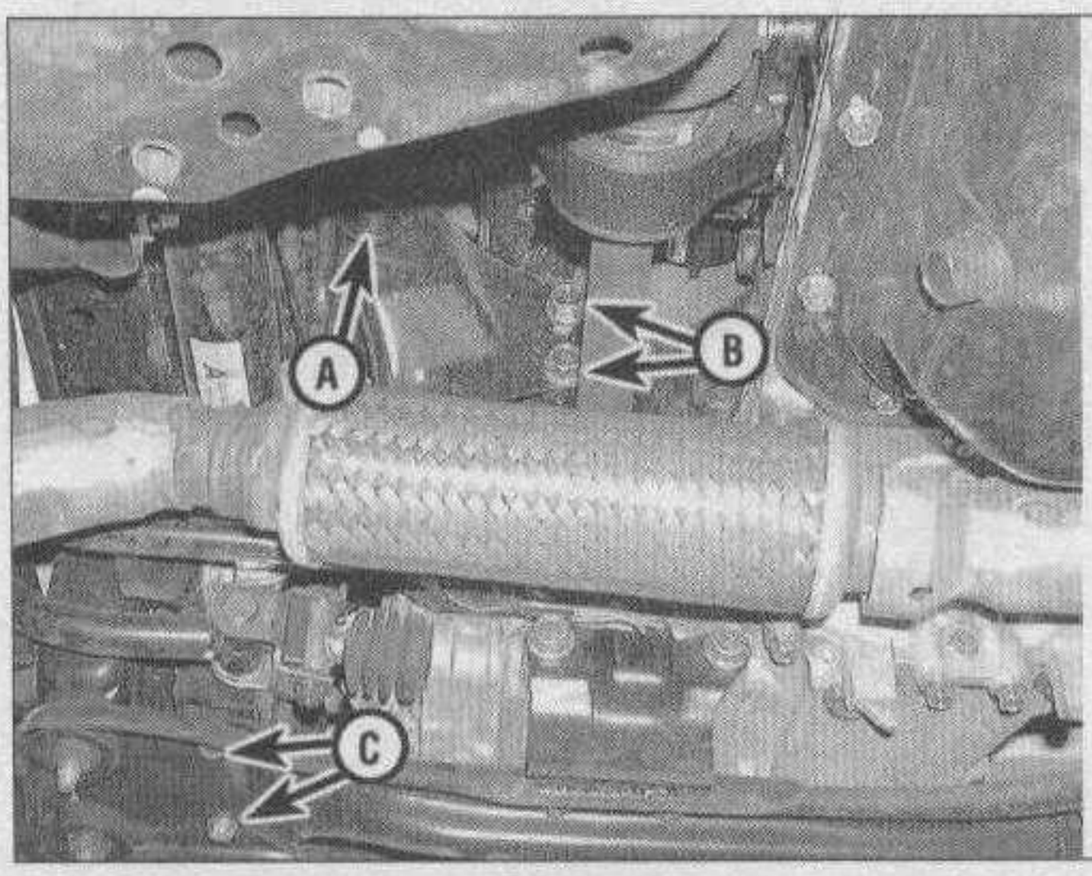
Rear mount

Refer to illustration 16.14

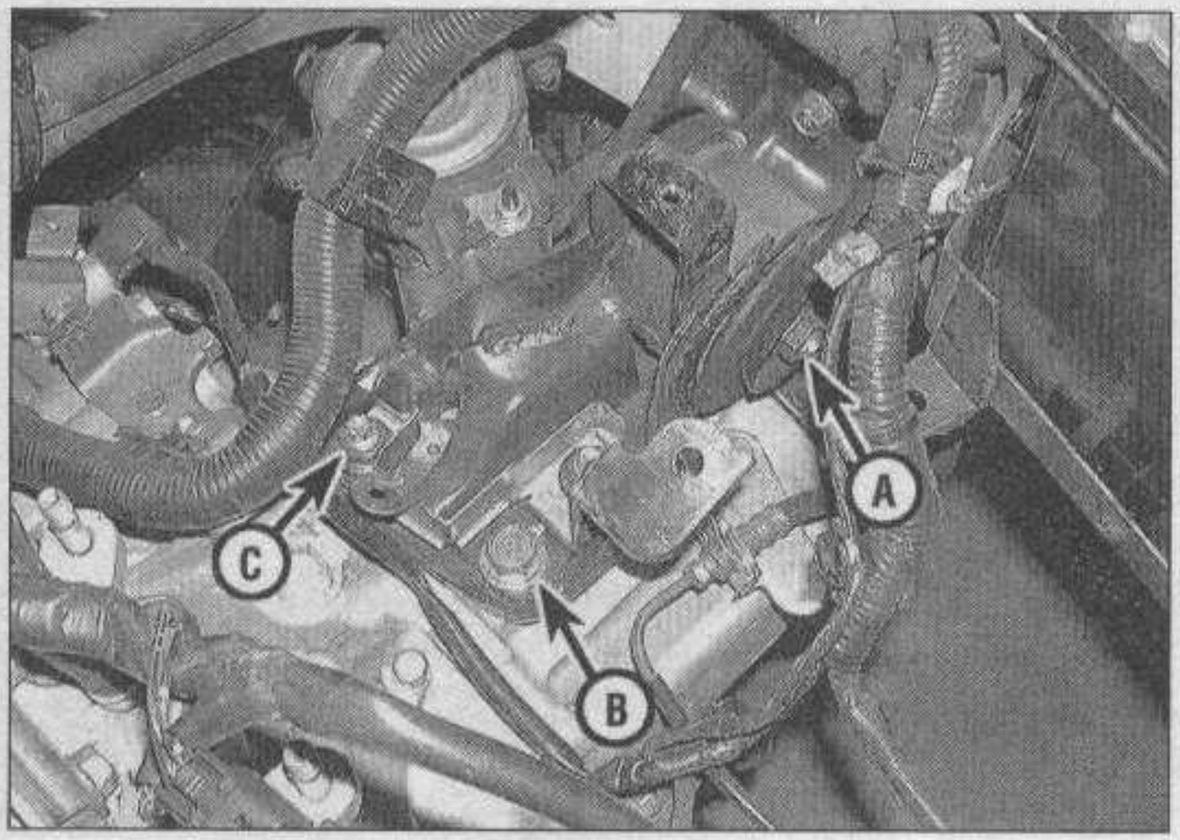
13 Unless the intake manifold is removed, access to this mount is tight and only from the bottom. Loosen the throughbolt and raise the engine enough to take the weight off the rear mount.

14 Remove the nuts holding the mount to the crossmember, remove the throughbolt, and raise the engine enough to pull out the mount **(see illustration)**.

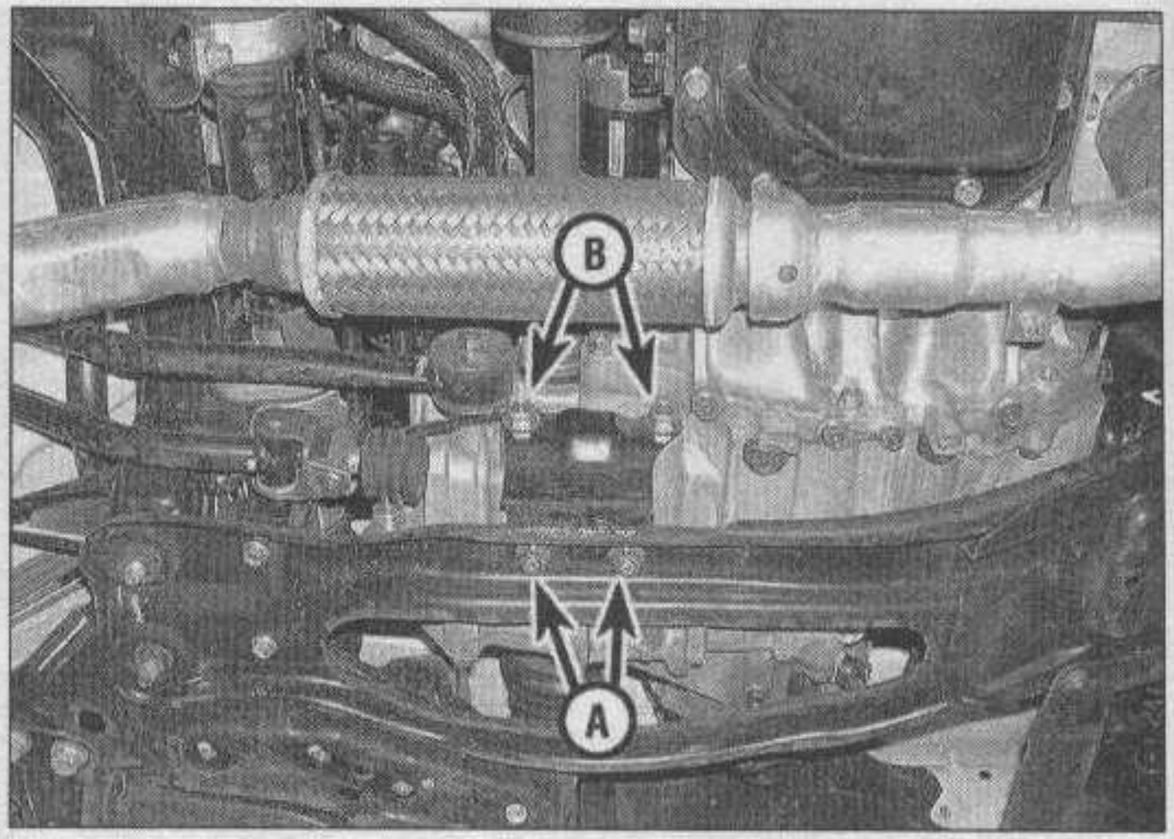
15 Installation is the reverse of removal. **Note:** *Tighten the bolts to Specifications only after the powertrain weight is back onto the mounts and the jack is removed. If more than one mount has been replaced, see Final tightening below.*



16.14 Models equipped with a manual transaxle have two rear mounts; remove the throughbolt (A) and bracket bolts (B) on the chassis-mount - remove the throughbolt (not seen here) and two nuts (C) on the crossmember-mount (used on both automatic and manual transaxles)



16.16 At the top of the transaxle, remove the left mount throughbolt (A) and the bolt (B) and nut (C) at the transaxle to remove the insulator



16.19 On the lower mount, remove the two nuts (A) at the crossmember, then the two bolts at the transaxle (B)

Left (driver's-side) mounts

Refer to illustrations 16.16 and 16.19

Top mount

16 The driver's-side mount is attached to the chassis and transaxle at the top of the transaxle **(see illustration)**.

17 With the engine supported, remove the throughbolt, then remove the bolt and nut on top of the transaxle and pull the mount out of its bracket.

18 Installation is the reverse of removal.

Note: *Tighten the bolts to Specifications only after the powertrain weight is back onto the mounts and the jack is removed. If more than one mount has been replaced, see Final tightening below.*

Bottom mount

19 The bottom mount connects the transaxle to the longitudinal crossmember under the powertrain **(see illustration)**.

20 With the powertrain supported, remove the two bolts from the transaxle and the two nuts from the crossmember.

Final tightening, all mounts

21 To ensure maximum bushing life and prevent excessive noise and vibration, the vehicle should be level and the engine weight should be on the mounts during the final tightening stage. **Note:** *Use thread locking compound on the nuts/bolts.* Ensure that the bushings are not twisted or offset. All bolts should be started and hand-tightened before any are torqued to Specifcations.

Chapter 2 Part B
V6 engine

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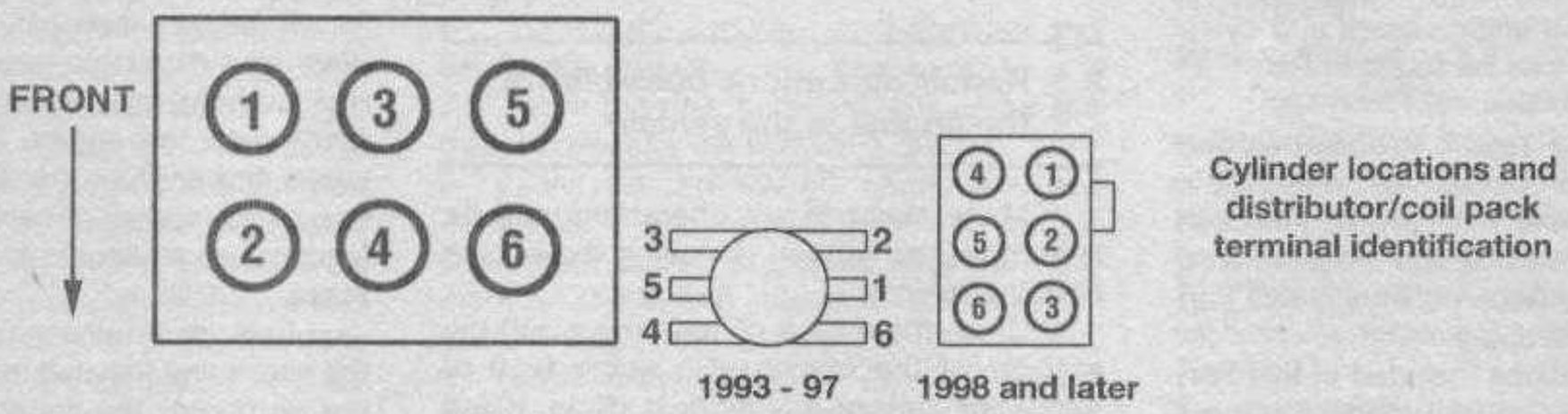
Specifications

General

Bore	3.33 inches
Stroke	2.92 inches
Displacement	152.2 cubic inches (2.5 liters)
Cylinder numbers (timing belt end-to-transaxle end)	
Rear bank	1-3-5
Front bank	2-4-6
Firing order	1-2-3-4-5-6



Cylinder locations and distributor/coil pack terminal identification

Oil pump

Driven rotor-to-pump body clearance	0.0087 inch maximum
Rotor tip clearance	0.0078 inch maximum
Clearance over rotors	0.0051 inch maximum
Relief spring length	1.842 inches

Torque specifications

	Ft-lbs (unless otherwise indicated)
Air conditioning compressor bracket mounting bolts	28 to 38
Intake manifold bolts/nuts	14 to 18
Exhaust manifold bolts/nuts	14 to 18
Exhaust manifold heat shield bolts	71 to 88 in-lbs
Crankshaft damper bolt	116 to 122
Timing belt cover bolts	71 to 88 in-lbs
Idler pulley bolts	28 to 38
Timing belt tensioner bolt	27 to 32
Timing belt tensioner arm bolts	14 to 18
Camshaft sprocket bolts	90 to 103
Camshaft bearing cap bolts	98 to 123 in-lbs
Cylinder head bolts	
Step 1	17 to 19
Step 2	Tighten an additional 90-degrees
Step 3	Tighten an additional 90-degrees
Oil pan bolts	
Long bolts	14 to 18
Short bolts	71 to 88 in-lbs
Oil pan baffle mounting bolts	14 to 18
Oil pump mounting bolts	14 to 18
Oil pick-up tube mounting bolts	71 to 88 in-lbs
Flywheel/driveplate bolts*	45 to 49
Valve cover nuts	45 to 70 in-lbs
Engine mounts*	
Right mount	
Insulator-to-chassis nuts	54 to 76
Throughbolt	50 to 68
Front mount	
Insulator-to-crossmember nuts	55 to 77
Throughbolt	63 to 86
Rear mount	
Insulator-to-crossmember nuts	50 to 68
Throughbolt	63 to 86
Left mount	
Insulator-to-transaxle nuts	50 to 68
Throughbolt	50 to 68
Bottom mount	
Mount to crossmember nuts	32 to 44
Mount to transaxle bolts	41 to 59

** Apply thread-locking compound to the threads prior to installation*

1 General information

This Part of Chapter 2 is devoted to in-vehicle repair procedures for the V6 engine. All information concerning engine removal and installation and engine block and cylinder head overhaul can be found in Part C of this Chapter.

The following repair procedures are based on the assumption that the engine is installed in the vehicle. If the engine has been removed from the vehicle and mounted on a stand, many of the steps outlined in this Part of Chapter 2 will not apply.

The Specifications included in this Part of Chapter 2 apply only to the procedures contained in this Part. Part C of Chapter 2 contains the Specifications necessary for cylinder head and engine block rebuilding.

Caution: *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery in any of the following procedures.*

2 Repair operations possible with the engine in the vehicle

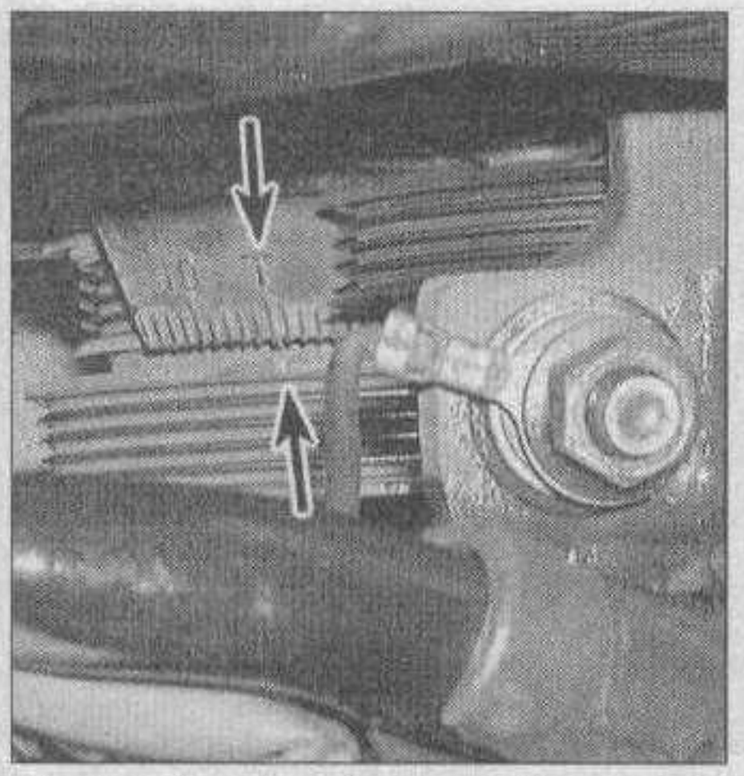
Many major repair operations can be accomplished without removing the engine from the vehicle.

Clean the engine compartment and the exterior of the engine with some type of degreaser before any work is done. It will make the job easier and help keep dirt out of the internal areas of the engine.

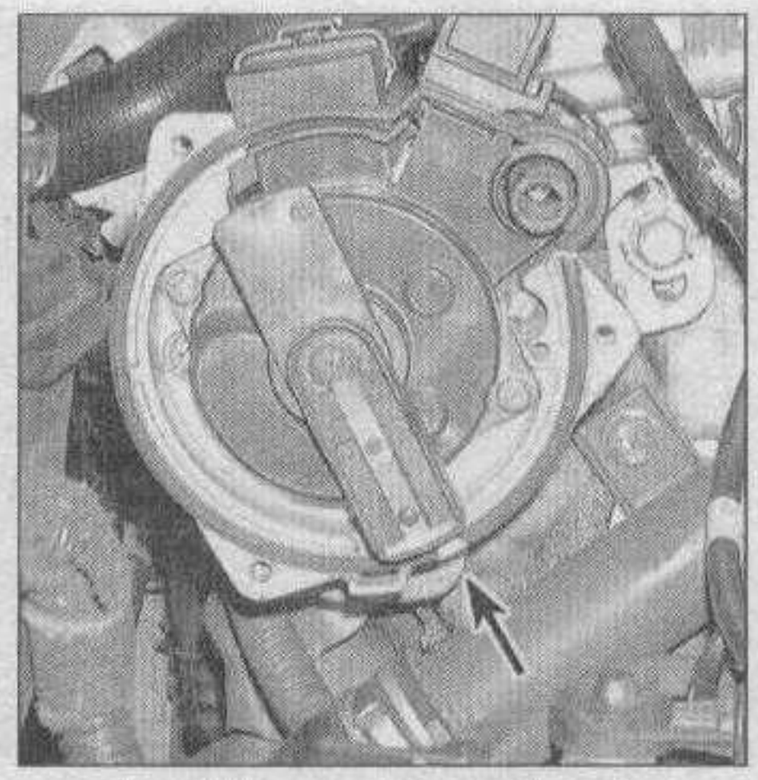
Depending on the components involved, it may be helpful to remove the hood to improve access to the engine as repairs are performed (refer to Chapter 11 if necessary). Cover the fenders to prevent damage to the paint. Special pads are available, but an old bedspread or blanket will also work.

If vacuum, exhaust, oil or coolant leaks develop, indicating a need for gasket or seal replacement, the repairs can generally be made with the engine in the vehicle. The intake and exhaust manifold gaskets, oil pan gasket, crankshaft oil seals and cylinder head gaskets are all accessible with the engine in place.

Exterior engine components, such as the intake and exhaust manifolds, the oil pan, the oil pump, the water pump, the starter motor, the alternator, and the fuel system components can be removed for repair with the engine in place.



3.8 Turn the crankshaft until the notch in the pulley aligns with the TDC mark (arrows) on the timing indicator



3.9 Make a mark (arrow) on the distributor body directly under the number 1 plug wire terminal - when the rotor aligns with this mark and the timing marks on the pulley align, the engine is at TDC for number 1

Since the cylinder heads can be removed without pulling the engine, valve component servicing can also be accomplished with the engine in the vehicle. Replacement of the camshafts, timing belt and sprockets is also possible with the engine in the vehicle.

In extreme cases caused by a lack of necessary equipment, repair or replacement of piston rings, pistons, connecting rods and rod bearings is possible with the engine in the vehicle. However, this practice is not recommended because of the cleaning and preparation work that must be done to the components involved.

3 Top Dead Center (TDC) for number one piston - locating

Note: *The following procedure is based on the assumption that the spark plug wires and distributor are correctly installed. If you are trying to locate TDC to install the distributor correctly, piston position must be determined by the method described for (distributorless) 1998 and later models.*

Refer to illustrations 3.8 and 3.9

1 Top Dead Center (TDC) is the highest point in the cylinder that each piston reaches traveling up-and-down as the crankshaft turns. Each piston reaches TDC on the compression stroke and again on the exhaust stroke, but TDC generally refers to piston position on the compression stroke.

2 Positioning the piston(s) at TDC is an essential part of many procedures such as camshaft and timing belt/sprocket removal.

3 Before beginning this procedure, be sure to place the transmission in Neutral and apply the parking brake or block the rear wheels. Also, disable the ignition system by detaching the primary (low voltage) wires from the ignition coil (see Chapter 5). Remove the spark plugs (see Chapter 1).

4 In order to bring any piston to TDC, the crankshaft must be turned using one of the methods outlined below. When looking at the front of the engine, normal crankshaft rotation is clockwise.

a) *The preferred method is to turn the crankshaft with a socket and ratchet attached to the bolt threaded into the front of the crankshaft.*
b) *A remote starter switch, which may save some time, can also be used. Follow the instructions included with the switch. Once the piston is close to TDC, use a socket and ratchet as described in the previous paragraph.*
c) *If an assistant is available to turn the ignition switch to the Start position in short bursts, you can get the piston close to TDC without a remote starter switch. Make sure your assistant is out of the vehicle, away from the ignition switch, then use a socket and ratchet as described in Paragraph a) to complete the procedure.*

1997 and earlier models

5 Note the position of the terminal for the number one spark plug wire on the distributor cap. If the terminal isn't marked, follow the plug wire from the number one cylinder spark plug to the cap.

6 Detach the cap from the distributor and set it aside (see Chapter 1 if necessary).

7 Mark the distributor directly under the rotor terminal for the number 1 cylinder.

8 Turn the crankshaft clockwise (see Paragraph 3 above) until the notch on the crankshaft pulley is aligned with the TDC mark on the timing indicator **(see illustration)**.

9 Look at the distributor rotor - it should be pointing directly at the mark you made on the distributor body **(see illustration)**. If the rotor is pointing at the mark, the engine is at TDC for number 1. If it isn't, go to Step 10.

10 If the rotor is 180-degrees off, the number one piston is at TDC on the exhaust stroke.

11 To get the piston to TDC on the compression stroke, turn the crankshaft one complete turn (360-degrees) clockwise. The rotor should now be pointing at the mark on the distributor. When the rotor is pointing at the number one spark plug wire terminal in the distributor cap and the crankshaft pulley timing marks are aligned, the number one piston is at TDC on the compression stroke.

1998 and later models

12 1998 and later models are equipped with a distributorless ignition system (see Chapter 5). To locate TDC, remove the no. 1 cylinder spark plug and install a compression gauge in the no. 1 spark plug hole (see the cylinder numbering diagram at the beginning of this Chapter).

13 Rotate the crankshaft (see Step 4 above). As the no. 1 piston nears TDC on the compression stroke, compression pressure will be indicated on the gauge. Continue turning the crankshaft until the notch in the crankshaft sprocket is aligned with the TDC mark on the timing indicator **(see illustration 3.8)**. When compression is indicated, do not rotate the crankshaft any farther than necessary to align the marks.

14 It may require at least two complete revolutions of the crankshaft to bring the no. 1 piston up on the compression stroke. If compression pressure was not indicated on the gauge during the first revolution, continue rotating the crankshaft. When compression is indicated at the no. 1 cylinder and the marks are aligned, the no. 1 piston is at TDC.

All models

15 After the number one piston has been positioned at TDC on the compression stroke, TDC for any of the remaining pistons can be located by turning the crankshaft in 120-degree increments and following the firing order (i.e. 120-degrees of crankshaft rotation past no. 1 TDC will position no. 2 at TDC).

4 Valve covers - removal and installation

Removal

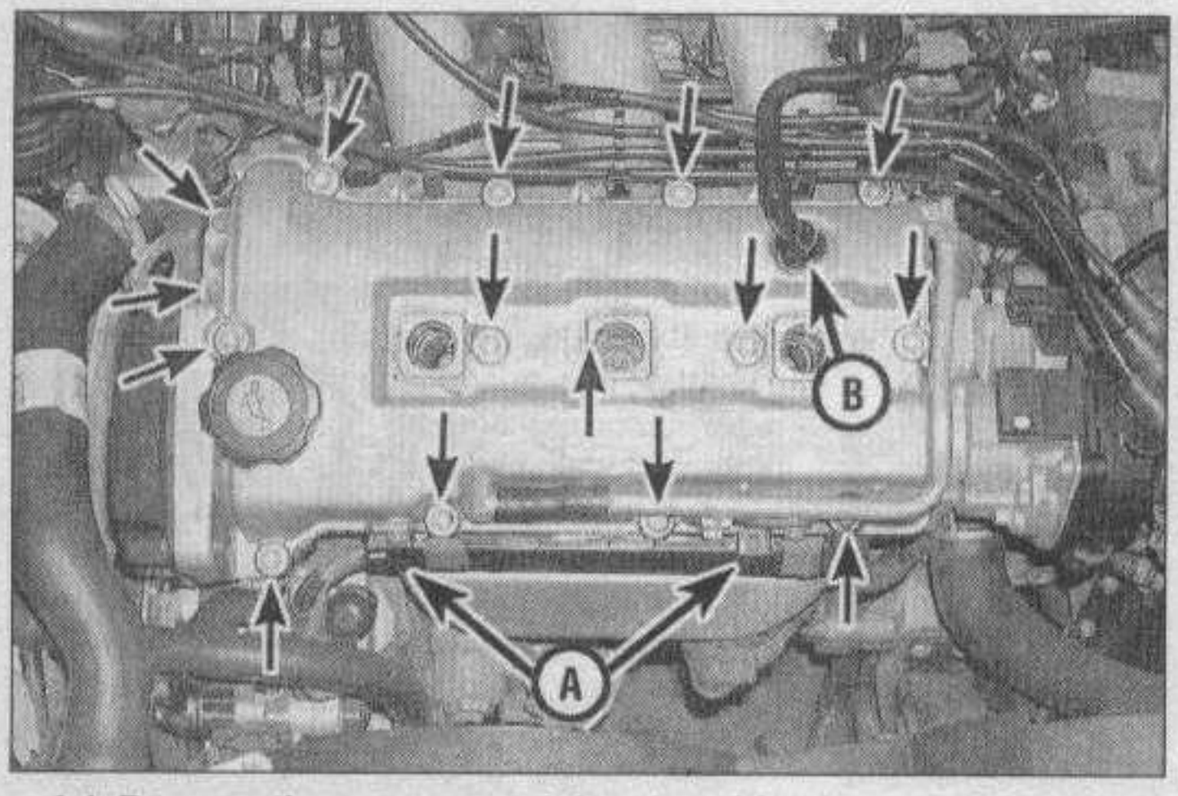
Refer to illustration 4.4

1 Disconnect the negative cable from the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

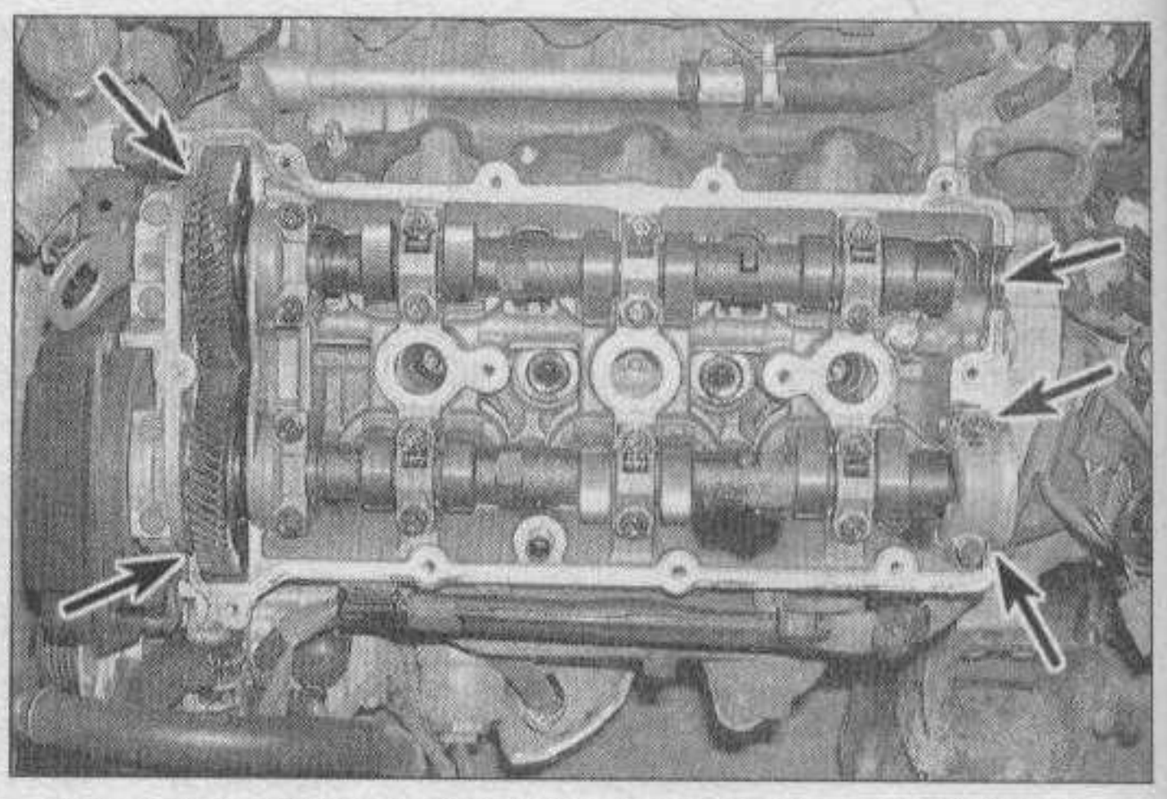
2 If you're removing the rear (firewall side) valve cover, remove the intake manifold (see Section 8).

3 Remove the spark plug wires and spark plugs from all cylinders.

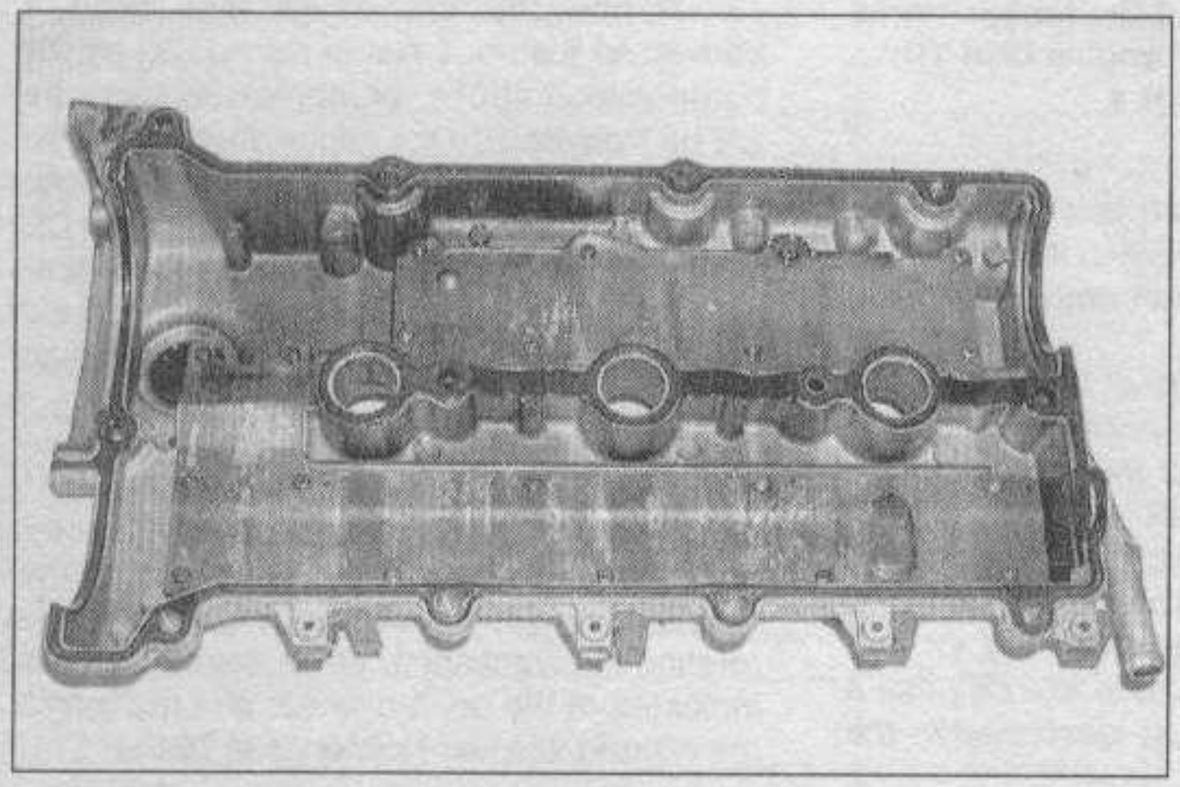
4 On the front valve cover, remove the bolt holding the PCV tube to the valve cover,



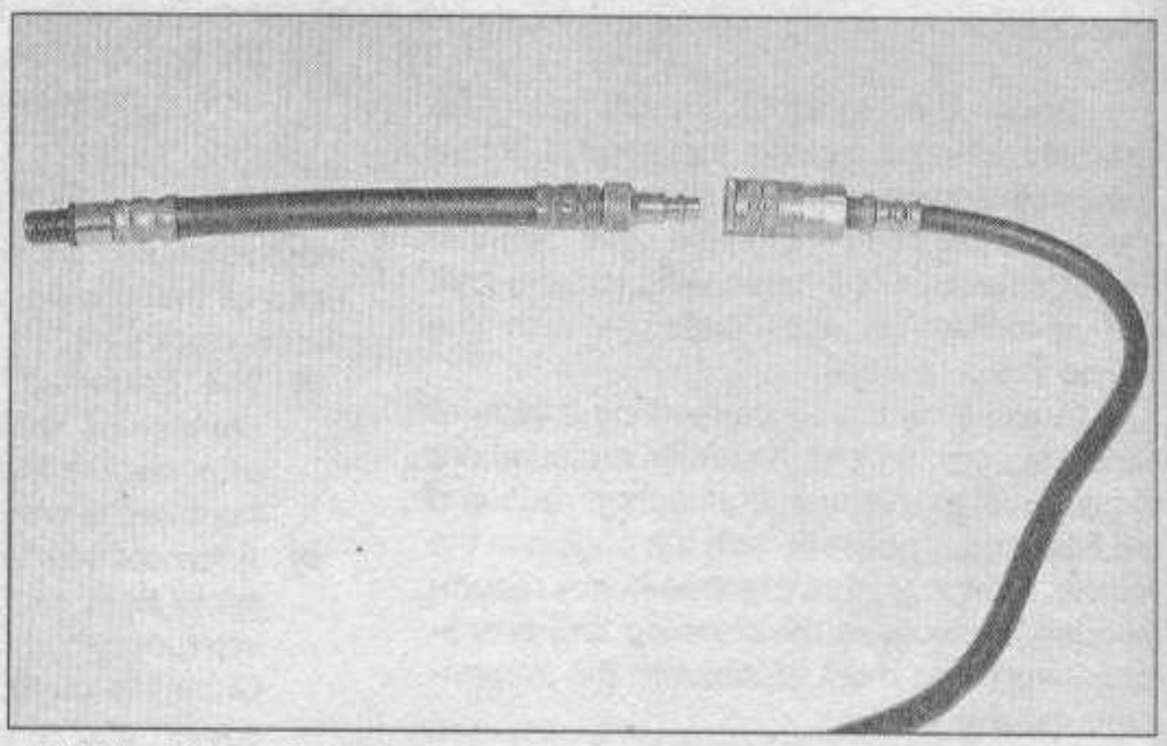
4.4 Remove the screws retaining the wiring harness (A) to the front valve cover, disconnect the PCV valve (B), remove the bolts (arrows) and sealing washers and remove the valve cover



4.8a Apply RTV sealant to the areas indicated (arrows) on the cylinder head



4.8b Press a new gasket firmly into the groove in the valve cover and install the valve cover



5.4 You'll need an air hose adapter long enough to reach down into the spark plug holes - they're commonly available at auto parts stores

or disconnect the rubber hose and leave the tube bolted to the cover **(see illustration)**.

5 Remove the upper two timing belt cover bolts at each valve cover.

6 Remove the retaining bolts and sealing washers, then detach the valve cover(s). If the cover is stuck to the head, bump the end with a wood block and a hammer to jar it loose. If that doesn't work, try to slip a flexible putty knife between the cylinder head and valve cover to break the seal. **Caution:** *Don't pry at the cover-to-head joint or damage to the sealing surfaces may occur, leading to oil leaks after the cover is reinstalled.*

Installation

Refer to illustrations 4.8a and 4.8b

7 The mating surfaces of the cylinder head and valve cover must be clean when the cover is installed. Use a gasket scraper to remove all traces of sealant and old gasket material, then clean the mating surfaces with lacquer thinner or acetone. If there's residue or oil on the mating surfaces when the cover is installed, oil leaks may develop.

8 Apply RTV sealant to the gasket/seal joints at the indicated areas and install the valve cover with a new gasket **(see illustrations)**.

9 Tighten the nuts to the torque listed in this Chapter's Specifications in three or four equal steps. Tighten the timing belt cover bolts after the valve cover bolts have been tightened.

10 Reinstall the remaining parts, run the engine and check for oil leaks.

5 Valve springs, retainers and seals - replacement

Refer to illustrations 5.4, 5.7, 5.8, 5.10 and 5.12

Note 1: *Broken valve springs and defective valve stem seals can be replaced without removing the cylinder head. Several 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.*

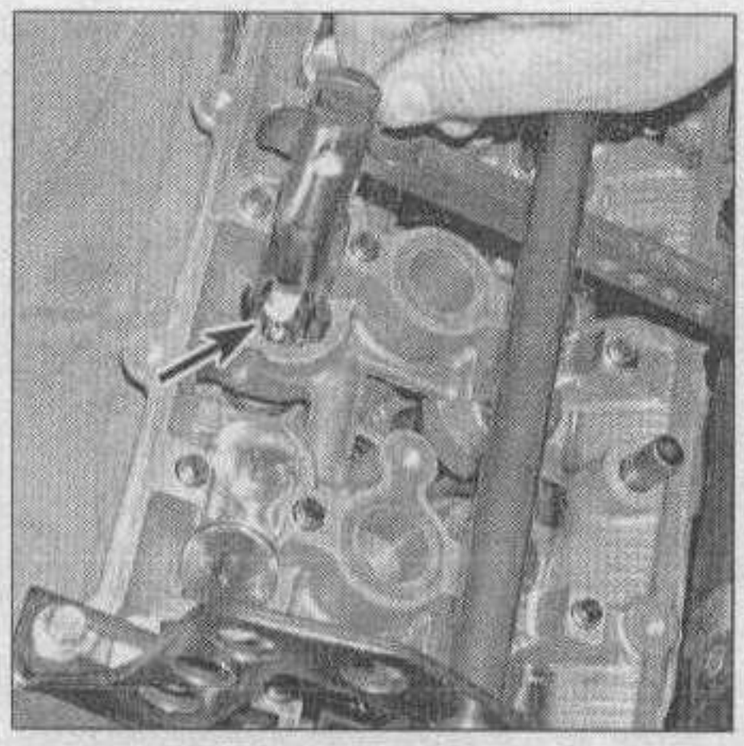
Note 2: *On 1998 and later models, check the valve clearance (see Chapter 1) before beginning this procedure. Any valves in need of adjustment can be corrected during this procedure.*

1 Refer to Section 7 and remove the camshaft(s). Remove the valve lifters from the defective valves. Store the lifters in an organized manner so they may be reinstalled in their original location.

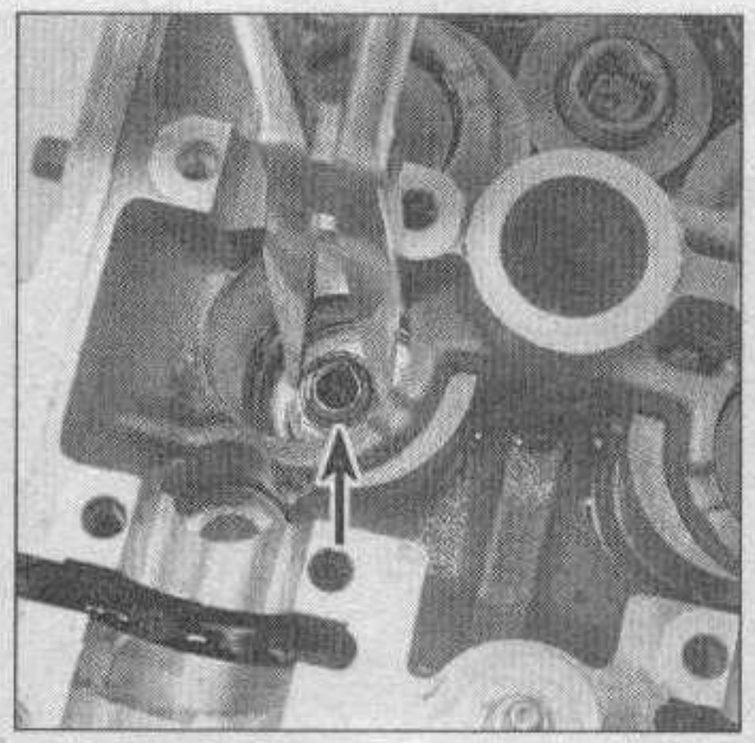
2 Remove the spark plug from the cylinder which has the defective component. If all of the valve stem seals are being replaced, all of the spark plugs should be removed.

3 Turn the crankshaft until the piston in the affected cylinder is at Top Dead Center (TDC) on the compression stroke (refer to Section 3). If you are 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).

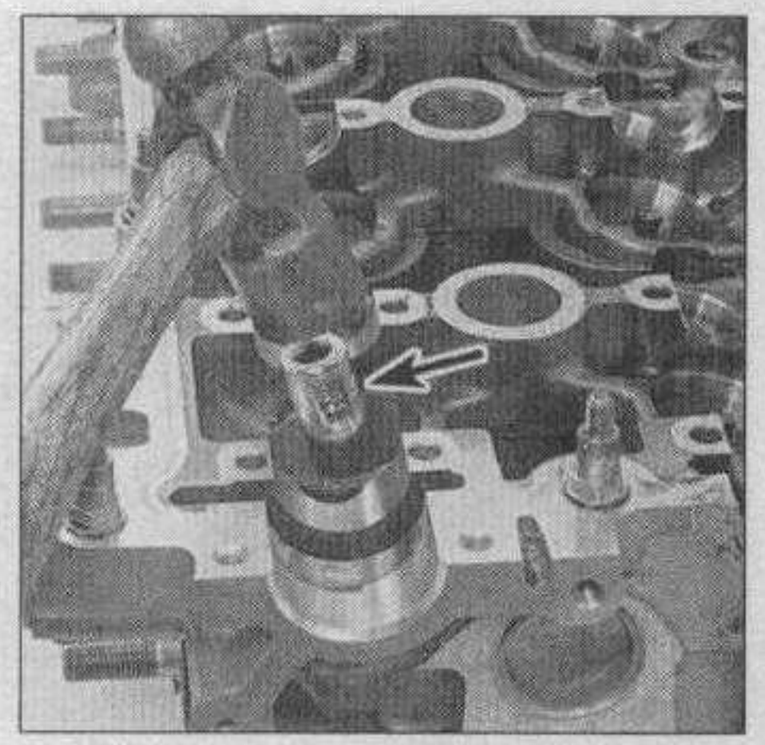
4 Thread a long adapter into the spark plug hole and connect an air hose from a compressed air source to it **(see illustration)**. Most auto parts stores can supply the air hose adapter. **Note:** *Because of the length of the spark plug holes, it will be necessary to*



5.7 A special valve spring compressor, that bolts to each end of the cylinder head, is needed to compress the springs - remove the valve stem locks (arrow) from the valve stem with a magnet or small needle-nose pliers



5.8 Remove the valve guide oil seal with an oil seal removal tool or a pair of pliers



5.10 Gently tap the seal into place with a hammer and a seal installer or deep socket

use a long spark plug adapter with a length of hose attached (as used on many cylinder compression gauges) utilizing a quick-disconnect fitting to hook to your air source.

5 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 pulley end, damage or injury could occur if the crankshaft moves.*

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

7 Stuff clean shop rags into any cylinder head holes around the valves to prevent parts and tools from falling into the engine, then use a valve spring compressor to compress the spring. Remove the valve stem locks with small needle-nose pliers or a magnet **(see illustration)**. **Note:** *A special valve spring compressor capable of compressing the valve springs with the cylinder head in place will be needed. Because the valves are recessed into the cylinder head, a special adapter is also necessary.*

8 Remove the spring retainer, valve spring and the lower spring seat. Measure and record the installed depth of the valve seal. Use needle-nose pliers to remove the old oil seal, twisting the seal around the valve guide until it loosens and can be withdrawn **(see illustration)**. **Note:** *If using air pressure fails to hold the valve in the closed position during this operation, the valve face and/or seat is probably damaged. If so, the cylinder head will have to be removed.*

9 Inspect the valve spring for cracks or damage and check that the free length is as listed in the Specifications for Chapter 2, Part C.

10 Lubricate the valve stem with engine oil and install a new oil seal using an oil seal installer tool or deep socket **(see illustration)**, measuring the installed depth as necessary. Install the oil seal to the same depth as the original.

11 Install the lower spring seat, then place the spring in position over the valve. Be sure the spring is installed with the end of the spring with the closely wound coils toward the cylinder head.

12 Install the valve spring retainer. Compress the valve spring and carefully position the valve stem locks in the groove. Apply a small dab of grease to the inside of each valve stem lock to hold it in place if necessary **(see illustration)**.

13 Remove the pressure from the spring tool and make sure the valve stem locks are seated.

14 Disconnect the compressed air hose and remove the adapter from the spark plug hole.

15 Refer to Section 7 and install the lifters and camshafts.

16 Install the remainder of the components in the reverse order of the removal procedure.

17 Start and run the engine, then check for oil leaks and unusual sounds coming from the valve cover area. **Note:** *On 1997 and earlier models, there may be some initial noise from the hydraulic lifters until full oiling is achieved.*

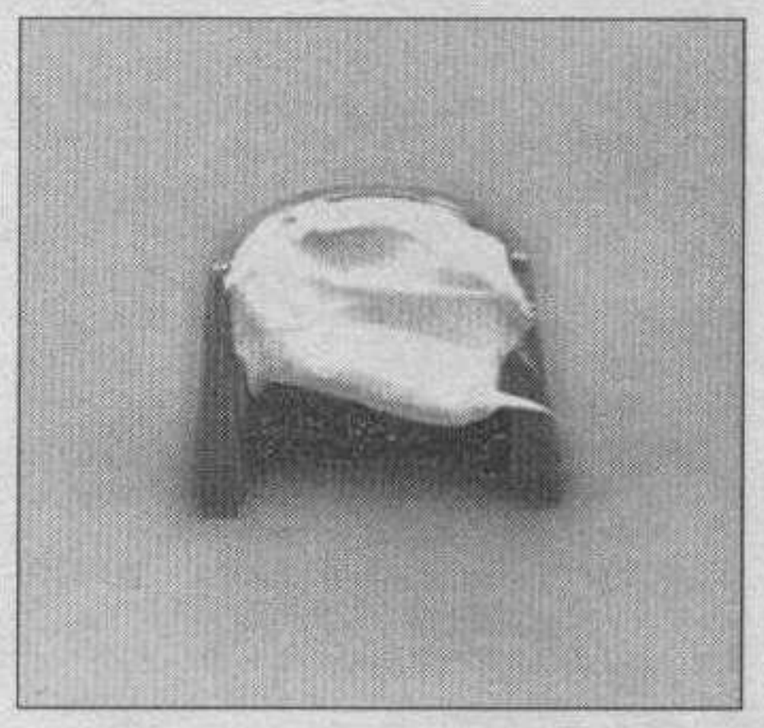
6 Timing belt and sprockets - removal, inspection and installation

Removal

Refer to illustrations 6.9, 6.13, 6.14a, 6.14b, 6.15, 6.16a, 6.16b, 6.16c, 6.17, 6.19, and 6.20

1 Disconnect the negative cable from the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Loosen the water pump pulley bolts, then remove the drivebelts from the alternator and power steering pump (see Chapter 1). Remove the water pump pulley (see Chapter 3).



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

3 Position the number one cylinder at TDC (see Section 3).

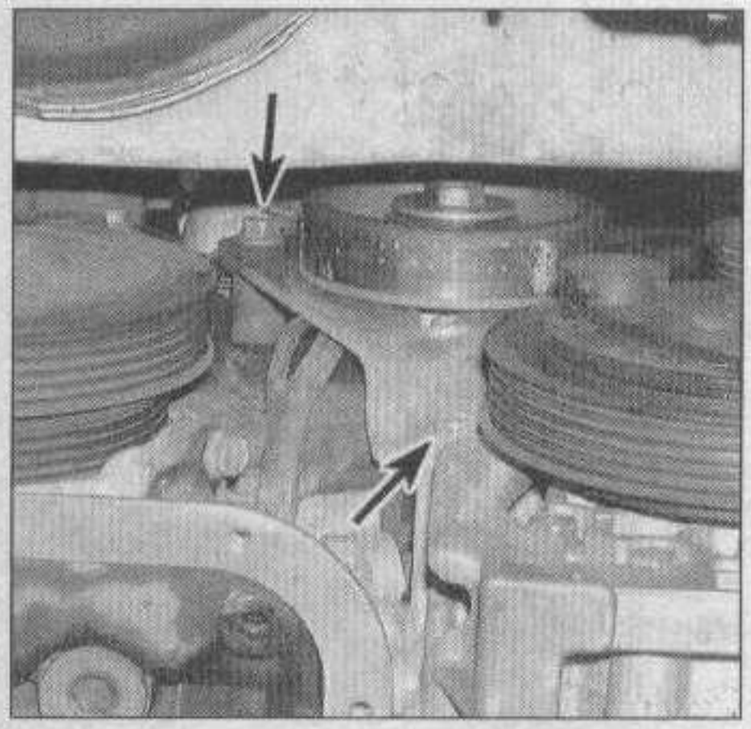
4 Loosen the lug nuts on the right front wheel, but don't remove them.

5 Apply the parking brake and block the rear wheels. Raise the front of the vehicle and support it securely on jackstands. Remove the right front wheel.

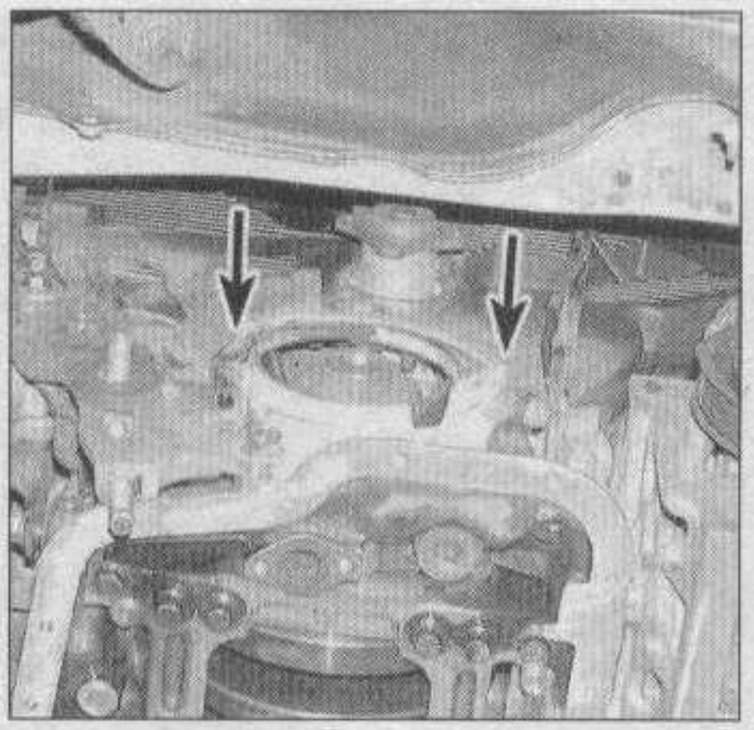
6 Remove the right front inner fender splash panel (see Chapter 11).

7 Support the engine with a jack from underneath. Use a wood block on the jack head to protect the oil pan and do not place the jack directly under the oil pan drain plug. Raise the engine just enough to support the weight and remove the right-hand engine mount (see Section 16). **Caution:** *The engine must remain supported during the remainder of this procedure. Use the proper equipment and make sure the engine is securely supported.*

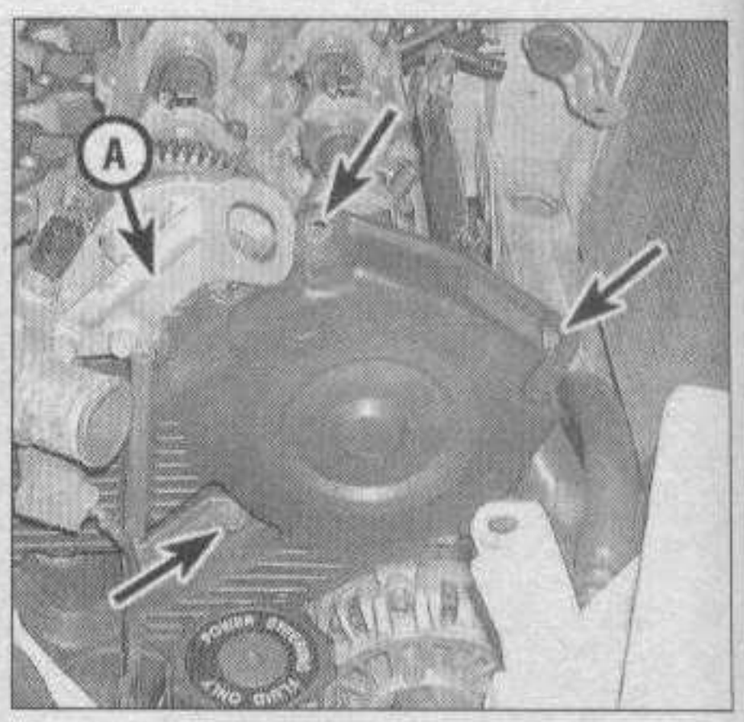
8 Remove the spark plugs (see Chapter 1).



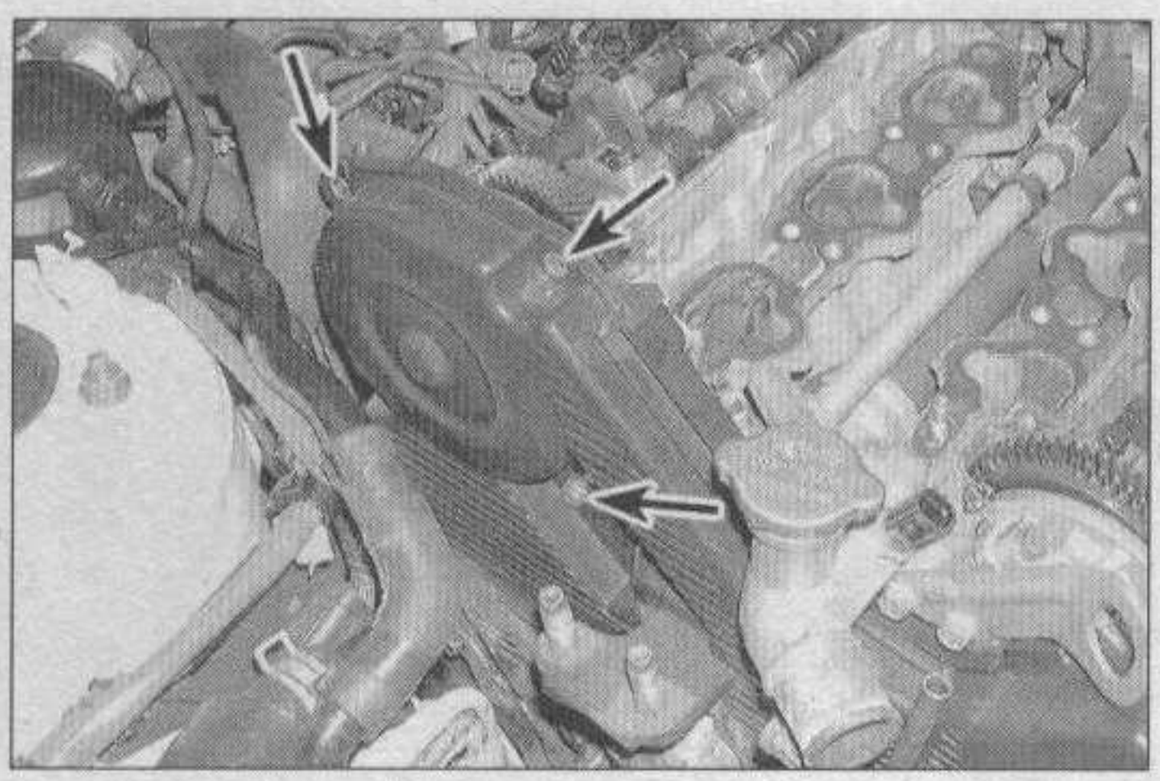
6.9 Remove the two bolts (arrows) and the drivebelt tensioner



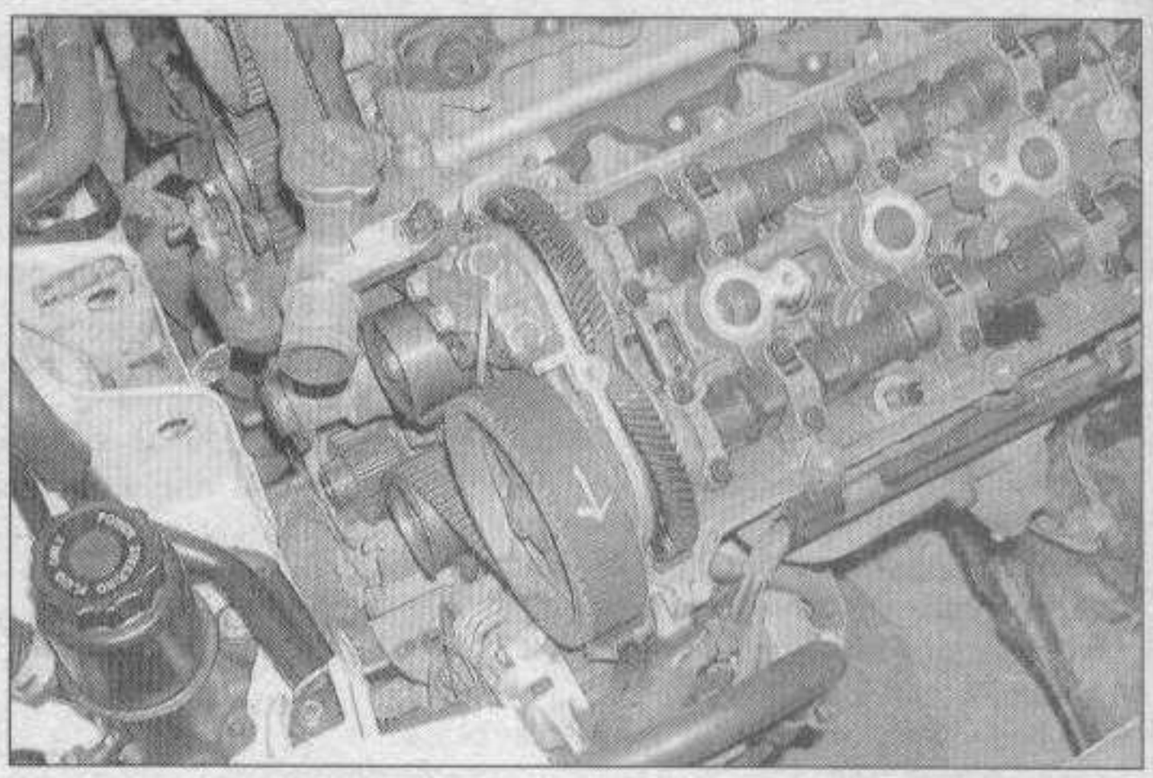
6.13 Remove the lower bolts (arrows) from the timing belt covers



6.14a At the front cylinder head, remove the engine lifting bracket (A) and the three timing belt cover bolts (arrows)



6.14b Remove the three upper bolts (arrows) and the timing belt cover



6.15 Mark the old timing belt if you are reusing it, and note the routing of the belt before removing it

9 Remove the two bolts from the drivebelt tensioner bracket and remove the tensioner **(see illustration)**.

10 Disconnect the following electrical connectors at the timing belt end of the engine: the crankshaft position sensor, temperature gauge sender and the two ECT sensor connectors. Label the connectors and position the wiring harness aside.

11 Refer to Section 11 and remove the crankshaft pulley.

12 Refer to Chapter 10 and remove the power steering pump pulley.

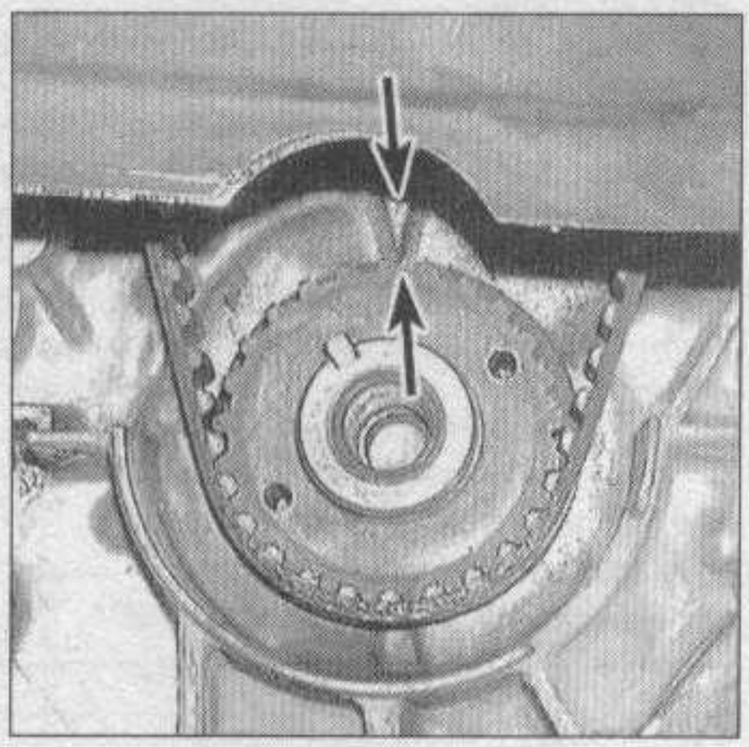
13 Remove the timing belt cover bolts accessible from underneath **(see illustration)**.

14 Remove the remainder of the bolts and the timing belt covers and gaskets **(see illustrations)**. Remove the engine oil dipstick tube.

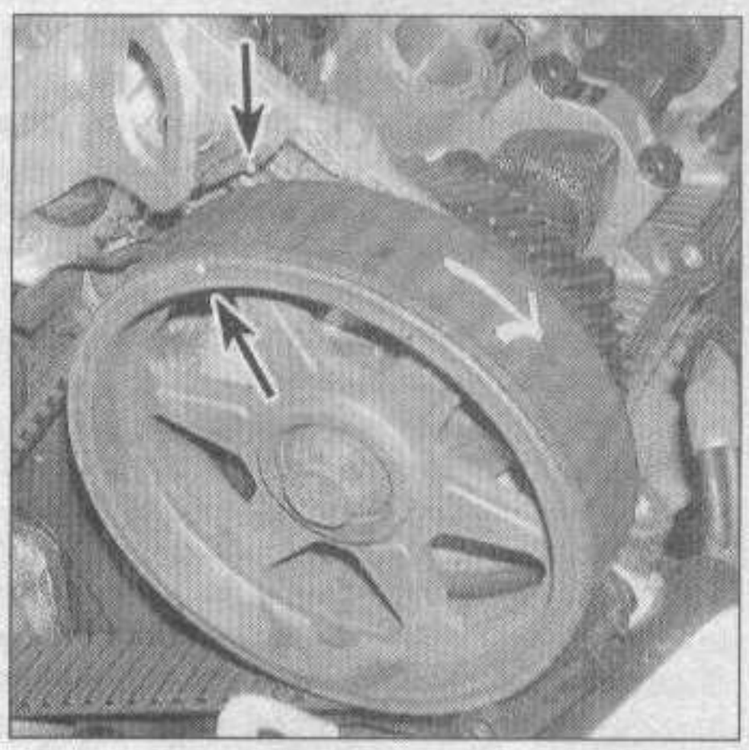
15 Check to see if there are installation marks on the timing belt - If you intend to reuse the belt and the marks have been obscured, make new ones **(see illustration)**.

16 Make sure the crankshaft and camshaft pulley timing marks are properly aligned **(see illustrations)**.

17 Remove the two bolts from the timing belt tensioner arm and remove the arm. Loosen the tensioner bolt **(see illustration)**. **Caution:** *Loosen the bolts a little at a time, and remove the lower bolt first, then the upper bolt.*



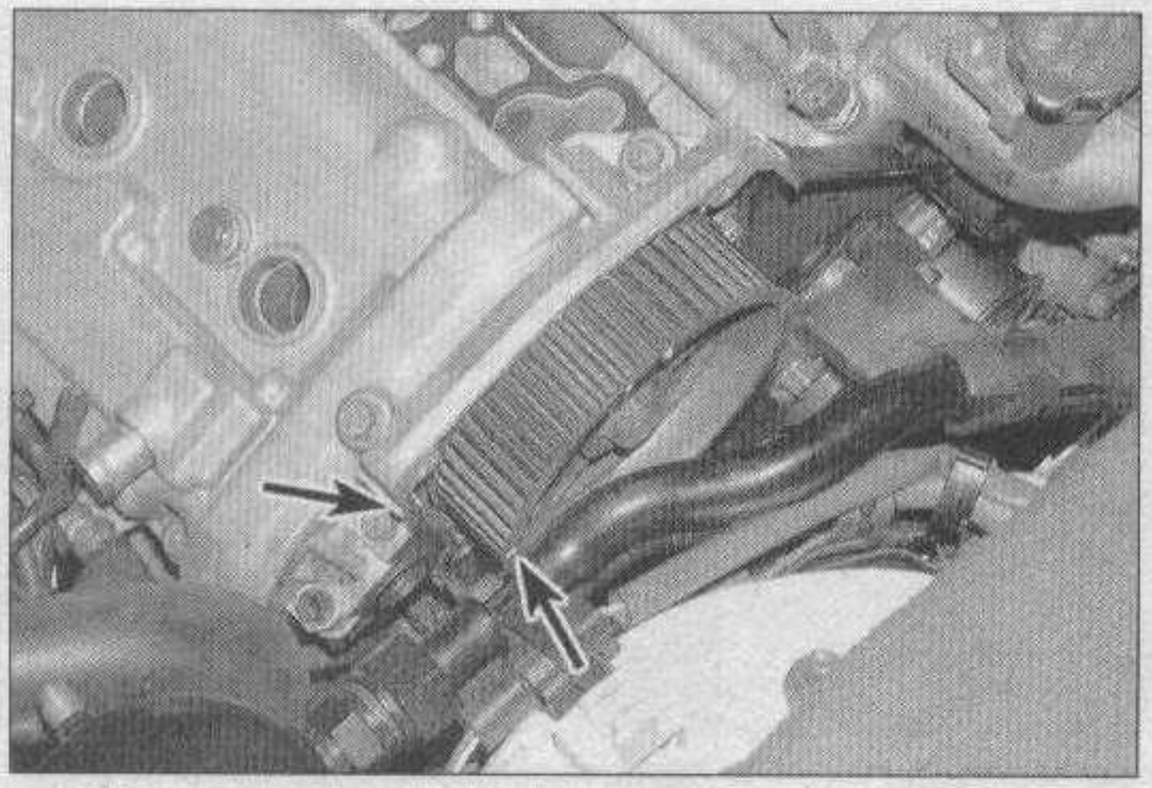
6.16a Crankshaft timing marks (arrows) at TDC



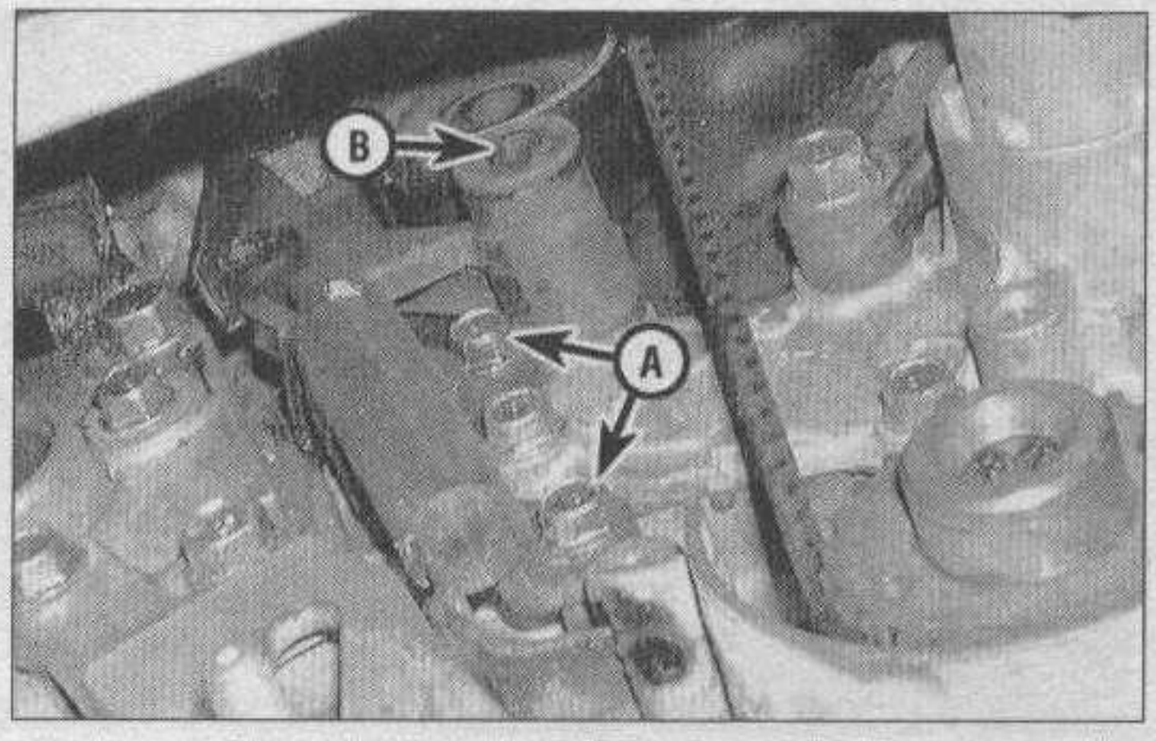
6.16b Camshaft timing marks (arrows) - front cylinder bank

18 Remove the timing belt from the crankshaft and camshaft sprockets.

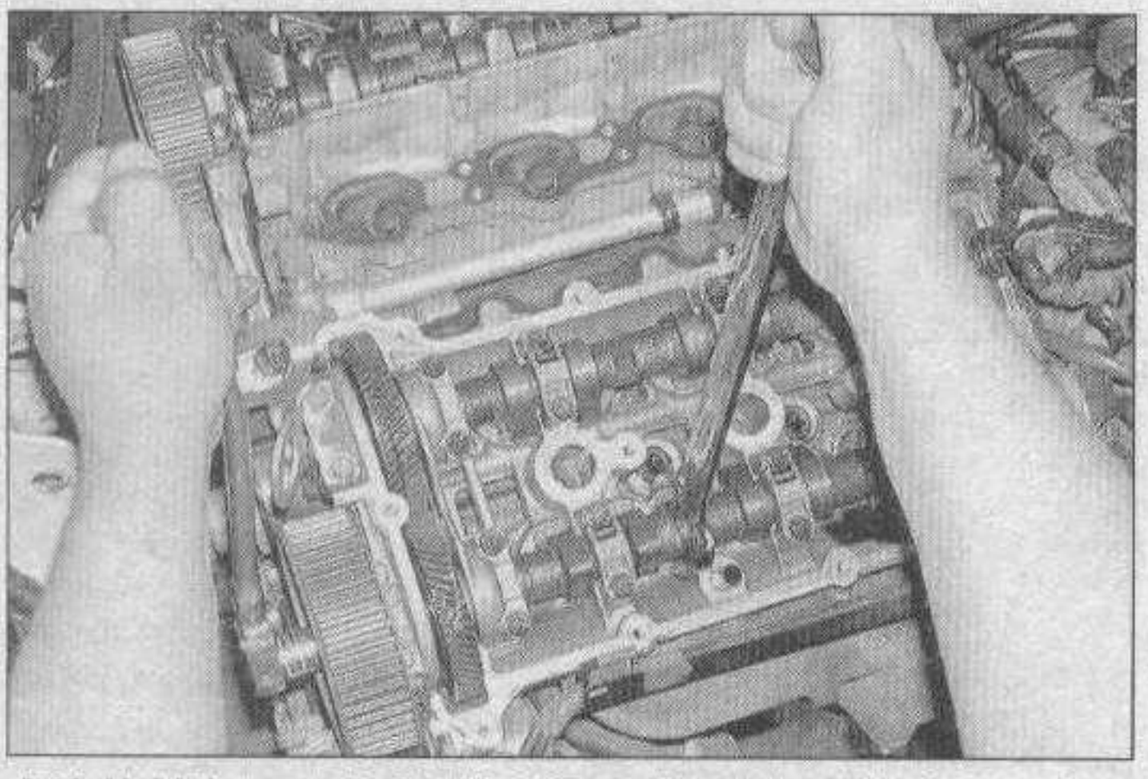
19 The camshaft sprockets can be removed at this point, if they are worn or damaged. Remove the valve cover(s) (see Section 4) and hold the camshaft with a wrench on the cast-in hex while loosening the sprocket bolt **(see illustration)**. Remove the bolt and detach the sprocket.



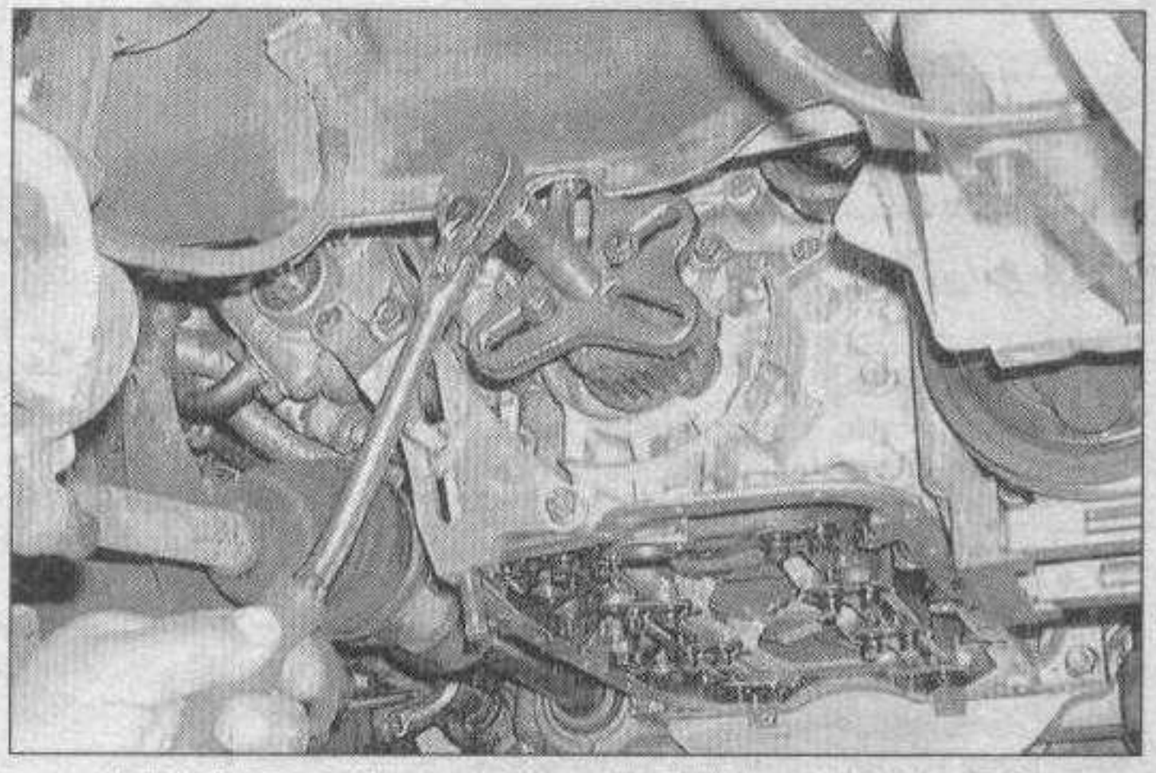
6.16c Camshaft timing marks (arrows) - rear cylinder bank



6.17 Remove the timing belt tensioner arm bolts (A), removing the lower bolt first - then loosen the tensioner bolt (B) with an Allen wrench



6.19 Hold the camshaft with a 27-mm wrench on the hex portion while loosening the camshaft sprocket bolt



6.20 If the crankshaft sprocket must be removed, use a two-bolt puller

20 Use a two-bolt puller to remove the crankshaft sprocket if it is damaged **(see illustration)**. Do not use a jaw-type puller. Be careful not to damage the crankshaft sensor portion of the sprocket during the removal process.

Inspection

Refer to illustration 6.22

21 Refer to Chapter 2, Part A for the timing belt inspection procedures.

22 Compress the tensioner arm piston with a press or vise until you can insert a 0.060-inch pin in the second (lower) hole in the tensioner arm body **(see illustration)**.

23 Check that the idler pulleys turn smoothly.

Installation

24 Remove all dirt, oil and grease from the timing belt area at the front of the engine.

25 If removed, install the crankshaft sprocket with the flange side against the engine **(see illustration 6.16a)**. Be careful not to damage the crankshaft sensor portion of the crankshaft sprocket.

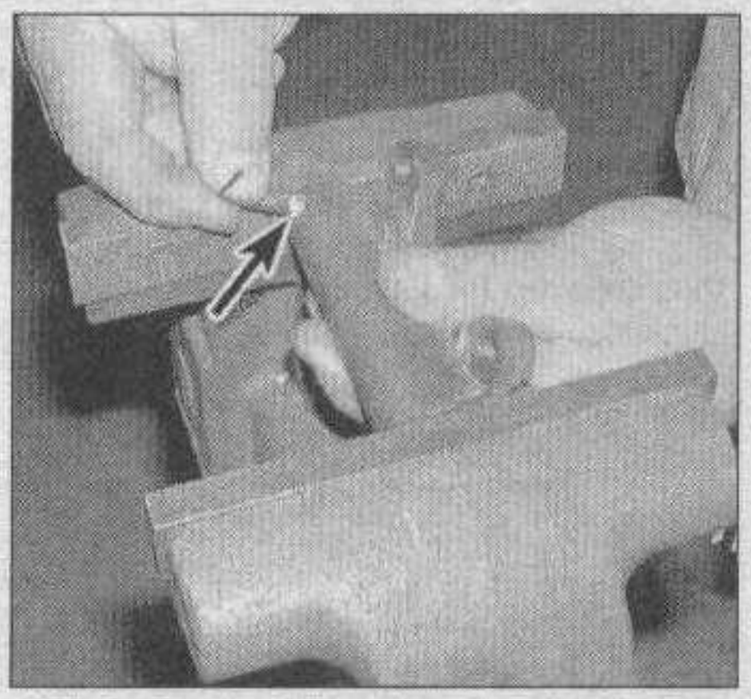
26 Temporarily install the crankshaft pulley bolt and rotate the crankshaft counterclockwise until the tooth to the right of the crankshaft sprocket is aligned with the timing mark on the engine.

27 Install the timing belt. If you're re-using the original belt, align the marks on the belt with the marks on the sprockets.

28 Rotate the crankshaft clockwise until the crankshaft sprocket TDC marks align - DO NOT allow the camshafts to move off their timing marks. This will place the timing belt slack in the area of the tensioner and all the timing marks properly aligned.

29 Install the timing belt tensioner arm (with the piston compressed and the pin installed) and tighten the bolts to the torque listed in this Chapter's Specifications.

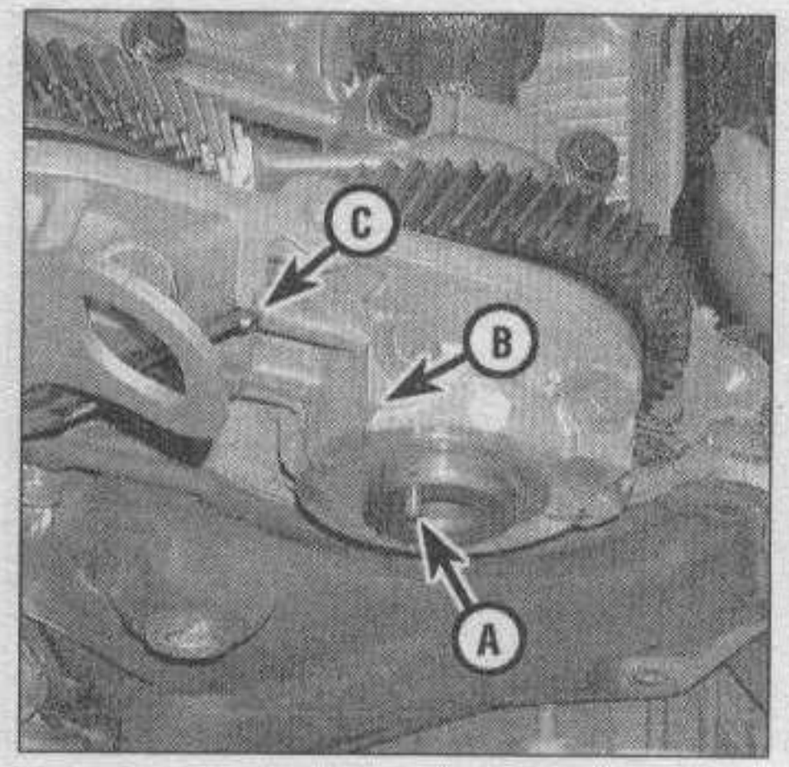
30 Remove the pin from the tensioner arm. Rotate the engine two complete revolutions (720-degrees). Recheck the timing marks **(see illustrations 6.16a, 6.16b and 6.16c)**. **Caution:** *If the timing marks are not aligned exactly as shown, repeat the timing belt installation procedure. DO NOT start the engine until you're absolutely certain that the timing belt is installed correctly. Serious and costly engine damage could occur if the belt is installed wrong.*



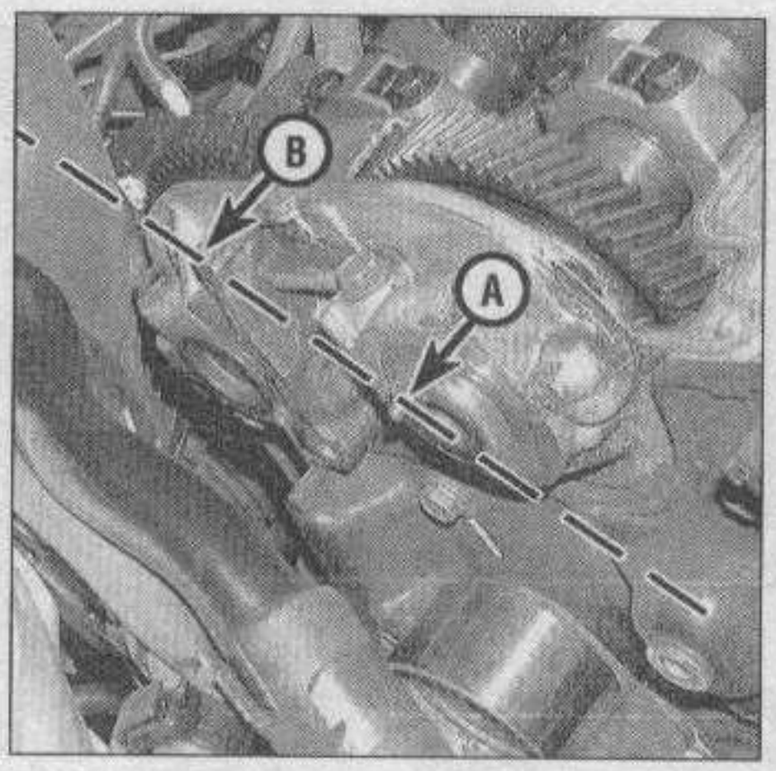
6.22 Compress the timing belt tensioner arm piston with a press or vise until a 0.060-inch pin can be inserted through the second hole (arrow) to hold the piston in place

31 Tighten the tensioner bolt with an Allen wrench or hex-bit to the torque listed in this Chapter's Specifications.

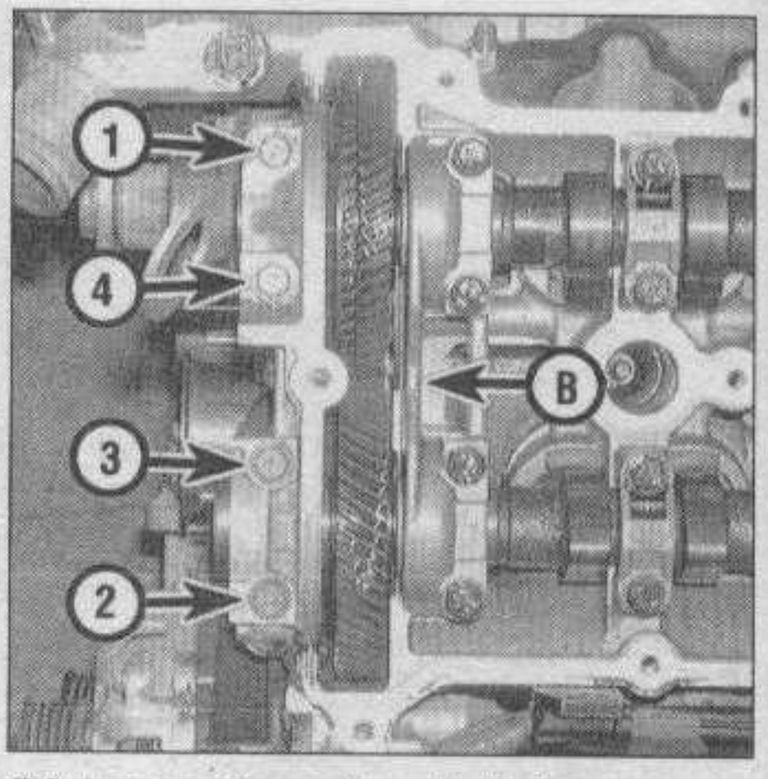
32 Reinstall the remaining parts in the reverse order of removal.



7.2a On the front cylinder head, align the exhaust camshaft's dowel pin (A) with the mark on the end cap (B) and the TDC mark (C)



7.2b On the rear cylinder head, align the intake camshaft dowel pin (A) with the mark on the end cap (B) - they should align in a straight line through the camshaft



7.3 Loosen the end cap bolts in sequence - front head shown, on the rear head, there is an extra bolt at B, which should be loosened last

7 Camshafts and lifters - removal and installation

Removal

Refer to illustrations 7.2a, 7.2b, 7.3, 7.5a, 7.5b, 7.8a and 7.8b

1 Remove the valve covers (see Section 4), timing belt and camshaft sprockets (see Section 6). If removing the camshafts from the front bank, remove the distributor on 1997 and earlier models (see Chapter 5). If removing the camshafts from the rear bank, remove the intake manifold (see Section 8).

2 The camshafts must be removed carefully. If the bearing caps are loosened out of sequence, valve spring pressure could cause the camshaft journals to cock in their saddles in the head, causing damage. To provide for even valve spring pressure on the camshaft as it is removed, align the camshaft dowel pins **(see illustrations)**.

3 Loosen the bolts on the end caps in 1/4-turn increments until they can be removed, starting with the outside two bolts and then the inside two **(see illustration)**.

4 Remove the camshaft oil seal and the cup plug at the front of the driven camshaft.

5 Loosen the camshaft bearing cap bolts in 1/4-turn increments until they can be removed by hand. Follow the recommended sequence **(see illustrations)**.

6 Remove the bearing caps and gently lift out the camshafts. Be sure to keep them level as they are lifted out.

7 Repeat the steps for the other cylinder head.

8 Store the bearing caps in the correct order; the caps on the front cylinder head are marked with letters, while rear bank caps are marked with numbers **(see illustration)**. If necessary, remove the valve lifters (and shims on 1998 and later models) with a magnetic tool **(see illustration)**. Be sure to store them separately so they can be reinstalled in their original locations. On 1997 and earlier models, store the hydraulic lifters upside down in clean engine oil, in a metal or plastic pan.

Inspection

9 Refer to Chapter 2, Part C for camshaft, lifter and related component inspection procedures. Camshaft and lifter Specifications are also in Part C.

Installation

Refer to illustrations 7.12, 7.16a and 7.16b

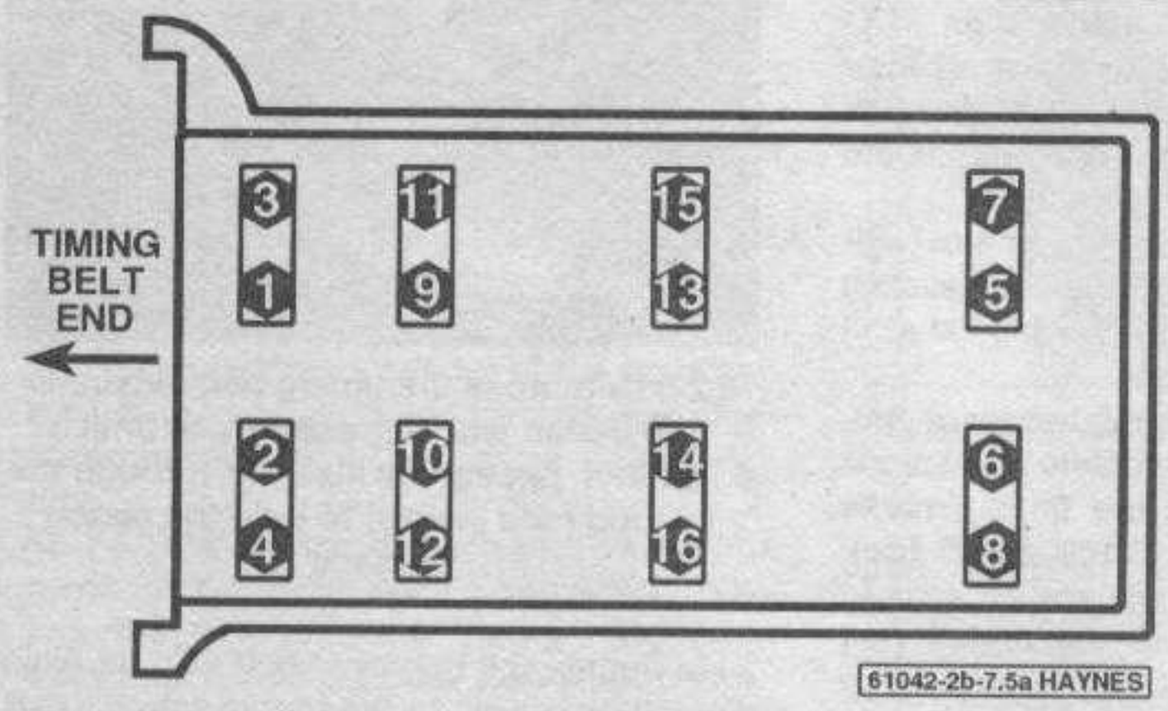
10 Apply moly-based engine assembly lube to the lifters, then install them in their original locations in the cylinder heads. On 1998 and later models, make sure the valve adjustment shims are in place in the lifters, and that all lifters are installed in their original bores.

11 Apply moly-based engine assembly lube to the camshaft lobes, bearing journals and gear thrust faces.

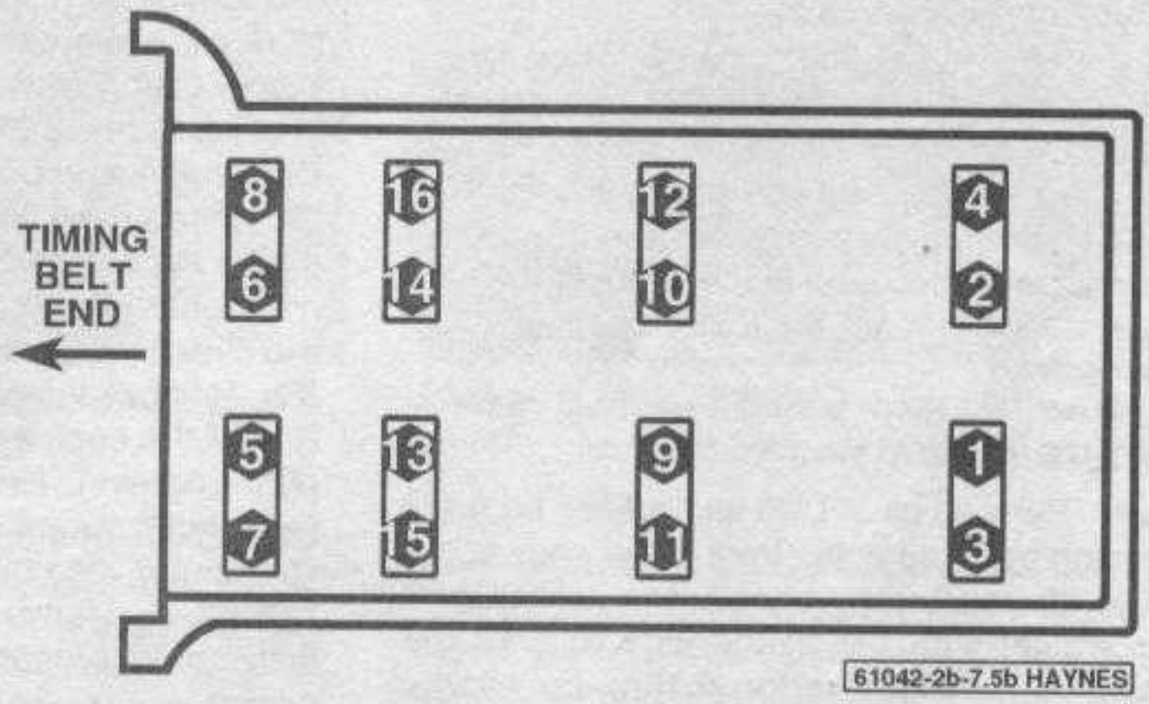
12 Set each camshaft in its saddles on the cylinder head, meshing their gears so that the timing marks on the back of each gear are aligned when the camshafts are installed **(see illustration)**.

13 Apply a thin coat of RTV sealant to the outer edges of the front (larger, thrust caps) bearing cap cylinder head mating surfaces, without getting any sealant on the camshafts.

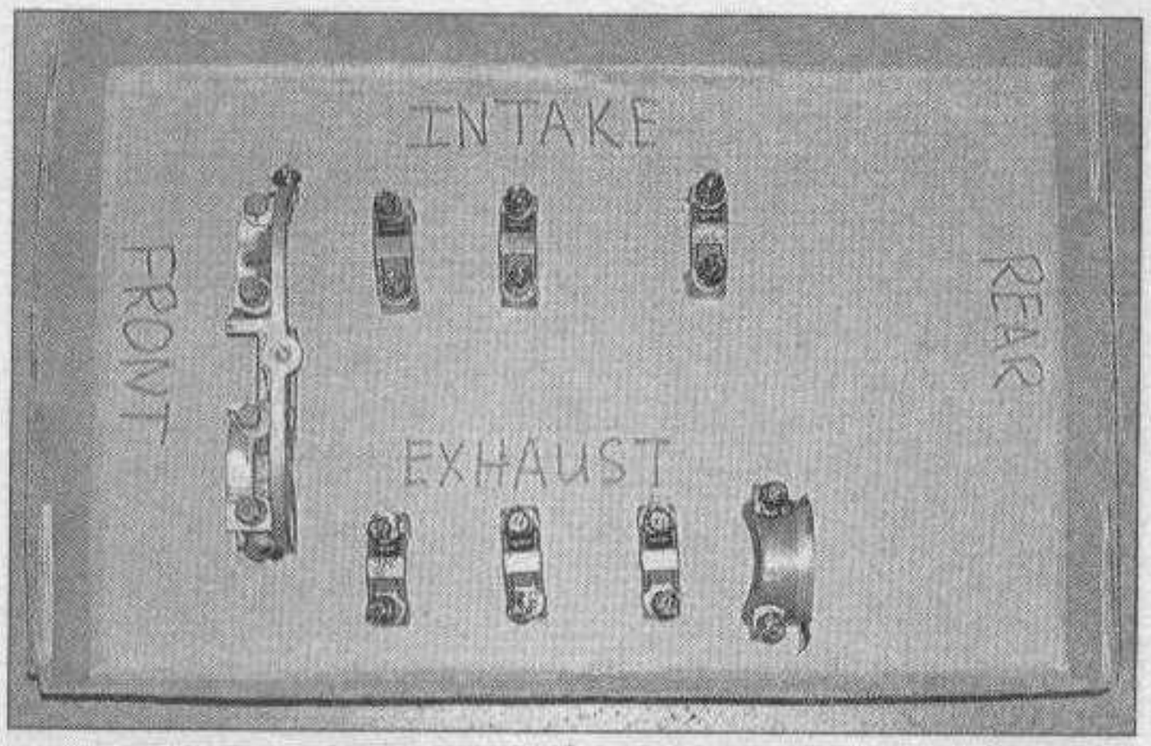
14 Align the dowel pins of the drive camshafts **(see illustrations 7.2a and 7.2b)**,



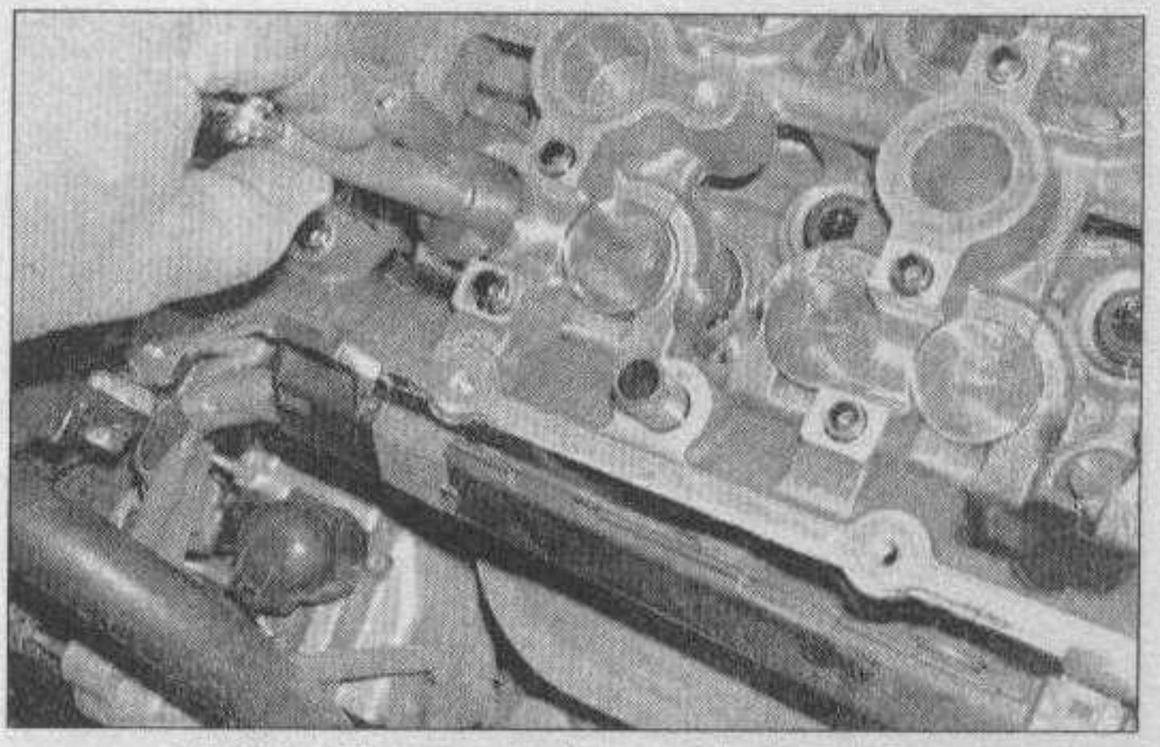
7.5a Camshaft bearing cap LOOSENING sequence - front cylinder head



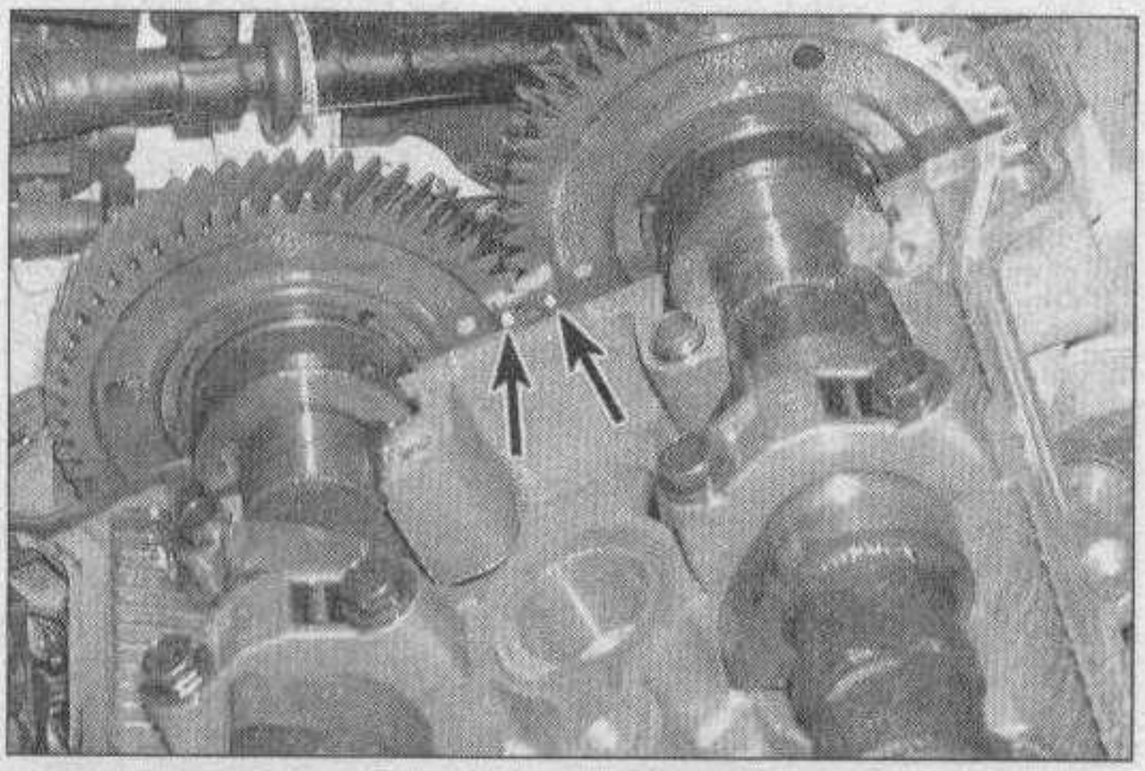
7.5b Camshaft bearing cap LOOSENING sequence - rear cylinder head



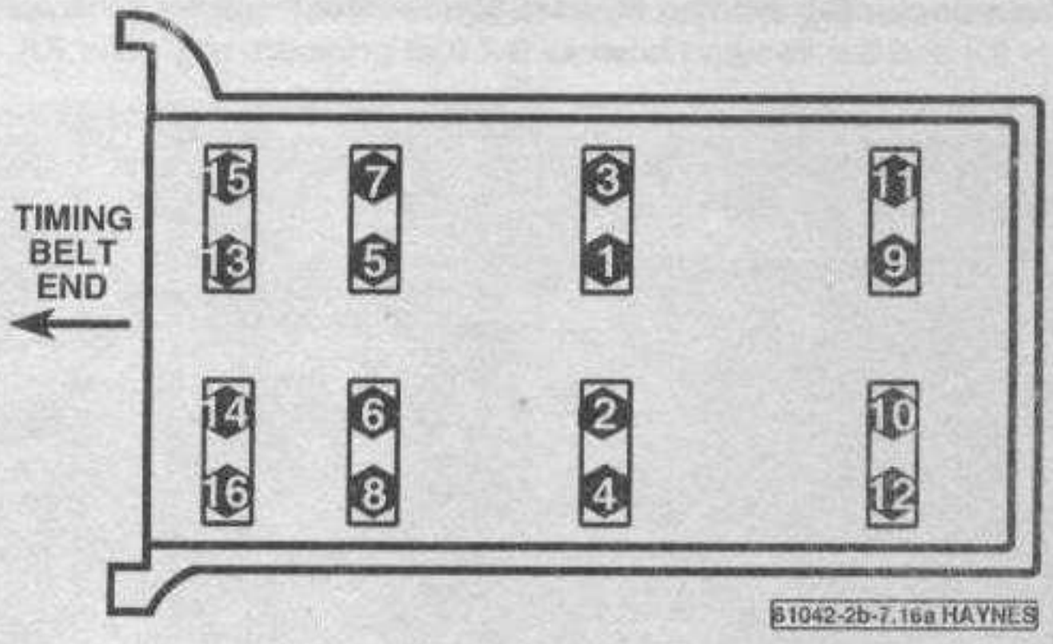
7.8a Store the bearing caps in order for easier reassembly



7.8b The lifters can be removed with a magnet



7.12 When the camshafts are installed, the timing marks (arrows) on the back of the gears must align



7.16a Camshaft bearing cap TIGHTENING sequence - front cylinder head - tighten the thrust cap bolts last, starting with the two inside bolts and then the outer bolts

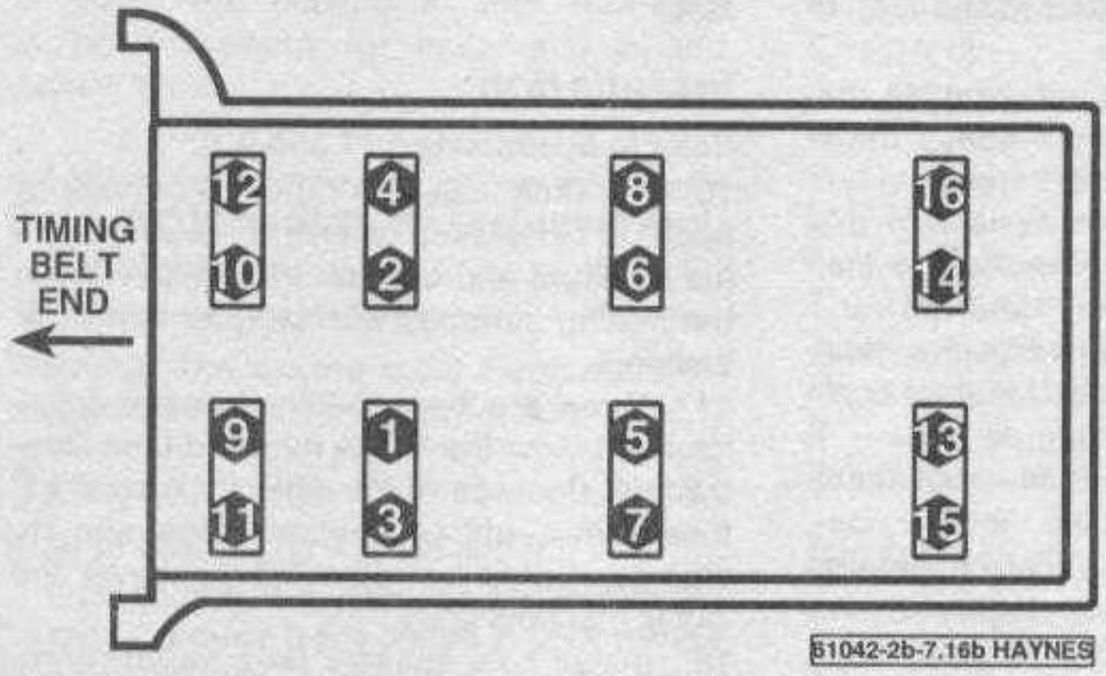
and set the camshaft thrust plates (the one piece cap that mounts just behind the camshaft gears) in place, tightening the bolts only until the cap is fully seated.

15 Install the remaining bearing caps in order. **Note:** *The caps on the front cylinder head are marked with letters, while rear bank caps are marked with numbers.*

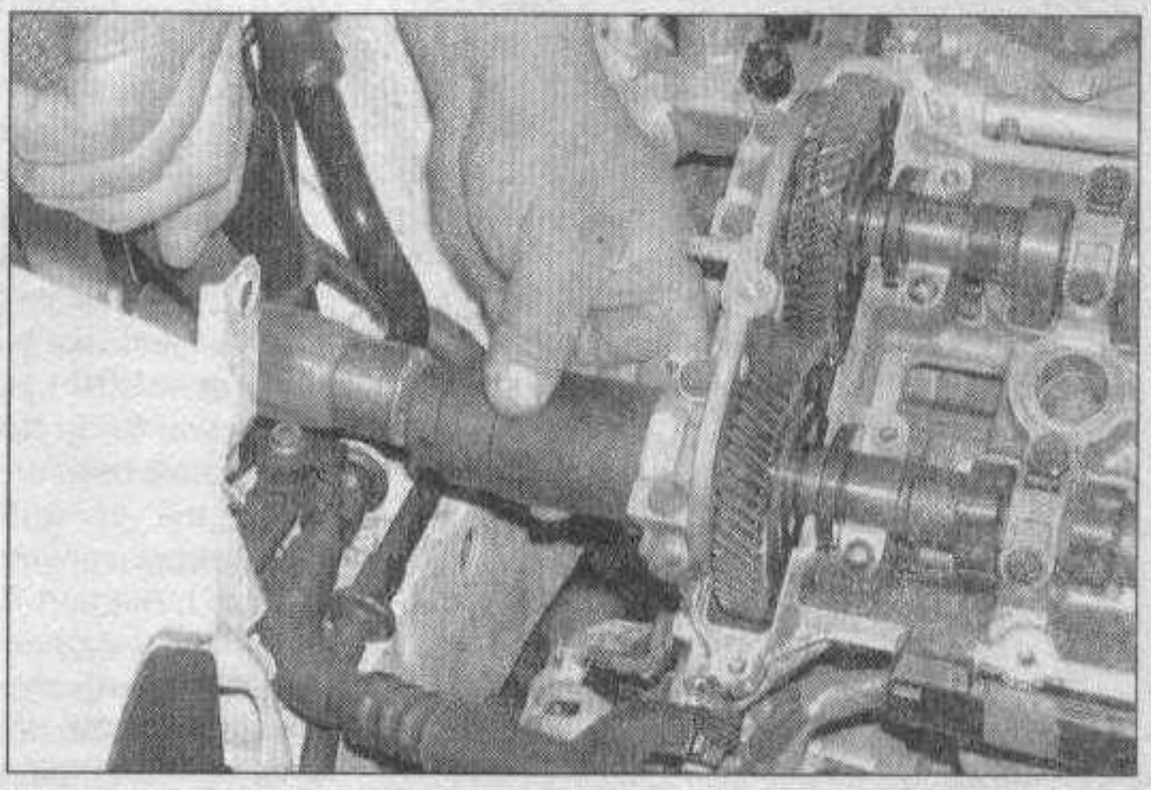
16 Tighten the bearing cap bolts in five or six steps (1/4-turn increments) to the torque listed in this Chapter's Specifications. Follow the recommended sequence **(see illustrations)**.

17 Apply a light coat of clean engine oil to the lip of the new camshaft oil seal. Position the seal over the camshaft and lightly drive the seal in with a seal driver, deep socket or short length of pipe sized to fit the camshaft oil seal **(see illustration)**. Seat the seal with the edge of the seal protruding approximately 0.020-inch.

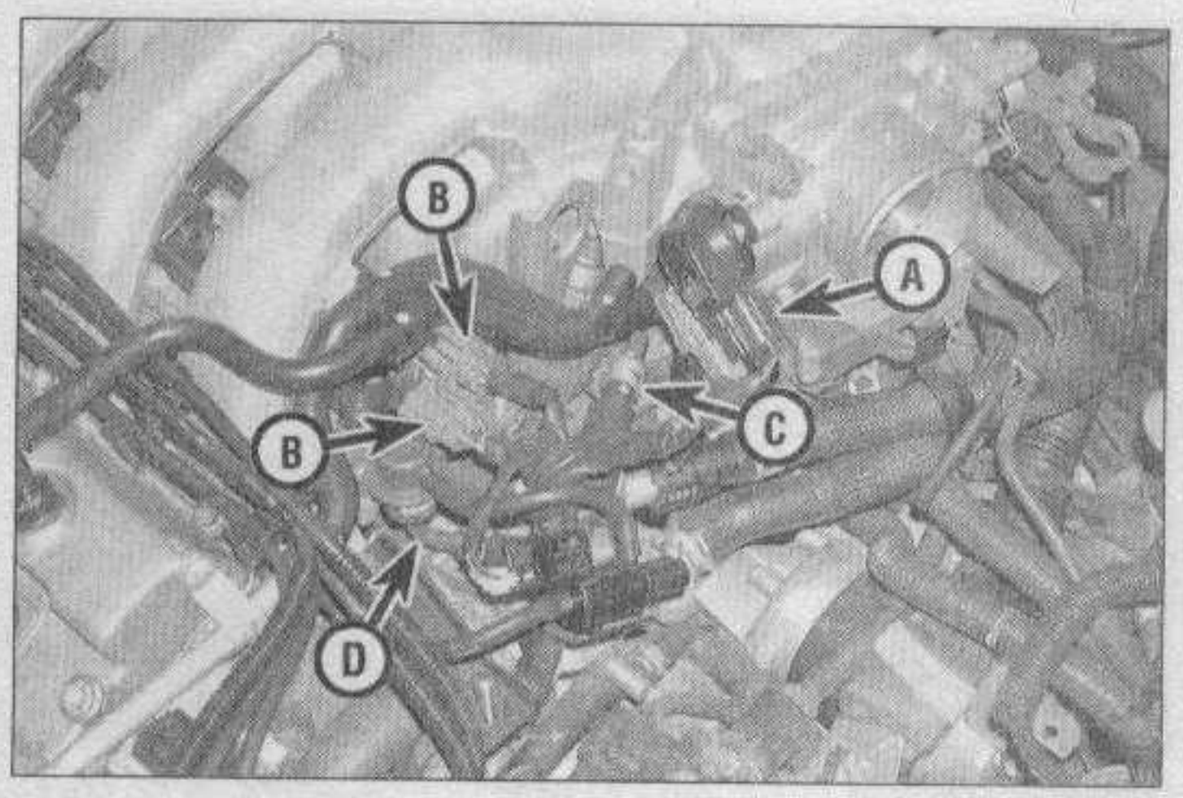
18 Install a cup plug, coated with RTV sealant, at the front of each driven camshaft. Drive the plug in with a soft-faced hammer



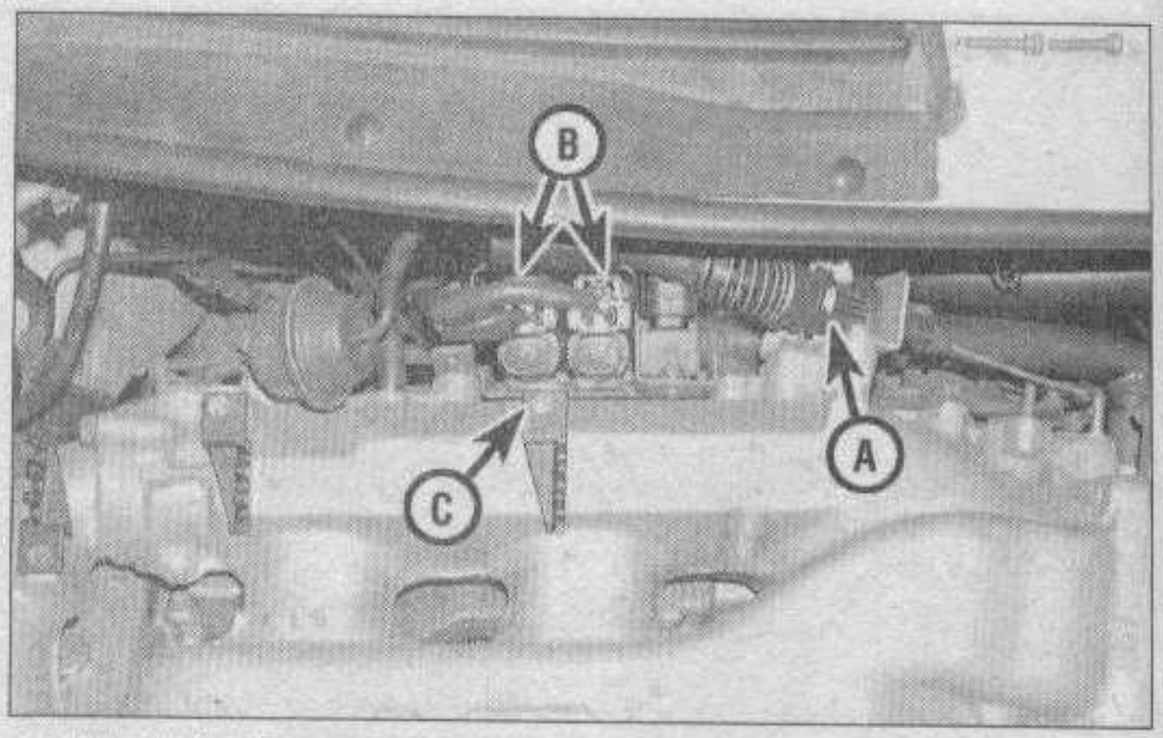
7.16b Camshaft bearing cap TIGHTENING sequence - rear cylinder head - tighten the thrust cap bolts last, starting with the two inside bolts and then the outer bolts



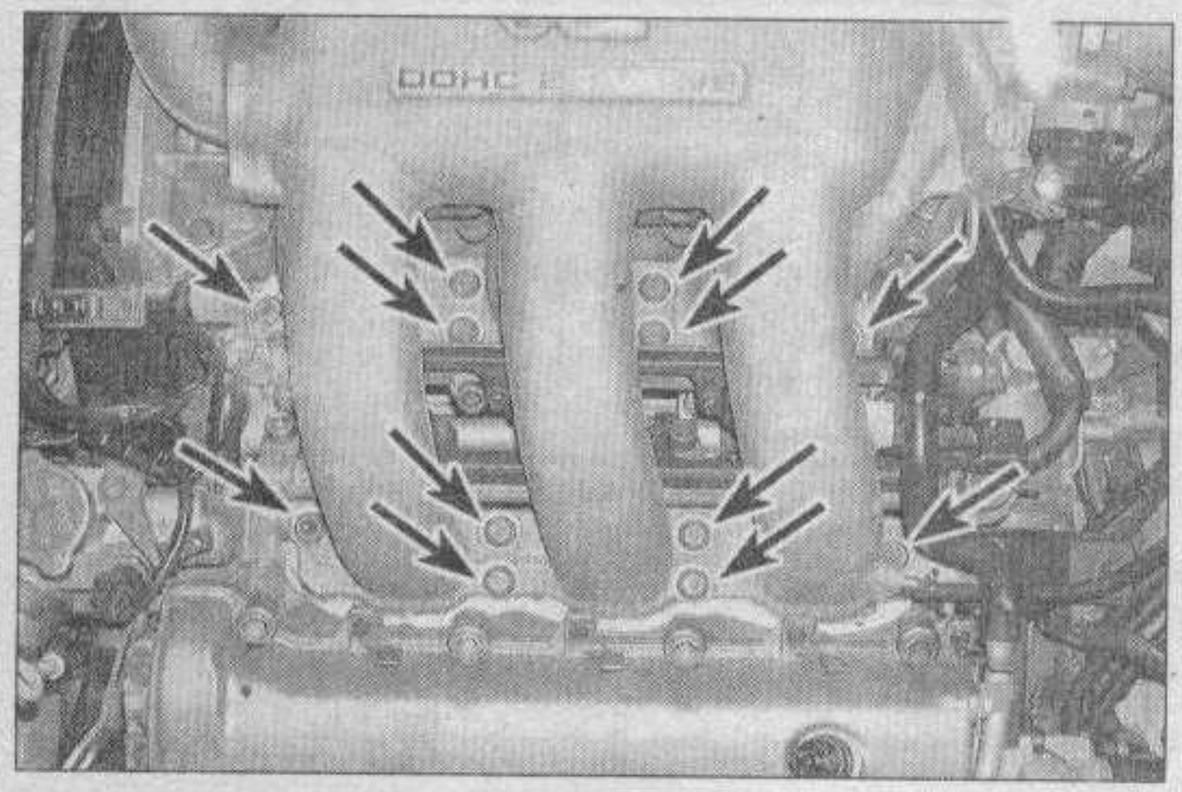
7.17 Evenly drive the new seal in place with a seal driver, deep socket or appropriate-size length of pipe



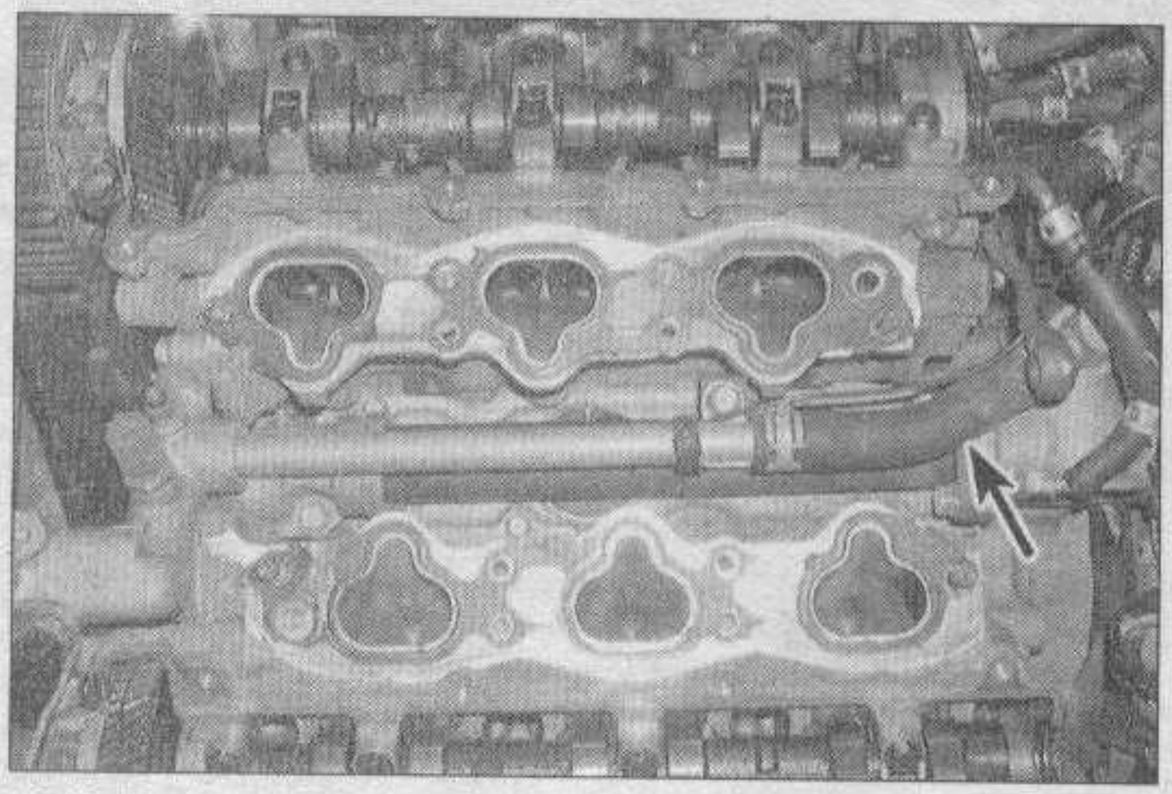
8.5a At the rear of the intake manifold, label and disconnect the TPS connector (A), the two injector connectors (B), the fuel supply line (C) and the vacuum hose to the fuel pressure regulator (D)



8.5b At the firewall side of the manifold, there are a number of connectors and hoses to disconnect, including the throttle linkage (A), the two VRIS connectors (B) and the bracket holding the connectors. Bolt (C) is one of the two bolts holding the bracket - there are other hoses to be disconnected below this area



8.9 Remove the intake manifold mounting bolts/nuts (arrows)



8.11 Replace this coolant hose (arrow) and its clamps whenever the intake manifold is off

until flush.

19 The remainder of the installation is the reverse of the disassembly sequence.

20 On 1998 and later models, check and adjust, if necessary, the valve clearance (see Chapter 1).

21 Run the engine and check for proper operation.

8 Intake manifold - removal and installation

Removal

Refer to illustrations 8.5a, 8.5b and 8.9

1 Relieve the fuel pressure (see Chapter 4) and then disconnect the negative cable from the battery. **Caution:** *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Drain the coolant into a clean container (see Chapter 1).

3 Remove the intake air duct (see Chapter 4).

4 Refer to Chapter 4 and disconnect the throttle linkage, hoses and electrical connectors at the throttle body. The throttle body can remain bolted to the intake manifold. Disconnect the PCV hose at the manifold.

5 Clearly label, then detach all wires, hoses and brackets attached to the intake manifold. **(see illustrations)**.

6 Detach the spark plug wires from the spark plugs and wire holders (leave them connected at the distributor or coilpack).

7 The fuel injectors can remain in the manifold, but disconnect the fuel supply line, injector electrical connectors, and the vacuum hose at the fuel pressure regulator **(see illustration 8.5a)**. **Note:** *Discard the two copper washers used at the fuel supply line.*

8 At the rear of the manifold, disconnect the electrical connectors at the Variable Resonance Induction System (VRIS) solenoid. Label and disconnect the coolant and vacuum hoses attached to the manifold **(see illustration 8.5b)**. Work slowly and carefully. Access at the rear is limited, and there are more hoses connected here than are readily apparent. Don't attempt to remove the manifold until you're certain all hoses are disconnected.

9 Remove the mounting nuts/bolts, then detach the manifold from the engine **(see illustration)**. If it's stuck, don't pry between the gasket mating surfaces or damage may result.

Installation

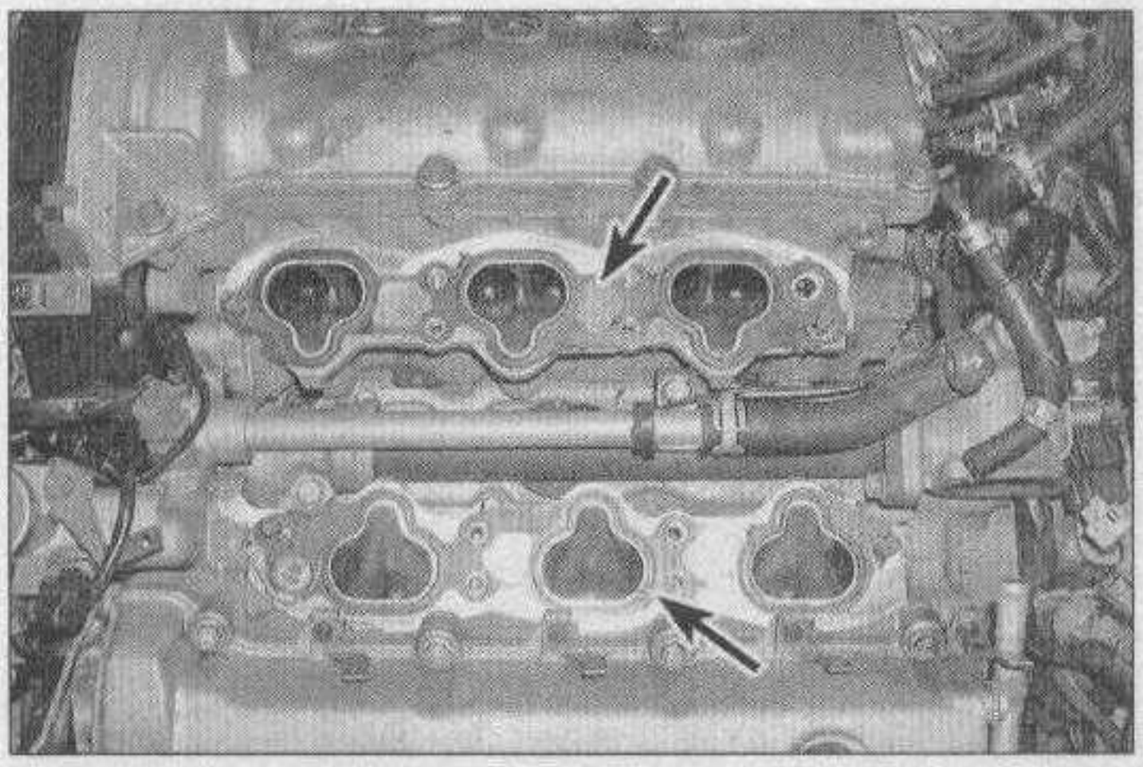
Refer to illustrations 8.11 and 8.12

10 Carefully use a scraper to remove all traces of old gasket material and sealant from the manifold and cylinder heads, then clean the mating surfaces with lacquer thinner or acetone.

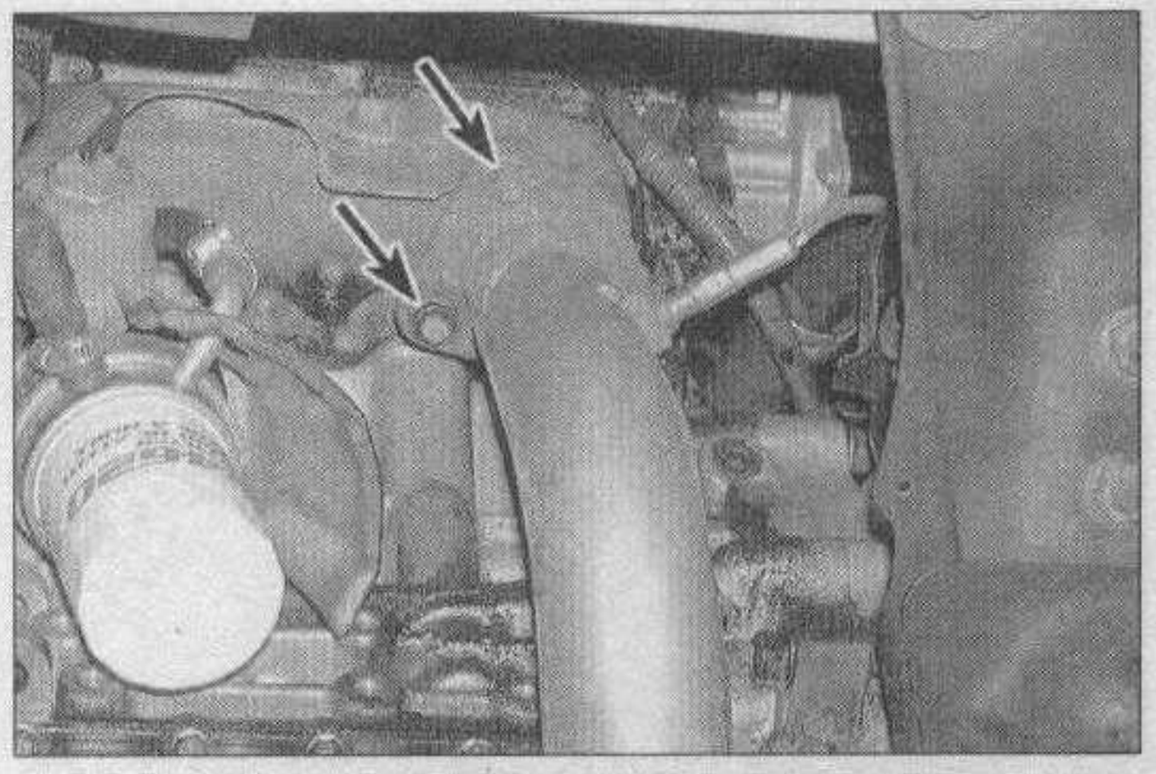
11 There are two coolant transfer pipes located below the intake manifold **(see illustration)**. Because of the difficulty in servicing these, the rubber coolant hose and its clamps should be replaced whenever the intake manifold is off.

12 Install new gaskets **(see illustration)**, then position the manifold on the engine. Make sure the gaskets haven't shifted and install the nuts/bolts.

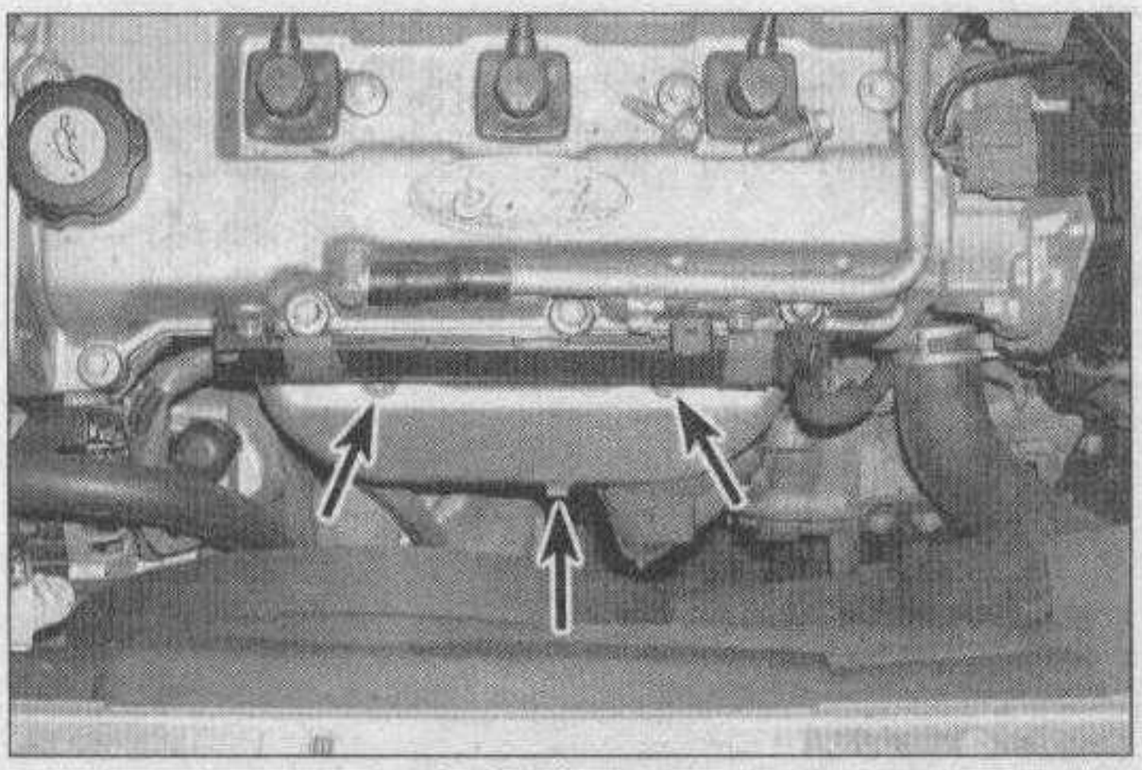
13 Tighten the nuts/bolts, in three equal



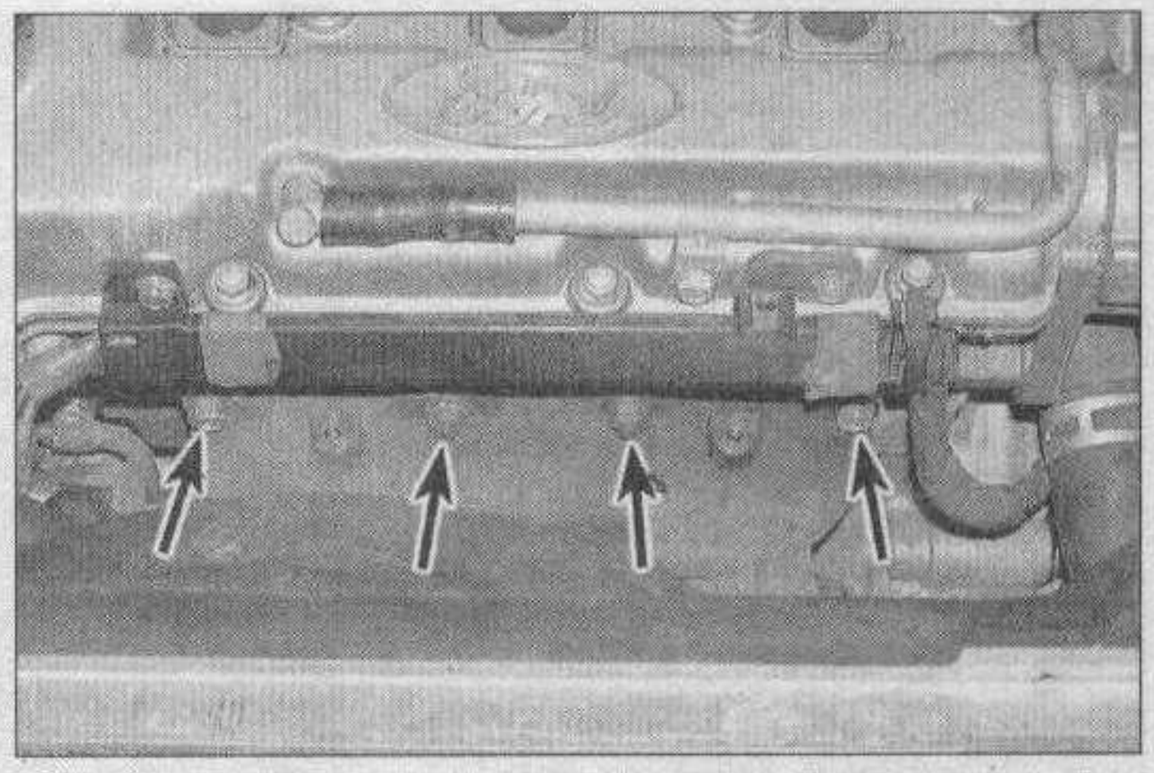
8.12 Install the new intake manifold gaskets (arrows) on the cylinder heads



9.5 Remove the exhaust pipe nuts (arrows indicate two of three nuts on the front pipe) on both front and rear manifolds and lower the pipe



9.6 Remove the exhaust manifold heat shield bolts (arrows) - front manifold shown



9.7 Remove the nuts and bolts at the exhaust manifold (arrows show the top four; there are three more accessible from below) - front manifold shown, rear similar

steps, to the torque listed in this Chapter's Specifications. Work from the center out towards the ends to avoid warping the manifold.

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

15 Refill the cooling system. Run the engine and check for fuel, vacuum and coolant leaks.

9 Exhaust manifolds - removal and installation

Warning: *The engine must be completely cool before beginning this procedure.*

Removal

Refer to illustrations 9.5, 9.6 and 9.7

1 Disconnect the negative cable from the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Spray penetrating oil on the exhaust manifold fasteners and allow the oil to soak in.

3 Disconnect the electrical connectors for the heated oxygen sensors at the front and rear pipes.

4 Remove the EGR pipe from the rear exhaust manifold and cylinder head (see Chapter 6).

5 Remove the nuts retaining the exhaust pipe to the front and rear exhaust manifolds and lower the pipe **(see illustration)**.

6 Remove the bolts and the heat shield over each manifold **(see illustration)**.

7 Unbolt the exhaust manifolds from the cylinder heads and slip them off the mounting studs **(see illustration)**.

8 Carefully inspect the manifolds and fasteners for cracks and damage.

Installation

9 Use a scraper to remove all traces of old gasket material and carbon deposits from the manifolds and cylinder head mating surfaces. If the gasket was leaking, check the manifolds for warpage on the cylinder head mounting surface by pacing a straightedge over the surface and trying to insert a feeler gauge. If the clearance exceeds the Specifications, have the manifold resurfaced at an automotive machine shop.

10 Position new gaskets over the cylinder head studs.

11 Install the manifolds and thread the mounting nuts into place.

12 Working from the center out, tighten the bolts/nuts to the torque listed in this Chapter's Specifications in three or four equal steps.

13 Reinstall the remaining parts in the reverse order of removal. Use new gaskets when connecting the exhaust pipes.

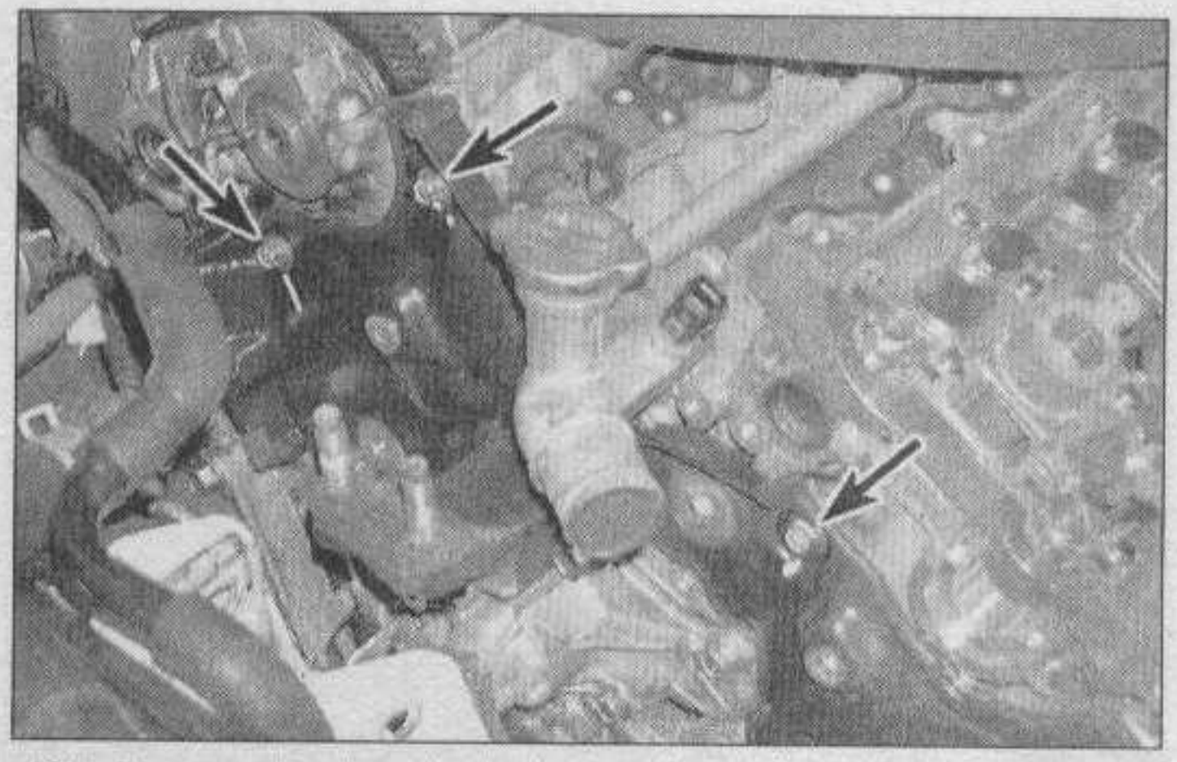
14 Run the engine and check for exhaust leaks.

10 Cylinder heads - removal and installation

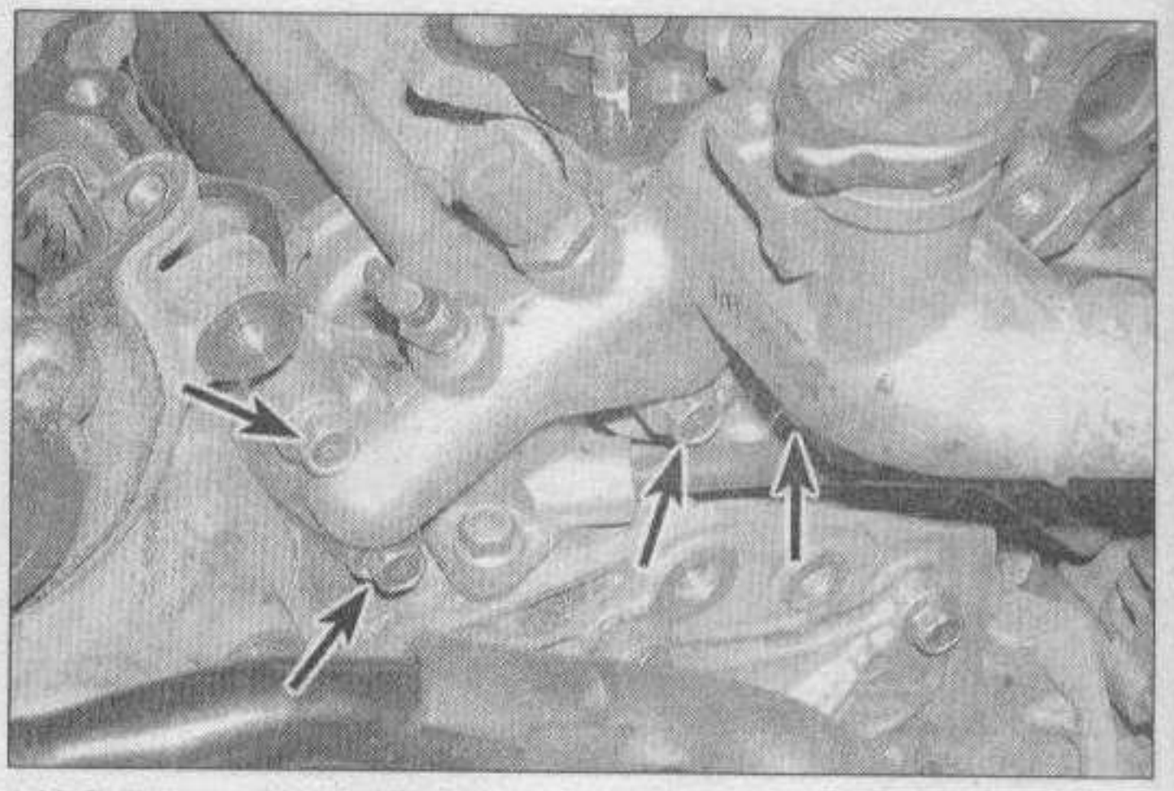
Removal

Refer to illustrations 10.8 and 10.9

1 Disconnect the negative cable from the



10.8 Remove the three bolts (arrows) and the seal plate from the front of the engine - it will slip out from under the coolant inlet and over the motor mount bracket



10.9 Remove the bolts (arrows) and remove the coolant outlet - remove the O-ring at the rear of the outlet

battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Drain the cooling system, including the block (see Chapter 1). Detach the upper radiator hose from the coolant outlet.

3 Remove the air intake ducts and air cleaner assembly. Remove the intake manifold (see Section 8).

4 Remove the exhaust manifold(s) (see Section 9).

5 Remove the alternator. Remove the spark plug wires and the distributor and ignition coil (or coil assembly on 1998 and later models) (see Chapter 5).

6 Remove the timing belt, camshaft sprockets, timing belt tensioner and idler pulleys (see Section 6).

7 Remove the camshafts and lifters (see Section 7).

8 Remove the bolts and the seal plate from the front of the engine **(see illustration)**.

9 Remove the coolant outlet from the cylinder heads **(see illustration)**.

10 Remove the bolts at the rear of the cylinder heads and move the engine wiring harnesses aside.

11 Loosen the cylinder head bolts in 1/4-turn increments until they can be removed by hand. Follow the reverse order of the recommended tightening sequence **(see illustration 10.22)**. Discard the bolts (but save the washers) and obtain new bolts for reassembly.

12 Lift the cylinder head off the engine block. If the cylinder head is stuck, place a wood block against it and strike the wood with a hammer. **Caution:** *Don't pry between the cylinder head and engine block. The gasket surfaces may be damaged and leaks could result.*

13 Repeat the procedure for the other cylinder head.

Installation

Refer to illustration 10.22

14 The mating surfaces of the cylinder heads and block must be perfectly clean when the heads are installed.

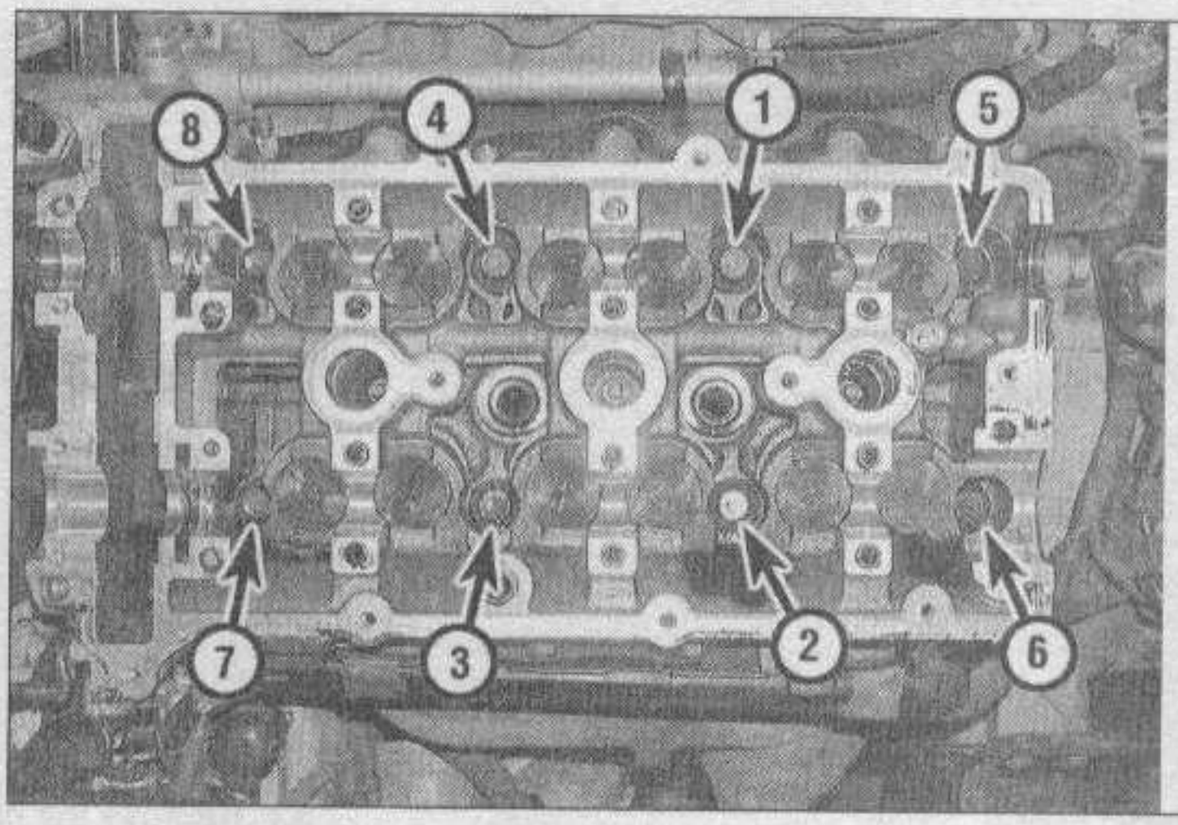
15 Use a gasket scraper to remove all traces of carbon and old gasket material, then clean the mating surfaces with lacquer thinner or acetone. If there's oil on the mating surfaces when the head is installed, the gasket may not seal correctly and leaks could develop. When working on the block, stuff the cylinders with clean shop rags to keep out debris. Use a vacuum cleaner to remove material that falls into the cylinders.

16 Check the block and head mating surfaces for nicks, deep scratches and other damage. Any damage to the aluminum cylinder heads should be removed by machining, do not sand or file the head's gasket surfaces.

17 Use a tap of the correct size to chase the threads in the cylinder head bolt holes, then clean the holes with compressed air - make sure that nothing remains in the holes. **Warning:** *Wear eye protection when using compressed air!*

18 It is suggested that the head bolts be replaced with a new set of bolts, but use the original washers on the new bolts.

19 Position the new gaskets over the dowel pins in the block. **Note:** *There are markings on each head gasket to indicate which side is UP and whether it is for the front or rear cylinder head.*



10.22 Cylinder head bolt TIGHTENING sequence

20 Carefully set the head on the block without disturbing the gasket.

21 Before installing the head bolts, apply a small amount of clean engine oil to the threads.

22 Install the bolts in their original locations and tighten them finger tight. Following the recommended sequence, tighten the bolts to the torque listed in this Chapter's Specifications **(see illustration)**.

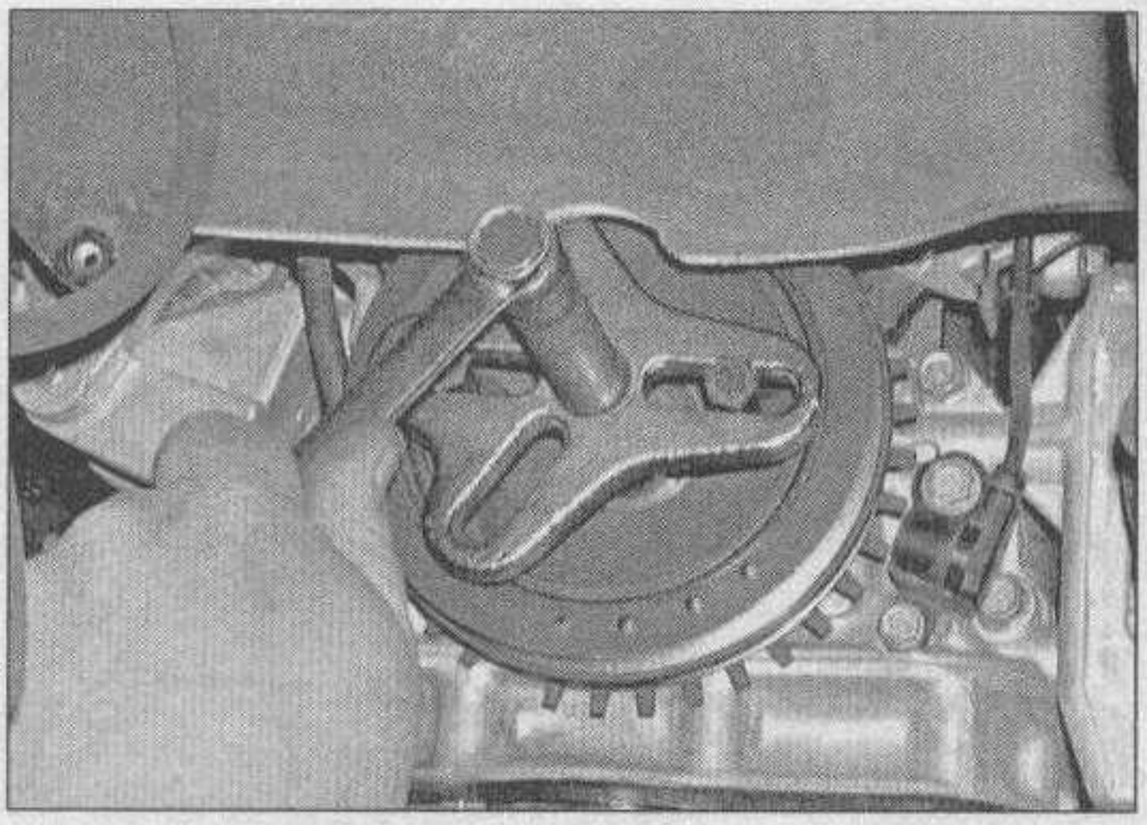
23 Mark the front of each bolt head with paint. You can also mark the socket you are using. Place the socket over the bolt so that you can observe the mark, and rotate the head bolts 1/4-turn (90 degrees) in sequence.

24 Following the same sequence, tighten each bolt an additional 1/4-turn (90-degrees).

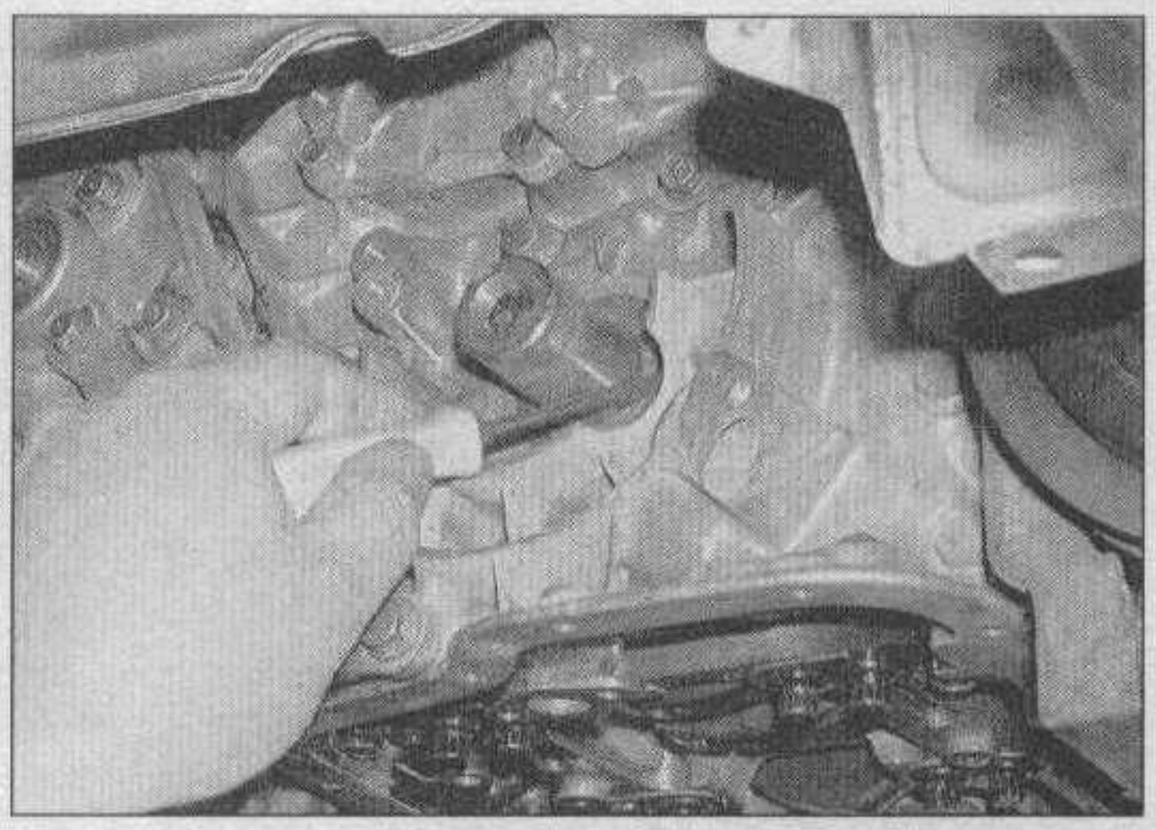
25 Repeat the entire procedure to install the other cylinder head.

26 The remaining installation steps are the reverse of removal. Use a new gasket and O-ring when installing the coolant outlet. This must be done before the intake manifold is installed.

27 Refill the cooling system, change the oil and filter (see Chapter 1), run the engine and check for leaks.



11.3 A bolt-type puller must be used to remove the crankshaft pulley; do not use a jaw-type puller



11.6 Pry the crankshaft front oil seal out with a seal removal tool

11 Crankshaft front oil seal - replacement

Refer to illustrations 11.3, 11.6 and 11.8

Note: *The factory-recommended procedure for replacing this seal is with the oil pump removed from the engine. The seal is driven out by a tool inserted from the back of the oil pump, and the new seal is pressed in with a hydraulic press or seal-driver. The following is an easier, in-vehicle procedure, but if you can't get the old seal out with this method, you may have resort to the manufacturers method (see Section 13 for oil pump removal).*

1 Disconnect the negative cable from the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Hold the crankshaft pulley with a strap wrench, while removing the crankshaft pulley bolt with a socket and breaker bar.

3 Use a two-bolt puller to remove the crankshaft pulley **(see illustration)**.

4 Refer to Section 6 and remove the timing belt and the crankshaft sprocket.

5 Note how far the seal is recessed in the bore, then cut away the seal lip with a razor knife.

6 Carefully pry the seal out of the engine with a screwdriver or seal-removal tool **(see illustration)**. If you use a screwdriver, wrap tape around the tip - don't scratch the housing bore or damage the crankshaft (if the crankshaft is damaged, the new seal will end up leaking).

7 Clean the bore in the engine and coat the outer edge of the new seal with engine oil or multi-purpose grease. Apply the same grease to the seal lip.

8 Using a socket with an outside diameter slightly smaller than the outside diameter of the seal, carefully drive the new seal into place with a hammer **(see illustration)**. Make sure it's installed squarely and driven in to the same depth as the original. If a socket isn't available, a short section of large-diameter pipe will also work.

9 Reinstall the crankshaft timing sprocket and timing belt (see Section 6). Be careful not to scratch the crankshaft sensor portion of the sprocket. The remainder of installation is the reverse of the removal procedure.

10 Run the engine and check for oil leaks at the front seal.

12 Oil pan - removal and installation

Removal

Refer to illustration 12.7

1 Disconnect the negative cable from the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Raise the vehicle and support it securely on jackstands.

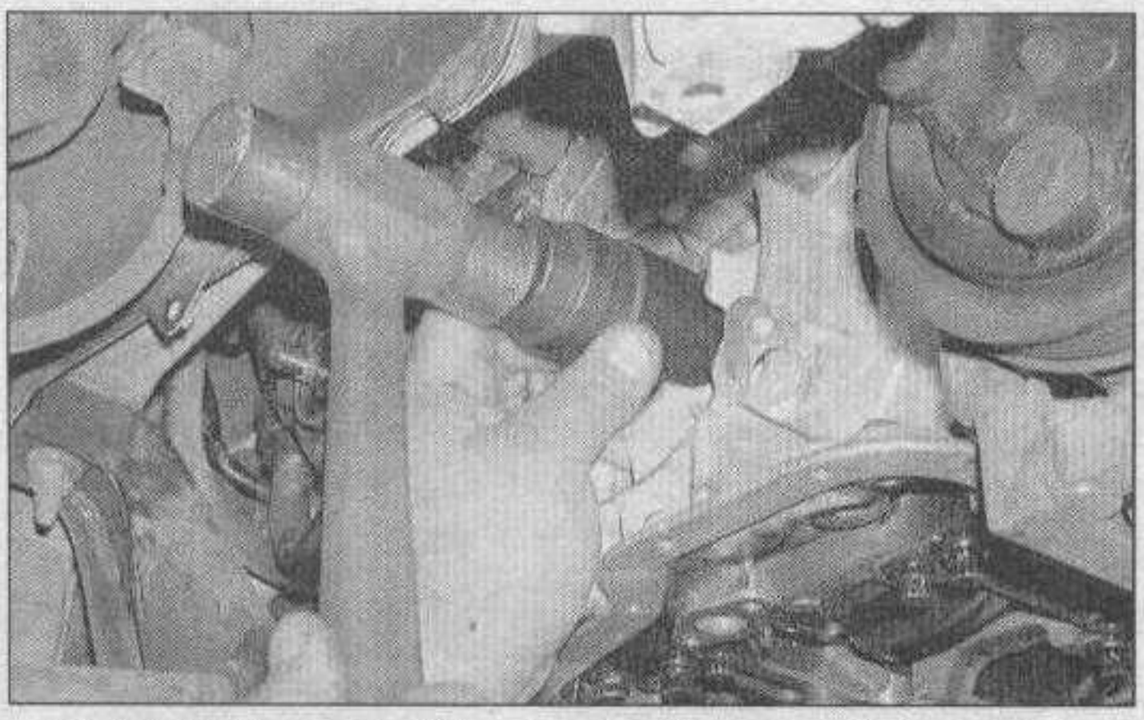
3 Remove the engine splash shields.

4 Drain the engine oil and remove the oil filter.

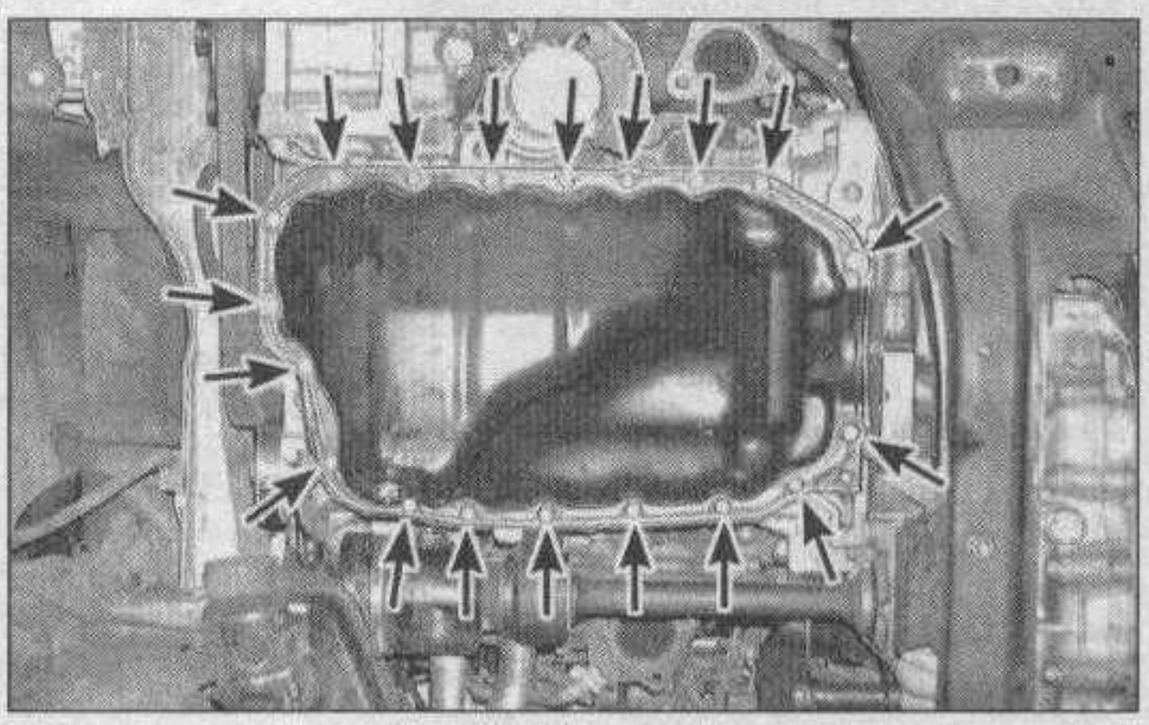
5 Disconnect the exhaust pipe from the front and rear exhaust manifolds (see Section 9) and the exhaust pipe-to-catalytic converter connection (see Chapter 4), then lower and support the exhaust pipe.

6 Remove the suspension crossmember.

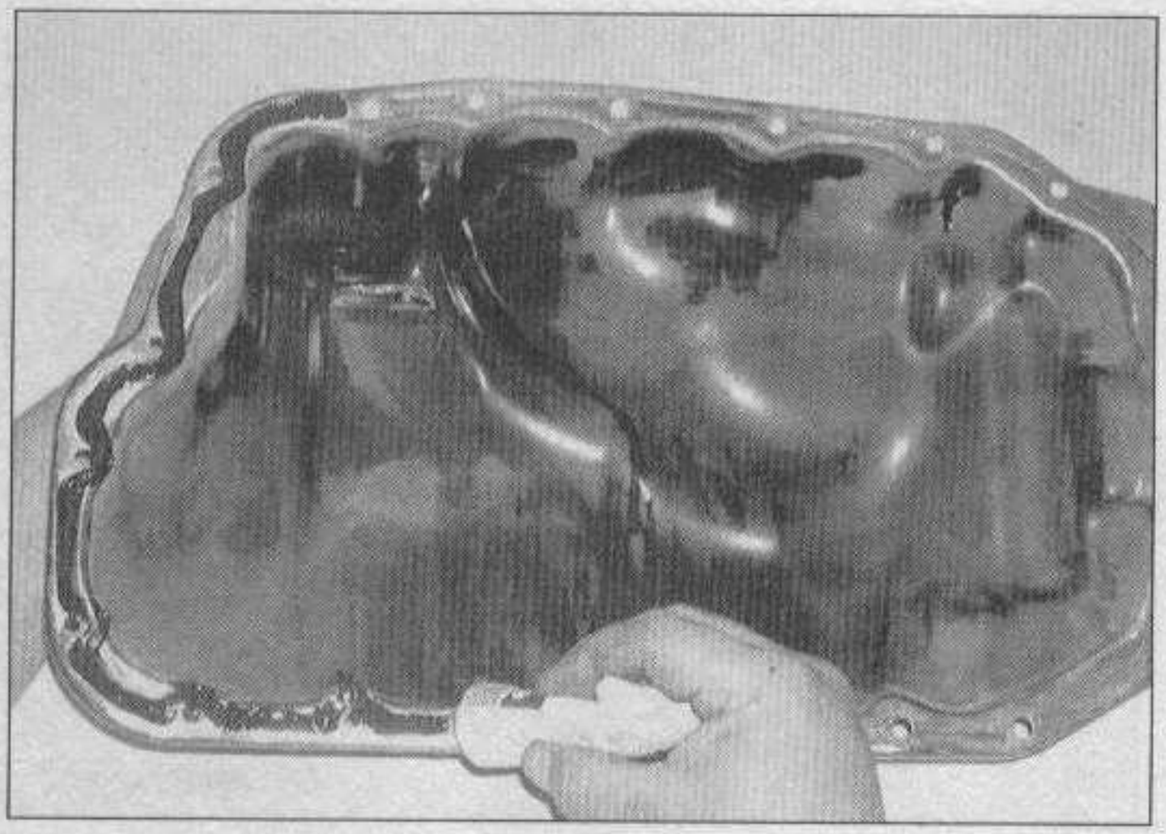
7 Remove the bolts securing the oil pan, and detach the pan **(see illustration)**. If it's stuck, pry it loose very carefully with a small



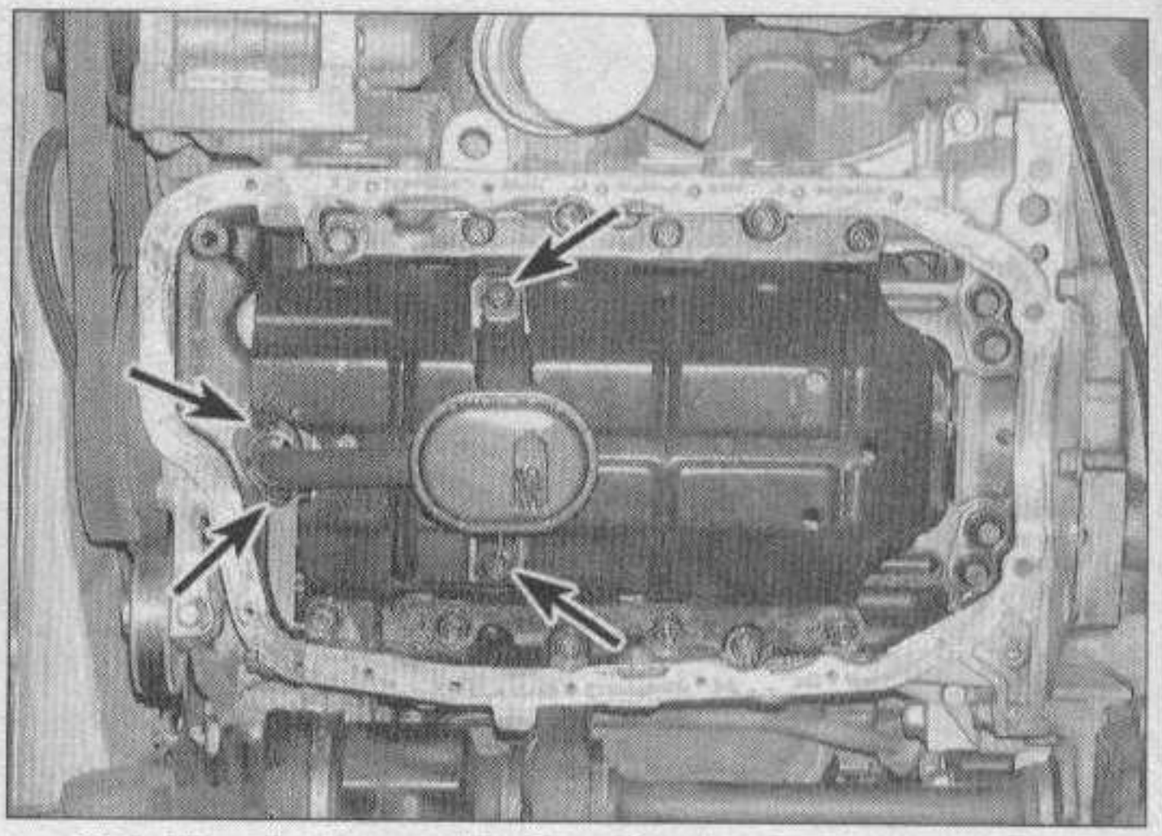
11.8 Drive the new seal in squarely with a socket or seal driver



12.7 Remove the oil pan bolts (arrows) - note the location of the long bolts



12.10 Apply a bead of RTV sealant around the perimeter of the oil pan, with the bead going to the inside of the bolt holes



13.3 The oil pick-up tube is retained by four bolts (arrows)

screwdriver or putty knife. Don't damage the mating surfaces of either the pan or the block, or oil leaks could develop. **Note:** *Note the location of the long bolts so they can be installed in their original locations.*

Installation

Refer to illustration 12.10

8 Use a scraper to remove all traces of old sealant from the block and oil pan. Clean the mating surfaces with lacquer thinner or acetone. **Caution:** *Clean any old sealant out of the threaded bolt holes in the bottom of the aluminum block. Debris in these blind holes could cause the casting to crack when the bolts are fully tightened.*

9 Check the flange of the pan for distortion, particularly around the bolt holes. If necessary, place the pan on a wood block and use a hammer to flatten and restore the gasket surface.

10 Apply a 3 to 4 mm-wide bead of RTV sealant to the flange of the oil pan **(see illustration)**. **Note:** *Once the sealant has been applied, the pan section must be installed within 5 minutes.*

11 Carefully position the steel pan on the engine block and install the bolts. Working from the center out, tighten them to the torque listed in this Chapter's Specifications in three or four steps. **Note:** *The torque specification for the long bolts is different from the short bolts.*

12 The remainder of installation is the reverse of removal. Be sure to add oil and install a new oil filter.

13 Run the engine and check for oil pressure and leaks.

13 Oil pump - removal, inspection and installation

Removal

Refer to illustrations 13.3 and 13.5

1 Remove the oil pan (see Section 12).

2 Remove the timing belt and crankshaft sprocket (see Section 6).

3 Remove the oil pick-up tube **(see illustration)**.

4 Unbolt the air conditioning compressor and set it aside without disconnecting the refrigerant lines (see Chapter 3).

5 Remove the compressor bracket **(see illustration)**.

6 Remove the power steering pump (two of the bolts go through the oil pump) and its bracket and set it aside without disconnect the hoses (see Chapter 10).

7 Remove the remaining bolts and detach the oil pump from the engine **(see illustration 13.5)**.

8 If necessary, remove the bolts and the oil pan baffle.

Inspection

9 Remove the O-ring and any old sealant from the back of the pump. Remove the oil pressure relief valve snap-ring (screw-in plug on some engines), retainer, spring and valve. **Warning:** *The spring is tightly compressed - be careful and wear eye protection.*

10 Use a large Phillips screwdriver to remove the eight screws retaining the body cover to the rear of the oil pump.

11 Lift the cover off and remove the pump rotors.

12 Use a scraper to remove all traces of sealant and old gasket material from the pump body and engine block, then clean the mating surfaces with lacquer thinner or acetone.

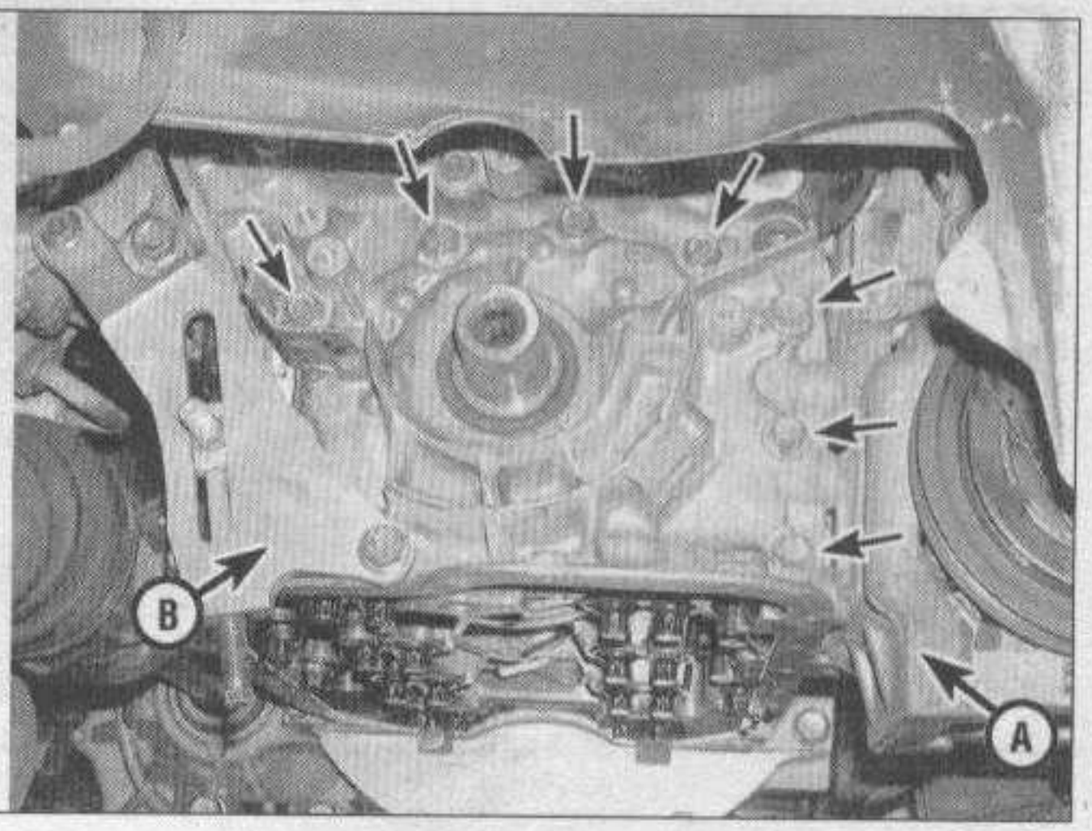
13 Clean all components with solvent, then inspect them for wear and damage.

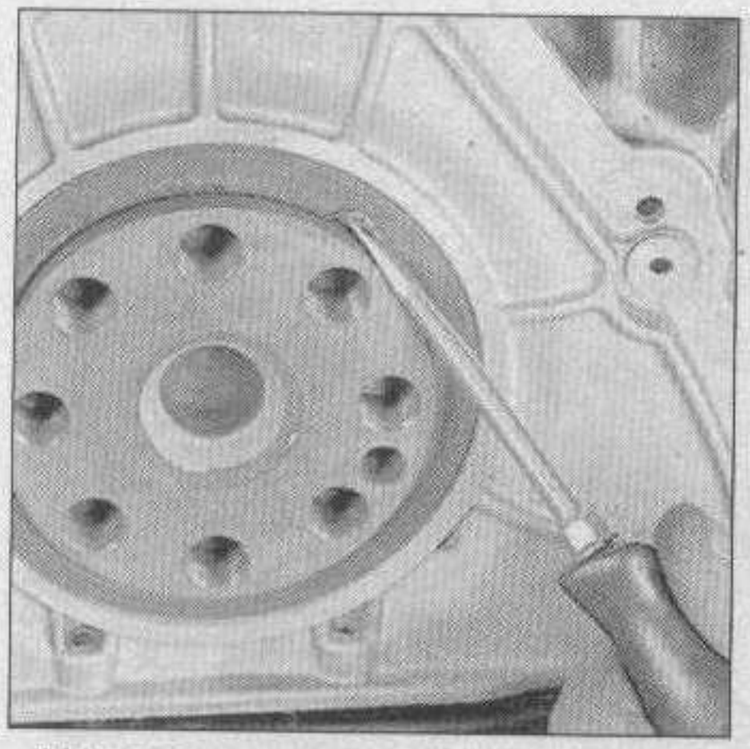
14 Check the oil pressure relief valve sliding surface and valve spring. If either the spring or the valve is damaged, they must be replaced as a set. Measure the length of the oil pressure relief spring and compare it to this Chapter's Specifications.

15 Check the clearance of the following components with a feeler gauge and compare the measurements to this Chapter's Specifications **(Refer to Chapter 2, Part A for illustrations)**:

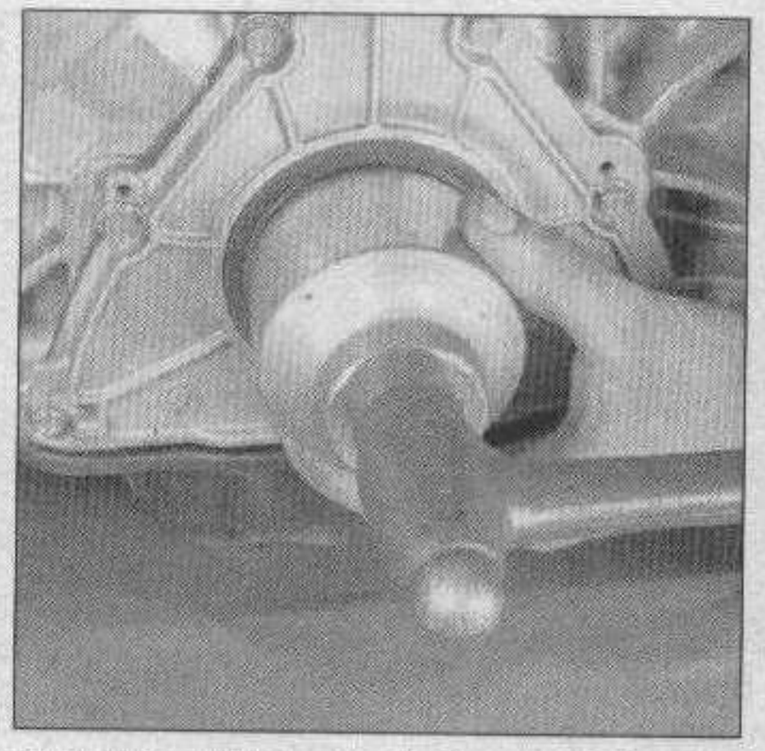
a) Driven rotor-to-oil pump body
b) Rotor side clearance
c) Rotor tip clearance

13.5 Unbolt the air conditioning compressor and its bracket (A), remove the power steering bracket (B), and the bolts (arrows) retaining the oil pump - there are two more oil pump bolts hidden by the power steering bracket

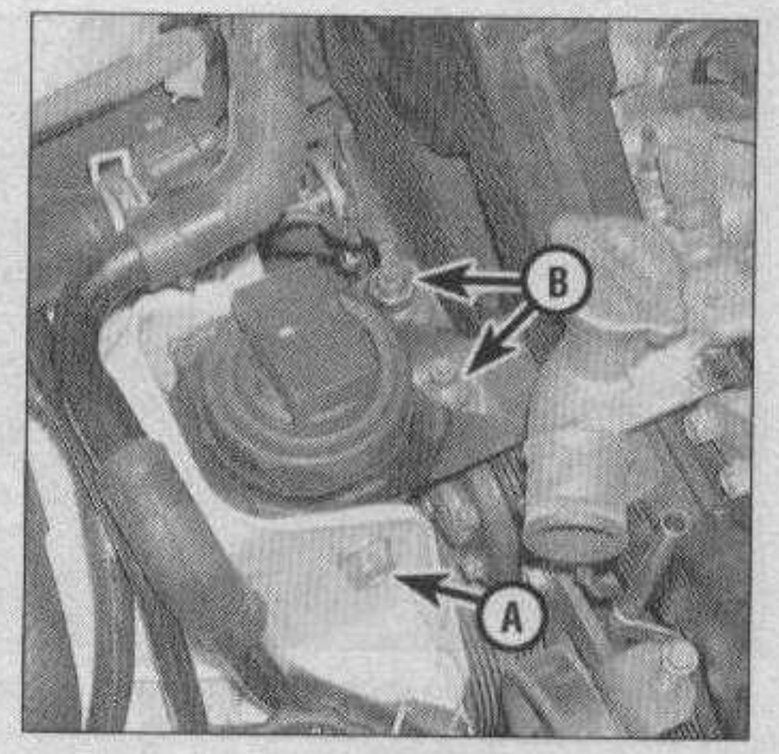




15.4 Before removal of the old oil seal, note how far the seal is seated in the bore and the direction the oil seal lip faces - remove the oil seal with a seal removal tool or screwdriver



15.5 Using a large socket or suitable pipe or tubing, drive the seal into the bore until it is flush with the face of the block



16.8 Remove the right engine mount by removing the throughbolt (A), then the mount-to-engine bracket nuts (B)

Installation

16 Pry the old crankshaft seal out with a screwdriver, or drive it out from behind, being careful not to damage the seal surface of the pump.

17 Apply multi-purpose grease or engine oil to the outer edge of the new seal and carefully press it into place. Also apply multi-purpose grease to the seal lip.

18 Place the drive and driven rotors into the pump body with the marks facing out.

19 Pack the pump cavity with petroleum jelly and install the cover. Tighten the screws securely following a criss-cross pattern.

20 Lubricate the oil pressure relief valve with engine oil and install the valve components in the pump body.

21 Use acetone or lacquer thinner and a clean rag to remove all traces of oil from the gasket surfaces.

22 Apply a 2 to 3 mm wide bead of RTV sealant to the oil pump. Avoid using an excessive amount of sealer, especially around oil passages and bolt holes. Assembly must be completed within five minutes of sealant application, otherwise the material must be removed and reapplied.

23 Position a new O-ring on the engine block.

24 Engage the oil pump drive rotor with the crankshaft (you may have to rotate the pump to engage the crankshaft) and slide the pump into place.

25 Install the oil pump mounting bolts in their original locations and tighten them to the torque listed in this Chapter's Specifications in a criss-cross pattern.

26 Using a new gasket, install the oil pick-up tube and tighten the fasteners to the torque listed in this Chapter's Specifications.

27 Reinstall the remaining parts in the reverse order of removal.

28 Add oil, start the engine and check for oil leaks.

29 Recheck the engine oil level.

14 Flywheel/driveplate - removal and installation

Refer to Chapter 2, Part A for this procedure, but be sure to use the torque Specifications in this Part of Chapter 2 for the V6 engine.

15 Rear main oil seal - replacement

Refer to illustrations 15.4 and 15.5

1 The transaxle must be removed from the vehicle for this procedure (see Chapter 7).

2 Remove the flywheel/driveplate (see Section 14).

3 Cut completely around the rear main oil seal lip with a razor knife, be careful not to damage the crankshaft sealing surface.

4 Pry out the old seal with a seal removal tool or screwdriver (tape the tip to protect the crankshaft) **(see illustration)**.

5 Apply engine oil to the crankshaft seal journal and to the lip of the new seal. Place the new seal and press it in with a seal installation tool. If a seal installation tool in unavailable, carefully tap into place using a flat punch, large socket, or a suitable section of tubing of the correct diameter, until the oil seal is flush with the edge of the rear cover **(see illustration)**.

6 Reinstall the flywheel/driveplate (see Section 14).

7 The remaining steps are the reverse of removal.

16 Engine mounts - check and replacement

Check

1 During the check, the engine must be raised slightly to remove the weight from the mounts.

2 Raise the vehicle and support it securely on jackstands, then position a jack under the engine oil pan. Place a large block of wood between the jack head and the oil pan, then carefully raise the engine just enough to take the weight off the mounts. **Warning:** *DO NOT place any part of your body under the engine when it's supported only by a jack!*

3 Check the mounts to see if the rubber is cracked, hardened or separated from the metal plates. Sometimes the rubber will split right down the center.

4 Check for relative movement between the mount plates and the engine or frame (use a large screwdriver or prybar to attempt to move the mounts). If movement is noted, lower the engine and tighten the mount fasteners.

5 Rubber preservative should be applied to the mounts to slow deterioration.

6 Disconnect the negative battery cable from the battery, then set the parking brake, block the rear wheels, raise the front of the vehicle and support it securely on jackstands (if not already done). **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

Replacement

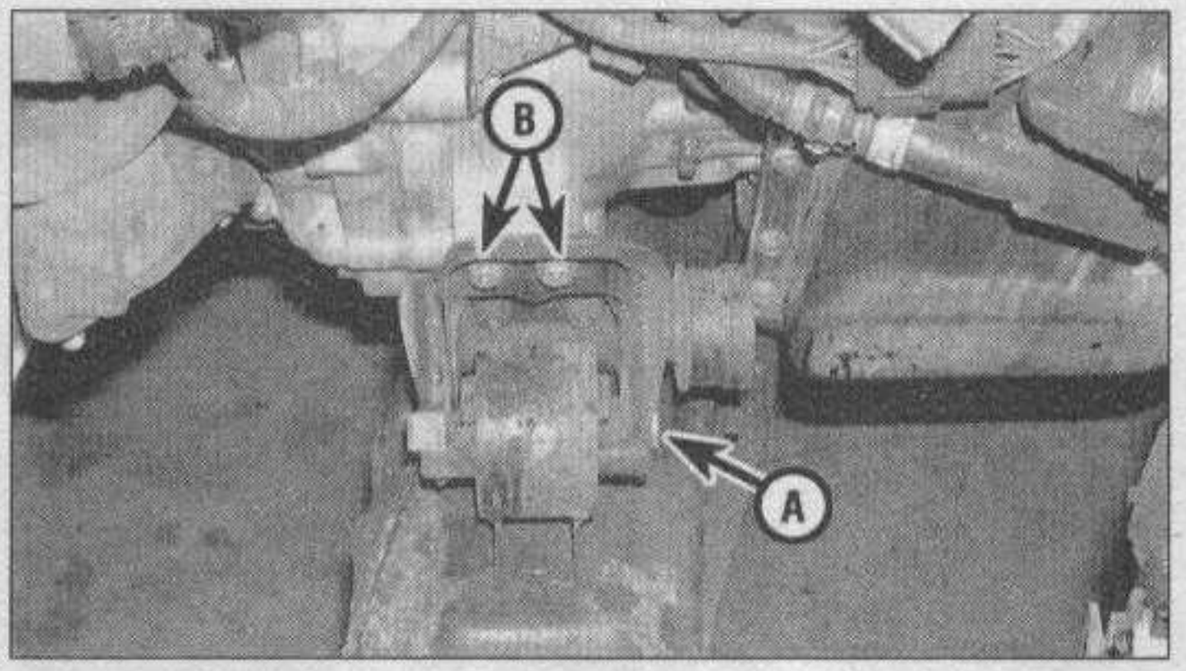
Right (passenger-side) mount

Refer to illustration 16.8

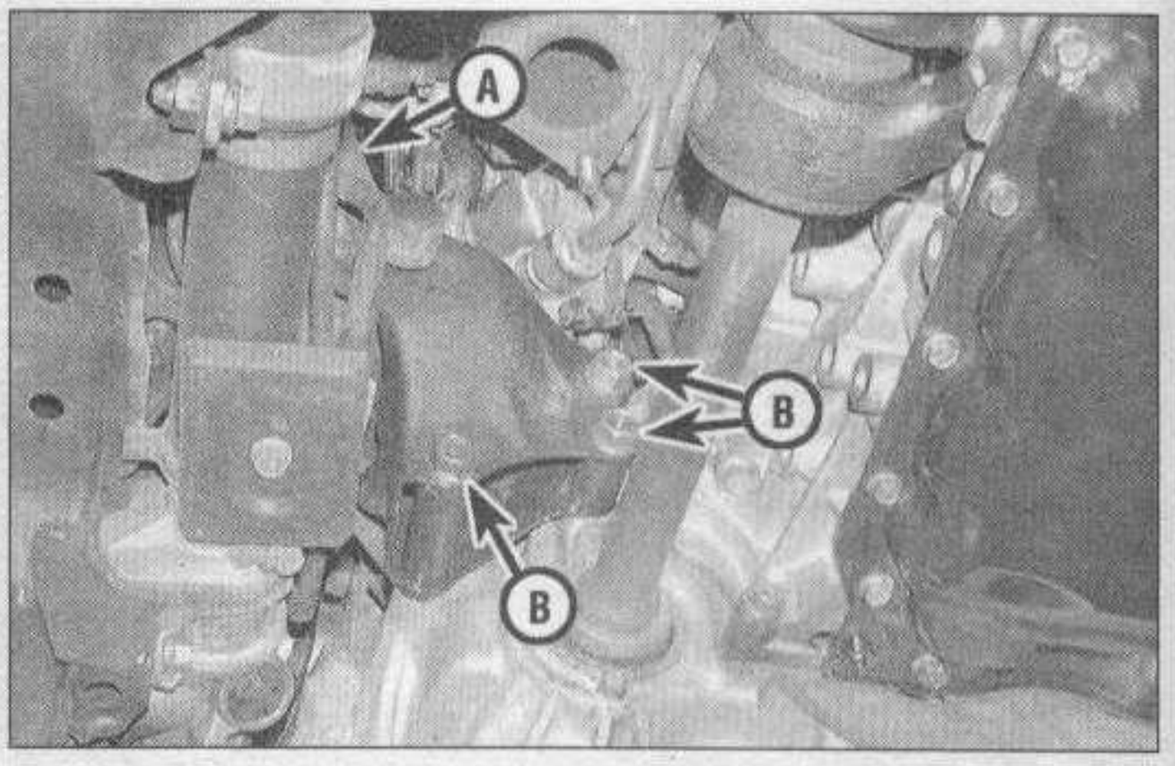
7 The mount supporting the timing-belt end of the powertrain is attached to the engine, and to a bracket mounted to the chassis. Perform the procedures of Step 6, then use a floorjack under the oil pan to take the weight from the mount. Use a block of wood on the jack and do not place the jack under the oil pan drain plug.

8 Remove the throughbolt from the mount, then the mount-to-engine fasteners and remove the rubber insulator **(see illustration)**.

9 Installation is the reverse of removal. **Note:** *Tighten the bolts to Specifications only after the powertrain weight is back onto the mounts and the jack is removed. If more than one mount has been replaced, see Final tightening below.*



16.10 Front engine mount throughbolt (A) and bracket bolts (B) - if the mount is to be removed with the crossmember in place, remove the bracket bolts and bracket, then the nuts under the crossmember to replace the insulator



16.14 Rear mount throughbolt (A) and transaxle bracket bolts (B)

Front mount

Refer to illustration 16.10

10 The front mount is located between the engine and radiator, at the junction of the engine and transaxle **(see illustration)**. **Note:** *If only the front or rear mounts are to be replaced, it's easier to remove the transaxle crossmember entirely, than to raise the powertrain enough for the studs to clear an installed crossmember (see Chapter 7).*

11 Perform Steps 7 through 9 to remove the front mount.

12 Installation is the reverse of removal. **Note:** *Tighten the bolts to Specifications only after the powertrain weight is back onto the mounts and the jack is removed. If more than one mount has been replaced, see Final tightening below.*

Rear mount

Refer to illustration 16.14

13 Unless the intake manifold is removed, access to this mount is tight and only from the bottom. Loosen the through-bolt and raise the engine enough to take the weight off the rear mount.

14 Remove the bolts holding the mount to the transaxle, remove the throughbolt, and raise the engine enough to pull out the mount **(see illustration)**.

15 Installation is the reverse of removal. **Note:** *Tighten the bolts to Specifications only after the powertrain weight is back onto the mounts and the jack is removed. If more than one mount has been replaced, see Final tightening below.*

Left (driver's-side) mounts

Refer to illustration 16.16

Top mount

16 The driver's-side mount is attached to the chassis and transaxle at the top of the transaxle **(see illustration)**. Remove the intake air duct and air cleaner housing for access (see Chapter 4).

17 With the engine supported, remove the throughbolt, then remove the bolt and nut on top of the transaxle and pull the mount out of its bracket.

18 Installation is the reverse of removal. **Note:** *Tighten the bolts to Specifications only after the powertrain weight is back onto the mounts and the jack is removed. If more than one mount has been replaced, see Final tightening below.*

Bottom mount

Refer to illustration 16.19

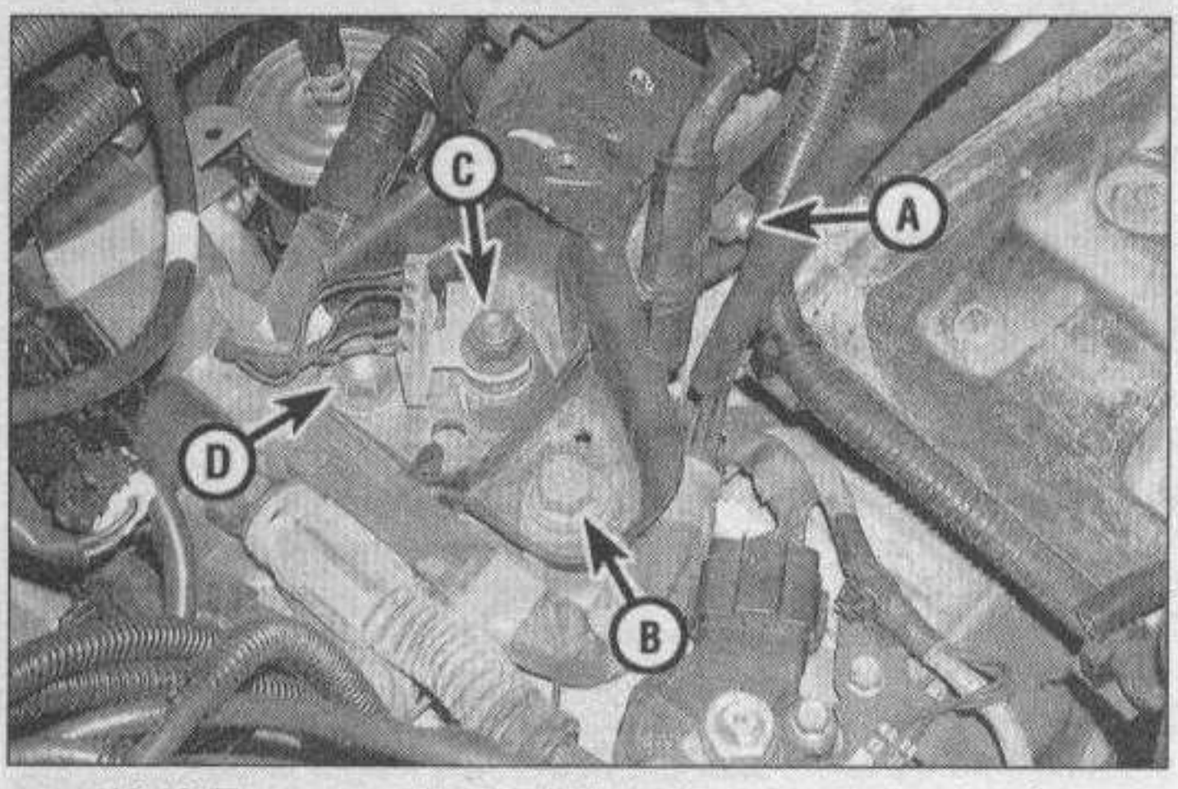
19 On most models, there is an additional mount located at the bottom of the transaxle/engine junction **(see illustration)**.

20 With a jack under the transaxle to take some weight from the mount, remove the two nuts at the crossmember and the two bolts at the transaxle.

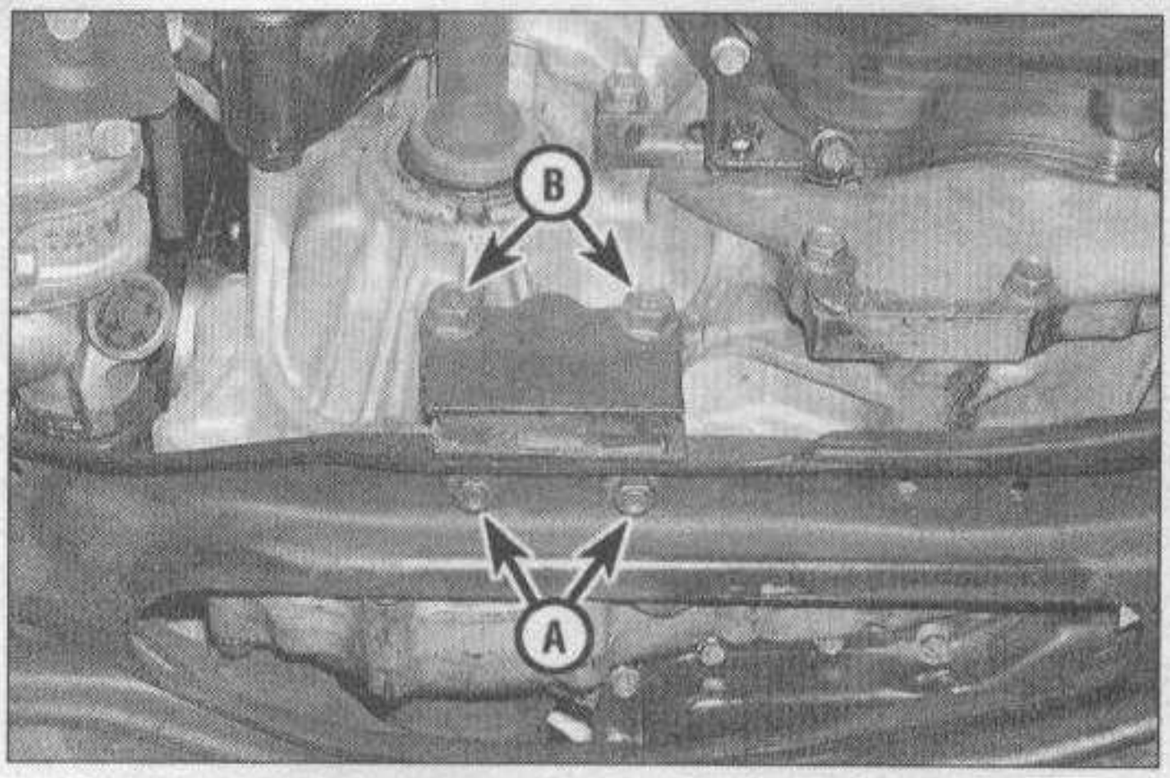
21 Installation is the reverse of removal. **Note:** *Tighten the bolts to Specifications only after the powertrain weight is back onto the mounts and the jack is removed. If more than one mount has been replaced, see Final tightening below.*

Final tightening, all mounts

22 To ensure maximum bushing life and prevent excessive noise and vibration, the vehicle should be level and the engine weight should be on the mounts during the final tightening stage. **Note:** *Use thread locking compound on the nuts/bolts.* Ensure that the bushings are not twisted or offset. All bolts should be started and hand-tightened before any are torqued to Specifications.



16.16 To remove the top left engine mount, remove the throughbolt (A), bolt (B), nut (C), the multiple-ground connector and the stud/bolt underneath nut (C); then remove the last nut (D)



16.19 At the bottom mount, remove the two nuts (A) from the crossmember and the two bolts (B) at the transaxle

Chapter 2 Part C
General engine overhaul procedures

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Specifications

Four-cylinder engine

General

Bore	3.27 inches
Stroke	3.62 inches
Displacement	121.5 cubic inches (2.0 liters)
Cylinder compression pressure	
Standard	171 psi
Minimum	119 psi
Maximum variation between cylinders	15 psi
Oil pressure (engine warm) at 3000 rpm	57 to 71 psi

Cylinder head

Warpage limit	0.002 inch

Valves and valve springs

Valve margin width	
Intake	0.0433 inch
Exhaust	0.0472 inch
Valve stem diameter	
Intake	0.2350 to 0.2356 inch
Exhaust	0.2348 to 0.2354 inch
Valve stem-to-guide clearance	
Intake	0.0010 to 0.0024 inch
Exhaust	0.0030 to 0.0065 inch
Valve spring	
Out-of-square limit	0.061 inch
Free length	1.437 to 1.732 inches

Camshafts and lifters

Lobe height	
Intake	1.6918 inches
Exhaust	1.7062 inches
Allowable lobe loss	0.006 inch
Journal diameter	1.0213 to 1.0222 inches
Out-of-round limit	0.00012 inch

Four-cylinder engine (continued)

Camshafts and lifters

Runout limit	0.0012 inch
Journal oil clearance	
Standard	0.0014 to 0.0032 inch
Service limit	0.006 inch
Endplay	0.0031 to 0.0079 inch
Lifter diameter	1.1795 to 1.1801 inches
Lifter-to-bore clearance	
Standard	0.00098 to 0.00260 inch
Service limit	0.0071 inch
Valve clearance (1998 and later models only)	0.0089 to 0.0116 inch

Crankshaft and connecting rods

Connecting rod journal	
Diameter	1.8874 to 1.8880 inches
Taper limit	0.0002 inch
Out-of-round limit	0.0001 inch
Bearing oil clearance (standard)	0.0005 to 0.0015 inch
Connecting rod side clearance (endplay)	
Standard	0.0043 to 0.0103 inch
Service limit	0.012 inch
Main bearing journal	
Diameter	2.2022 to 2.2029 inches
Taper limit	0.0002 inch
Out-of-round limit	0.0001 inch
Runout limit	0.0012 inch
Bearing oil clearance (standard)	
No. 3 (center) main	0.0012 to 0.0022 inch
All others	0.0009 to 0.0020 inch
Service limit	0.0026 inch
Crankshaft endplay	
Standard	0.0031 to 0.0111 inch
Service limit	0.0118 inch

Engine block

Deck warpage limit	0.0020 inch
Cylinder bore diameter	
Standard	3.2677to 3.2685 inches
Taper and out-of-round limits	0.0004 inch

Pistons and rings

Piston diameter	3.2659 to 3.2667 inches
Piston-to-bore clearance	
Standard	0.0015 to 0.0020 inch
Service limit	0.006 inch
Piston ring end gap	
Compression rings	
Standard	0.006 to 0.012 inch
Service limit	0.020 inch
Oil ring	
Standard	0.008 to 0.028 inch
Service limit	0.035 inch
Piston ring groove clearance (compression rings only)	
Standard	0.0014 to 0.0026 inch
Maximum	0.0033 inch

Torque specifications*

	Ft-lbs (unless otherwise indicated)
Main bearing cap bolts	
Step 1	13 to 16
Step 2	Tighten an additional 90-degrees
Connecting rod cap nuts	
Step 1	16 to 19
Step 2	Tighten an additional 90-degrees
Lower block reinforcement bolts	14 to 18

*__Note:__ *Refer to Part A for additional torque specifications.*

V6 engine

General

Bore	3.33 inches
Stroke	2.92 inches
Displacement	152.2 cubic inches (2.5 liters)
Cylinder compression pressure at 250 rpm	
Standard	203 psi
Minimum	142 psi
Oil pressure (engine hot)	
At 1000 rpm	28 psi
At 3000 rpm	49 to 71 psi

Cylinder head

Warpage limit	0.0039 inch

Valves and valve springs

Valve margin width	
Intake	0.0355 inch
Exhaust	0.0394 inch
Valve stem diameter	
Intake	0.2351 to 0.2356 inch
Exhaust	0.2349 to 0.2354 inch
Valve stem-to-guide clearance	
Intake	0.0010 to 0.0023 inch
Exhaust	0.0012 to 0.0025 inch
Valve spring	
Out-of-square limit	0.0642 inch
Free length	
Intake	1.732 inches
Exhaust	1.847 inches

Camshafts and lifters

Bearing journal diameter	
Rear bank	
No. 1	
Intake	1.1801 to 1.1811 inches
Exhaust	1.0213 to 1.0220 inches
No. 2, 3 and 4	1.0201 to 1.0209 inches
No. 5	1.0213 to 1.0220 inches
Front bank	
No. 1	
Intake	1.0213 to 1.0220 inches
Exhaust	1.1802 to 1.1809 inches
No. 2, 3 and 4	1.0201 to 1.0209 inches
No. 5	1.0213 to 1.0220 inches
Bearing oil clearance	
No. 1 and 5	0.0016 to 0.0032 inch
No. 2, 3 and 4	0.0028 to 0.0044 inch
Lobe height (intake and exhaust)	
Standard	1.7145 inches
Service Limit	1.7067 inches
Endplay	
Standard	0.0020 to 0.0039 inch
Service limit	0.0056 inch
Runout limit	0.0007 inch
Lifter diameter	1.1795 to 1.1801 inches
Lifter-to-bore clearance	
Standard	0.0098 to 0.0026 inch
Service limit	0.0071 inch
Valve clearance (engine cold, 1998 and later only)	
Intake	0.0097 to 0.0124 inch
Exhaust	0.0105 to 0.0131 inch

Crankshaft and connecting rods

Connecting rod journal	
Diameter	2.0843 to 2.0848 inches
Taper and out-of-round limits	0.002 inch
Bearing oil clearance	
Standard	0.0009 to 0.0017 inch
Service limit	0.0032 inch

V6 engine (continued)

Crankshaft and connecting rods

Connecting rod side clearance (endplay)	
Standard	0.0070 to 0.0130 inch
Service limit	0.0160 inch
Main bearing journal	
Diameter	
Standard	2.4385 to 2.4392 inches
Minimum	2.4382 inches
Taper and out-of-round limits	0.0002 inch
Bearing oil clearance	
Standard	0.0015 to 0.0022 inch
Service limit	0.0025 inch
Crankshaft endplay	
Standard	0.0032 to 0.0111 inch
Service limit	0.0125 inch
Thrust washer thickness	0.0788 to 0.0807 inch

Engine block

Deck warpage limit	0.0059 inch
Cylinder bore diameter	3.3268 to 3.3276 inches

Pistons and rings

Piston diameter (standard)	3.3250 to 3.261 inches
Piston-to-bore clearance	
Standard	0.0012 to 0.0022 inches
Service limit	0.0051 inch
Piston ring end gap	
No. 1 (top) compression ring	0.0060 to 0.0118 inch
No. 2 (middle) compression ring	0.010 to 0.015 inch
Oil ring	0.008 to 0.027 inch
Piston ring groove clearance	
No. 1 (top) compression ring	0.0008 to 0.0026 inch
No. 2 (middle) compression ring	0.0012 to 0.0026 inch
Maximum	0.006 inch

Torque specifications*

	Ft-lbs (unless otherwise indicated)
Main bearing cap assembly bolts	
Step 1, A and B bolts	17 to 19
Step 2, C bolts	156 to 180 in-lbs
Step 3, A bolts	Tighten an additional 80-degrees
Step 4, B bolts	Tighten an additional 70-degrees
Step 5, C bolts	Tighten an additional 60-degrees
Step 6, A, B and C bolts	Repeat Steps 3, 4 and 5
Lower block half-to-upper-half perimeter bolts**	168 to 180 in-lbs
Connecting rod cap bolts	
Step 1	16 to 19
Step 2	Tighten an additional 90-degrees

*__Note:__ *Refer to Part B for additional torque specifications.*
**__Note:__ *Tighten after main cap tightening sequence.*

1 General information - engine overhaul

Included in this portion of Chapter 2 are the general overhaul procedures for the cylinder head and internal engine components.

The information ranges from advice concerning preparation for an overhaul and the purchase of replacement parts to detailed, step-by-step procedures covering removal and installation of internal engine components and the inspection of parts.

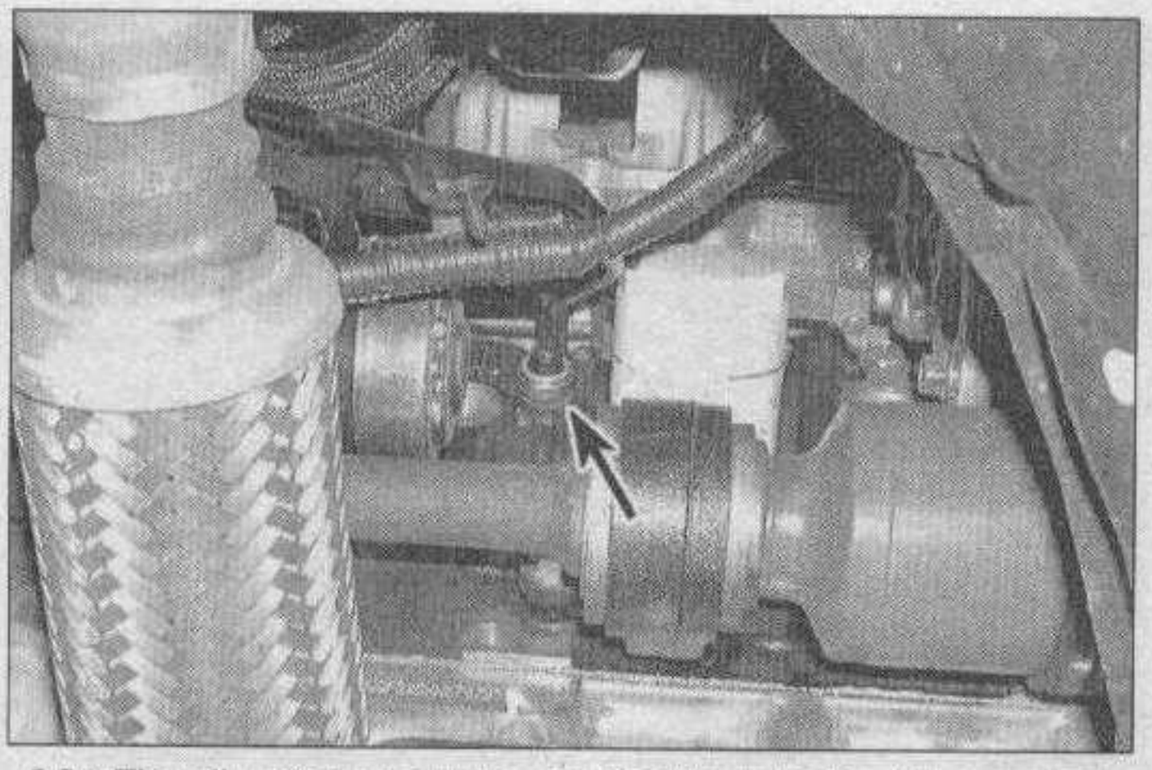
The following Sections have been written based on the assumption that the engine has been removed from the vehicle. For information concerning in-vehicle engine repair, as well as removal and installation of the external components necessary for the overhaul, see Chapter 2A or 2B.

The Specifications included in this Part are only those necessary for the inspection and overhaul procedures which follow. Refer to Chapter 2A or 2B for additional Specifications.

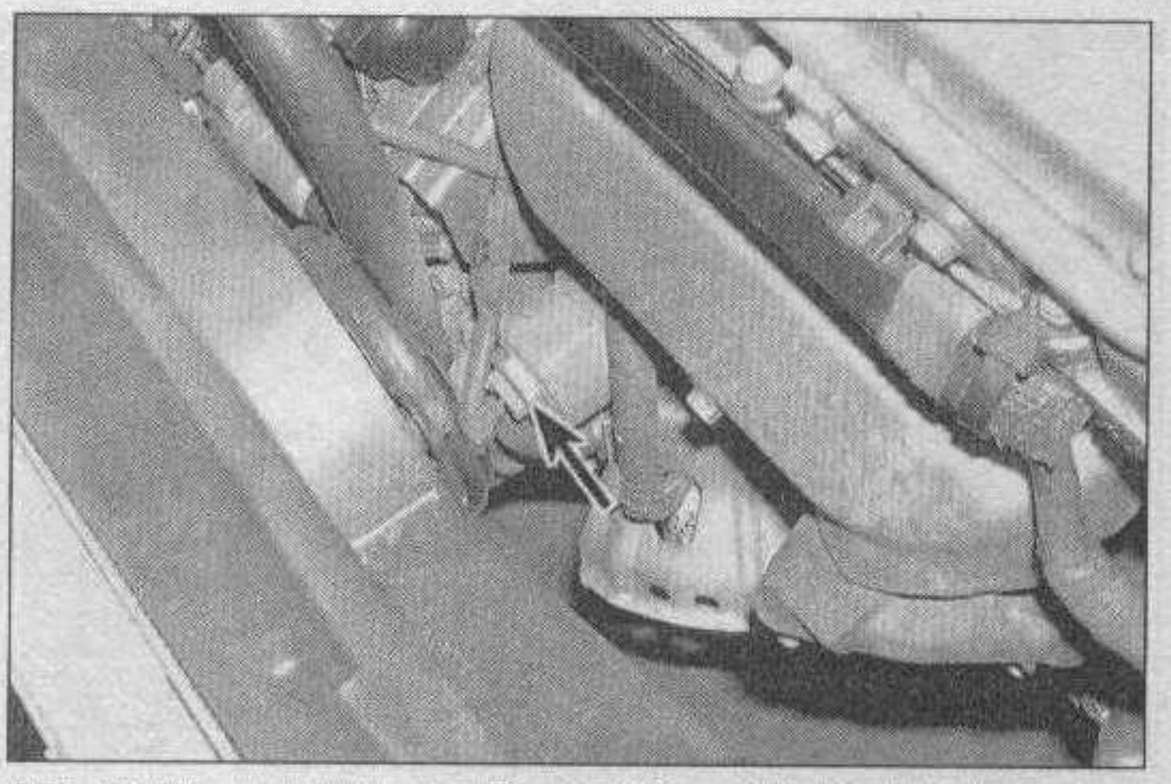
It's not always easy to determine when, or if, an engine should be completely overhauled, as a number of factors must be considered.

High mileage is not necessarily an indication that an overhaul is needed, while low mileage doesn't preclude the need for an overhaul. Frequency of servicing is probably the most important consideration. An engine that's had regular and frequent oil and filter changes, as well as other required maintenance, will most likely give many thousands of miles of reliable service. Conversely, a neglected engine may require an overhaul very early in its life.

Excessive oil consumption is an indication that piston rings, valve seals and/or valve guides are in need of attention. Make sure that oil leaks aren't responsible before deciding that the rings and/or guides are bad. Perform a cylinder compression check to determine the extent of the work required (see Section 3). Also check the vacuum readings



2.2a The oil pressure can be checked by removing the sending unit (arrow) and installing a pressure gauge in its place (four-cylinder engine shown)



2.2b On V6 models, the sending unit (arrow) is located at the front of the engine, on the oil cooler adapter

under various conditions (see Section 4).

Loss of power, rough running, knocking or metallic engine noises, excessive valve train noise and high fuel consumption rates may also point to the need for an overhaul, especially if they're all present at the same time. If a complete tune-up doesn't remedy the situation, major mechanical work is the only solution.

An engine overhaul involves restoring the internal parts to the specifications of a new engine. During an overhaul, the piston rings are replaced and the cylinder walls are reconditioned (re-bored and/or honed). If a re-bore is done by an automotive machine shop, new oversize pistons will also be installed. The main bearings, connecting rod bearings and camshaft bearings are generally replaced with new ones and, if necessary, the crankshaft may be reground to restore the journals. Generally, the valves are serviced as well, since they're usually in less-than-perfect condition at this point. While the engine is being overhauled, other components, such as the distributor, starter and alternator, can be rebuilt as well. The end result should be a like-new engine that will give many trouble-free miles. **Note:** *Critical cooling system components such as the hoses, drivebelts, thermostat and water pump should be replaced with new parts when an engine is overhauled. The radiator should be checked carefully to ensure that it isn't clogged or leaking* (see Chapter 3). *If you purchase a rebuilt engine or short block, some rebuilders will not warranty their engines unless the radiator has been professionally flushed. Always install a new oil pump when an engine is rebuilt.*

Before beginning the engine overhaul, read through the entire procedure to familiarize yourself with the scope and requirements of the job. Overhauling an engine isn't difficult, but it is time-consuming. Plan on the vehicle being tied up for a minimum of two weeks, especially if parts must be taken to an automotive machine shop for repair or reconditioning. Check on availability of parts and make sure that any necessary special tools and equipment are obtained in advance. Most work can be done with typical hand tools, although a number of precision measuring tools are required for inspecting parts to determine if they must be replaced. Often an automotive machine shop will handle the inspection of parts and offer advice concerning reconditioning and replacement. **Note:** *Always wait until the engine has been completely disassembled and all components, especially the engine block, have been inspected before deciding what service and repair operations must be performed by an automotive machine shop*. Since the block's condition will be the major factor to consider when determining whether to overhaul the original engine or buy a rebuilt one, never purchase parts or have machine work done on other components until the block has been thoroughly inspected. As a general rule, time is the primary cost of an overhaul, so it doesn't pay to install worn or substandard parts.

As a final note, to ensure maximum life and minimum trouble from a rebuilt engine, everything must be assembled with care in a spotlessly-clean environment.

2 Oil pressure check

Refer to illustrations 2.2a and 2.2b

1 Low engine oil pressure can be a sign of an engine in need of rebuilding. A "low oil pressure" indicator (often called an "idiot light") is not a test of the oiling system. Such indicators only come on when the oil pressure is dangerously low. Even the oil pressure gauge in the instrument panel is only a relative indication, although much better for driver information than a warning light. A better test is with a mechanical (not electrical) oil pressure gauge. When used in conjunction with an accurate tachometer, an engine's oil pressure performance can be compared to factory Specifications for that year and model.

2 Locate the oil pressure indicator sending unit **(see illustrations)**.

3 Remove the oil pressure sending unit and install a fitting which will allow you to directly connect your hand-held, mechanical oil pressure gauge. Use Teflon tape or sealant on the threads of the adapter and the fitting on the end of your gauge's hose.

4 Connect an accurate tachometer to the engine, according to the tachometer manufacturer's instructions.

5 Check the oil pressure with the engine running (full operating temperature) at the specified engine speed, and compare it to this Chapter's Specifications. If it's extremely low, the bearings and/or oil pump are probably worn out.

3 Cylinder compression check

Refer to illustration 3.6

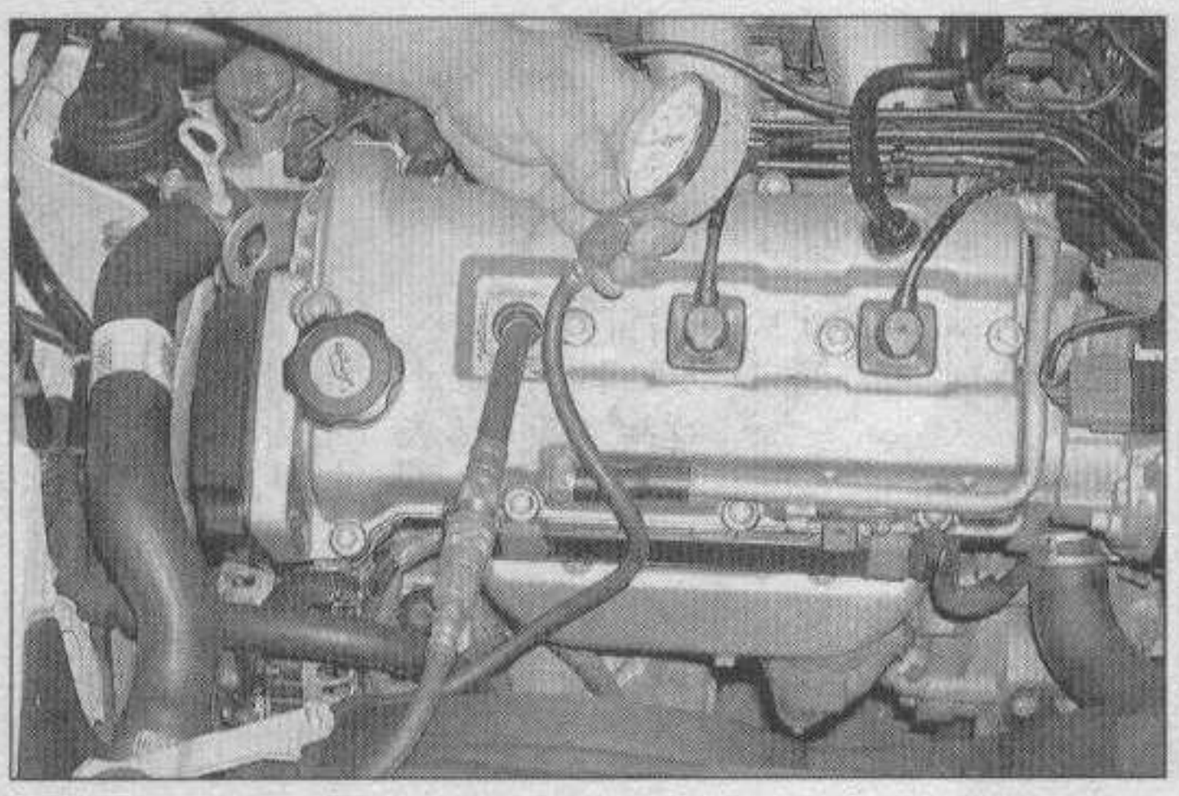
1 A compression check will tell you what mechanical condition the upper end of your engine (pistons, rings, valves, head gaskets) is in. Specifically, it can tell you if the compression is down due to leakage caused by worn piston rings, defective valves and seats or a blown head gasket. **Note:** *The engine must be at normal operating temperature and the battery must be fully charged for this check.*

2 Begin by cleaning the area around the spark plugs before you remove them (compressed air should be used, if available, otherwise a small brush or even a bicycle tire pump will work). The idea is to prevent dirt from getting into the cylinders as the compression check is being done.

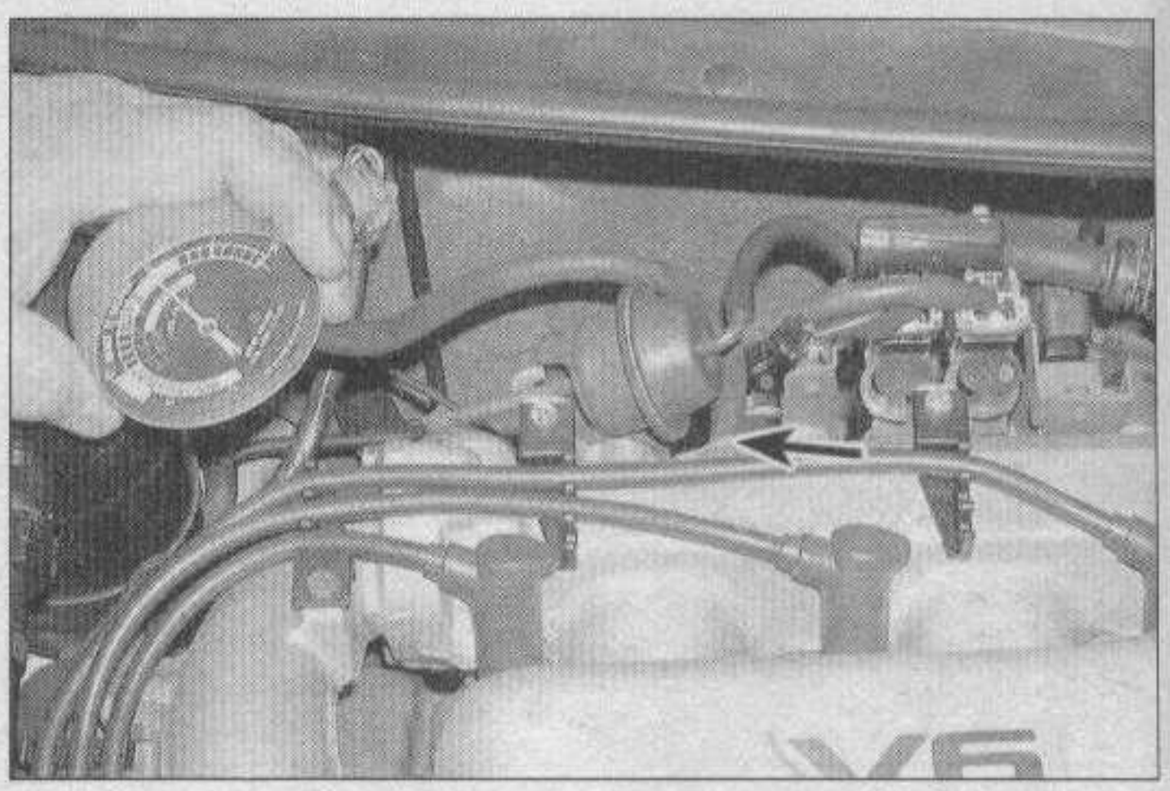
3 Remove all of the spark plugs from the engine (see Chapter 1).

4 Block the throttle wide open.

5 Detach the coil wire from the center of the distributor cap and ground it on the engine block (on models without a distributor, disconnect the electrical connector from the ignition coil module). Use a jumper wire



3.6 A compression gauge with a threaded fitting for the spark plug hole is preferred over the type that requires hand pressure to maintain the seal - a long hose on the adapter is needed due to the depth of the spark plug holes



4.4 A simple vacuum gauge can be very handy in diagnosing engine condition and performance - arrow indicates source of manifold vacuum

with alligator clips on each end to ensure a good ground. The fuel pump circuit should also be disabled (see Chapter 4).

6 Install the compression gauge in the spark plug hole **(see illustration)**.

7 Crank the engine over at least seven compression strokes and watch the gauge. The compression should build up quickly in a healthy engine. Low compression on the first stroke, followed by gradually increasing pressure on successive strokes, indicates worn piston 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 and compare the results to this Chapter's Specifications.

9 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 that 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 slightly lower than the others, and the engine has a slightly rough idle, a worn 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 head(s) 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.

4 Vacuum gauge diagnostic checks

Refer to illustrations 4.4 and 4.6

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 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 absolute 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 (throttle body) vacuum **(see illustration)**. 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. **Warning:** *Keep your hands and the vacuum gauge clear of the fans.*

Read the vacuum gauge; an average, healthy engine should normally produce about 17 to 22 in-Hg with a fairly steady needle **(see illustration)**. 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 cylinder head(s) or throttle body, a leaky vacuum hose, late ignition timing or incorrect camshaft timing. Check ignition timing with a timing light and 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 or a faulty fuel injector.

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 check or leak-down test to confirm this.

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

5 A rapid vibration of about four in-Hg vibration at idle combined with exhaust smoke indicates worn valve guides. Perform a leak-down test to confirm this. If the rapid vibration occurs with an increase in engine speed, check for a leaking intake manifold gasket or head gasket, weak valve springs, burned valves or ignition misfire.

6 A slight fluctuation, say one inch up and down, may mean ignition problems. Check all the usual tune-up items and, if necessary, run the engine on an ignition analyzer.

7 If there is a large fluctuation, perform a compression or leak-down test to look for a weak or dead cylinder or a blown head gasket.

0279H

Low , steady reading

0282H

Low, fluctuating needle

0280H

regular drops

0281H

Irregular drops

0278H

Rapid vibration

0284H

Large fluctuation

0283H

Slow Fluctuation

4.6 Typical vacuum gauge readings

8 If the needle moves slowly through a wide range, check for a clogged PCV system, incorrect idle fuel mixture, carburetor/throttle body or intake manifold gasket leaks.

9 Check for a slow return after revving the engine by quickly snapping the throttle open until the engine reaches about 2,500 rpm and let it shut. Normally the reading should drop to near zero, rise above normal idle reading (about 5 in-Hg over) and then return to the previous idle reading. If the vacuum returns slowly and doesn't peak when the throttle is snapped shut, the rings may be worn. If there is a long delay, look for a restricted exhaust system (often the muffler or catalytic converter). An easy way to check this is to temporarily disconnect the exhaust ahead of the suspected part and redo the test.

5 Engine rebuilding alternatives

The do-it-yourselfer is faced with a number of options when performing an engine overhaul. The decision to replace the engine block, piston/connecting rod assemblies and crankshaft depends on a number of factors, with the number one consideration being the condition of the block. Other considerations are cost, access to machine shop facilities, parts availability, time required to complete the project and the extent of prior mechanical experience on the part of the do-it-yourselfer.

Some of the rebuilding alternatives include:

Individual parts - If the inspection procedures reveal that the engine block and most engine components are in reusable condition, purchasing individual parts may be the most economical alternative. The block, crankshaft and piston/connecting rod assemblies should all be inspected carefully. Even if the block shows little wear, the cylinder bores should be surface-honed.

Short block - A short block consists of an engine block with a crankshaft and piston/connecting rod assemblies already installed. All new bearings are incorporated and all clearances will be correct. The existing camshaft, valve train components, cylinder head(s) and external parts can be bolted to the short block with little or no machine shop work necessary.

Long block - A long block consists of a short block plus an oil pump, oil pan, cylinder head(s), valve cover(s), camshaft and valve train components, timing sprockets and chain or gears and timing cover. All components are installed with new bearings, seals and gaskets incorporated throughout. The installation of manifolds and external parts is all that's necessary.

Used engine assembly - While overhaul provides the best assurance of a like-new engine, used engines available from wrecking yards and importers are often a very simple and economical solution. Many used engines come with warranties, but always give any engine a thorough diagnostic check-out before purchase. Check compression, vacuum and also for signs of oil leakage. If possible, have the seller run the engine, ether in the vehicle or on a test stand so you can be sure it runs smoothly with no knocking or other noises.

Give careful thought to which alternative is best for you and discuss the situation with local automotive machine shops, auto parts dealers and experienced rebuilders before ordering or purchasing replacement parts.

6 Engine removal - methods and precautions

If you've decided that an engine must be removed for overhaul or major repair work, several preliminary steps should be taken.

Locating a suitable place to work is extremely important. Adequate work space, along with storage space for the vehicle, will be needed. If a shop or garage isn't available, at the very least a flat, level, clean work surface made of concrete or asphalt is required.

Cleaning the engine compartment and engine before beginning the removal procedure will help keep tools clean and organized.

An engine hoist or A-frame will also be necessary. Make sure the equipment is rated in excess of the combined weight of the engine and transaxle. Safety is of primary importance, considering the potential hazards involved in lifting the engine out of the vehicle.

If the engine is being removed by a novice, a helper should be available. Advice and aid from someone more experienced would also be helpful. There are many instances when one person cannot simultaneously perform all of the operations required when lifting the engine out of the vehicle.

Plan the operation ahead of time. Arrange for or obtain all of the tools and equipment you'll need prior to beginning the job. Some of the equipment necessary to perform engine removal and installation safely and with relative ease are (in addition to an engine hoist) a heavy duty floor jack, complete sets of wrenches and sockets as described in the front of this manual, wooden blocks and plenty of rags and cleaning solvent for mopping up spilled oil, coolant and gasoline. If the hoist must be rented, make sure that you arrange for it in advance and perform all of the operations possible without it beforehand. This will save you money and time.

Plan for the vehicle to be out of use for

quite a while. A machine shop will be required to perform some of the work which the do-it-yourselfer can't accomplish without special equipment. These shops often have a busy schedule, so it would be a good idea to consult them before removing the engine in order to accurately estimate the amount of time required to rebuild or repair components that may need work.

Always be extremely careful when removing and installing the engine. Serious injury can result from careless actions. Plan ahead, take your time and a job of this nature, although major, can be accomplished successfully.

7 Engine - removal and installation

Refer to illustrations 7.7, 7.15a, 7.15b, 7.15c and 7.20

Note: *Read through the entire Section before beginning this procedure. The manufacturer recommends removing the engine and transaxle from the top as a unit, then separating the engine from the transaxle on the shop floor. This applies to all V6 models and four-cylinder applications with a manual transaxle. On four-cylinder models with an automatic transaxle, the engine may be removed from the top while the transaxle stays in the vehicle (supported by a jack).*

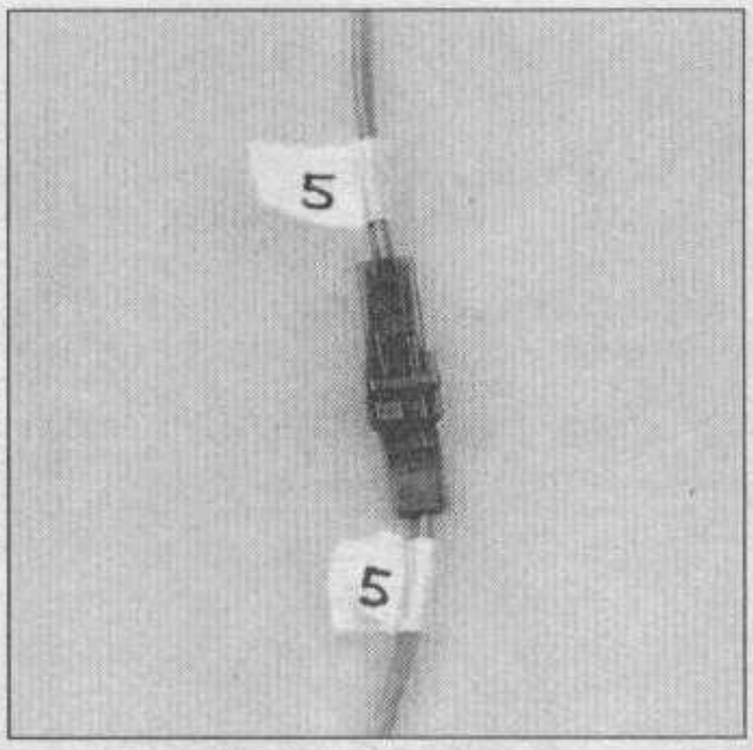
Removal

Warning 1: *The models covered by this manual are equipped with Supplemental Restraint systems (SRS), more commonly known as airbags. Always disable the airbag system before working in the vicinity of the airbag system components to avoid the possibility of accidental deployment of the airbag, which could cause personal injury* (see Chapter 12).

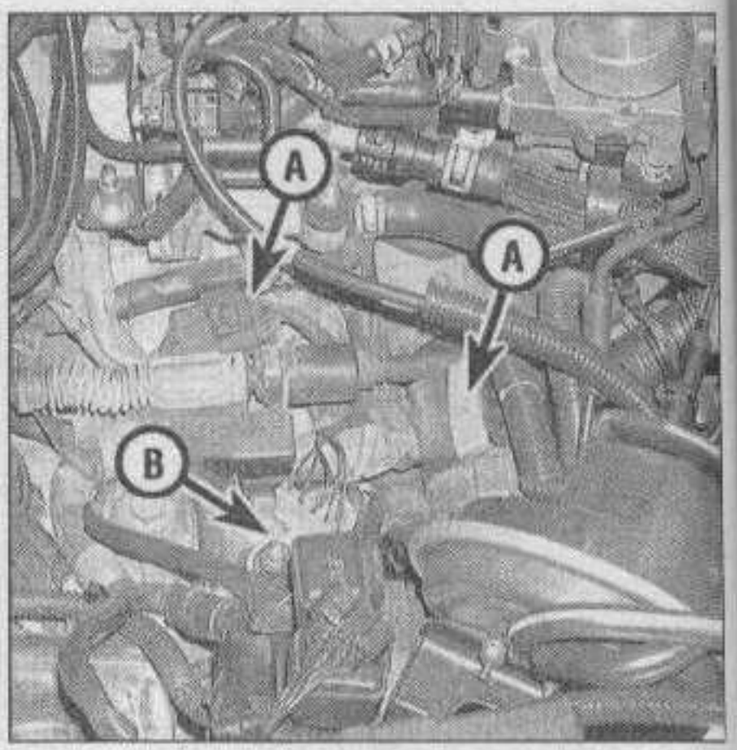
Warning 2: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or a clothes dryer) with a pilot light is present. Since gasoline is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. The fuel system is under constant pressure, so, if any fuel lines are to be disconnected, the fuel pressure in the system must be relieved first (see Chapter 4 for more information). When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand.*

1 Relieve the fuel system pressure (see Chapter 4).

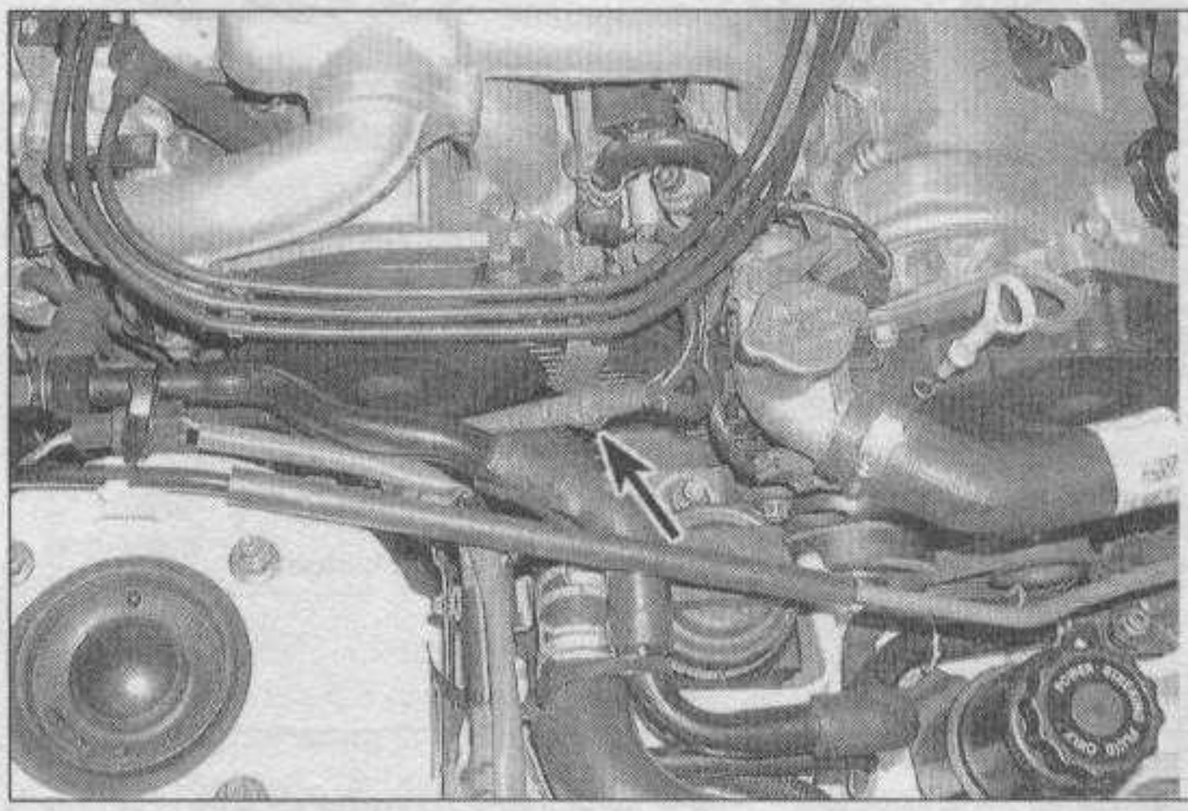
2 Disconnect the negative cable from the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*



7.7 Label both ends of each wire and hose before disconnecting it



7.15a Disconnect the main wiring harness electrical connectors (A), and the ground connector (B)



7.15b Disconnect the temperature sensors and crankshaft position sensor, then remove the engine harness bracket (arrow) and set the wiring aside

3 Remove the battery and battery tray.

4 Place protective covers on the fenders and cowl and remove the hood (see Chapter 11).

5 Remove the air cleaner assembly (see Chapter 4). Remove the splash shields.

6 Raise the vehicle and support it securely on jackstands. Drain the cooling system and engine oil and remove the drivebelts (see Chapter 1).

7 Clearly label, then disconnect all vacuum lines, coolant and emissions hoses, wiring harness connectors, ground straps and fuel lines. Masking tape and/or a touch-up paint applicator work well for marking items **(see illustration)**. Take instant photos or sketch the locations of components and brackets.

8 Remove the cooling fans/shroud and radiator (see Chapter 3). Remove the upper and lower radiator hoses. Disconnect the heater hoses from the engine.

9 Release the residual fuel pressure in the tank by removing the gas cap, then undo the fuel lines connecting the engine to the chassis (see Chapter 4). Plug or cap all open fittings.

10 On four-cylinder models, remove the intake manifold brace.

11 Refer to Chapter 5 and remove the starter motor.

12 Refer to Chapter 2A or 2B, and remove the crankshaft pulley.

13 On four-cylinder models, remove the alternator (see Chapter 5).

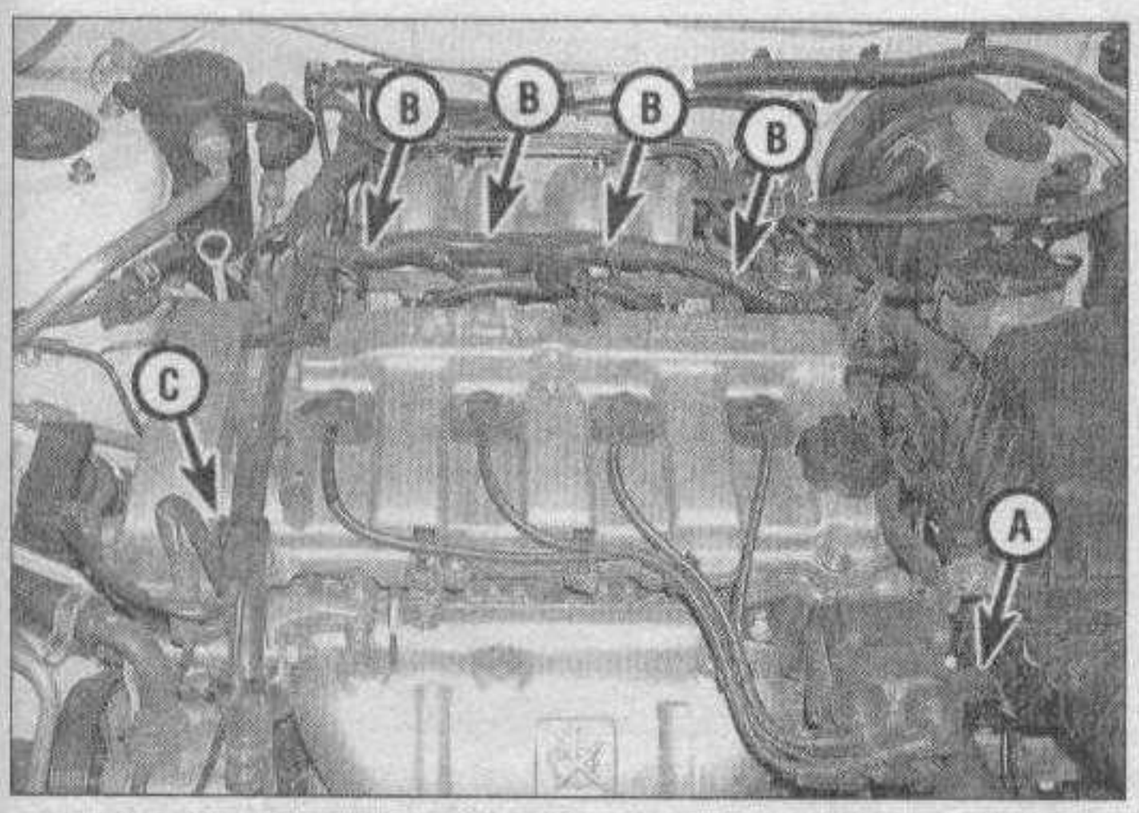
14 Disconnect the throttle linkage, transmission Throttle Valve (TV) linkage and speed control cable, if equipped, from the engine (see Chapter 4).

15 Disconnect the engine wiring harness connectors and retaining clips from the engine **(see illustrations)**. Pull the wiring harness back from the engine and secure it aside.

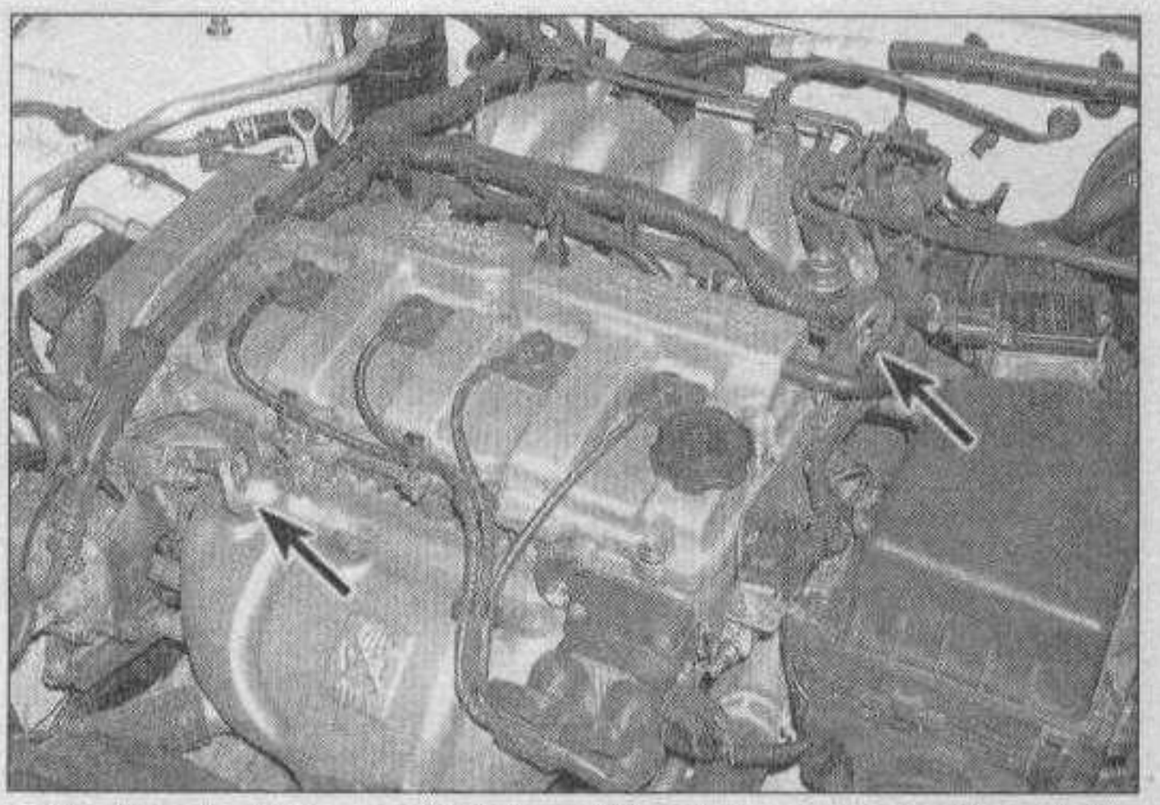
16 On models equipped with power steering equipped, remove the power steering pump. If clearance allows, secure the pump aside without disconnecting the hoses. If necessary, remove the pump (see Chapter 10).

17 On models equipped with air-conditioning, unbolt the compressor and secure it aside (see Chapter 3). Do not disconnect the refrigerant hoses.

18 Disconnect the electrical connector from the oxygen sensor. Detach the exhaust pipe(s) from the manifold(s) (see Chapter 4)



7.15c On four-cylinder models, disconnect the electrical connectors at the distributor (A), the fuel injectors (B) and detach the retaining clips (C), then lay the harness back over the cowl



7.20 Attach a sling or chain securely-fastened with bolts/nuts to the two lifting eyes (arrows) - four-cylinder shown, V6 similar

and detach the exhaust insulators from the brackets. Remove the crossmember and lower the exhaust pipe.

19 On V6 engines equipped with an oil cooler (small canister mounted between the oil filter and the block), remove the oil filter, hoses connected to the cooler, and the oil cooler (see Chapter 3).

20 Attach a lifting sling to the engine **(see illustration)**. Position a hoist and connect the sling to it. Take up the slack until there is slight tension on the hoist.

21 On four-cylinder models equipped with an automatic transaxle, remove the passenger-side driveaxle (see Chapter 8), and detach the torque converter dust shield from the lower bellhousing. Remove the torque converter-to-driveplate fasteners (see Chapter 7) and push the converter back slightly into the bellhousing.

22 On all V6 and four-cylinder manual transaxle models, the engine and transaxle are removed as a unit. Refer to Chapter 7 and disconnect all linkages and electrical connectors at the transaxle. Refer to Chapter 8 and remove the driveaxles.

23 Remove the bolts/nuts securing the front and rear engine mounts to the chassis, and the lower mount at the crossmember (see Chapter 2A or 2B).

24 On four-cylinder automatic transaxle models, remove the engine-to-transaxle bolts and separate the engine from the transaxle. The torque converter should remain in the transaxle. Support the transaxle with a floor-jack. Place a block of wood on the jack head to prevent damage to the transaxle. On all other models, the transaxle is to be removed with the engine, and the engine-to-transaxle bolts should remain in place at this time.

25 Recheck to be sure nothing except the right and left engine mounts are still connecting the engine to the vehicle or to the transaxle. Disconnect and label anything still remaining.

26 Remove the bolts from the right and left engine mounts. **Warning:** *Do not place any part of your body under the engine/transaxle when it's supported only by a hoist or other lifting device.*

27 Slowly lift the engine (or engine/transaxle) out of the vehicle. It may be necessary to pry the mounts away from the frame brackets.

28 Move the engine away from the vehicle and carefully lower the hoist until the engine can be set on the floor; or remove the flywheel/driveplate (and engine rear plate on four-cylinder engines) and mount the engine on an engine stand. **Note:** *On automatic transaxle-equipped models, mark the front and rear spacer plates and keep them with the driveplate.*

Installation

29 Check the engine/transaxle mounts. If they're worn or damaged, replace them.

30 On manual transaxle equipped models, inspect the clutch components (see Chapter 8) and on automatic models inspect the converter seal and bushing.

31 On manual transaxle equipped vehicles, apply a dab of high temperature grease to the pilot bearing. On automatic transaxle equipped models, apply a dab of grease to the nose of the converter.

32 Carefully guide the transaxle into place, following the procedure outlined in Chapter 7B. **Caution:** *Do not use the bolts to force the engine and transaxle into alignment. It may crack or damage major components.*

33 Install the engine-to-transaxle bolts and tighten them securely.

34 Attach the hoist to the engine lifting eyes and carefully lower the engine/transaxle assembly into the engine compartment. **Note:** *If the engine was removed with the transaxle remaining in the car, lower the engine into the car until an assistant can help you line up the dowels pins on the block with the transaxle. Some twisting and angling of the engine and/or the transaxle will be necessary to secure proper alignment of the two. See Chapter 7 for alignment of the converter with the flywheel.*

35 Install the mount bolts and tighten them securely.

36 Reinstall the remaining components and fasteners in the reverse order of removal.

37 Add coolant, oil, power steering and transmission fluids as needed (see Chapter 1).

38 Run the engine and check for proper operation and leaks. Shut off the engine and recheck the fluid levels.

8 Engine overhaul - disassembly sequence

1 It's much easier to disassemble and work on the engine if it's mounted on a portable engine stand. A stand can often be rented quite cheaply from an equipment-rental yard. Before the engine is mounted on a stand, the flywheel/driveplate and rear oil seal retainer should be removed from the engine.

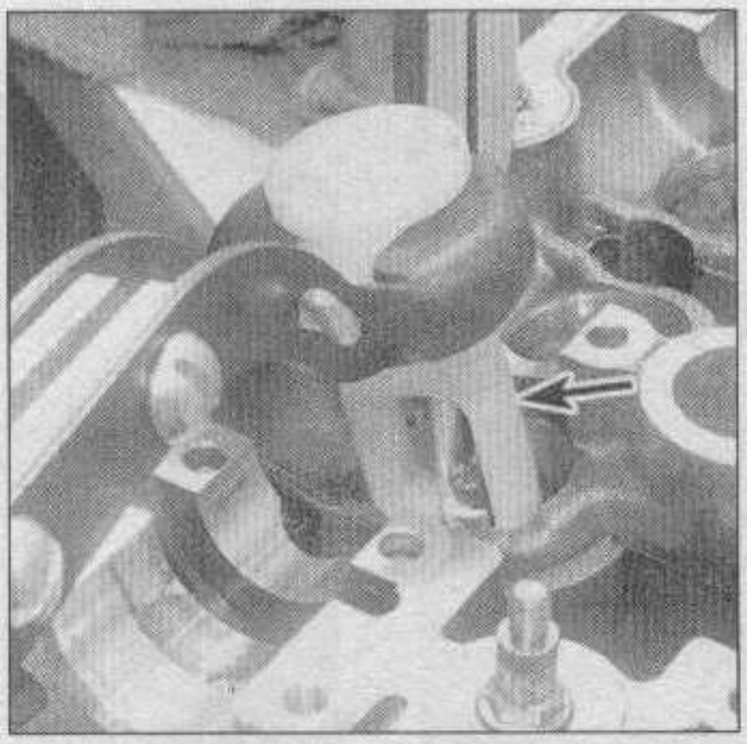
2 If a stand isn't available, it's possible to disassemble the engine with it blocked up on the floor. Be extra careful not to tip or drop the engine when working without a stand.

3 If you're going to obtain a rebuilt engine, all external components must come off first, to be transferred to the replacement engine, just as they will if you're doing a complete engine overhaul yourself. These include:

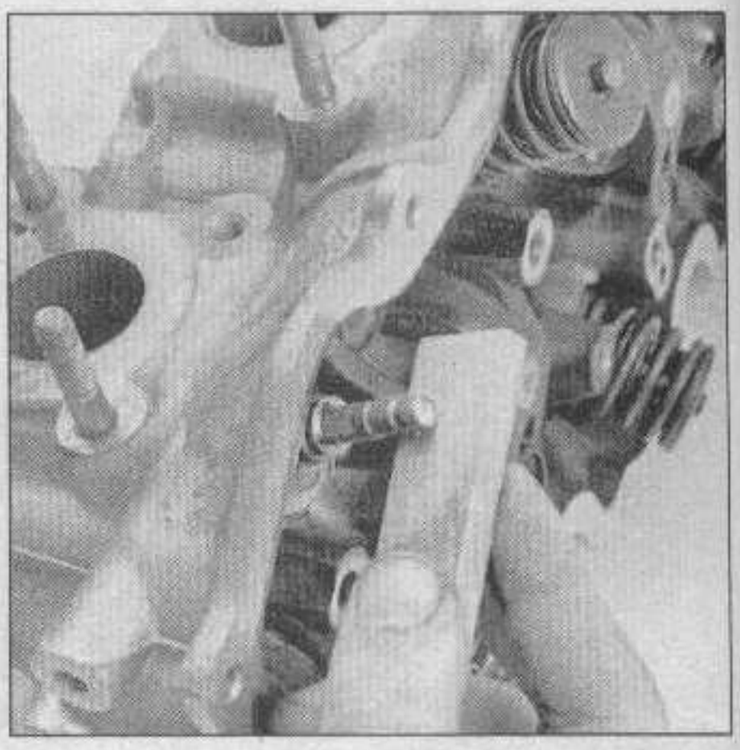
Alternator and brackets
Emissions control components
Distributor, spark plug wires and spark plugs (coilpack on 1998 and later models)
Thermostat and housing cover
Water pump
EFI components
Intake/exhaust manifolds
Oil filter
Engine mounts
Clutch and flywheel/driveplate

Note: *When removing the external components from the engine, pay close attention to*

9.2 A small plastic bag, with an appropriate label, can be used to store the valve train components so they can be kept together and reinstalled in the correct guide



9.3 Compress the spring until the valve stem locks can be removed with a small magnet or needle-nose pliers - because of tight quarters, a spring compressor must be used with an adapter (arrow) that has a slot in the side to access the valve stem locks



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

details that may be helpful or important during installation. Note the installed position of gaskets, seals, spacers, pins, brackets, washers, bolts and other small items.

4 If you're obtaining a short block, which consists of the engine block, crankshaft, pistons and connecting rods all assembled, then the cylinder head(s), oil pan and oil pump will have to be removed as well. See *Engine rebuilding alternatives* for additional information regarding the different possibilities to be considered.

5 If you're planning a complete overhaul, the engine must be disassembled and the internal components removed in the following order:

Valve cover(s)
Intake and exhaust manifolds
Timing belt covers
Timing belt and sprockets
Cylinder head(s)
Oil pan and baffle
Oil pump
Piston/connecting rod assemblies
Crankshaft rear oil seal
Lower block reinforcement
Crankshaft and main bearings

6 Before beginning the disassembly and overhaul procedures, make sure the following items are available. Also, refer to Section 22 for a list of tools and materials needed for engine reassembly.

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

9 Cylinder head - disassembly

Refer to illustrations 9.2, 9.3 and 9.4

Note: *New and rebuilt cylinder heads are commonly available for most engines at dealerships and auto parts stores. Due to the fact that some specialized tools are necessary for the disassembly and inspection procedures, and replacement parts may not be readily available, it may be more practical and economical for the home mechanic to purchase replacement head(s) rather than taking the time to disassemble, inspect and recondition the original(s).*

1 Cylinder head disassembly involves removal of the intake and exhaust valves and related components. It's assumed that the lifters and camshaft(s) have already been removed (see Chapter 2A or 2B).

2 Before the valves are removed, arrange to label and store them, along with their related components, so they can be kept separate and reinstalled in the same valve guides they are removed from **(see illustration)**.

3 Compress the springs on the first valve with a spring compressor and remove the valve stem locks **(see illustration)**. Carefully release the valve spring compressor and remove the retainer, the spring and the spring seat (if used). **Caution:** *Be very careful not to nick or otherwise damage the lifter bores when compressing the valve springs.*

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

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

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

10 Cylinder head - cleaning and inspection

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

Note: *If the engine was severely overheated, the cylinder head is probably warped (see Step 12).*

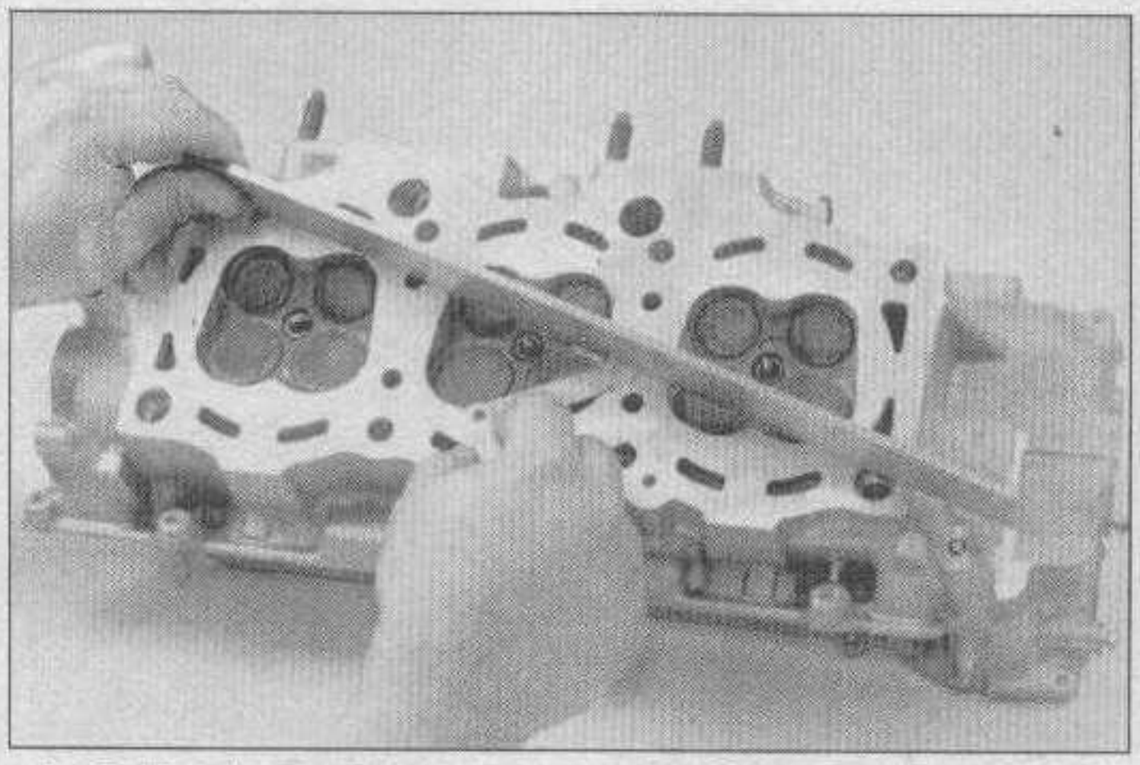
Cleaning

2 Scrape all traces of old gasket material and sealing compound off the head gasket, intake manifold and exhaust manifold sealing surfaces. Be very careful not to gouge the cylinder head. Special gasket-removal solvents that soften gaskets and make removal much easier are available at auto parts stores.

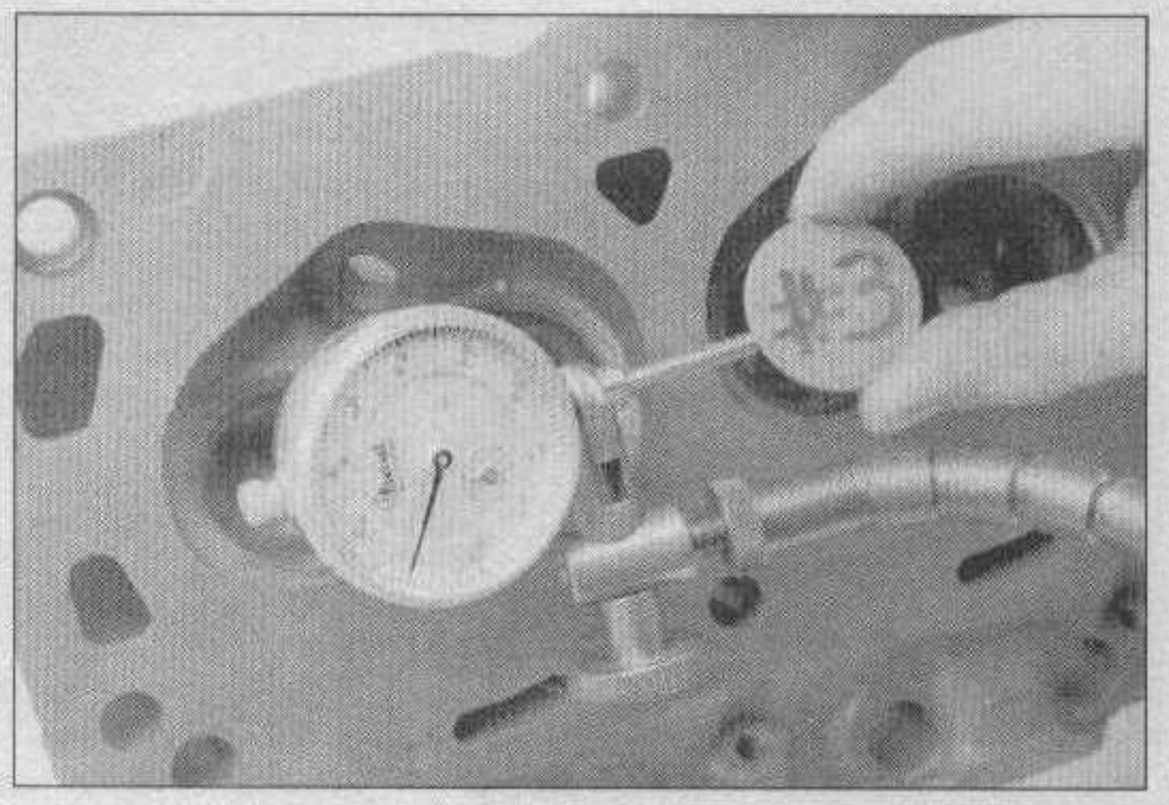
3 Remove all built-up scale from the coolant passages.

4 Run a stiff wire brush through the various holes to remove deposits that may have formed in them. If there are heavy rust deposits in the water passages, the bare head should be professionally cleaned at a machine shop.

5 Run an appropriate-size tap into each of the threaded holes to remove corrosion and thread sealant that may be present. If com-



10.12 Check the cylinder head gasket surfaces for warpage by trying to slip a feeler gauge under the precision straightedge (see the Specifications for the maximum warpage allowed and use a feeler gauge of that thickness)



10.14 A dial indicator can be used to measure valve stem-to-guide clearance - move the valve stem back and forth as shown (typical)

pressed air is available, use it to clear the holes of debris produced by this operation. **Warning:** *Wear eye protection when using compressed air!*

6 Clean the exhaust and intake manifold stud threads with a wire brush.

7 Clean the cylinder head with solvent and dry it thoroughly. Compressed air will speed the drying process and ensure that all holes and recessed areas are clean. **Note:** *Decarbonizing chemicals are available and may prove very useful when cleaning cylinder heads and valve train components. They are very caustic and should be used with caution. Be sure to follow the instructions on the container.*

8 Clean the lifters with solvent and dry them thoroughly (don't mix them up during the cleaning process). Compressed air will speed the drying process and can be used to clean out the oil passages. Hydraulic lifters should be stored upside-down in clean engine oil.

9 Clean all the valve springs, spring seats, valve stem locks and retainers with solvent and dry them thoroughly. Work on the components from one valve at a time to avoid mixing up the parts.

10 Scrape off any heavy deposits that may have formed on the valves, then use a motorized wire brush to remove deposits from the valve heads and stems. Again, make sure the valves don't get mixed up.

Inspection

Refer to illustrations 10.12, 10.14, 10.15, 10.16, 10.17 and 10.18

Note: *Be sure to perform all of the following inspection procedures before concluding that machine shop work is required. Make a list of the items that need attention. The inspection procedures for the lifters and the camshafts, can be found in Section 21.*

Cylinder head

11 Inspect the head very carefully for cracks, evidence of coolant leakage and other damage. If cracks are found, check with an automotive machine shop concerning repair. If repair isn't possible, a new cylinder head should be obtained.

12 Using a straightedge and feeler gauge, check the head gasket mating surface for warpage **(see illustration)**. If the warpage exceeds the limit found in this Chapter's Specifications, it can be resurfaced at an automotive machine shop.

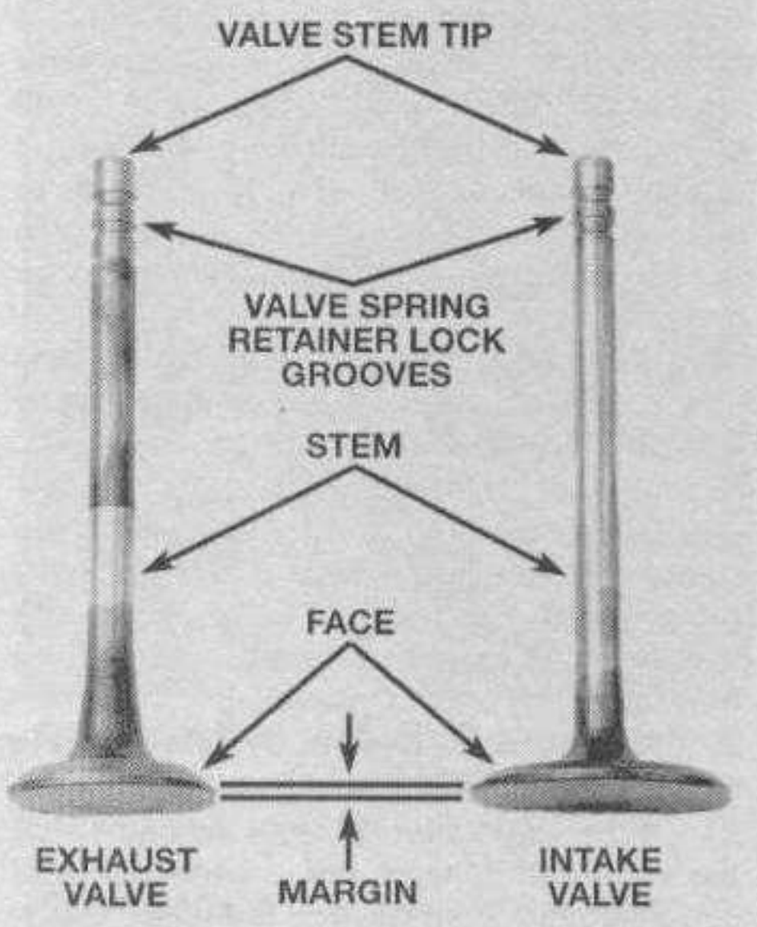
13 Examine the valve seats in each of the combustion chambers. If they're pitted, cracked or burned, the head will require valve service that's beyond the scope of the home mechanic.

14 Check the valve stem-to-guide clearance with a dial indicator **(see illustration)**. The valve must be in the guide and approximately 1/16-inch off the seat. The total valve stem movement indicated by the gauge needle must be noted, then divided by two to obtain the actual clearance value. If it exceeds the stem-to-guide clearance limit found in this Chapter's Specifications, the valve guides should be replaced. After this is done, if there's still some doubt regarding the condition of the valve guides they should be checked by an automotive machine shop (the cost should be minimal).

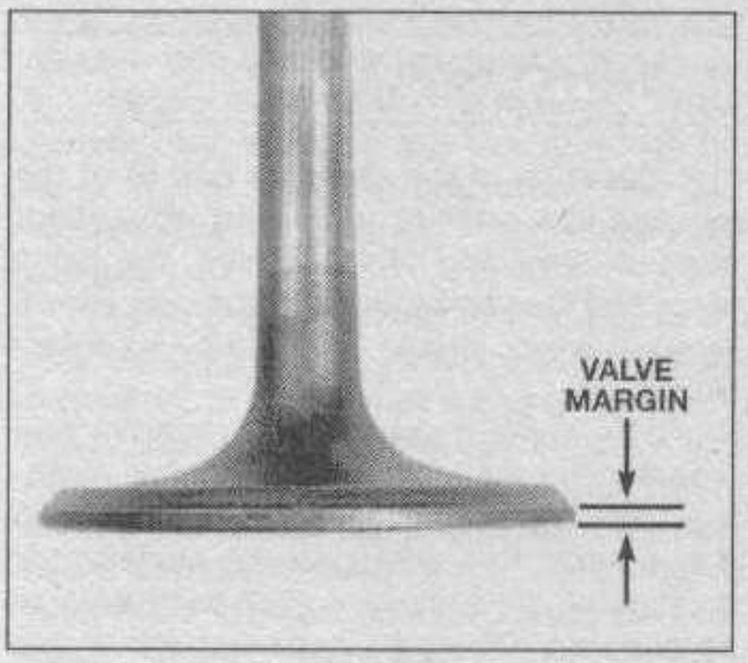
Valves

15 Carefully inspect each valve face for uneven wear, deformation, cracks, pits and burned areas **(see illustration)**. Check the valve stem for scuffing and galling and the neck for cracks. Rotate the valve and check for any obvious indication that it's bent. Look for pits and excessive wear on the end of the stem. The presence of any of these conditions indicates the need for valve service by an automotive machine shop.

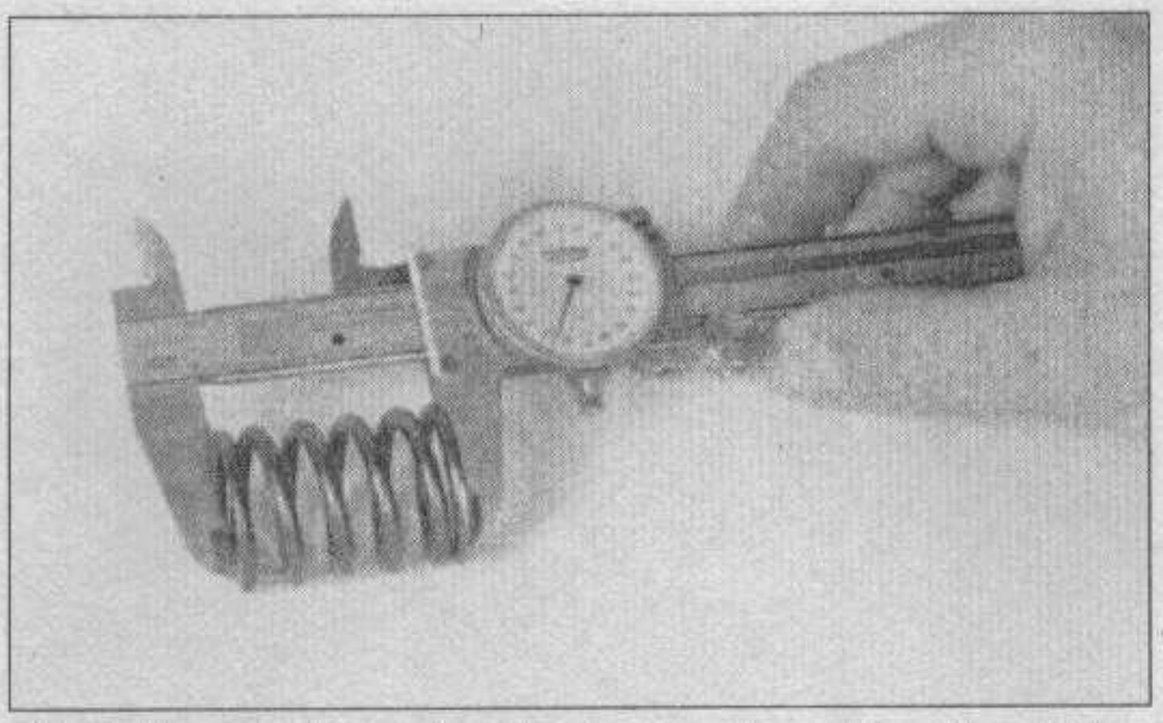
16 Measure the margin width on each valve **(see illustration)**. Any valve with a margin narrower than that listed in this Chapter's Specifications will have to be replaced with a new one.



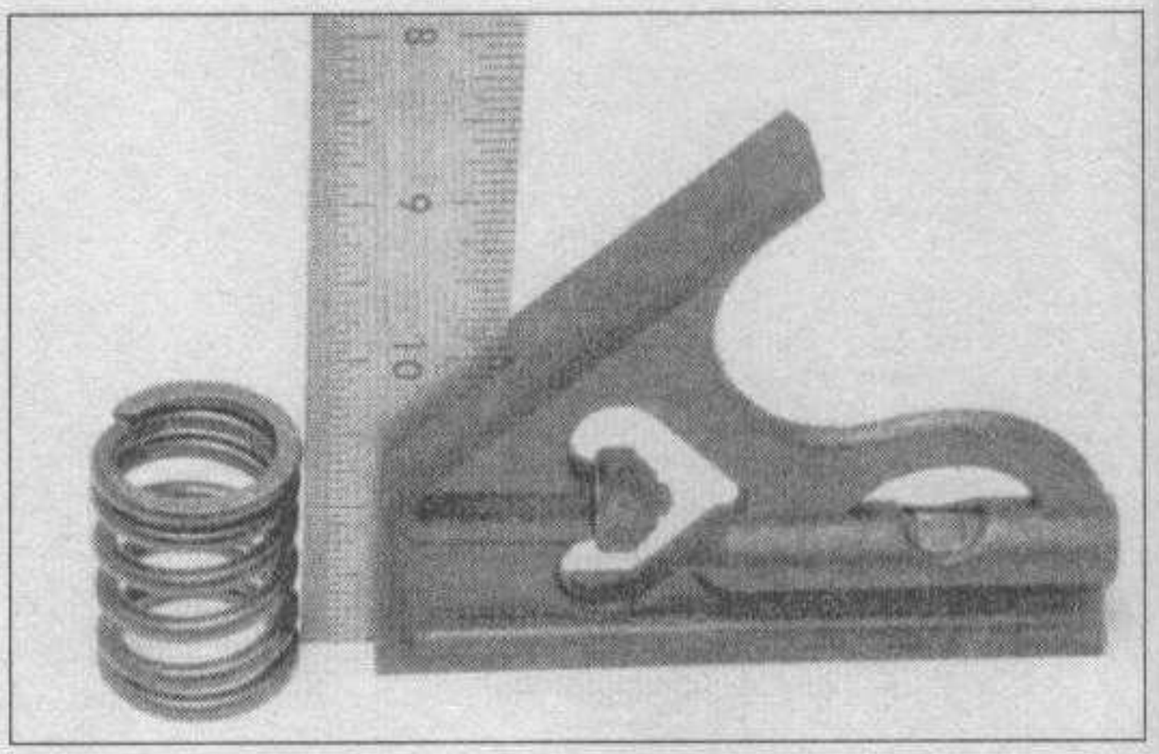
10.15 Check for valve wear at the points shown here



10.16 The margin width on each valve must be as specified (if no margin exists, the valve cannot be re-used)



10.17 Measure the free length of each valve spring with a dial or vernier caliper



10.18 Check each valve spring for squareness

Valve components

17 Check each valve spring for wear (on the ends) and pits. Measure the free length and compare it to this Chapter's Specifications **(see illustration)**. Any springs that are shorter than specified have sagged and should not be re-used. The tension of all springs should be pressure checked with a special fixture before deciding that they're suitable for use in a rebuilt engine (take the springs to an automotive machine shop for this check).

18 Stand each spring on a flat surface and check it for squareness **(see illustration)**. If any of the springs are distorted or sagged, replace all of them with new parts.

19 Check the spring retainers and valve stem locks for obvious wear and cracks. Any questionable parts should be replaced with new ones, as extensive damage will occur if they fail during engine operation.

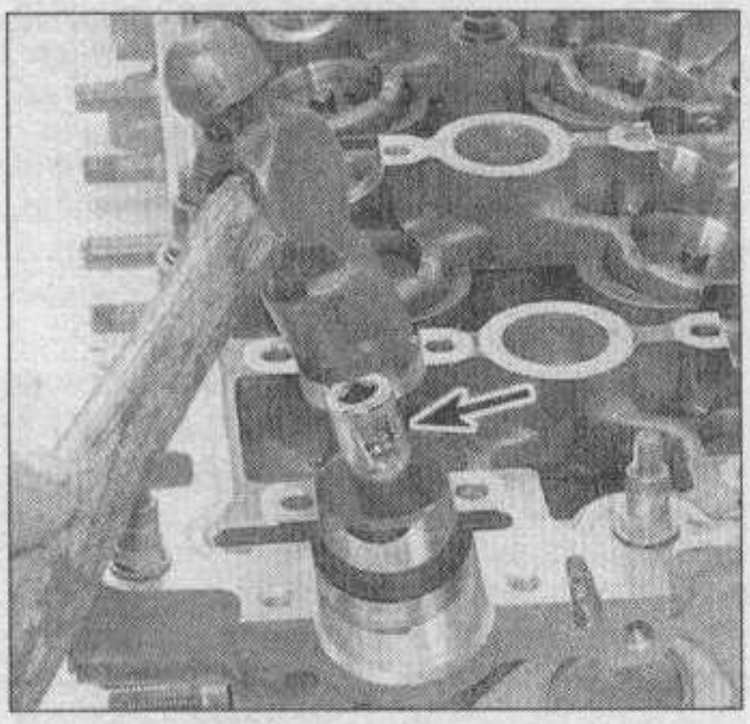
20 Any damaged or excessively worn parts must be replaced with new ones.

21 If the inspection process indicates that the valve components are in generally poor condition and worn beyond the limits specified, which is usually the case in an engine that's being overhauled, reassemble the valves in the cylinder head and refer to Section 11 for valve servicing recommendations.

11 Valves - servicing

1 Because of the complex nature of the job and the special tools and equipment needed, servicing of the valves, the valve seats and the valve guides, commonly known as a valve job, should be done by a professional.

2 The home mechanic can remove and disassemble the head(s), do the initial cleaning and inspection, then reassemble and deliver them to a dealer service department or an automotive machine shop for the actual service work. Doing the inspection will enable you to see what condition the head(s) and valvetrain components are in and will ensure that you know what work and new parts are



12.3 Gently tap the valve seals (arrow) into place with a deep socket and hammer

required when dealing with an automotive machine shop.

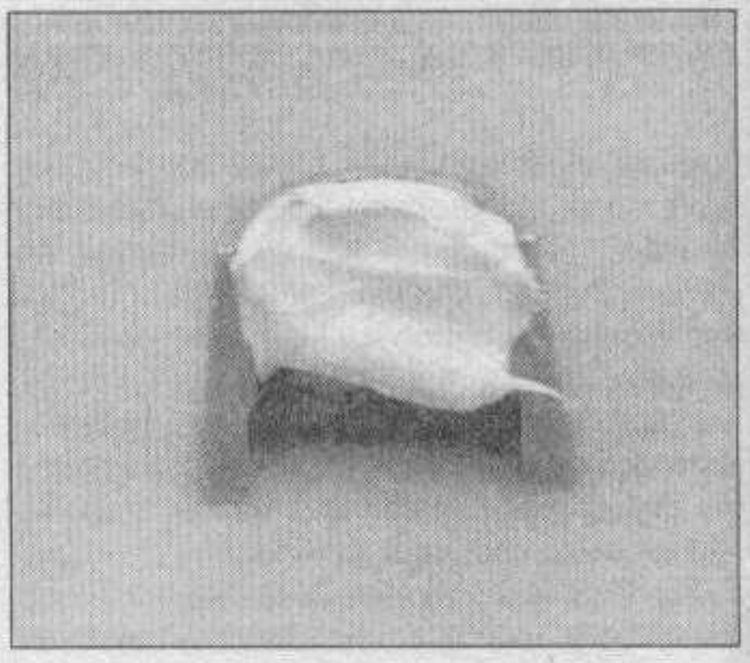
3 The dealer service department, or automotive machine shop, will remove the valves and springs, recondition or replace the valves and valve seats, recondition the valve guides, check and replace the valve springs, spring retainers and valve stem locks (as necessary), replace the valve seals with new ones, and reassemble the valve components. The cylinder head gasket surface will also be resurfaced if it's warped.

4 After the valve job has been performed by a professional, the head(s) will be in like-new condition. When the heads are returned, be sure to clean them again before installation on the engine to remove any metal particles and abrasive grit that may still be present from the valve service or head resurfacing operations. Use compressed air, if available, to blow out all the oil holes and passages. **Caution:** *Always wear eye protection when using compressed air!*

12 Cylinder head - reassembly

Refer to illustrations 12.3 and 12.6

1 Regardless of whether or not the head



12.6 Apply a dab of grease to the valve stem lock to hold it in position during installation

was sent to an automotive machine shop for valve servicing, make sure it's clean before beginning reassembly.

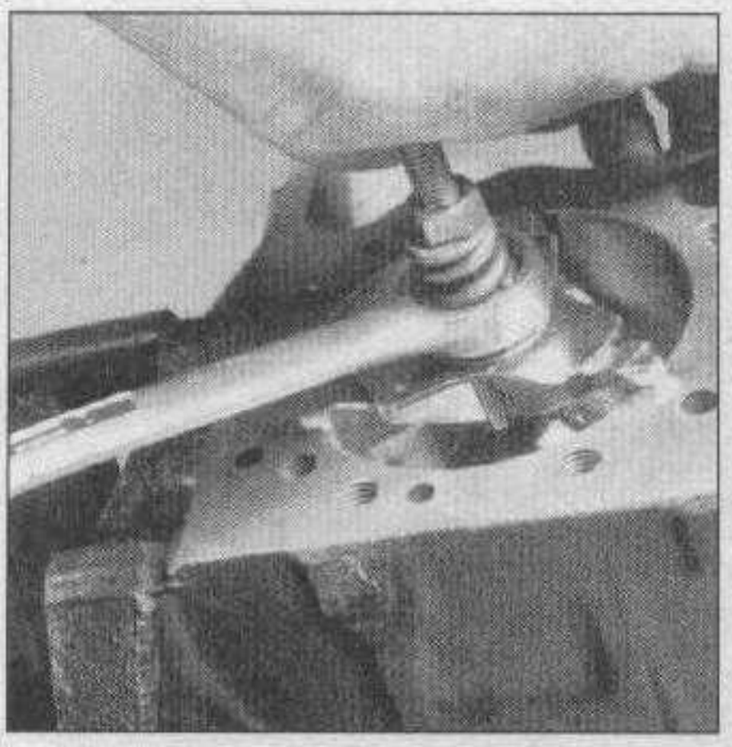
2 If the head was sent out for valve servicing, the valves and related components will already be in place.

3 Lubricate the valve guides and valve stems with clean engine oil and install the valves into the cylinder head. Be sure to return the valves and components to their original locations - don't mix them up!

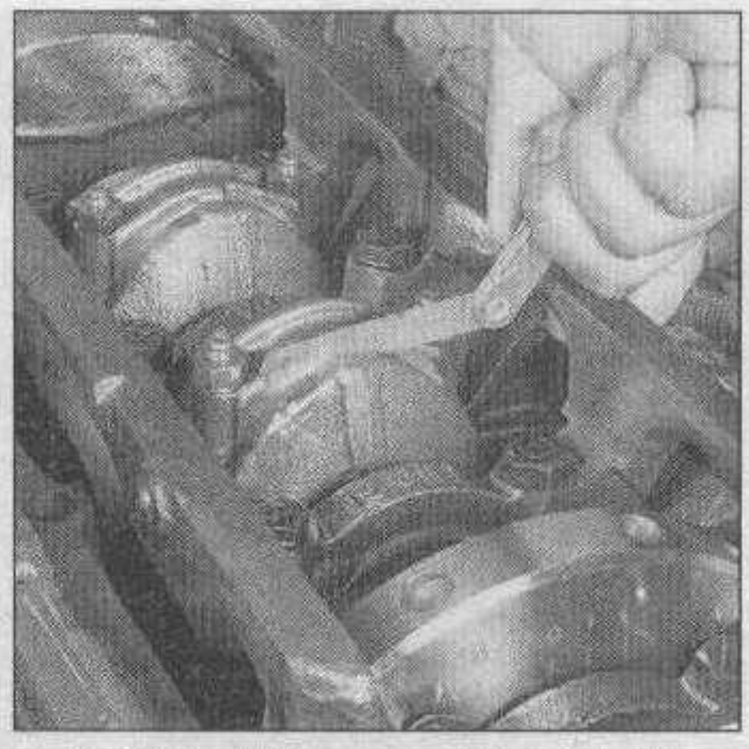
4 Place the valve seal protector (usually provided with the new seals) on the end of the first valve stem. Lubricate the valve seal and slip it down the valve stem and seat it on the valve guide. **Note:** *Intake and exhaust valves require different seals, the exhaust seals have ridges at the top, the intake seals don't - DO NOT mix them up!* Gently tap each intake valve seal into place until it's seated on the guide **(see illustration)**. **Caution:** *Don't hammer on the valve seals once they're seated or you may damage them. Don't twist or cock the seals during installation or they won't seat properly on the valve stems.* Install the seals on the remaining valves.

5 Install the spring seats, valve springs and retainers on each valve.

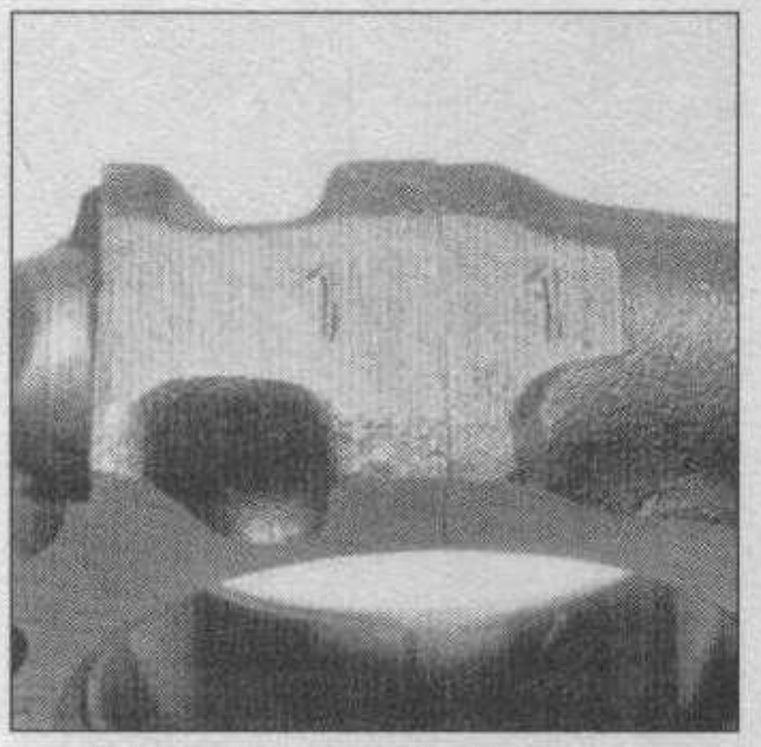
6 Starting with the first valve, compress the spring with a valve spring compressor



13.2 A ridge reamer is required to remove the ridge from the top of each cylinder - do this before removing the pistons!



13.4 Check the connecting rod side clearance (endplay) with a feeler gauge as shown here



13.5 Mark the connecting rods and caps with a number stamp or center punch to avoid confusion during reassembly

and carefully install the valve stem locks in the upper groove, then slowly release the compressor and make sure the valve stem locks seat properly. Apply a small dab of grease to each valve stem lock to hold it in place if necessary **(see illustration)**.

7 Repeat the procedure for the remaining valves. Using a soft faced hammer, tap directly on the end of each valve stem to make sure the valve stem locks are seated.

13 Pistons/connecting rods - removal

Refer to illustrations 13.2, 13.4 and 13.5

Note: *Prior to removing the piston/connecting rod assemblies, remove the cylinder head(s), the oil pan, the oil pump pick-up tube and baffle by referring to the appropriate Sections in Chapter 2, Part A or B.*

1 On four-cylinder engines only, remove the engine block stiffener, loosening the bolts opposite the tightening sequence in several steps (see Chapter 2, Part A).

2 Use your fingernail to feel if a ridge has formed at the upper limit of ring travel (about 1/4-inch down from the top of each cylinder). If carbon deposits or cylinder wear have produced ridges, they must be completely removed with a special tool **(see illustration)**. Follow the manufacturer's instructions provided with the tool. Failure to remove the ridges before attempting to remove the piston/connecting rod assemblies may result in piston damage.

3 After the cylinder ridges have been removed, turn the engine upside-down so the crankshaft is facing up.

4 Before the connecting rods are removed, check the connecting rod side clearance (endplay) with feeler gauges. Slide them between the first connecting rod and the crankshaft throw until the play is removed **(see illustration)**. The endplay is equal to the thickness of the feeler gauge(s). If the endplay exceeds the specified service limit, new connecting rods will be required. If new rods (or a new crankshaft) are installed, the endplay may fall under the service limit (if it does, the rods will have to be machined to restore it - consult an automotive machine shop for advice if necessary). Repeat the procedure for the remaining connecting rods.

5 Check the connecting rods and caps for identification marks. If they aren't plainly marked, use a small center punch to make the appropriate number of indentations on each rod and cap (1, 2, 3, etc., depending on the engine type and cylinder they're associated with) **(see illustration)**.

6 Loosen each of the connecting rod cap bolts 1/2-turn at a time until they can be removed by hand. Remove the number one connecting rod cap and bearing insert. Don't drop the bearing insert out of the cap.

7 Remove the bearing insert and push the connecting rod/piston assembly out through the top of the engine. Use a wooden hammer handle to push on the upper bearing surface in the connecting rod. If resistance is felt, double-check to make sure that all of the ridge was removed from the cylinder.

8 Repeat the procedure for the remaining cylinders. **Note:** *Turn the crankshaft as needed to place the rod to be removed close to parallel with the cylinder bore, i.e. don't try to drive it out while at a large angle to the bore.*

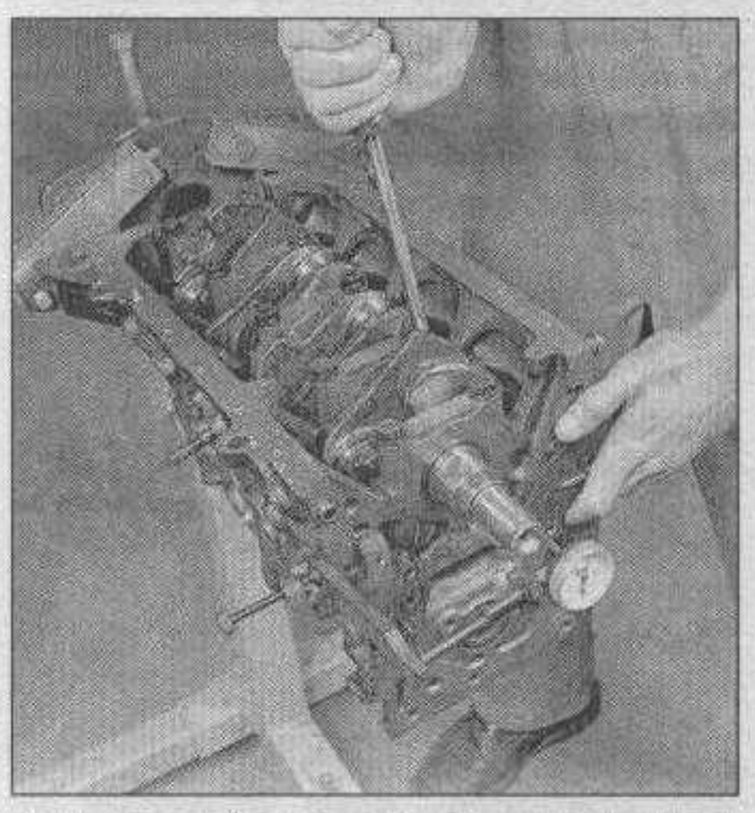
9 After removal, reassemble the connecting rod caps and bearing inserts in their respective connecting rods and install the cap nuts finger tight. Leaving the old bearing inserts in place until reassembly will help prevent the connecting rod bearing surfaces from being accidentally nicked or gouged.

10 Don't separate the pistons from the connecting rods (see Section 18 for additional information).

14 Crankshaft - removal

Refer to illustrations 14.1, 14.3 and 14.4

Note: *The crankshaft can be removed only after the engine has been removed from the vehicle. It's assumed that the flywheel or driveplate, vibration damper, timing belt, oil pan, oil pick-up tube, oil pump and piston/connecting rod assemblies have already been removed. The rear main oil seal must be removed from the block before proceeding with crankshaft removal.*



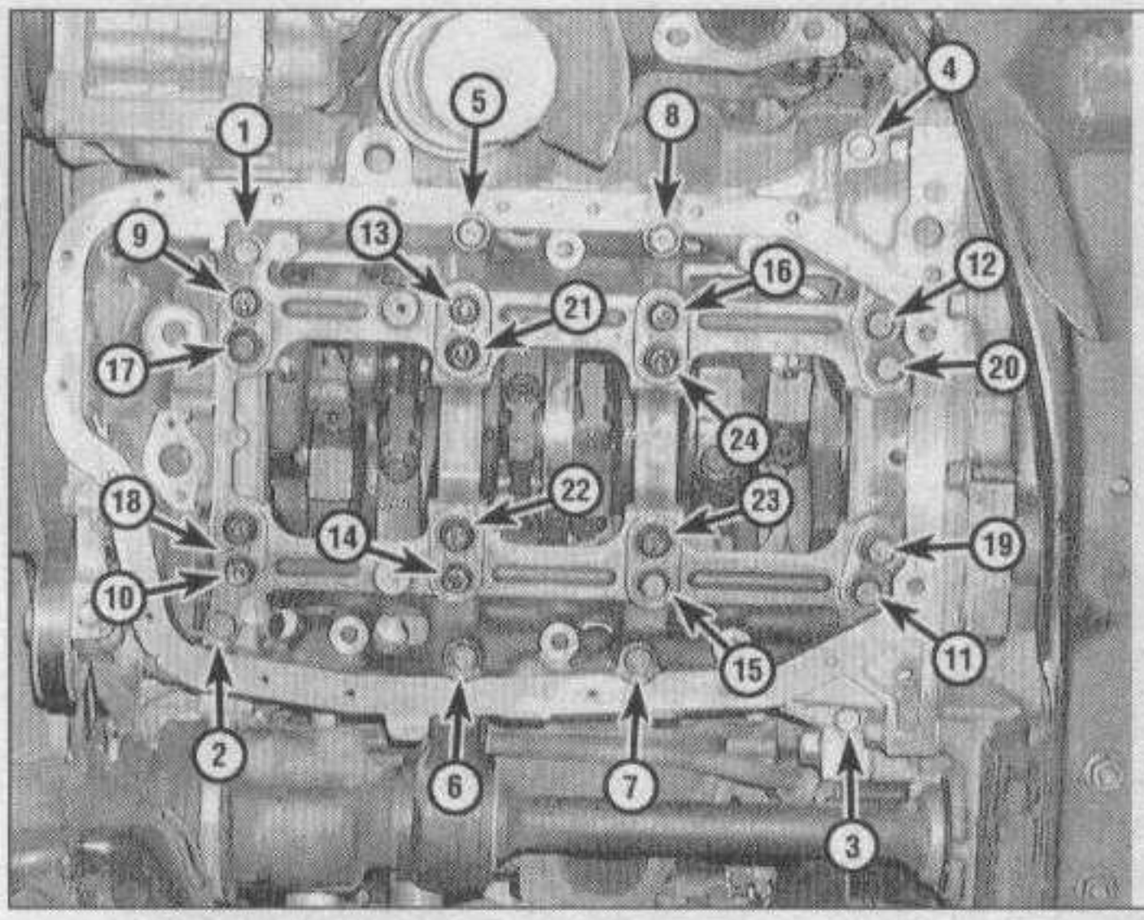
14.1 Checking crankshaft endplay with a dial indicator

1 Before the crankshaft is removed, check the endplay. Mount a dial indicator with the stem in line with the crankshaft and just touching one of the crank throws **(see illustration)**.

2 Push the crankshaft all the way to the rear and zero the dial indicator. Next, pry the crankshaft to the front as far as possible and check the reading on the dial indicator. The distance that it moves is the endplay. If it's greater than specified, check the crankshaft thrust surfaces for wear. If no wear is evident, new thrust washers should correct the endplay.

3 If a dial indicator isn't available, feeler gauges can be used. Gently pry or push the crankshaft all the way to the front of the

14.3 Checking crankshaft endplay with a feeler gauge



14.4 Lower engine block bolt LOOSENING sequence - V6 engines

engine. Slip feeler gauges between the crankshaft and the front face of the thrust main bearing to determine the clearance **(see illustration)**. The thrust bearing on all engines is the number four bearing. Four-cylinder engines have a total of five main bearings, while V6 engines have four.

4 On four-cylinder engines, check the main bearing caps to see if they're marked to indicate 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. Main bearing caps generally have a cast-in arrow, which points to the front of the engine. Loosen the main bearing cap bolts 1/4-turn at a time each. On V6 engines, loosen the lower engine block bolts in sequence until they can be removed by hand **(see illustration)**. **Note:** *V6 engines are designed with a two-piece engine block, with the lower block section serving as the main cap assembly. The lower block section must be removed before removing the crankshaft. Keep track of the location of all bolts, there are three lengths.*

5 Gently tap the caps or lower block section 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.

6 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 or cap assembly, return the caps to their respective locations on the engine block and tighten the bolts finger tight.

15 Engine block - cleaning

Refer to illustrations 15.2a, 15.2b, 15.9 and 15.11

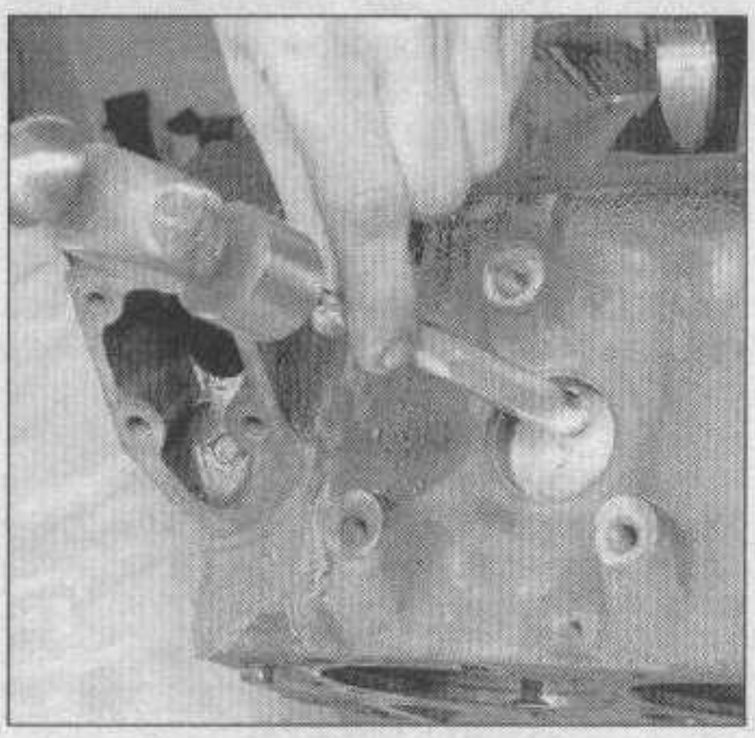
1 Several types of core or expansion plugs (also known as freeze or soft plugs) are used on these engines. At the transaxle end of the block, the plugs are usually screw-in type. These are removed with an Allen socket and breaker bar. On some stubborn cases, heat may be require to loosen a screw-in plug.

2 Other core plugs are metal cup-type. Using the blunt end of a punch, tap in on the outer edge of the core plug to turn the plug sideways in the bore. Then using pliers, pull the core plug from the engine block **(see illustrations)**.

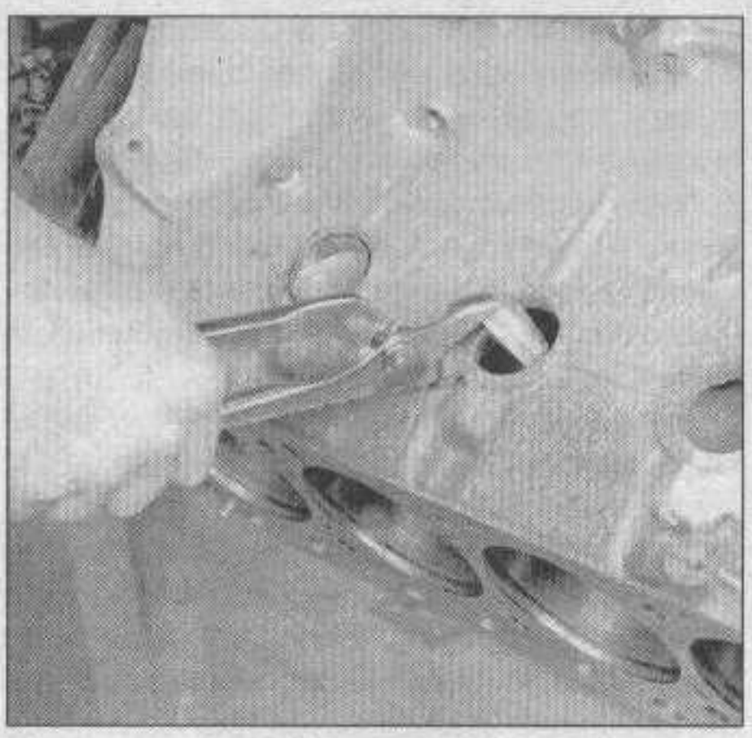
3 Using a gasket scraper, remove all traces of gasket material from the engine block. Be very careful not to nick or gouge the gasket sealing surfaces.

4 Remove the main bearing caps or cap assembly 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.

5 Remove all of the 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.



15.2a A hammer and a large punch can be used to knock the core plugs sideways in their bores



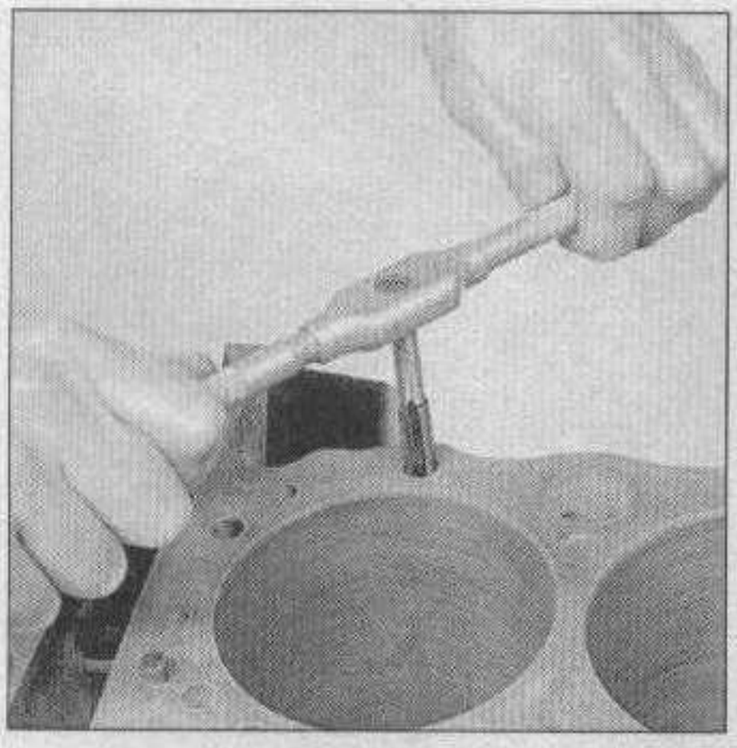
15.2b Pull the core plugs from the block with pliers

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

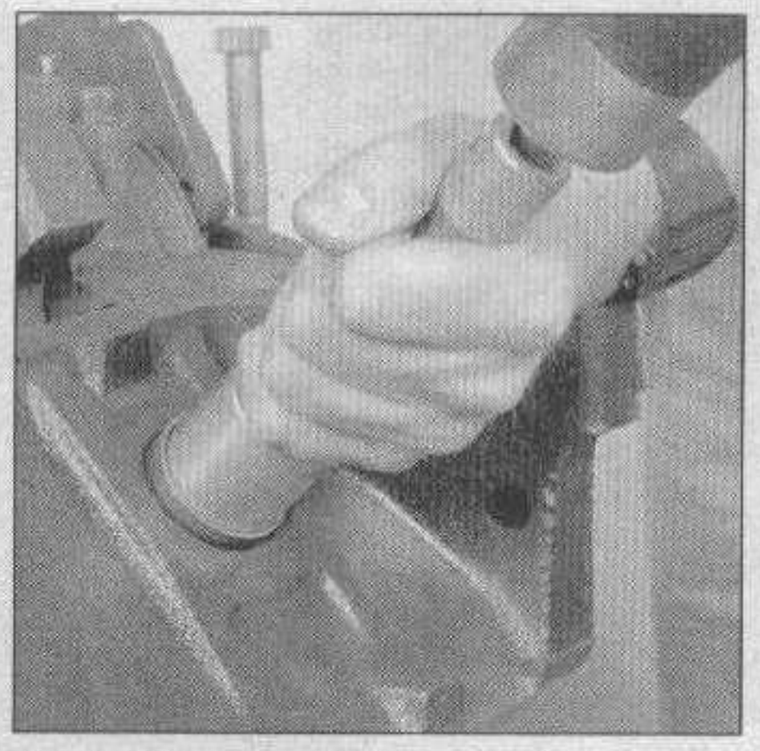
7 After the block is returned, clean all oil holes and oil galleries one more time. Brushes specifically designed for this purpose are available at most auto parts stores. Flush the passages with warm water until the water runs clear, dry the block thoroughly and wipe all machined surfaces with a light,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

8 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.

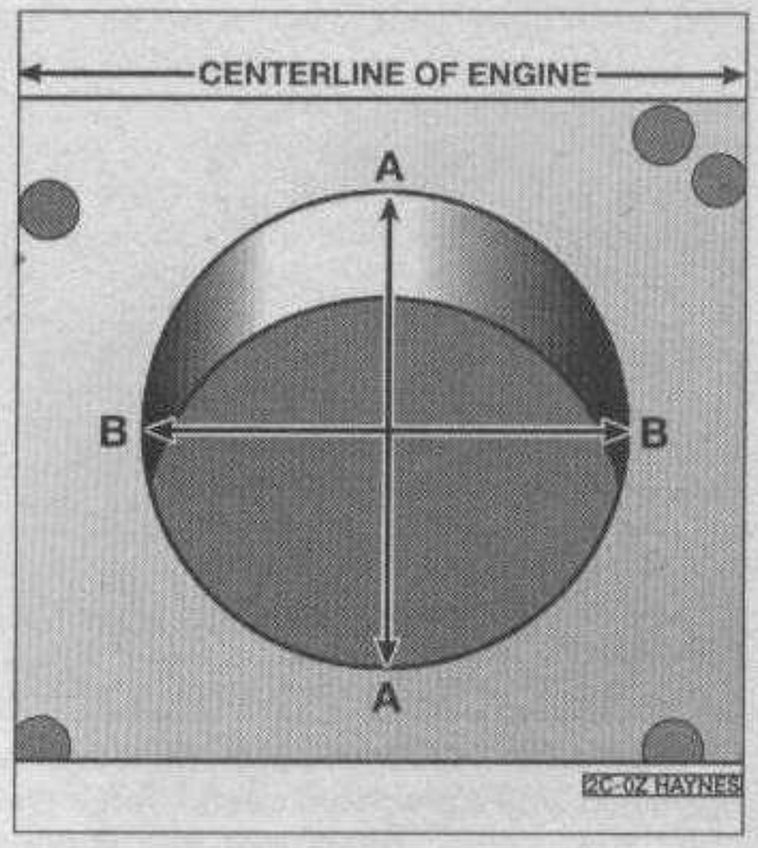
9 The threaded holes in the block must be clean to ensure accurate torque readings during reassembly. Run the proper size tap into each of the holes to remove rust, corro-



15.9 All bolt holes in the block - particularly the main bearing cap and head bolt holes - should be cleaned and restored with a tap (be sure to remove debris from the holes after this is done)



15.11 A large socket on an extension can be used to drive the new core plugs into the bores



16.4a Measure the diameter of each cylinder at a right angle to the engine centerline (A), and parallel to engine centerline (B) - out-of-round is the difference between A and B, taper is the difference between A and B at the top of the cylinder and A and B at the bottom of the cylinder

sion, thread sealant or sludge and restore damaged threads **(see illustration)**. If possible, use compressed air to clear the holes of debris produced by this operation. Now is a good time to clean the threads on the head bolts and the main bearing cap bolts as well.

10 Reinstall the main bearing caps and tighten the bolts finger tight.

11 After coating the sealing surfaces of the new core plugs with core plug sealant, install them in the engine block **(see illustration)**. Make sure they're driven in straight and seated properly or leakage could result. Special tools are available for this purpose, but a large socket, with an outside diameter that will just slip into the core plug, a 1/2-inch drive extension and a hammer will work just as well. **Note:** *There are two types of drive-in plugs, cup-type and expansion-type. The cup-type installs with concave portion facing the outside of the block, and the expansion-type is driven in with the concave portion facing the inside of the block (exposed to coolant). To tell them apart, look at the flange. If the flange is larger in diameter at the outside, it's a cup-type. If the flange is smaller-diameter than the base, it's an expansion plug. Replace block plugs with the same type as equipped originally, and face them the correct way in the block. Never install any block plug by driving against it s flange, or the plug could fail, possibly causing engine damage.*

12 Apply non-hardening sealant to the new oil gallery plugs or thread-in block plugs and thread them into the holes in the block. Make sure they're tightened securely.

13 If the engine isn't going to be reassembled right away, cover it with a large plastic trash bag to keep it clean.

16 Engine block - inspection

Refer to illustrations 16.4a, 16.4b, 16.4c and 16.12

1 Before the block is inspected, it should be cleaned as described in Section 15.

2 Visually check the block for cracks, rust and corrosion. Look for stripped threads in the threaded holes. It's also a good idea to have the block checked for hidden cracks by an automotive machine shop that has the special equipment to do this type of work, especially if the vehicle had a history of overheating or using coolant. If defects are found, have the block repaired, if possible, or replaced.

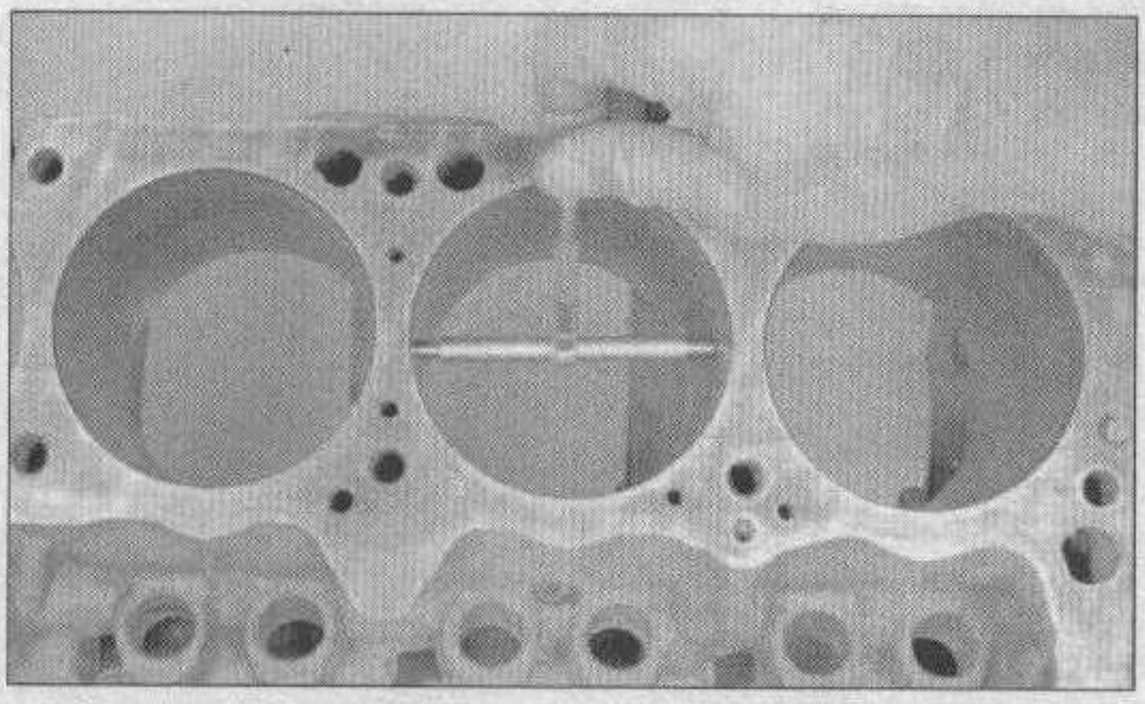
3 Check the cylinder bores for scuffing and scoring.

4 Measure the diameter of each cylinder at the top (just under the ridge area), center and bottom of the cylinder bore, parallel to the crankshaft axis **(see illustrations)**.

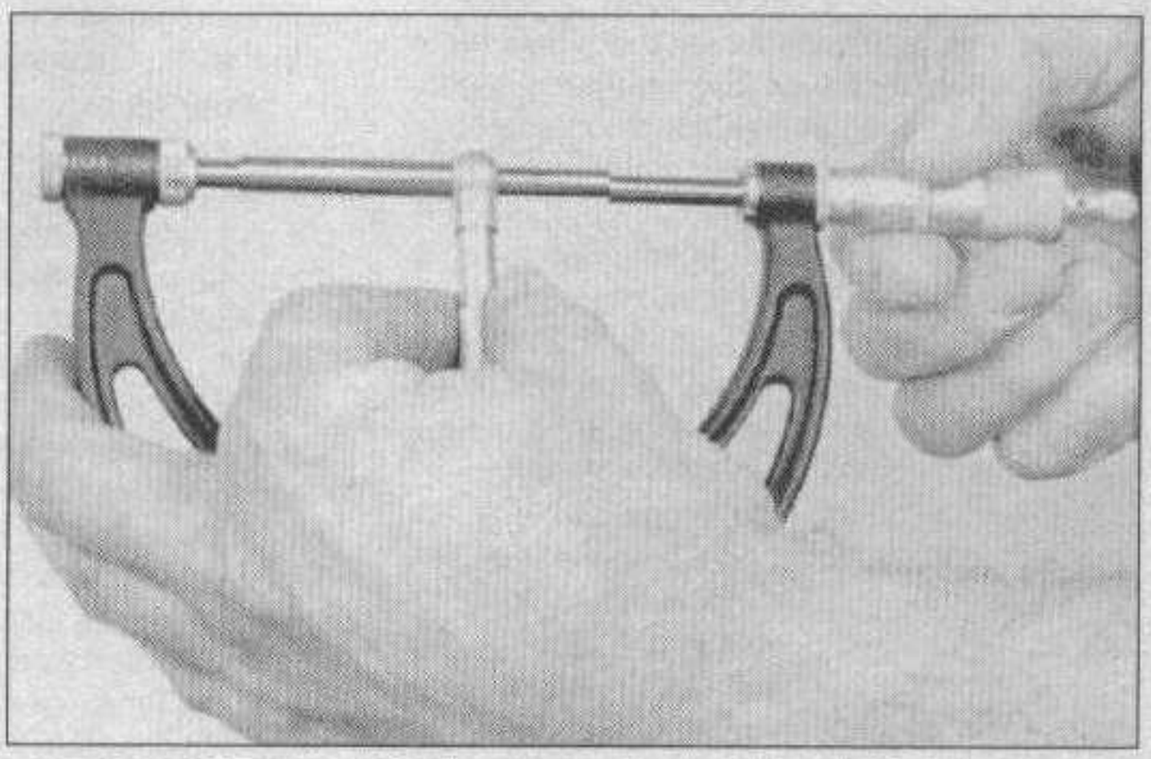
5 Next, measure each cylinder's diameter at the same three locations across the crankshaft axis. Compare the results to this Chapter's Specifications.

6 If the required precision measuring tools aren't available and there isn't a tool rental facility nearby, the piston-to-cylinder clear-

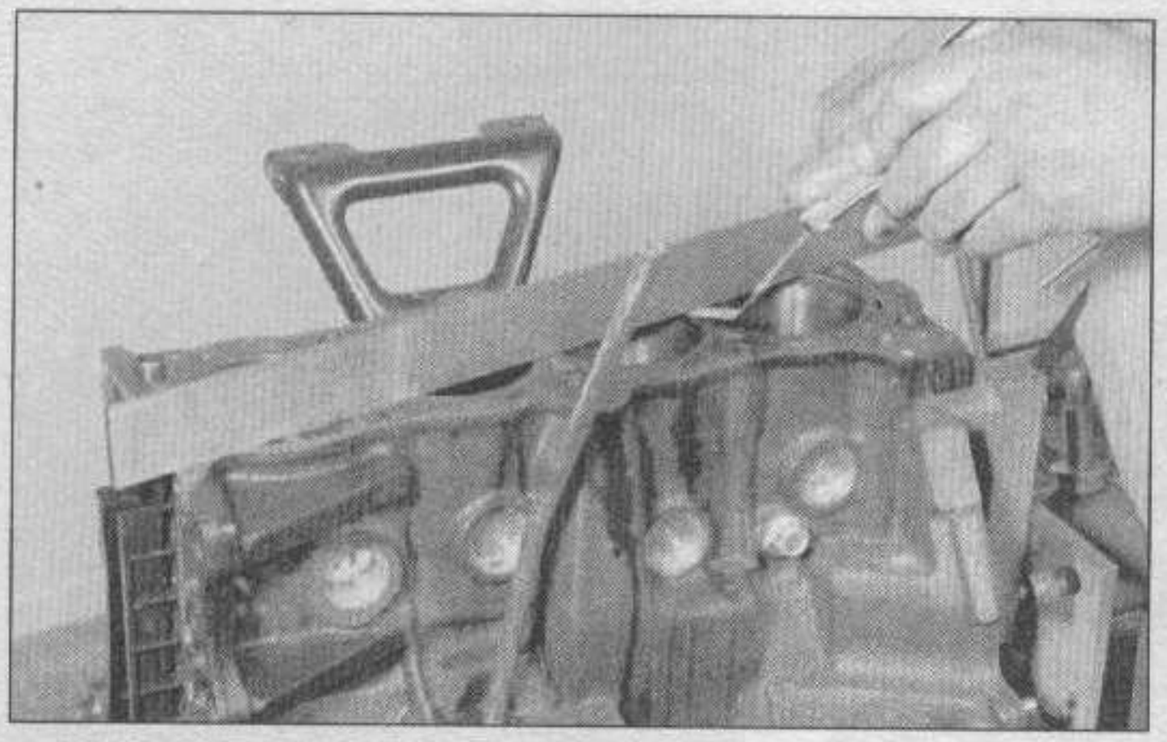
2C



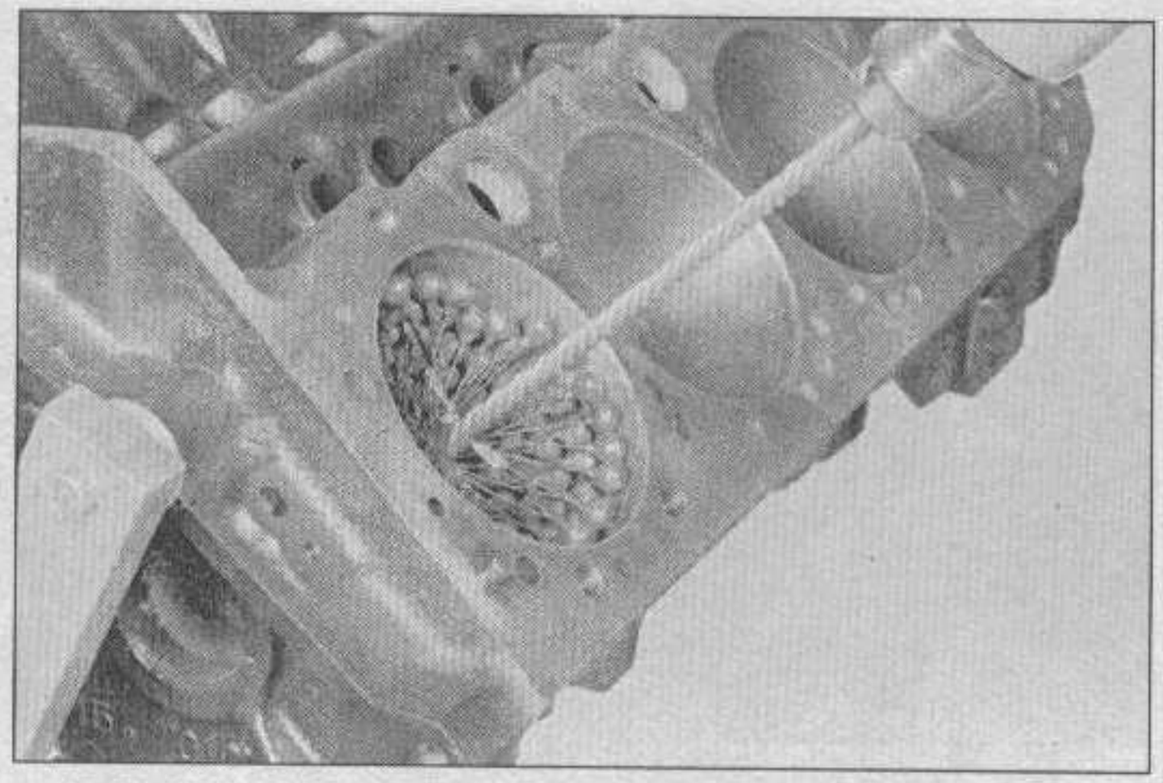
16.4b The ability to "feel" when the telescoping gauge is at the correct point will be developed over time, so work slowly and repeat the check until you're satisfied that the bore measurement is accurate



16.4c The gauge is then measured with a micrometer to determine the bore size



16.12 Check the block deck (both banks on a V6 engine) for distortion with a precision straightedge and feeler gauges - check lengthwise and diagonally



17.3a A "bottle brush" hone will produce better results if you have never done cylinder honing before

ances can be obtained, though not quite as accurately, using feeler gauge stock. Feeler gauge stock comes in 12-inch lengths and various thickness and is generally available at auto parts stores.

7 To check the clearance with feeler stock, select a feeler gauge and slip it into the cylinder along with the matching piston. The piston must be positioned exactly as it normally would be. The feeler gauge must be between the piston and cylinder on one of the thrust faces (90-degrees to the piston pin bore).

8 The piston should slip through the cylinder (with the feeler gauge in place) with moderate pressure.

9 If it falls through or slides through easily, the clearance is excessive and a new piston will be required. If the piston binds at the lower end of the cylinder and is loose toward the top, the cylinder is tapered. If tight spots are encountered as the piston/feeler gauge is rotated in the cylinder, the cylinder is out-of-round.

10 Repeat the procedure for the remaining pistons and cylinders.

11 If the cylinder walls are badly scuffed or scored, or if they're out-of-round or tapered beyond the limits given in this Chapter's Specifications, have the engine block rebored and honed at an automotive machine shop. If a rebore is done, oversize pistons and rings will be required.

12 Using a precision straightedge and feeler gauge, check the block deck (the surface that mates with the cylinder head(s) for distortion **(see illustration)**. If it's distorted beyond the specified limit, it can be resurfaced by an automotive machine shop.

13 If the cylinders are in reasonably good condition and not worn to the outside of the limits, and if the piston-to-cylinder clearances can be maintained properly, then they don't have to be rebored. Honing is all that's necessary (refer to Section 17).

14 Both four-cylinder and V6 engines covered by this manual have special piston-cooling oil jets in the block. On V6 engines, they are located in the main bearing saddles of the upper block section, and can be removed and installed with a screwdriver. Clean these jets, then reinstall them with thread-locking sealant. On four-cylinder engines, the jets are mounted in the block at the bottom of each cylinder bore, with a nozzle that directs oil at the bottom of the piston. Special factory tools are needed to properly remove or install them. **Note:** *When reassembling an engine, make sure that these nozzles align with the notch in the bottom of the piston they are directed at.*

15 At the head-mounting surface of the V6 engine, there are two oil control plugs, one on each bank. These can be removed with locking pliers, and new ones installed, with new O-rings, by tapping them in with a plastic hammer. This should be done after an engine has been cleaned, to eliminate the chance that any grit or chemicals are trapped under the plugs. **Note:** *Tap the plugs down until they are sticking out of the block 0.52 to 0.55 inch.*

17 Cylinder honing

Refer to illustrations 17.3a and 17.3b

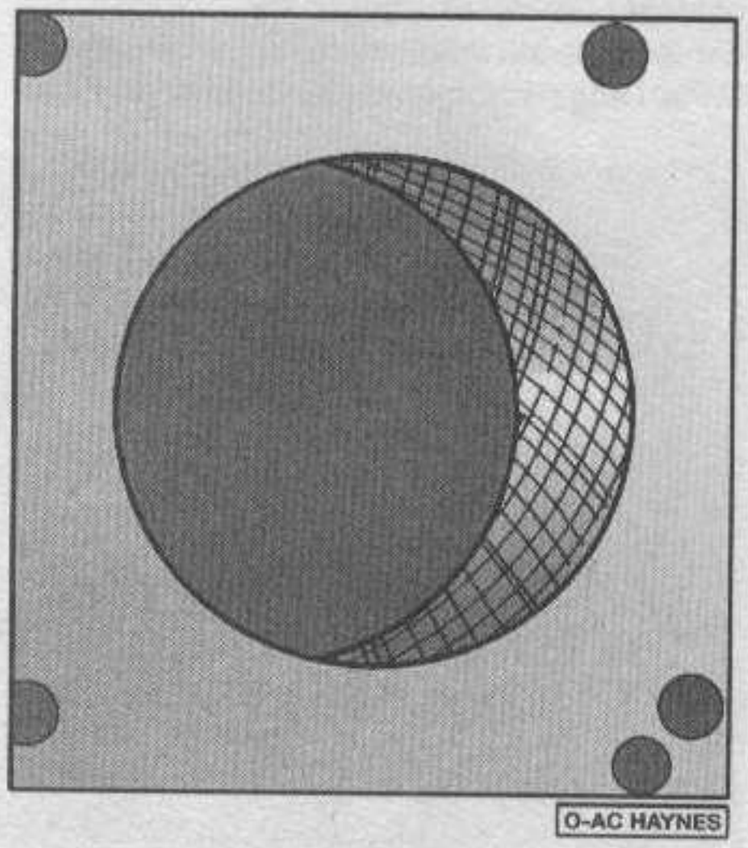
1 Prior to engine reassembly, the cylinder bores must be honed so the new piston rings will seat correctly and provide the best possible combustion chamber seal. **Note:** *If you don't have the tools or don't want to tackle the honing operation, most automotive machine shops will do it for a reasonable fee. Read the instructions with your new piston ring set before honing. Different ring materials require different grits of honing stones.*

2 Before honing the cylinders, install the main bearing caps or lower block section (V6) (without bearing inserts) and tighten the bolts to the specified torque (see Section 26).

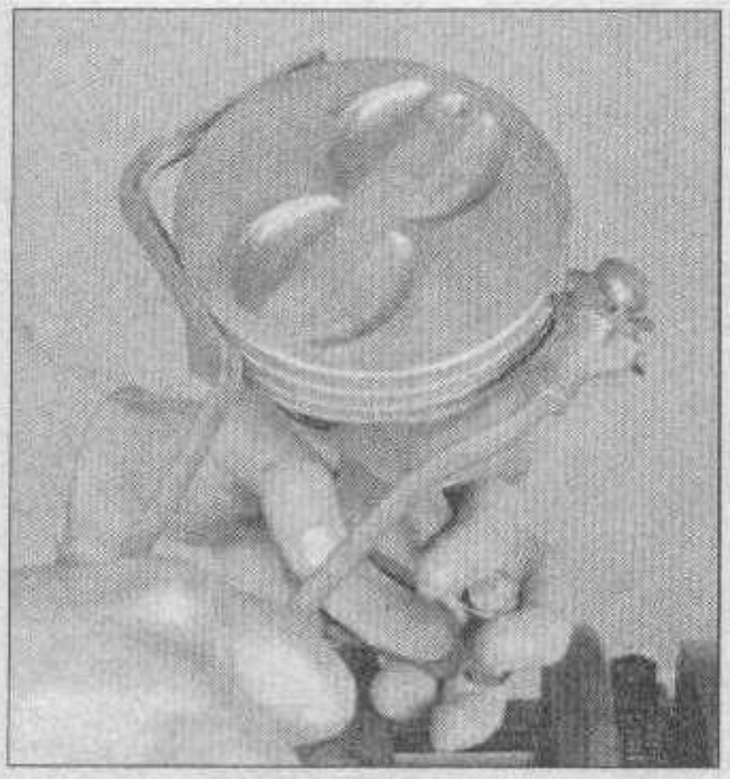
3 Two types of cylinder hones are commonly available - the flex hone or "bottle brush" type and the more traditional surfacing hone with spring-loaded stones. Both will do the job, but for the less experienced mechanic the "bottle brush" hone will probably be easier to use. You'll also need some kerosene or honing oil, rags and an electric drill motor. The drill motor should be operated at a steady, slow speed. Use a large 1/2-inch drill or a 3/8-inch variable-speed drill. Proceed as follows:

a) *Mount the hone in the drill motor, compress the stones and slip it into the first cylinder* **(see illustration)**. **Warning:** *Be sure to wear safety goggles or a face shield!*

b) *Lubricate the cylinder with plenty of honing oil, turn on the drill and move the hone up-and-down in the cylinder at a pace that will produce a fine crosshatch pattern on the cylinder walls. Ideally, the crosshatch lines should intersect at approximately a 60-degree angle* **(see illustration)**. *Be sure to use plenty of lubricant and don't take off any more material than is absolutely necessary to*



17.3b The cylinder hone should leave a smooth, crosshatch pattern with the lines intersecting at approximately a 60-degree angle



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

produce the desired finish. **Note:** *Piston ring manufacturers may specify a smaller crosshatch angle than the traditional 60-degrees - read and follow any instructions included with the new rings.*

c) *Don't withdraw the hone from the cylinder while it's running. Instead, shut off the drill and continue moving the hone up-and-down in the cylinder until it comes to a complete stop, then compress the stones and withdraw the hone. If you're using a "bottle brush" type hone, stop the drill motor, then turn the chuck in the normal direction of rotation while withdrawing the hone from the cylinder.*

d) *Wipe the oil out of the cylinder and repeat the procedure for the remaining cylinders.*

4 After the honing job is complete, chamfer the top edges of the cylinder bores with a small file so the rings won't catch when the pistons are installed. Be very careful not to nick the cylinder walls with the end of the file.

5 The entire engine block must be washed again very thoroughly with warm, soapy water to remove all traces of the abrasive grit produced during the honing operation. **Note:** *The bores can be considered clean when a lint-free white cloth - dampened with clean engine oil - used to wipe them out doesn't pick up any more honing residue, which will show up as gray areas on the cloth. Be sure to run a brush through all oil holes and galleries and flush them with running water.*

6 After rinsing, dry the block and apply a coat of light rust preventive oil to all machined surfaces. Wrap the block in a plastic trash bag to keep it clean and set it aside until reassembly.

18 Pistons/connecting rods - inspection

Refer to illustrations 18.4a, 18.4b, 18.10 and 18.11

1 Before the inspection process can be carried out, the piston/connecting rod assemblies must be cleaned and the original piston rings removed from the pistons. **Note:** *Always use new piston rings when the engine is reassembled.*

2 Using a piston ring installation tool, carefully remove the rings from the pistons. Be careful not to nick or gouge the pistons in the process.

3 Scrape all traces of carbon from the top of the piston. A hand-held wire brush or a piece of fine emery cloth can be used once the majority of the deposits have been scraped away. Do not, under any circumstances, use a wire brush mounted in a drill motor to remove deposits from the pistons. The piston material is soft and may be eroded away by the wire brush.

4 Use a piston ring groove-cleaning tool to remove carbon deposits from the ring grooves. If a tool isn't available, a piece broken off the old ring will do the job. Be very careful to remove only the carbon deposits - don't remove any metal and do not nick or scratch the sides of the ring grooves **(see illustrations)**.

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

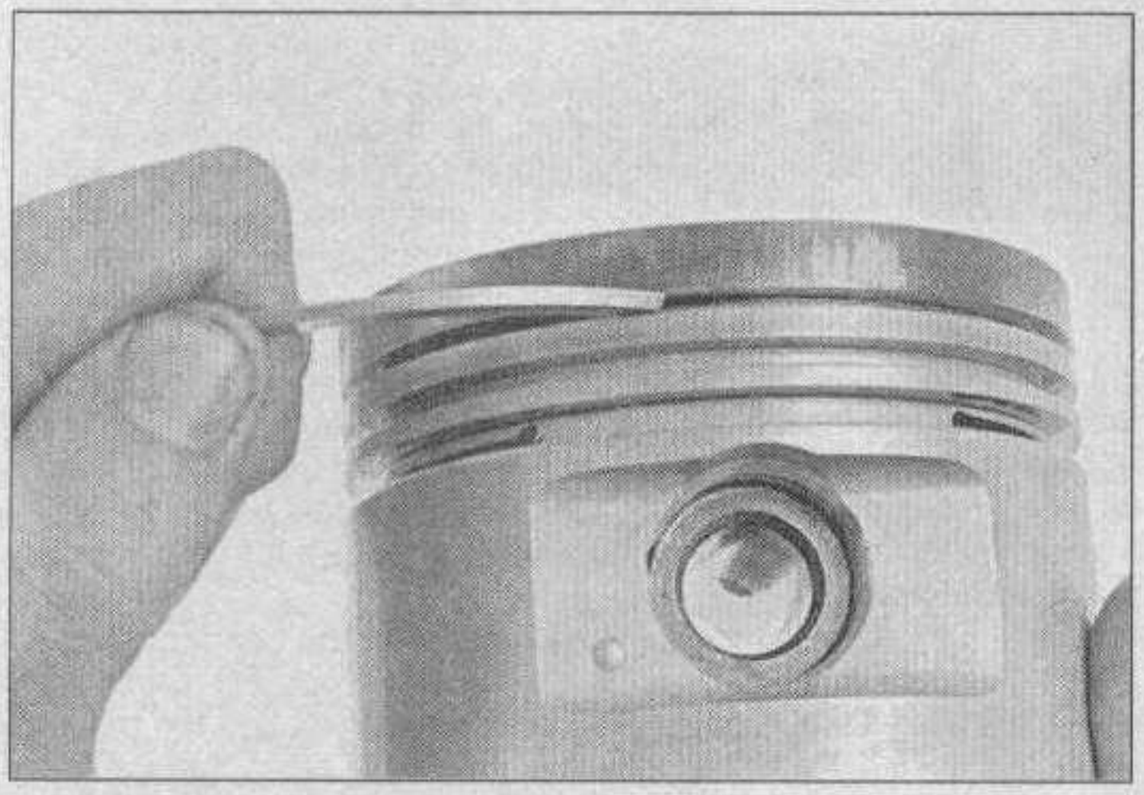
6 If the pistons and cylinder walls aren't damaged or worn excessively, and if the engine block is not rebored, new pistons won't be necessary. Normal piston wear appears as even, vertical wear on the piston thrust surfaces and slight looseness of the top ring in its groove. New piston rings, however,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

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

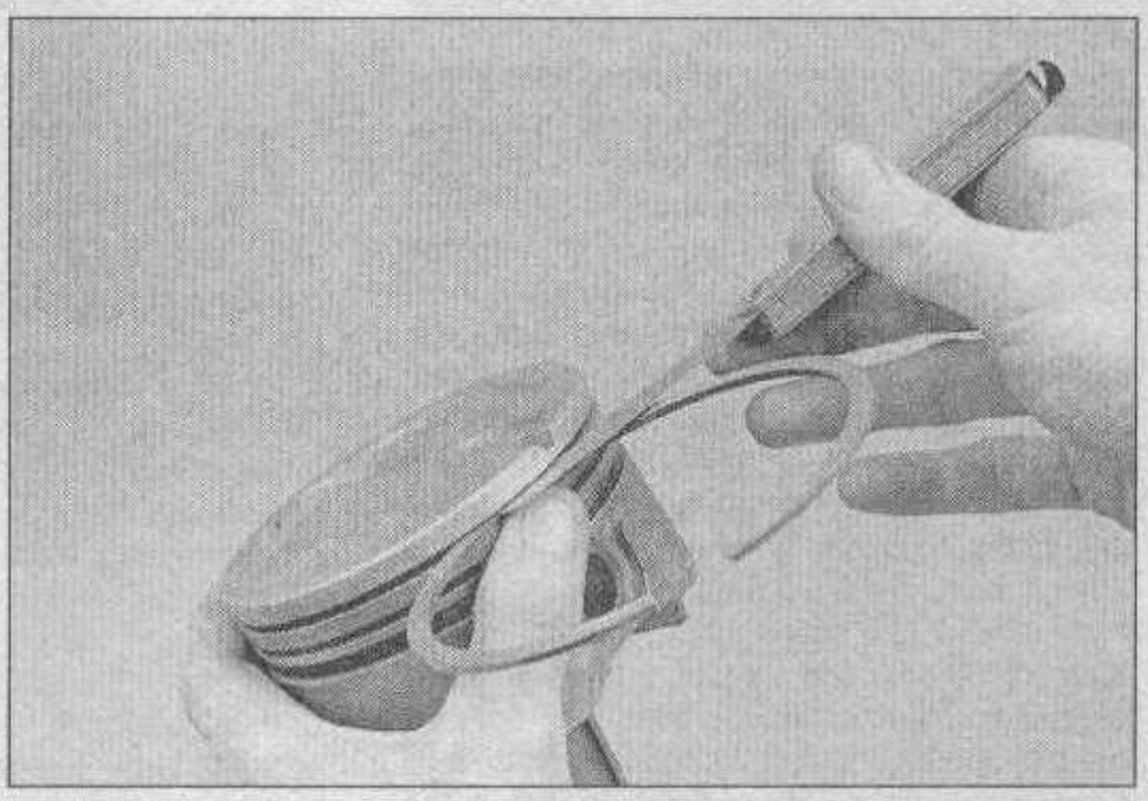
8 Look for scoring and scuffing on the thrust faces of the skirt, holes in the piston crown and burned areas at the edge of the crown. If the skirt is scored or scuffed, the engine may have been suffering from overheating and/or abnormal combustion, which caused excessively high operating temperatures.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

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

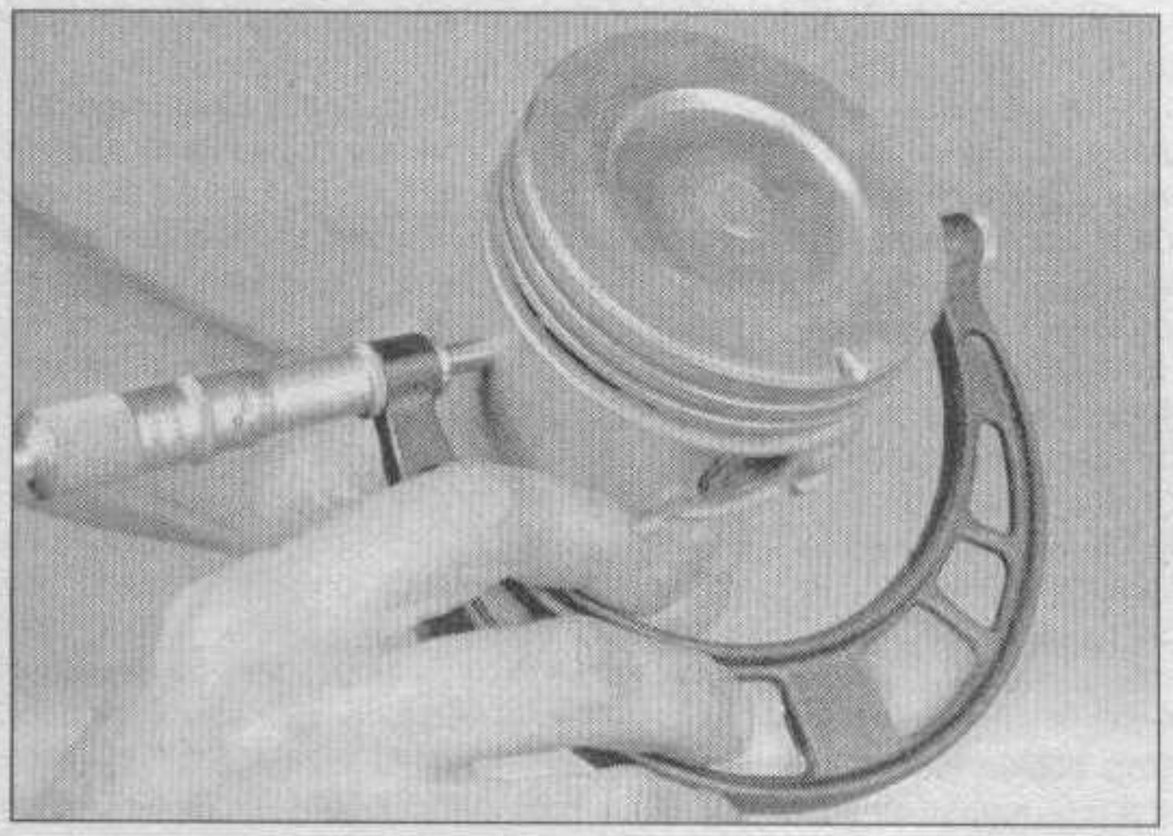
10 Measure the piston ring groove clearance by laying a new piston ring in each ring groove and slipping a feeler gauge in beside it **(see illustration)**. Check the clearance at



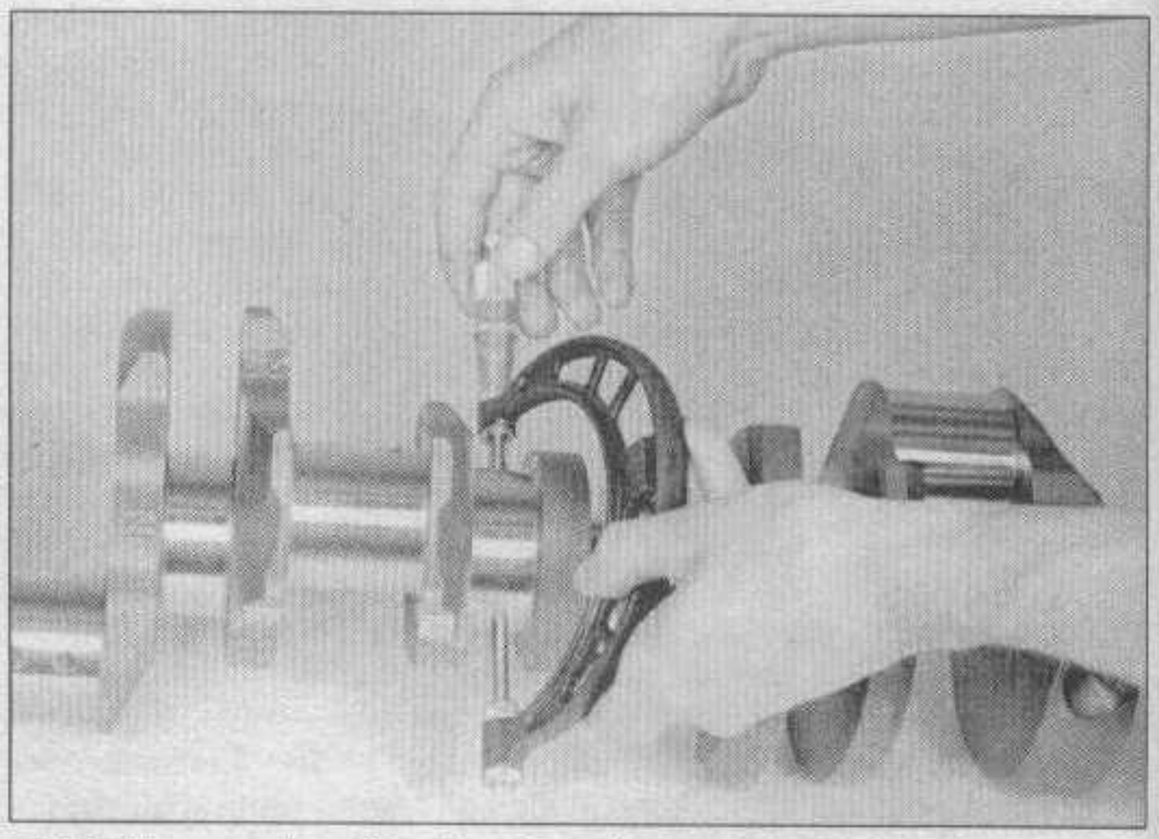
18.4b . . . or a section of a broken ring



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



18.11 Measure the piston diameter at a 90-degree angle to the piston pin, approximately 0.65-inch below the oil ring groove - a precision caliper may be used if a micrometer isn't available



19.5 Measure the diameter of each crankshaft journal at several points to detect taper and out-of-round conditions

three or four locations around each groove. Be sure to use the correct ring for each groove - they are different. If the clearance is greater than that listed in this Chapter's Specifications, new pistons will have to be used.

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

12 Check the piston-to-rod clearance by twisting the piston and rod in opposite directions. Any noticeable play indicates excessive wear, which must be corrected.

13 If the pistons must be removed from the connecting rods for any reason, the rods should be taken to an automotive machine shop, to be checked for bend and twist, since automotive machine shops have special equipment for this purpose.

14 Using a precision measuring tool, measure the length of the connecting rod bolts, from under the head to the tip of the threads. On four-cylinder engines, they should be no longer than 1.80 inches, and on V6 engines no longer than 1.89 inches. Longer bolts indicate they have been stretched in use, and should be replaced. Replace the all of the connecting rod bolts if one or more shows stretch.

15 Check the connecting rods for cracks and other damage. Temporarily remove the rod caps, lift out the old bearing inserts, wipe the rod and cap bearing surfaces clean and inspect them for nicks, gouges and scratches. After checking the rods, replace the old bearings, slip the caps into place and tighten the bolts finger tight. **Note:** *If the engine is being rebuilt because of a connecting rod knock, be sure to install new rods.*

19 Crankshaft - inspection

Refer to illustration 19.5

1 Clean the crankshaft with solvent and dry it with compressed air (if available). Be sure to clean the oil holes with a stiff brush and flush them with solvent.

2 Check the main and connecting rod bearing journals for uneven wear, scoring, pits and cracks.

3 Remove all burrs from the crankshaft oil holes with a stone, file or scraper.

4 Check the rest of the crankshaft for cracks and other damage. It should be magnafluxed to reveal hidden cracks - an automotive machine shop will handle the procedure.

5 Using a micrometer, measure the diameter of the main and connecting rod journals and compare the results to this Chapter's Specifications **(see illustration)**. By measuring the diameter at a number of points around each journal's circumference, you'll be able to determine whether or not the journal is out-of-round. Take the measurement at each end of the journal, near the crank throws, to determine if the journal is tapered. Crankshaft runout should be checked also, but large V-blocks and a dial indicator are needed to do it correctly. If you don't have the equipment, have a machine shop check the runout.

6 If the crankshaft journals are damaged, tapered, out-of-round or worn beyond the limits given in the Specifications, have the crankshaft reground by an automotive machine shop. Be sure to use the correct size bearing inserts if the crankshaft is reconditioned.

7 Check the oil seal journals at each end of the crankshaft for wear and damage. If the seal has worn a groove in the journal, or if it's nicked or scratched, the new seal may leak when the engine is reassembled. In some cases, an automotive machine shop may be able to repair the journal by pressing on a thin sleeve. If repair isn't feasible, a new or different crankshaft should be installed.

8 All of the main cap or lower engine block bolts should be measured for length (from under the head to the tip of the threads) before they are reused. Bolts longer than specified are stretched and should not be used. Replace all the bolts if one or more of the bolts have been stretched. On four-cylinder engines, main cap bolts should be no longer than 2.70-inches. On V6 engines, the longer bolt limit is 5.452-inches and the shorter bolt limit is 4.763-inches.

9 Refer to Section 20 and examine the main and rod bearing inserts.

20 Main and connecting rod bearings - inspection and selection

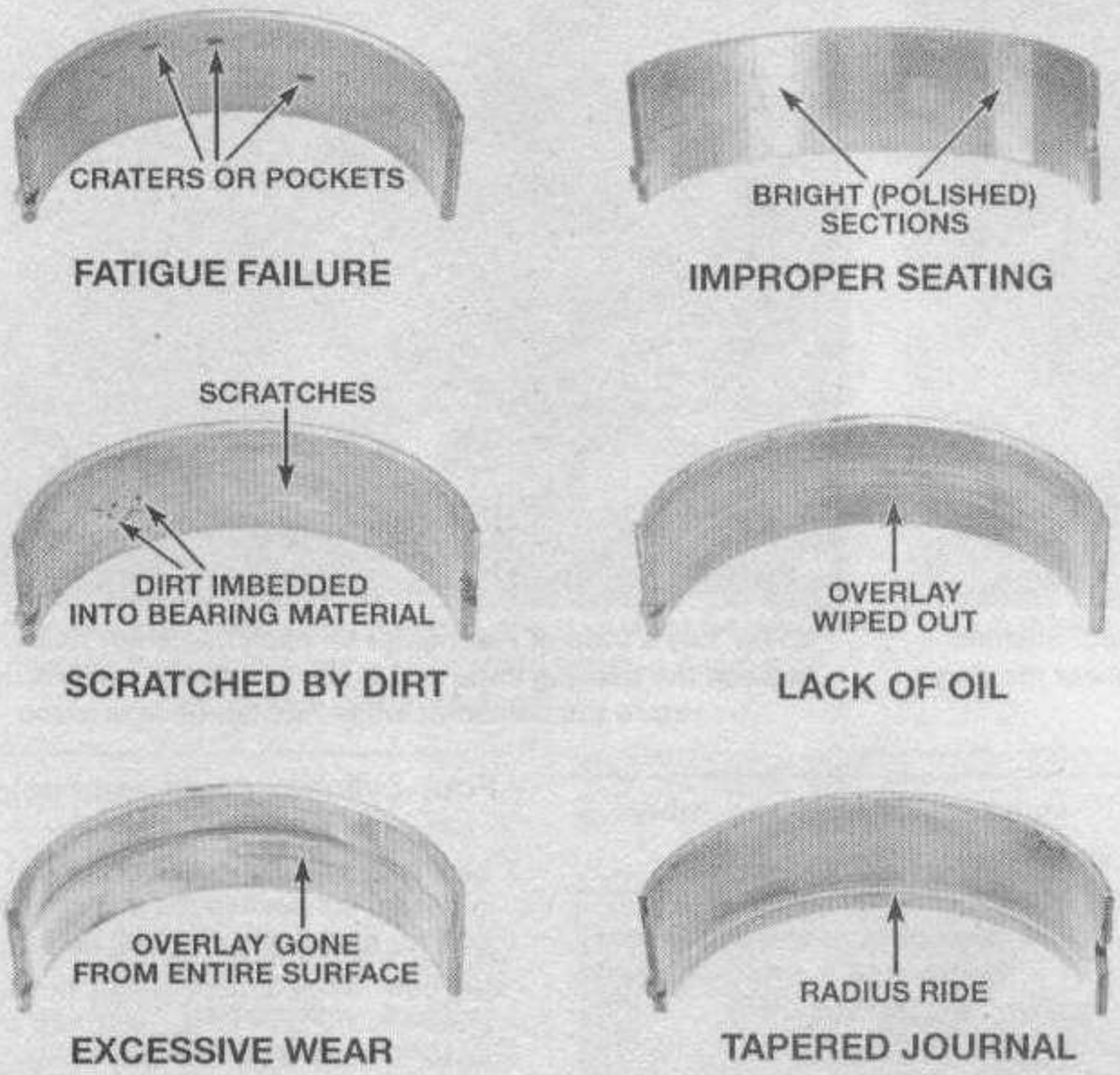
Inspection

Refer to illustration 20.1

1 Even though the main and connecting rod bearings should be replaced with new ones during the engine overhaul, the old bearings should be retained for close examination, as they may reveal valuable information about the condition of the engine **(see illustration)**.

2 Bearing failure occurs because of lack of lubrication, the presence of dirt or other foreign particles, overloading the engine and corrosion. Regardless of the cause of bearing failure, it must be corrected before the engine is reassembled to prevent it from happening again.

3 When examining the bearings, remove them from the engine block, the main bearing caps, the connecting rods and the rod caps and lay them out on a clean surface in the same general position as their location in the engine. This will enable you to match any bearing problems with the corresponding



20.1 When inspecting the main and connecting rod bearings, look for these problems

crankshaft journal.

4 Dirt and other foreign particles get into the engine in a variety of ways. It may be left in the engine during assembly, or it may pass through filters or the PCV system. It may get into the oil, and from there into the bearings. Metal chips from machining operations and normal engine wear are often present. Abrasives are sometimes left in engine components after reconditioning, especially when parts are not thoroughly cleaned using the proper cleaning methods. Whatever the source, these foreign objects often end up embedded in the soft bearing material and are easily recognized. Large particles will not embed in the bearing and will score or gouge the bearing and journal. The best prevention for this cause of bearing failure is to clean all parts thoroughly and keep everything spotlessly-clean during engine assembly. Frequent and regular engine oil and filter changes are also recommended.

5 Lack of lubrication (or lubrication breakdown) has a number of interrelated causes. Excessive heat (which thins the oil), overloading (which squeezes the oil from the bearing face) and oil leakage or throw off (from excessive bearing clearances, worn oil pump or high engine speeds) all contribute to lubrication breakdown. Blocked oil passages, which usually are the result of misaligned oil holes in a bearing shell, will also oil starve a bearing and destroy it. When lack of lubrication is the cause of bearing failure, the bearing material is wiped or extruded from the steel backing of the bearing. Temperatures may increase to the point where the steel backing turns blue from overheating.

6 Driving habits can have a definite effect on bearing life. Driving habits can have a definite effect on bearing life. Low speed operation in too high a gear (lugging the engine) puts very high loads on bearings, which tends to squeeze out the oil film. These loads cause the bearings to flex, which produces fine cracks in the bearing face (fatigue failure). Eventually the bearing material will loosen in pieces and tear away from the steel backing. Short-trip driving leads to corrosion of bearings because insufficient engine heat is produced to drive off the condensed water and corrosive gases. These products collect in the engine oil, forming acid and sludge. As the oil is carried to the engine bearings, the acid attacks and corrodes the bearing material.

7 Incorrect bearing installation during engine assembly will lead to bearing failure as well. Tight-fitting bearings leave insufficient bearing oil clearance and will result in oil starvation. Dirt or foreign particles trapped behind a bearing insert result in high spots on the bearing which lead to failure.

Selection

8 If the original bearings are worn or damaged, or if the oil clearances are incorrect (see Sections 24 or 26), new bearings will have to be purchased. It is rare during a thorough rebuild of an engine with many miles on it that new replacement bearings would not be employed. However, if the crankshaft has been reground, new **undersize** bearings must be installed.

9 The automotive machine shop that reconditions the crankshaft will provide or help you select the correct size bearings. Depending on how much material has to be ground from the crankshaft to restore it, different undersize bearings are required. Crankshafts are normally ground in increments of 0.010-inch. Sometimes the amount of material machined on a crankshaft will differ between the mains and rod journals, especially if a rod journal was damaged. Markings on most reground crankshafts indicate how much was machined, such as "10-10", meaning that 0.010-inch was removed from both the rod and main journals. Such a crankshaft would require 0.010-inch undersize bearings, a common replacement bearing size.

10 Regardless of how the bearing sizes are determined, use the oil clearance, measured with Plastigage, as a the final guide to ensure the bearings are the right size. If you have any questions or are unsure which bearings to use, get help from your machine shop or a dealer parts or service department.

21 Camshafts and lifters - inspection

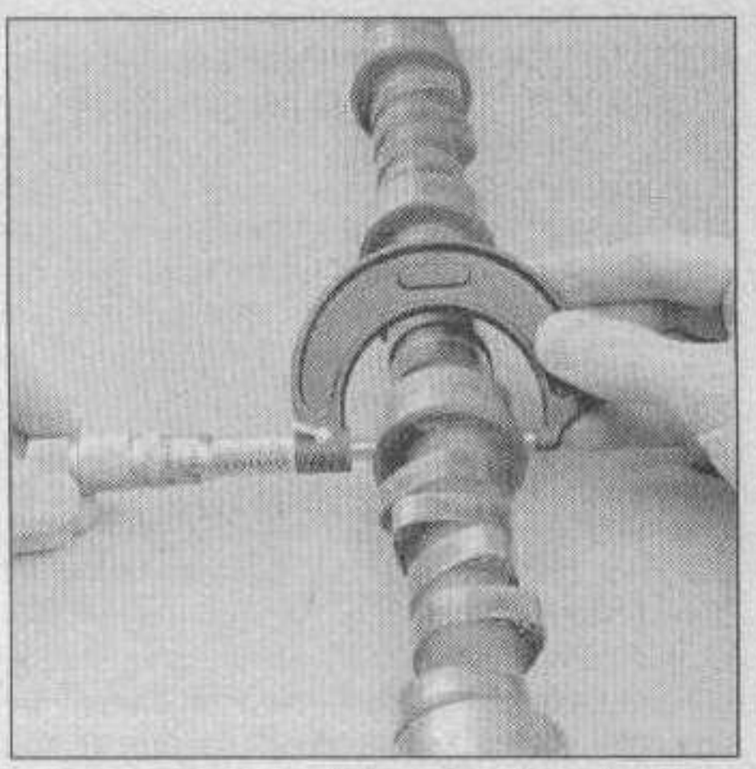
2C

Camshafts

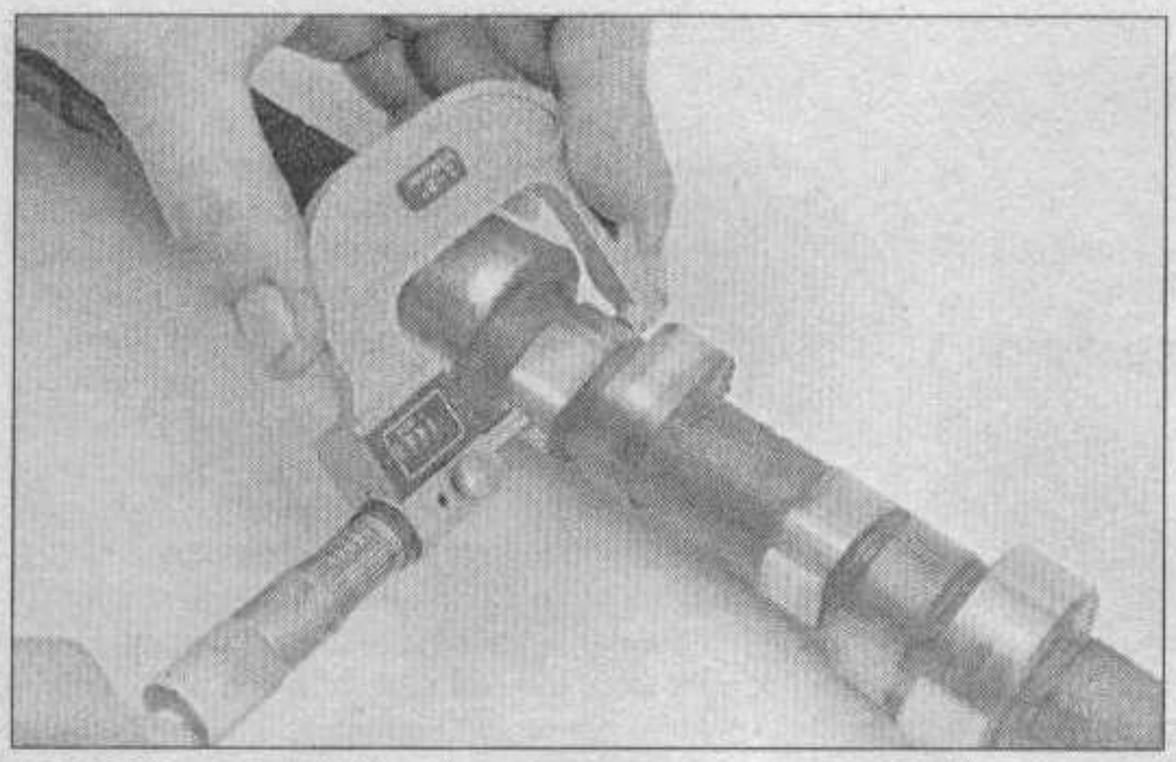
Refer to illustrations 21.2, 21.3, 21.4a and 21.4b

1 To check camshaft runout requires a pair of precision-ground V-blocks and a dial indicator. Only a machine shop would generally have such equipment, so if in doubt about the straightness of a camshaft, have it checked at your local machine shop and compare the runout to this Chapter's Specifications. Replace the camshaft if the runout is excessive.

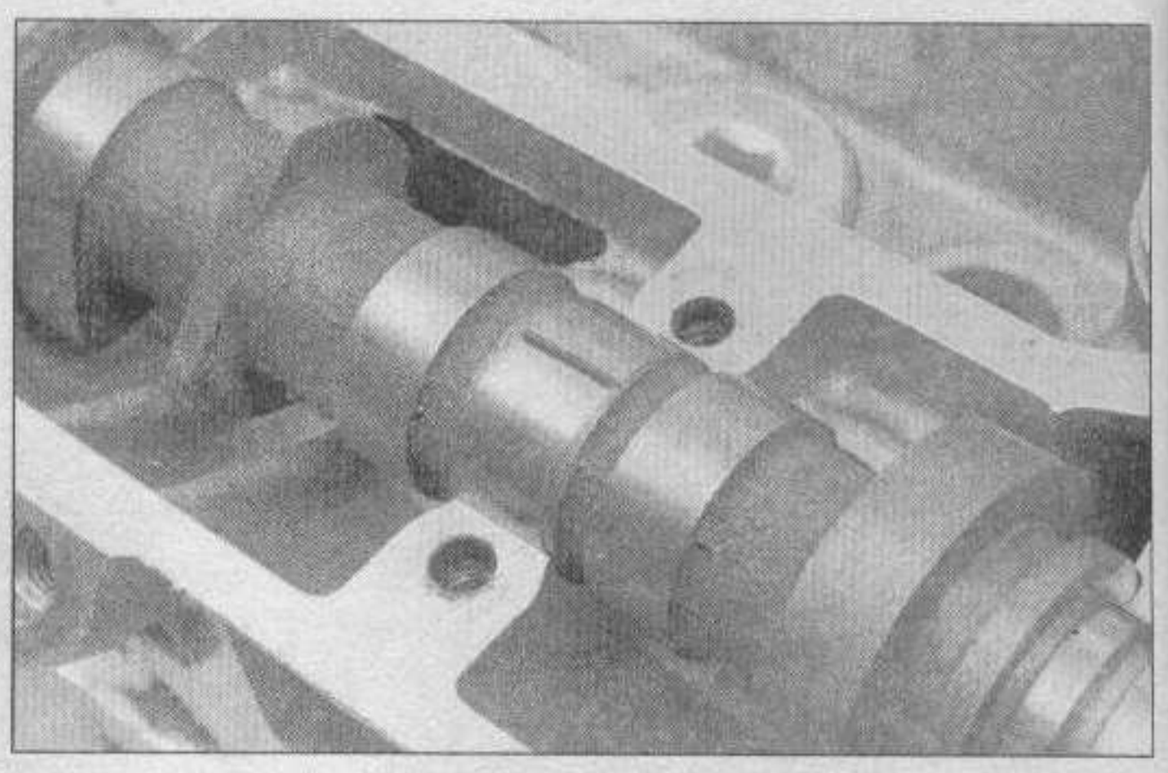
2 Check the camshaft bearing journals and caps for scoring and signs of wear. If they are worn, replace the cylinder head with a new or rebuilt unit. Measure the journals on the camshaft with a micrometer **(see illustration)**.



21.2 Measure each journal diameter with a micrometer



21.3 Measure the lobe heights and compare to Specifications - move the micrometer across the lobe until the highest reading is obtained



21.4a Lay a strip of Plastigage on each camshaft journal, then replace the bearing caps and tighten to Specifications - do not rotate the camshaft while Plastigage is in place

3 Check the cam lobes for wear:

a) *Check the toe and ramp areas of each cam lobe for score marks and uneven wear. Also check for flaking and pitting.*

b) *If there's wear on the toe or the ramp, replace the camshaft, but first try to find the cause of the wear. Look for abrasive substances in the oil and inspect the oil pump and oil passages for blockage. Lobe wear is usually caused by inadequate lubrication or dirty oil.*

c) *Using a micrometer, measure the cam lobe height* **(see illustration)**. *If the lobe wear is greater than listed in this Chapter's Specifications, replace the camshaft.*

4 Check the oil clearance of each camshaft journal with plastigage, comparing your readings with this Chapter's Specifications **(see illustrations)**. If the oil clearance of any of the journals is excessive, replace the camshaft and check the oil clearance again. If it's still excessive replace the cylinder head.

Lifters

Refer to illustration 21.6

5 Where mechanical (non-hydraulic) lifters are used, clean the oil off the valve lifter shims, mark them with a felt-tip marker and remove the lifters, keeping the shims with their lifters. Store the camshaft bearing caps, lifters and shims so they can be reinstalled without mixing them up.

6 Examine the camshaft surface of each lifter, as well as the exterior surface, for signs of wear, scoring or overheating **(see illustration)**. Generally, if one or more lifters are found to be damaged, replacing the whole set is advisable.

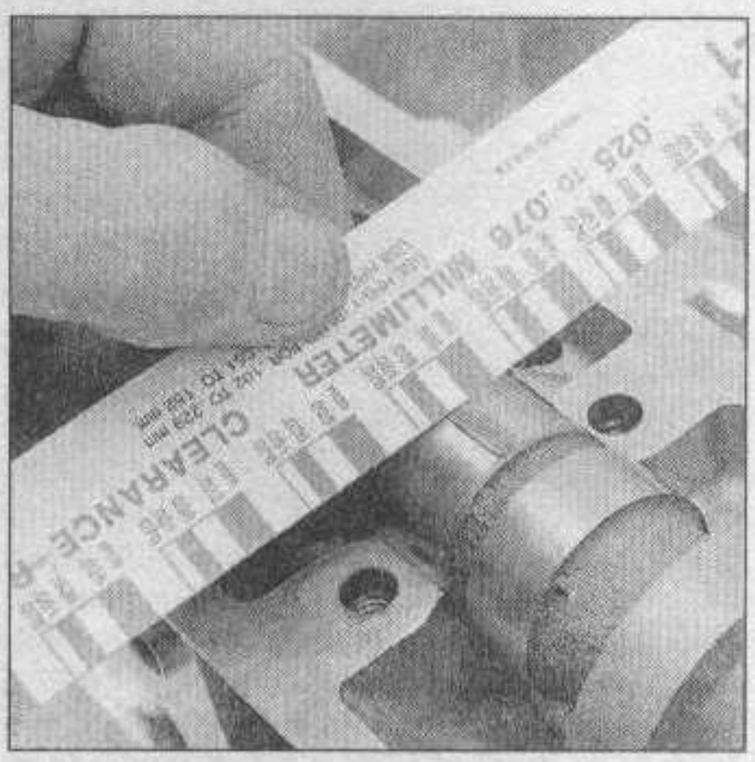
7 Measure the outside diameter of each lifter and the corresponding lifter bore inside diameter. Subtract the lifter diameter from the lifter bore diameter to determine the oil clearance. Compare it to this Chapter's Specifications. If the oil clearance is excessive, a new head and/or new lifters will be required. Until reassembly, store the hydraulic lifters upside-down in clean engine oil.

22 Engine overhaul - reassembly sequence

1 Before beginning engine reassembly, make sure you have all the necessary new parts, gaskets and seals as well as the following items on hand:

Common hand tools
A 1/2-inch drive torque wrench
Piston ring installation tool
Piston ring compressor
Short lengths of rubber or plastic hose to fit over connecting rod bolts
Plastigage
Feeler gauges
A fine-tooth file
New engine oil
Engine assembly lube or moly-base grease
Gasket sealer
Thread locking compound

2 In order to save time and avoid problems, engine reassembly must be done in the following general order:



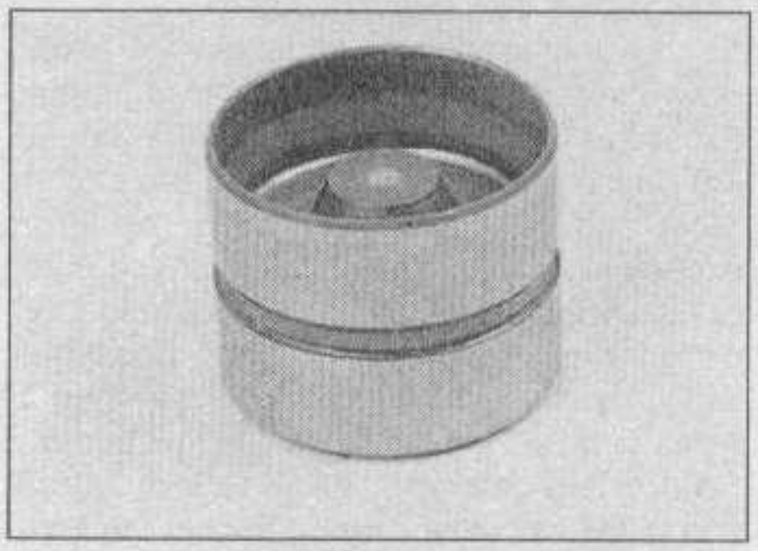
21.4b Remove the camshaft bearing caps and compare the width of the crushed Plastigage with the scale on the envelope to determine the oil clearance

Four-cylinder engine

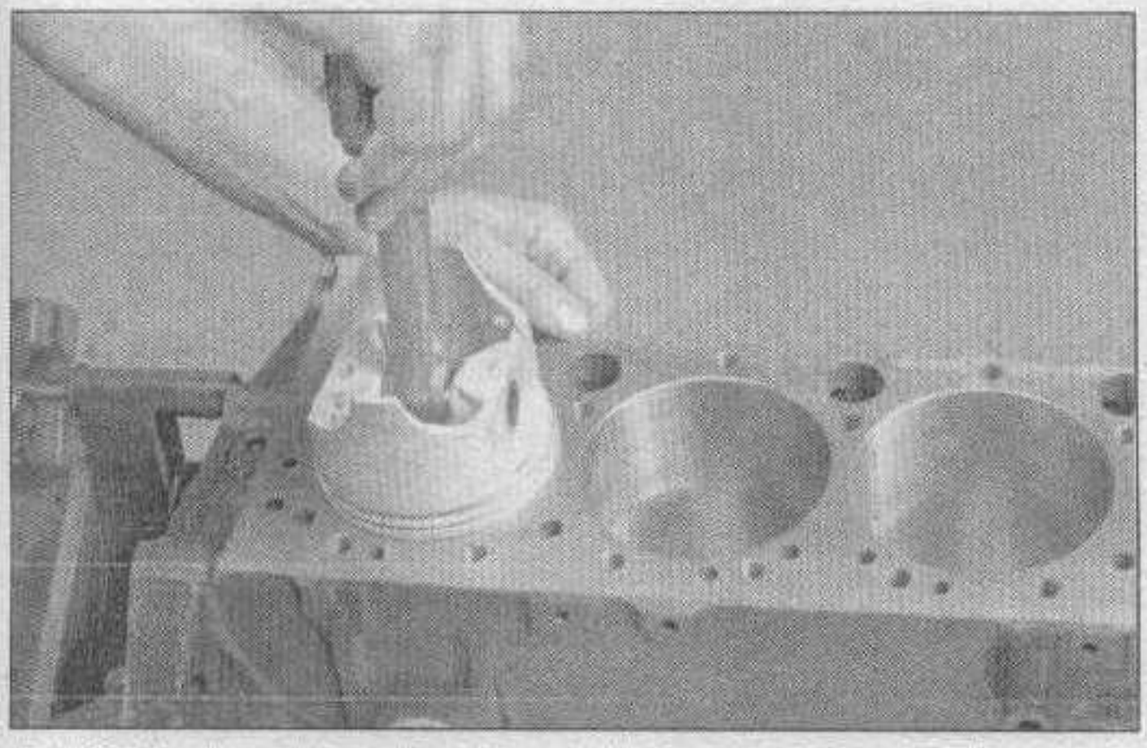
Piston rings
Crankshaft and main bearings
Piston/connecting rod assemblies
Rear main (crankshaft) oil seal
Oil pump
Block reinforcement
Cylinder head and lifters
Camshafts
Timing belt and sprockets
Timing belt covers
Oil pick-up
Oil pan
Intake and exhaust manifolds
Valve cover
Engine rear plate
Flywheel/driveplate

V6 engine

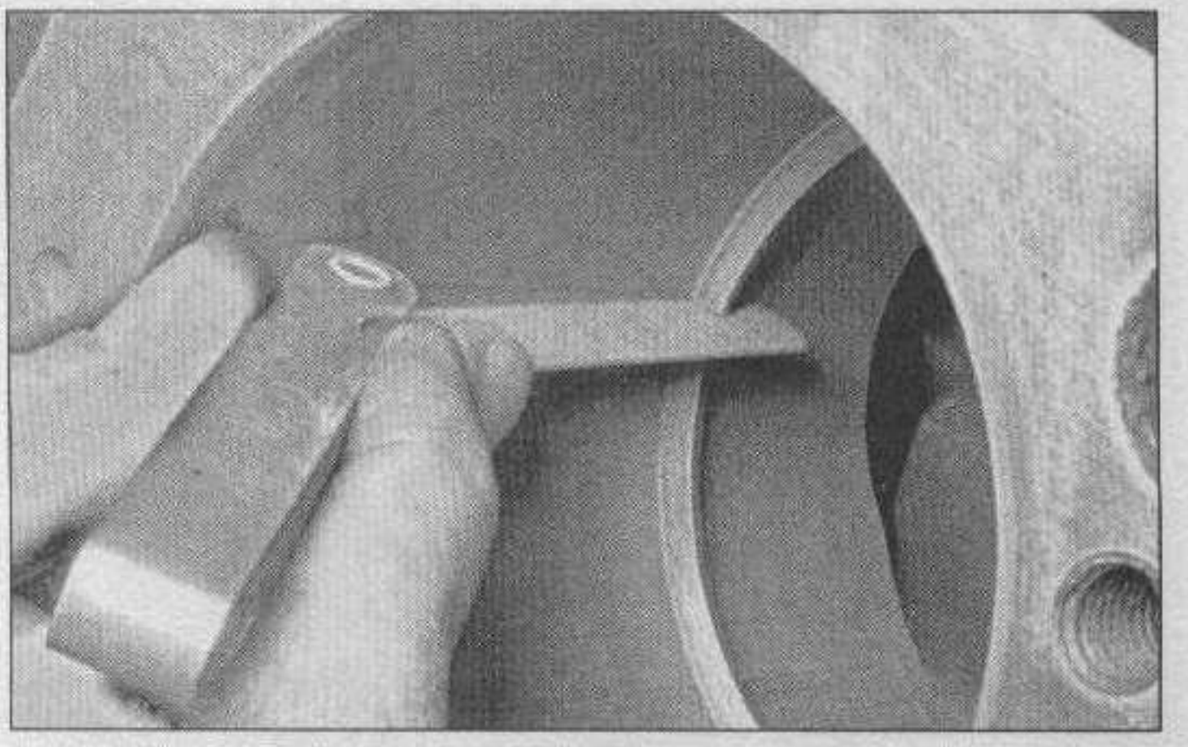
Piston rings
Crankshaft and main bearings
Lower block section
Piston/connecting rod assemblies
Rear main oil seal/retainer
Oil pump
Oil pan
Cylinder heads
Camshafts and lifters
Timing belt and sprockets
Timing belt covers
Valve covers
Intake and exhaust manifolds
Flywheel/driveplate



21.6 Check the sides of the lifters for scoring, pitting or discoloration



23.3 When checking piston ring end gap, the ring must be square in the cylinder bore (this is done by pushing the ring down with the top of a piston as shown)



23.4 With the ring square in the cylinder, measure the end gap with a feeler gauge

23 Piston rings - installation

Refer to illustrations 23.3, 23.4, 23.9a, 23.9b and 23.12

1 Before installing the new piston rings, the ring end gaps must be checked. It's assumed that the piston ring groove clearance has been checked and verified correct (see Section 18).

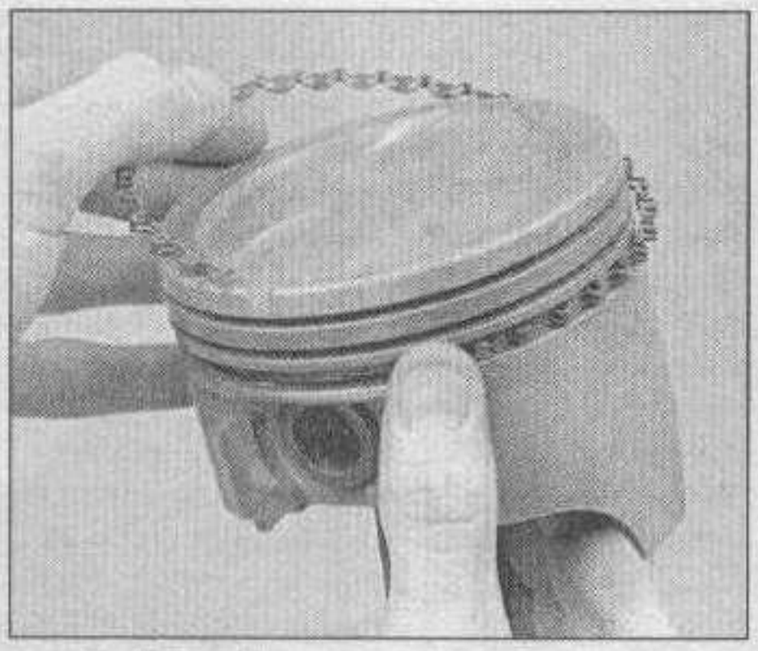
2 Lay out the piston/connecting rod assemblies and the new ring sets so the ring sets will be matched with the same piston and cylinder during the end gap measurement and engine assembly.

3 Insert the top (number one) ring into the first cylinder and square it up with the cylinder walls by pushing it in with the top of the piston **(see illustration)**. The ring should be near the bottom of the cylinder, at the lower limit of ring travel.

4 To measure the end gap, slip feeler gauges between the ends of the ring until a gauge equal to the gap width is found **(see illustration)**. The feeler gauge should slide between the ring ends with a slight amount of drag. Compare the measurement to that found in this Chapter's Specifications. If the gap is larger or smaller than specified, double-check to make sure you have the correct rings before proceeding.

5 If the gap is too small, you may have to file the rings to fit or exchange the set. The type of ring set you buy, and the material the rings are faced with, determine whether they can be filed. Carefully read the instructions with the ring set.

6 Excess end gap isn't as critical as too little gap, unless the gap is greater than 0.020-inch. Compare your measurements to this Chapter's Specifications for maximum end gap. Again, double-check to make sure you have the correct rings for your engine. If you do file the ring gaps, mount a file in a vise, lubricate the tops of the jaws, and slide the ring back and forth across the file, resting the ring against the top of the jaws and with even pressure on both sides of the ring gap. File a little, then recheck that ring's end gap in the bore before filing any more. When the correct gap is achieved, use a whetstone or fine file to deburr the edges that have been filed.



23.9a Install the spacer/expander in the oil control ring groove

23.9b DO NOT use a piston ring installation tool when installing the oil ring side rails

7 Repeat the procedure for each ring that will be installed in the first cylinder and for each ring in the remaining cylinders. Remember to keep rings, pistons and cylinders matched up.

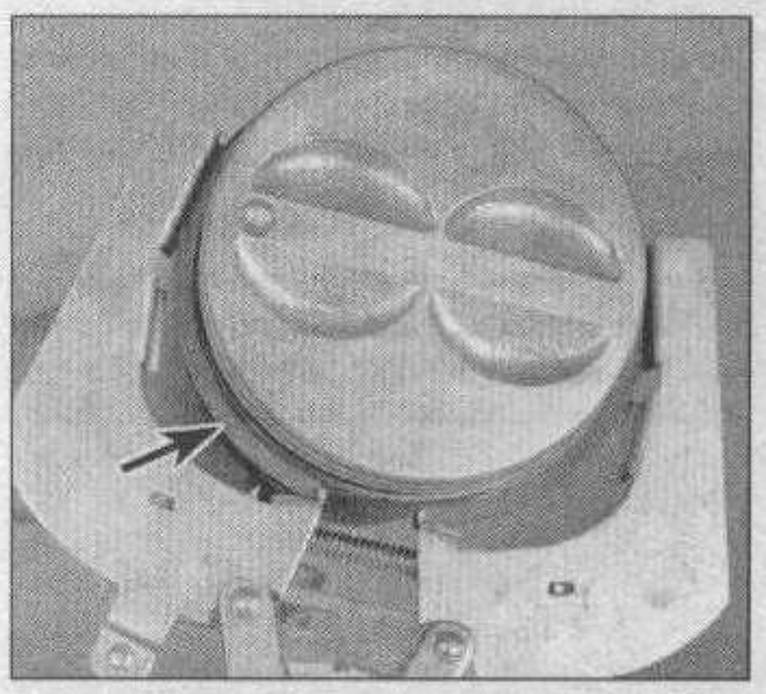
8 Once the ring end gaps have been checked/corrected, the rings can be installed on the pistons.

9 The oil control ring (lowest one on the piston) is usually installed first. It's composed of three separate components. Slip the spacer/expander into the groove **(see illustration)**. If an anti-rotation tang is used, make sure it's inserted into the drilled hole in the ring groove. Refer to Section 26 for the orientation of the expander gap to the piston. Next, install the lower side rail. Don't use a piston ring installation tool on the oil ring side rails, as they may be damaged. Instead, place one end of the side rail into the groove between the spacer/expander and the ring land, hold it firmly in place and slide a finger around the piston while pushing the rail into the groove **(see illustration)**. Next, install the upper side rail in the same manner.

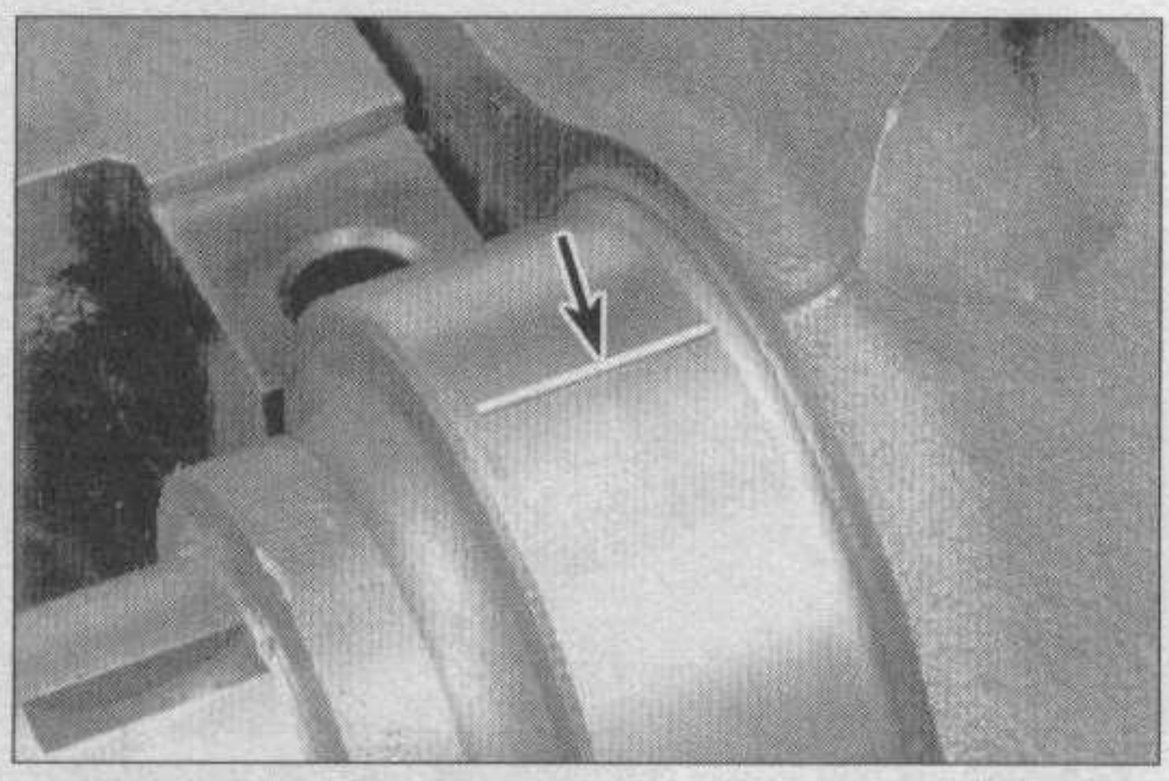
10 After the three oil ring components have been installed, check to make sure that both the upper and lower side rails can be turned smoothly in the ring groove.

11 The number two (middle) ring is installed next. It's usually stamped with a mark which must face up, toward the top of the piston. **Note:** *Always follow the instructions printed on the ring package or box - different manufacturers may require different approaches. Do not mix up the top and middle rings, as they have different cross sections.*

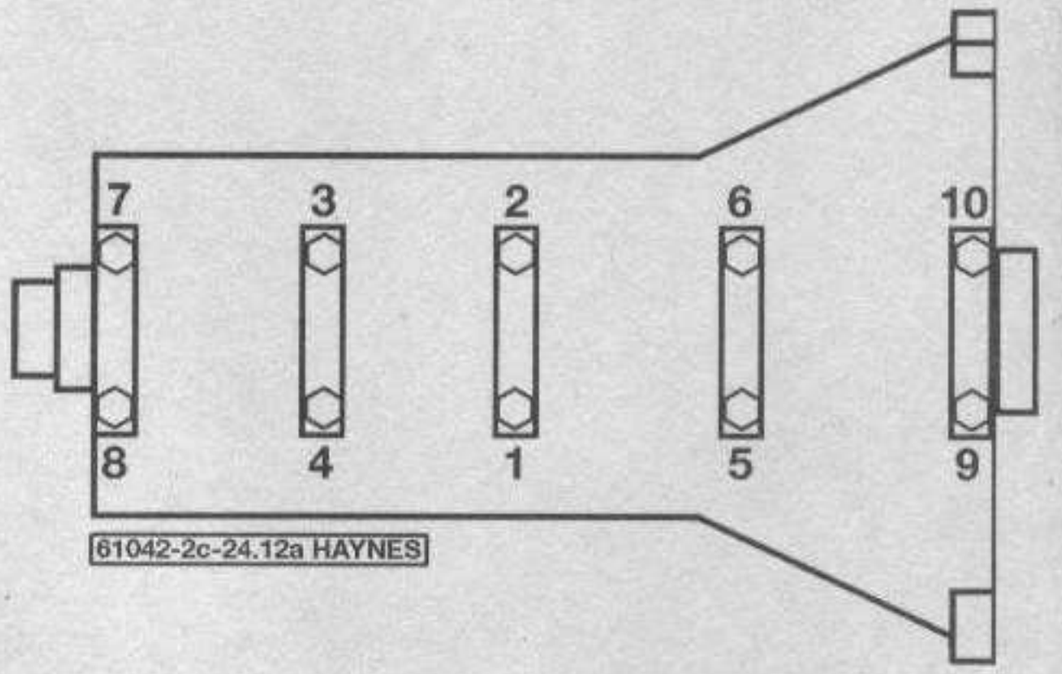
12 Use a piston ring installation tool and



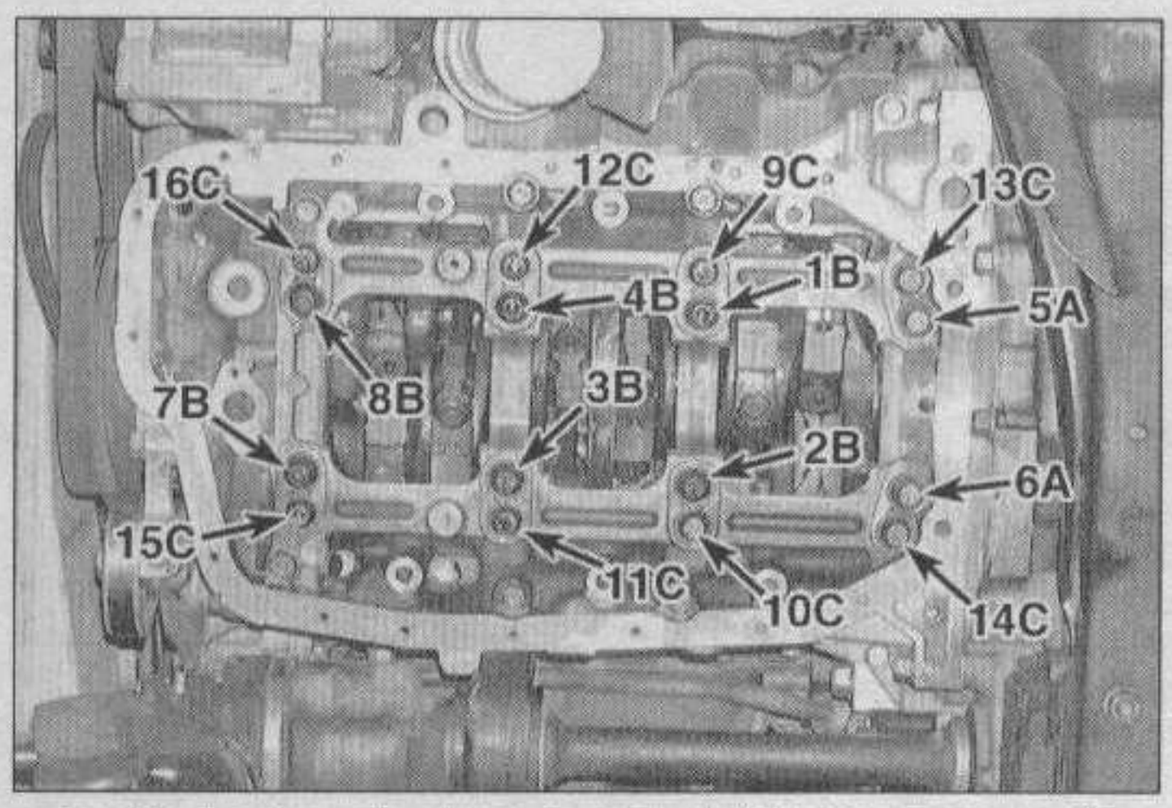
23.12 Install the compression rings with a ring expander - the mark (arrow) must face up



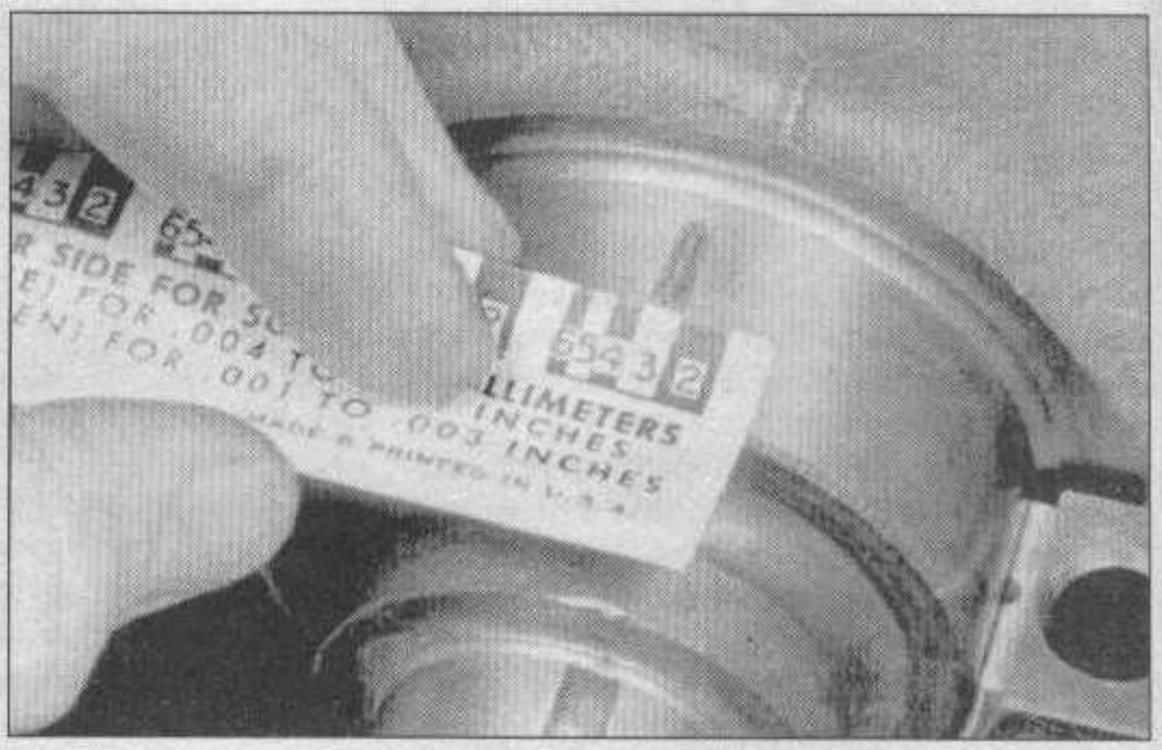
24.10 Lay the Plastigage strips (arrow) on the main bearing journals, parallel to the crankshaft centerline



24.12a Main bearing cap bolt TIGHTENING sequence - four-cylinder engine



24.12b Lower engine block bolt TIGHTENING sequence - V6 engine - tighten the bolts in the numbered sequence - the letters are used to indicate the different torque specifications for each bolt



24.14 Compare the width of the crushed Plastigage to the scale on the envelope to determine the main bearing oil clearance (always take the measurement at the widest point of the Plastigage) - be sure to use the correct scale; standard and metric scales are included

make sure the ring's identification mark is facing the top of the piston, then slip the ring into the middle groove on the piston **(see illustration)**. Don't expand the ring any more than necessary to slide it over the piston.

13 Install the number one (top) ring in the same manner. Make sure the mark is facing up. Be careful not to confuse the number one and number two rings.

14 Repeat the procedure for the remaining pistons and rings.

24 Crankshaft - installation and main bearing oil clearance check

Refer to illustrations 24.10, 24.12a, 24.12b, 24.14, 24.20a and 24.20b

1 Crankshaft installation is the first major step in engine reassembly. It's assumed at this point that the engine block and crankshaft have been cleaned, inspected and repaired or reconditioned.

2 Position the engine with the bottom facing up.

3 Remove the main bearing cap bolts and lift out the caps or lower block section (V6). Lay the caps out in the proper sequence.

4 If they're still in place, remove the old bearing inserts from the block and the main bearing caps. Wipe the main bearing surfaces of the block and caps with a clean, lint-free cloth. They must be kept spotlessly clean!

Main bearing oil clearance check

5 Clean the back sides of the new main bearing inserts and lay the bearing half with the oil groove in each main bearing saddle in the block. Lay the other bearing half from each bearing set in the corresponding main bearing cap or position on the lower block section (V6). Make sure the tab on each bearing insert fits into the recess in the block or cap. Also, the oil holes in the block must line up with the oil holes in the bearing insert. **Caution:** *Do not hammer the bearings into place and don't nick or gouge the bearing faces. No lubrication should be used at this time.*

6 On all engines, the thrust bearings (washers) must be installed in the number four cap, counting from the front (timing belt) end of the engine.

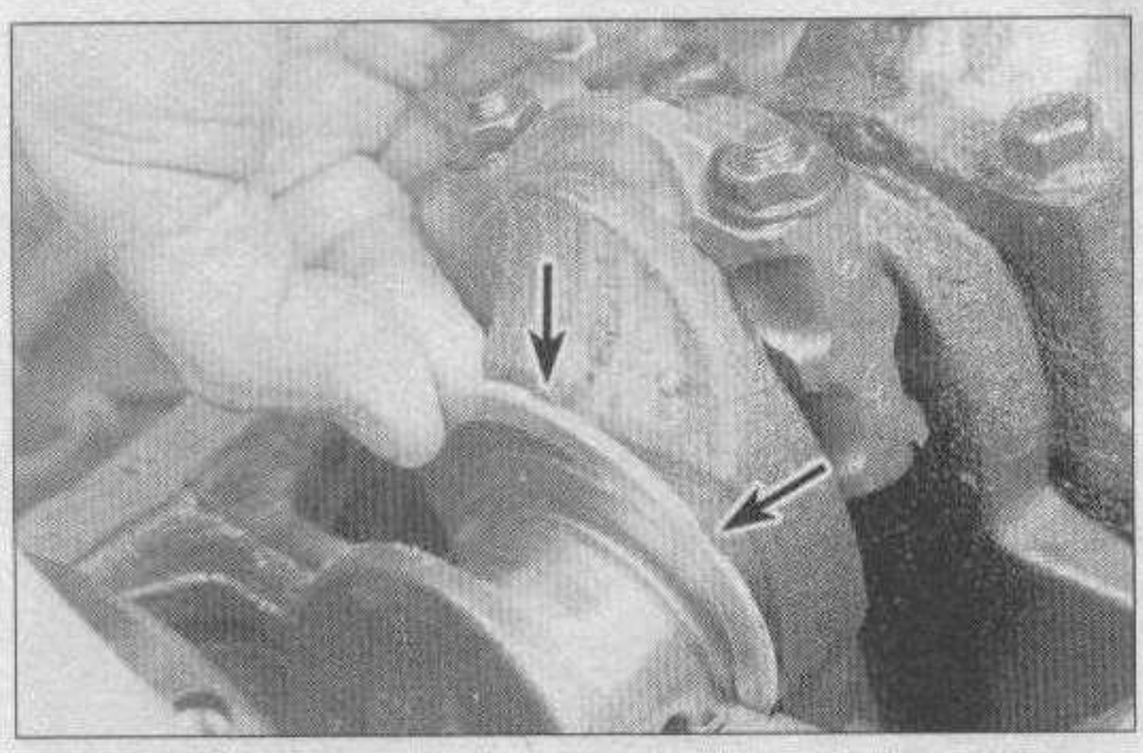
7 Clean the faces of the bearings in the block and the crankshaft main bearing journals with a clean, lint-free cloth. Check or clean the oil holes in the crankshaft, as any dirt here can go only one way - straight through the new bearings.

8 Once you're certain the crankshaft is clean, carefully lay it in position in the main bearings.

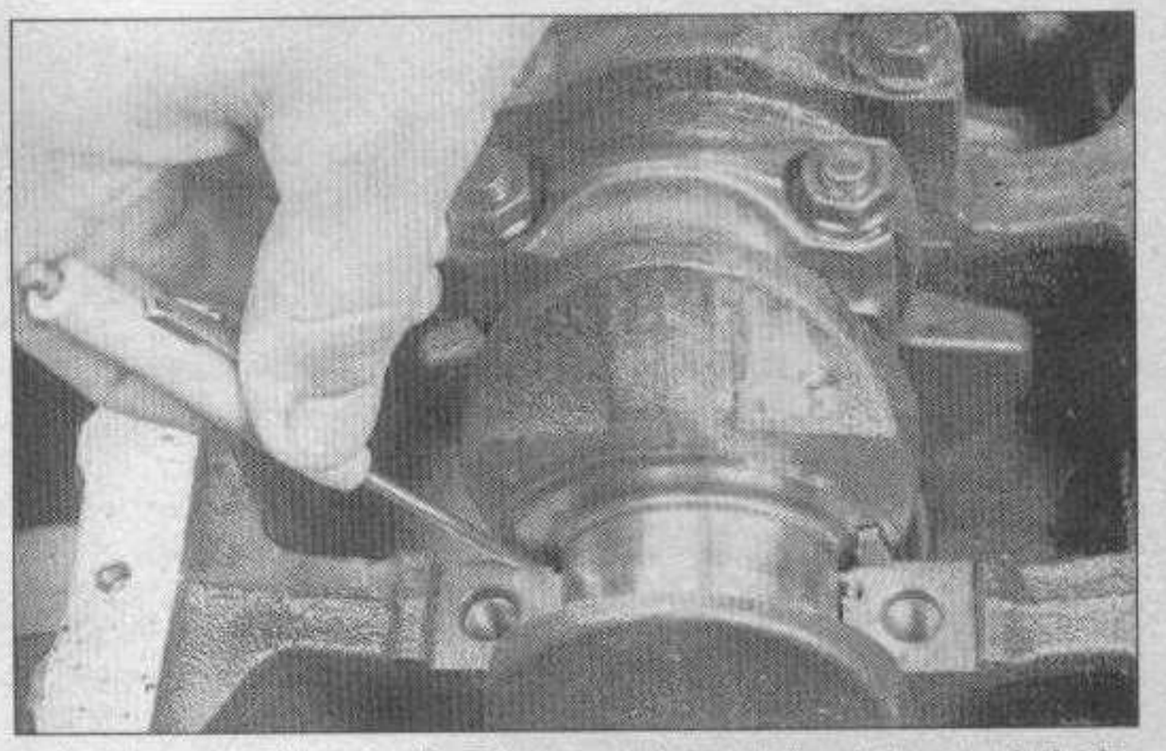
9 Before the crankshaft can be permanently installed, the main bearing oil clearance must be checked.

10 Trim several pieces of the appropriate-size Plastigage (they must be slightly shorter than the width of the main bearings) and place one piece on each crankshaft main bearing journal, parallel with the journal axis **(see illustration)**.

11 Clean the faces of the bearings in the caps and install the caps in their respective positions (don't mix them up) with the arrows



24.20a Place the upper thrust washer into position with the grooves facing OUT (arrows) . . .



24.20b . . . and rotate the thrust washers around the crankshaft and into position in the engine block

pointing toward the front of the engine. If you're working on a V6 engine, carefully lay the lower block half in place. Don't disturb the Plastigage. Apply a light coat of oil to the bolt threads and the undersides of the bolt heads, then install them.

12 Following the recommended sequence **(see illustrations)**, tighten the main bearing cap bolts, in three steps, to the torque listed in this Chapter's Specifications. Don't rotate the crankshaft at any time during this operation! **Note:** *On V6 engines, the lower block section bolts are identified by markings on the heads. The "A" bolts are marked "4", and the "B" bolts with a "1". The "C" bolts have no head marking.* After the 16 bolts that support the crankshaft are tightened, tighten the perimeter bolts, working from the center of the engine out toward each end.

13 Remove the bolts and carefully lift off the main bearing caps or cap assembly. Keep them in order. Don't disturb the Plastigage or rotate the crankshaft. If any of the main bearing caps are difficult to remove, tap them gently from side-to-side with a soft-face hammer to loosen them.

14 Compare the width of the crushed Plastigage on each journal to the scale printed on the Plastigage envelope to obtain the main bearing oil clearance **(see illustration)**. Check the Specifications to make sure it's correct.

15 If the clearance is not as specified, the bearing inserts may be the wrong size (which means different ones will be required - see Section 20). Before deciding that different inserts are needed, make sure that no dirt or oil was between the bearing inserts and the caps or block when the clearance was measured. If the Plastigage is noticeably wider at one end than the other, the journal may be tapered (see Section 19).

16 Carefully scrape all traces of the Plastigage material off the main bearing journals and/or the bearing faces. Don't nick or scratch the bearing faces.

Final crankshaft installation

17 Carefully lift the crankshaft out of the engine. Clean the bearing faces in the block, then apply a thin, uniform layer of clean moly-based engine assembly lube to each of the bearing surfaces. Coat the thrust washers as well.

18 Lubricate the crankshaft surfaces that contact the oil seals with clean engine oil.

19 Make sure the crankshaft journals are clean, then lay the crankshaft back in place in the block. Clean the faces of the bearings in the caps or cap assembly, then apply lubricant to them.

20 The upper (block side) thrust washers can be rotated into position around the crankshaft with the crankshaft in the block **(see illustrations)**. Be sure to install the thrust washers in the number four main bearing position with the thrust washer grooves facing OUT. The lower thrust washers should be placed on the caps or cap assembly with their grooves OUT and the tangs fitting into the cap slots.

21 On four-cylinder engines, install the caps in their respective positions with the arrows pointing toward the front of the engine. Apply a light coat of oil to the bolt threads and the under sides of the bolt heads, and install the bolts. Tighten the main bearing cap bolts to the torque listed in this Chapter's Specifications, following the recommended sequence.

22 On V6 engines, apply a bead of RTV sealant on the engine block-to-lower block section mating surface. Install the lower block section. Apply a light coat of engine oil to the bolt threads. Install and tighten the bolts to the torque listed in this Chapter's Specifications, in sequence as in Step 12, within five minutes of applying the sealant.

23 On manual transmission equipped models, install a new pilot bearing in the end of the crankshaft (see Chapter 8).

24 Rotate the crankshaft a number of times by hand to check for any obvious binding.

25 Check the crankshaft endplay with a feeler gauge or a dial indicator as described in Section 14. The endplay should be correct if the crankshaft thrust faces aren't worn or damaged and new thrust washers have been installed.

26 Install a new rear main oil seal (see Section 25).

25 Rear main oil seal installation

The crankshaft must be installed first and the main bearing caps or lower block half bolted in place, then the new seal should be installed in the block or seal retainer plate. Refer to Chapter 2, Part A for the procedure.

2C

26 Pistons/connecting rods - installation and rod bearing oil clearance check

Refer to illustrations 26.5, 26.11, 26.13 and 26.17

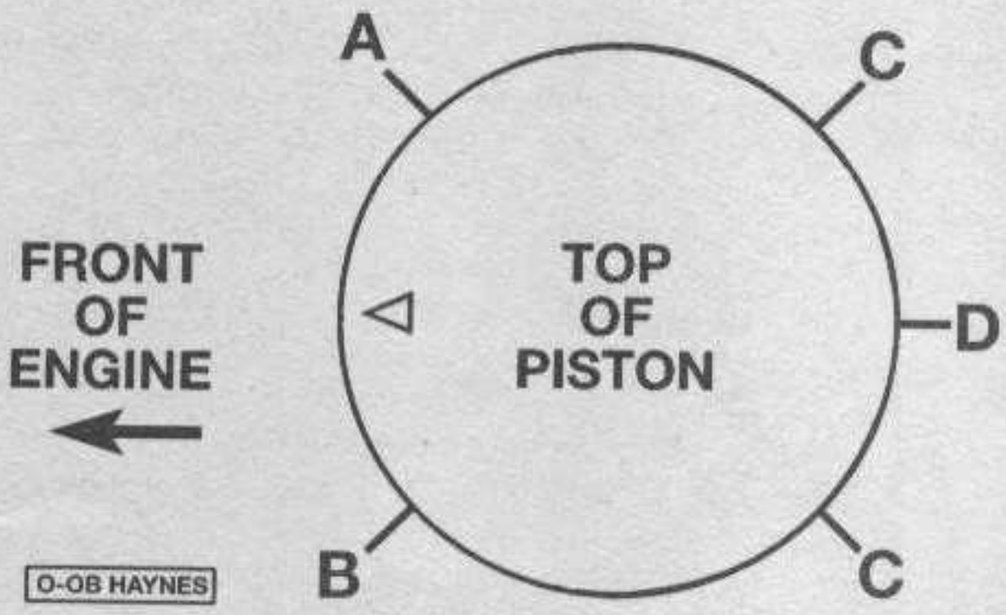
1 Before installing the piston/connecting rod assemblies, the cylinder walls must be perfectly clean, the top edge of each cylinder must be chamfered, and the crankshaft must be in place.

2 Remove the cap from the end of the number one connecting rod (refer to the marks made during removal). Remove the original bearing inserts and wipe the bearing surfaces of the connecting rod and cap with a clean, lint-free cloth. They must be kept spotlessly clean.

Connecting rod bearing oil clearance check

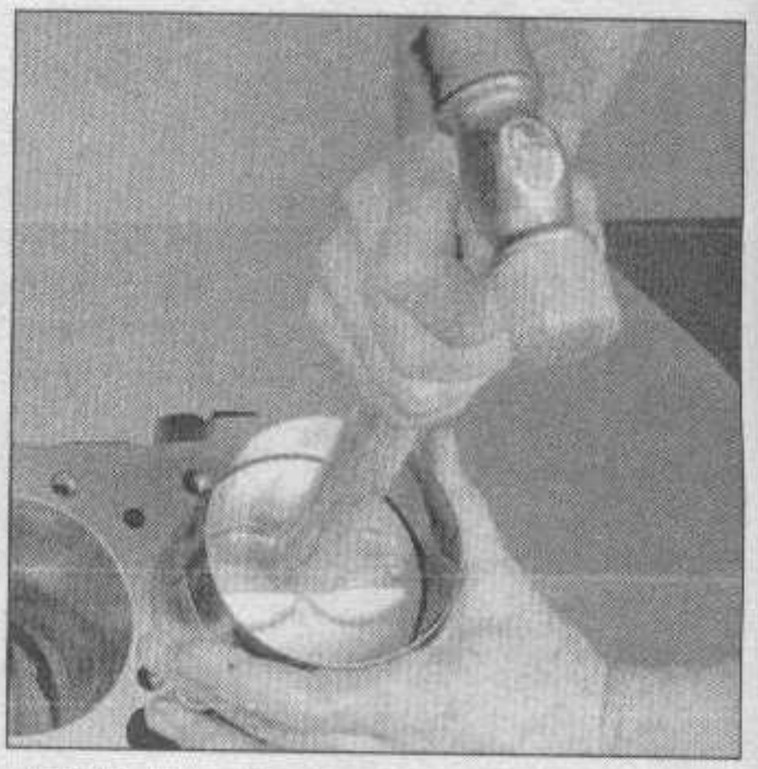
3 Clean the back side of the new upper bearing insert, then lay it in place in the connecting rod. Make sure the tab on the bearing fits into the recess in the rod. Don't hammer the bearing insert into place and be very careful not to nick or gouge the bearing face. Don't lubricate the bearing at this time.

4 Clean the back side of the other bearing insert and install it in the rod cap. Again, make sure the tab on the bearing fits into the recess in the cap, and don't apply any lubricant. It's critically important that the mating surfaces of the bearing and connecting rod



26.5 Position the ring end gaps around the piston as shown, before installing the piston/connecting rod assembly into the cylinder

A Top compression ring end gap
B Second compression ring end gap
C Oil ring end gaps
D Oil ring spacer gap



26.11 The piston can be driven (gently) into the cylinder bore with the end of a wooden or plastic hammer handle

are perfectly clean and oil free when they're assembled.

5 Position the piston ring gaps at staggered intervals around the piston **(see illustration)**.

6 Rotate the engine on the engine stand so that the bore for the piston/rod being installed is vertical. In this position the rod will hang straight down toward the crankshaft journal.

7 Lubricate the piston and rings with clean engine oil and attach a piston ring compressor to the piston. Leave the skirt protruding about 1/4-inch to guide the piston into the cylinder. The rings must be compressed until they're flush with the piston.

8 Rotate the crankshaft until the number one connecting rod journal is at BDC (bottom dead center) and apply a coat of engine oil to the cylinder wall.

9 With the piston's Front mark facing the front of the engine, gently insert the piston/connecting rod assembly into the number one cylinder bore and rest the bottom edge of the ring compressor on the engine block. On four-cylinder engines, the pistons are marked with an "F" for Front in the recess around the piston pin, and V6 pistons are marked in the same position with an "R" for right bank or "L" for left bank.

10 Tap the top edge of the ring compressor to make sure it's contacting the block around its entire circumference.

11 Gently tap on the top of the piston with the end of a wooden hammer handle **(see illustration)** while guiding the end of the connecting rod into place on the crankshaft journal. The piston rings may try to pop out of the ring compressor just before entering the cylinder bore, so keep some downward pressure on the ring compressor. Work slowly, and if any resistance is felt as the piston enters the cylinder, stop immediately. Find out what's hanging up and fix it before proceeding. **Caution:** *Do not, for any reason, force the piston into the cylinder - you might break a ring and/or the piston.*

12 Once the piston/connecting rod assembly is installed, the connecting rod bearing oil clearance must be checked before the rod cap is permanently bolted in place.

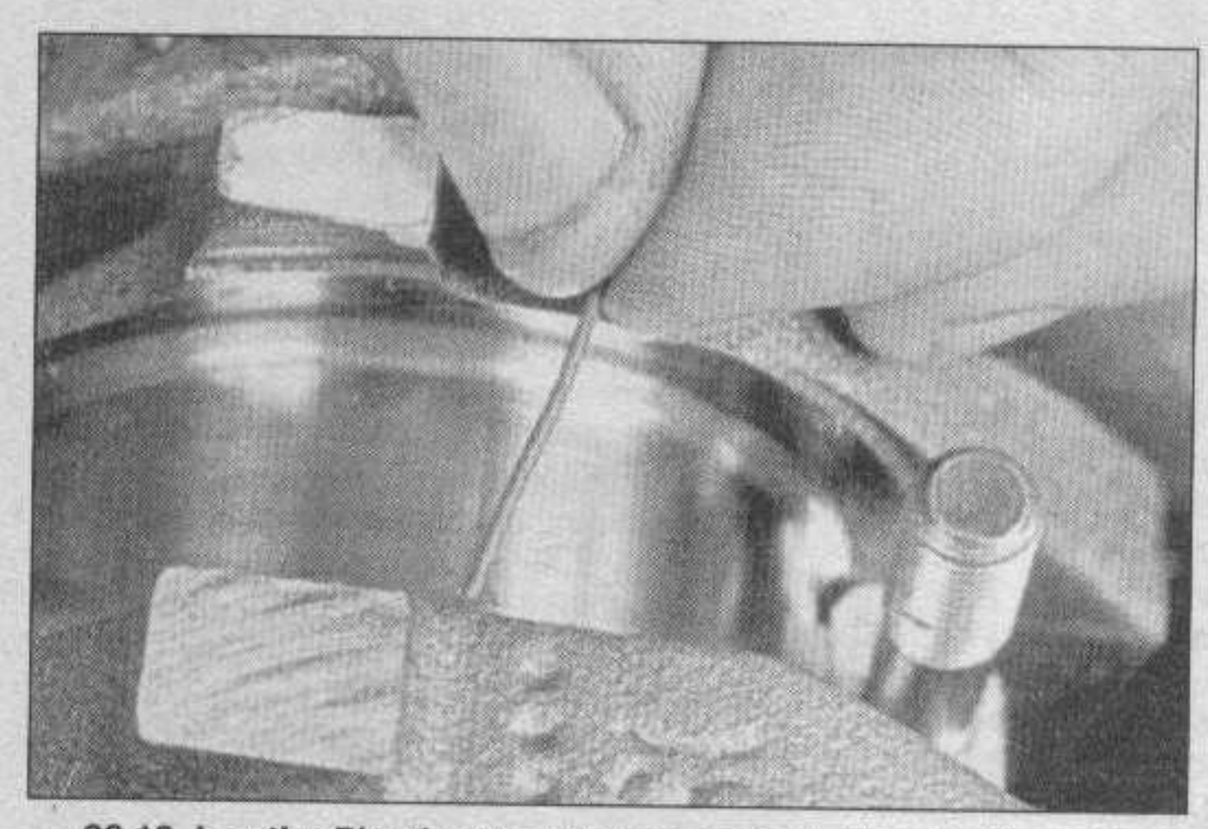
13 Cut a piece of the appropriate size Plastigage slightly shorter than the width of the connecting rod bearing and lay it in place on the number one connecting rod journal, parallel with the journal axis **(see illustration)**.

14 Clean the connecting rod cap bearing face, remove the protective hoses from the connecting rod bolts and install the rod cap. Make sure the mating mark on the cap is on the same side as the mark on the connecting rod. Check the cap to make sure the front mark is facing the timing belt end of the engine.

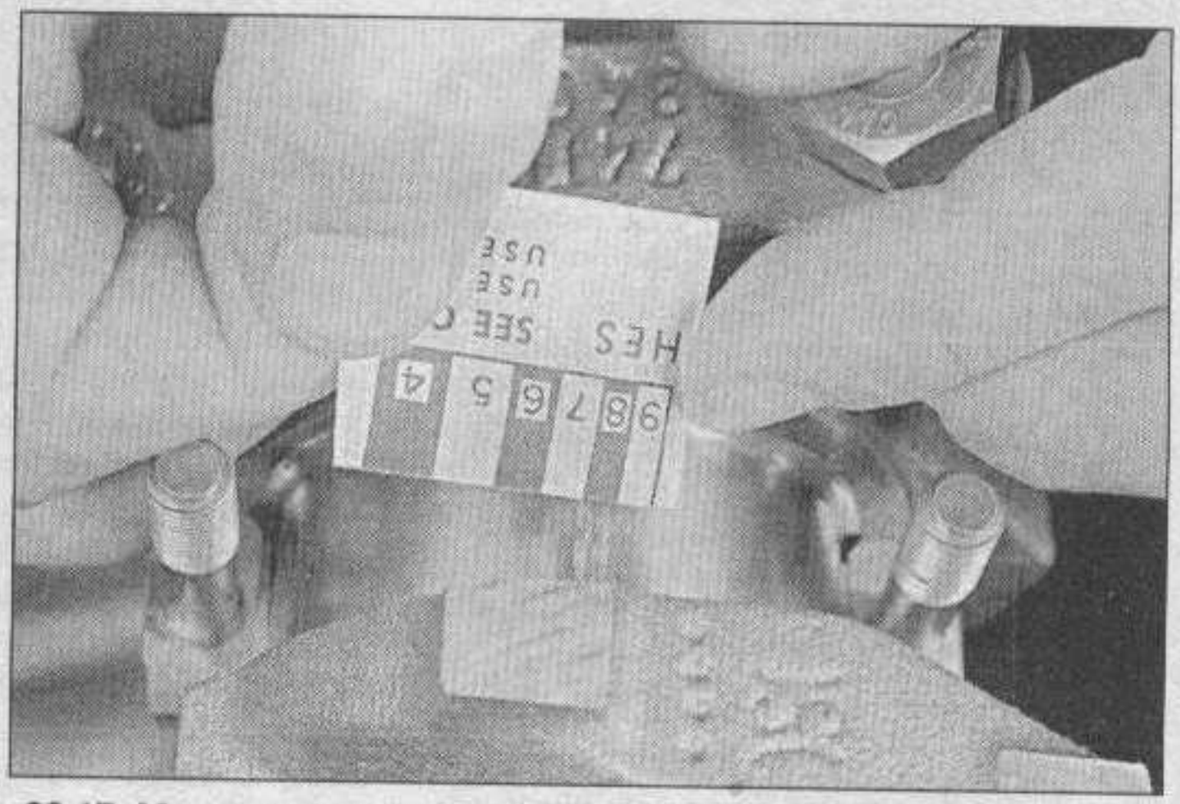
15 Apply a light coat of oil to the under sides of the bolts, then install and tighten them to the torque listed in this Chapter's Specifications, working up to it in three steps. Use a thin-wall socket to avoid erroneous torque readings that can result if the socket is wedged between the rod cap and nut. If the socket tends to wedge itself between the nut and the cap, lift up on it slightly until it no longer contacts the cap. Do not rotate the crankshaft at any time during this operation.

16 Remove the nuts and detach the rod cap, being very careful not to disturb the Plastigage.

17 Compare the width of the crushed Plastigage to the scale printed on the Plastigage envelope to obtain the oil clearance **(see illustration)**. Compare it to this Chapter's Specifications to make sure the clearance is correct.



26.13 Lay the Plastigage strips on each rod bearing journal, parallel to the crankshaft centerline



26.17 Measure the width of the crushed Plastigage to determine the rod bearing oil clearance (be sure to use the correct scale - standard and metric scales are included)

18 If the clearance is not as specified, the bearing inserts may be the wrong size (which means different ones will be required). Before deciding that different inserts are needed, make sure that no dirt or oil was between the bearing inserts and the connecting rod or cap when the clearance 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 19).

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 to remove the Plastigage.

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 higher 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 listed in this Chapter's Specifications. 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 mark on the piston must face the front (timing belt 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 13 for this procedure and to Chapter 2, Part A for installation of the block stiffener on four-cylinder engines.

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 engine oil and coolant levels.

2 With the spark plugs out of the engine and the ignition system and fuel pump disabled (see Section 3), 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 and restore the ignition system and fuel pump functions (see Section 3).

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.

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 is 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. Do not pamper it or abuse it. After 2000 miles, change the oil and filter again and consider the engine broken in.

Chapter 3
Cooling, heating and air conditioning systems

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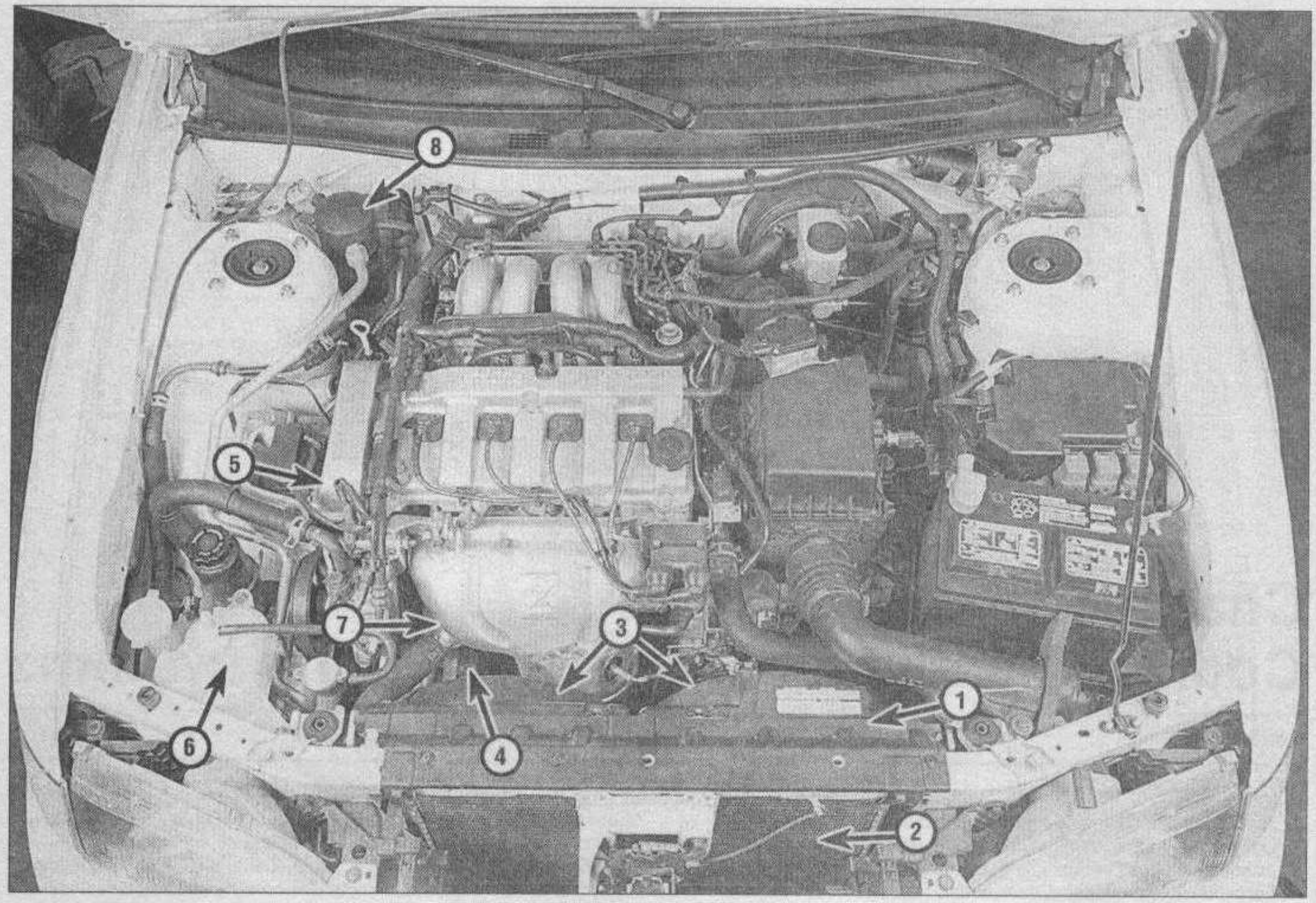
Specifications

General

Radiator cap pressure rating	13.5 to 17.8 psi
Thermostat rating	
Opening temperature	176 to 183 degrees F
Fully open temperature	203 degrees F
Refrigerant type	
1993	R-12
1994 and later	R-134a
Refrigerant capacity	28.2 ounces

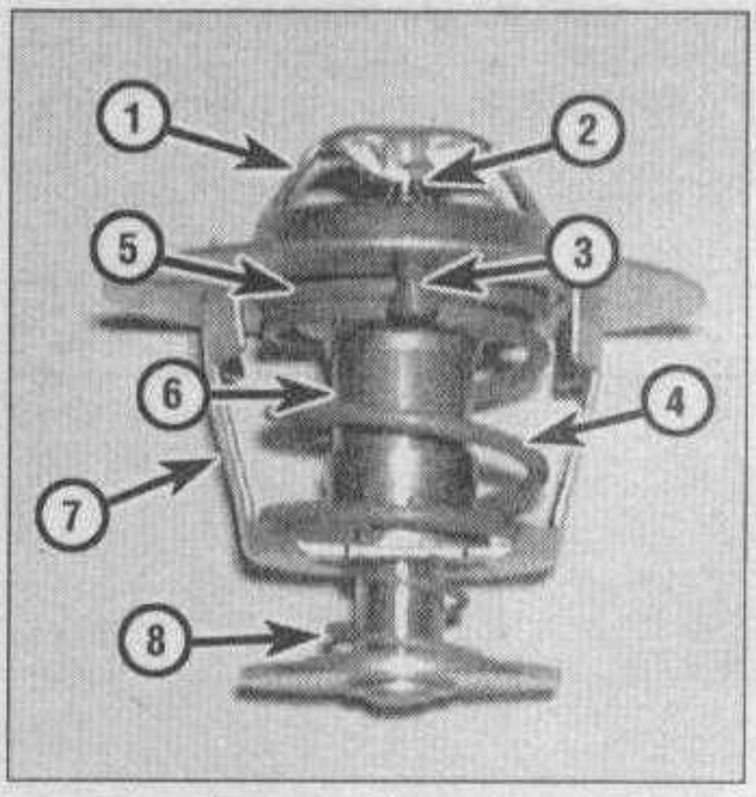
Torque specifications

	Ft-lbs (unless otherwise indicated)
Thermostat housing bolts	14 to 18
Water pump-to-block bolts	14 to 18
Water pump pulley bolts	71 to 88 in-lbs
Inlet pipe bolts	14 to 18



1.1 Engine cooling system and air conditioning system components

1 *Radiator*
2 *Condenser*
3 *Radiator and condenser cooling fans*
4 *Air conditioning compressor*
5 *Water pump*
6 *Coolant reservoir*
7 *Thermostat housing*
8 *Air conditioning accumulator/drier*



1.2 Typical thermostat

1 *Flange*
2 *Piston*
3 *Jiggle valve*
4 *Main coil spring*
5 *Valve seat*
6 *Frame*
7 *Valve*
8 *Secondary coil spring*

1 General information

Engine cooling system

Refer to illustrations 1.1 and 1.2

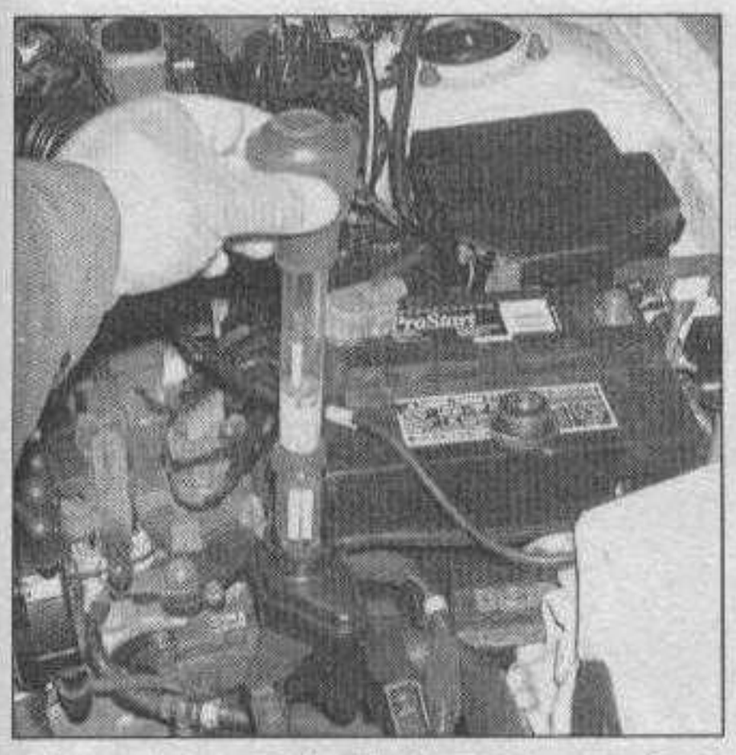
All models covered by this manual employ a pressurized engine cooling system with thermostatically-controlled coolant circulation **(see illustration)**. An impeller-type water pump mounted on the front of the block pumps coolant through the engine. The coolant flows around each cylinder and toward the rear of the engine. Cast-in coolant passages direct coolant around the intake and exhaust ports, near the spark plug areas and in proximity to the exhaust valve guides.

A wax-pellet type thermostat is located in the thermostat housing, located at the radiator side of the timing belt end on four-cylinder engines, and at the top of the engine at the transaxle end on V6 engines **(see illustration)**. During warm up, the closed thermostat prevents coolant from circulating through the radiator. When the engine reaches normal operating temperature, the thermostat opens and allows hot coolant to travel through the radiator, where it is cooled before returning to the engine.

The cooling system is sealed by a pressure-type radiator cap. This raises the boiling point of the coolant, and the higher boiling point of the coolant increases the cooling efficiency of the radiator. If the system pressure exceeds the cap pressure-relief value, the excess pressure in the system forces the spring-loaded valve inside the cap off its seat and allows the coolant to escape through the overflow tube into a coolant reservoir. When the system cools, the excess coolant is automatically drawn from the reservoir back into the radiator.

The coolant reservoir does double duty as both the point at which fresh coolant is added to the cooling system to maintain the proper fluid level and as a holding tank for overheated coolant.

This type of cooling system is known as a closed design because coolant that escapes past the pressure cap is saved and reused.



2.4 An inexpensive hydrometer can be used to test the condition of your coolant

Heating system

The heating system consists of a blower fan and heater core located within the heater unit under the dashboard, the inlet and outlet hoses connecting the heater core to the engine cooling system and the heater/air conditioning control head on the dashboard. Hot engine coolant is circulated through the heater core. When the heater mode is activated, a flap door opens to expose the heater unit to the passenger compartment. A fan switch on the control head activates the blower motor, which forces air through the core, heating the air.

Air conditioning system

The air conditioning system consists of a condenser mounted in front of the radiator, an evaporator mounted adjacent to the heater core, a compressor mounted on the engine, an accumulator/drier which contains a high pressure relief valve and the plumbing connecting all of the above.

A blower fan forces the warmer air of the passenger compartment through the evaporator core (similar to a radiator in reverse), transferring the heat from the air to the refrigerant. The liquid refrigerant boils off into low pressure vapor, taking the heat with it when it leaves the evaporator. The compressor keeps refrigerant circulating through the system, pumping the warmed refrigerant through the condenser where it is cooled and then circulated back to the evaporator.

Refrigerant has changed from the use of R-12 on 1993 models, to the "environmentally friendly" R-134a used in 1994 and later models. The two refrigerants are not compatible, and their oils are also not compatible. Even after purging and evacuating an R-12 system, there is enough residual oil and refrigerant in the hoses and components that simply filling the system with R-134a should not be done by the home mechanic. Special fittings and manifold gauge sets are used on the different refrigerant types so that an accidental hook-up of the two systems cannot be made.

2 Antifreeze - general information

Refer to illustration 2.4

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

1 The cooling system should be filled with a water/ethylene-glycol based antifreeze solution, which will prevent freezing down to -34 degrees F, if the local climate requires it. It also provides protection against corrosion and increases the coolant boiling point.

2 The cooling system should be drained, flushed and refilled every 30,000 miles or every two years (see Chapter 1). The use of antifreeze solutions for periods of longer than two years is likely to cause damage and encourage the formation of rust and scale in the system. If your tap water is "hard," i.e. contains a lot of dissolved minerals, use distilled water with the antifreeze.

3 Before adding antifreeze to the system, check all hose connections, because antifreeze tends to search out and leak through very minute openings. Engines do not normally consume coolant. Therefore, if the level goes down, find the cause and correct it.

4 The exact mixture of antifreeze-to-water you should use depends on the relative weather conditions. The mixture should contain at least 50 percent antifreeze, but should never contain more than 70 percent antifreeze. Consult the mixture ratio chart on the antifreeze container before adding coolant. Hydrometers are available at most auto parts stores to test the ratio of antifreeze to water **(see illustration)** or antifreeze test strips are available instead of the hydrometer gauge. Use antifreeze which meets the vehicle manufacturer's specifications.

3 Thermostat - check and replacement

Warning: *Do not attempt to remove the radiator cap, coolant or thermostat until the engine has cooled completely.*

Check

Refer to illustration 3.7

1 Before assuming the thermostat is responsible for a cooling system problem, check the coolant level (Chapter 1), drivebelt tension (Chapter 1) and temperature gauge (or light) operation.

2 If the engine takes a long time to warm up (as indicated by the temperature gauge or heater operation), the thermostat is probably stuck open. Replace the thermostat with a new one.

3 If the engine runs hot, use your hand to check the temperature of the upper radiator hose. If the hose is not hot, but the engine is, the thermostat is probably stuck in the closed position, preventing the coolant inside the engine from traveling through the radiator. Replace the thermostat. **Caution:** *Do not drive the vehicle without a thermostat. The computer may stay in open loop and emissions and fuel economy will suffer.*

4 If the lower radiator hose is hot, it means that the coolant is flowing and the thermostat is open. Consult the *Troubleshooting* Section at the front of this manual for further diagnosis.

5 A more thorough test of the thermostat can only be made when it is removed from the vehicle (see below). If the thermostat remains in the open position at room temperature, it is faulty and must be replaced.

6 To test it fully, suspend the (closed) thermostat on a length of string or wire in a container of cold water, with a thermometer (cooking type that reads beyond 212 degrees F). A clear Pyrex cooking container is easiest to use.

7 Heat the water on a stove while observing the temperature and the thermostat. Neither should contact the sides of the container **(see illustration)**.

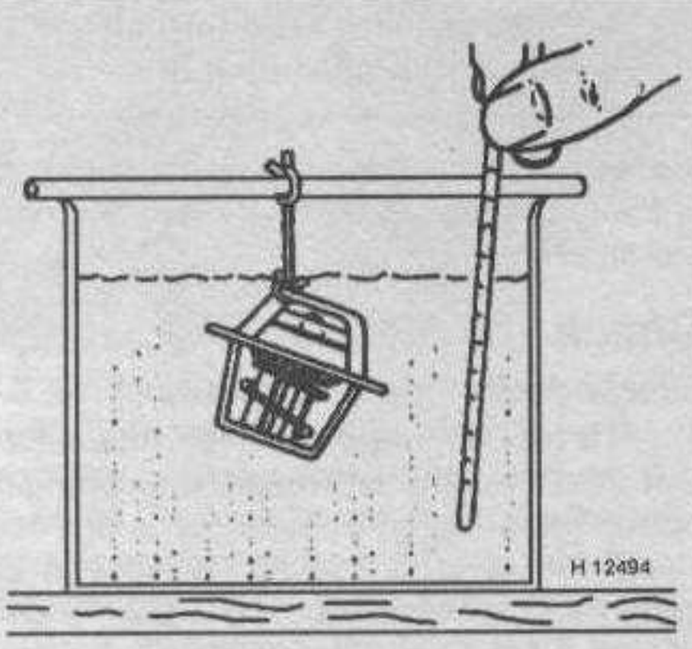
8 Note the temperature when the thermostat begins to open and when it is fully open. Compare the temperatures to the Specifications in this Chapter. The number stamped into the thermostat is generally the fully-open temperature. The thermostat should open a minimum of 0.33-inch.

9 If the thermostat doesn't open and close as specified, or sticks in any position, replace it.

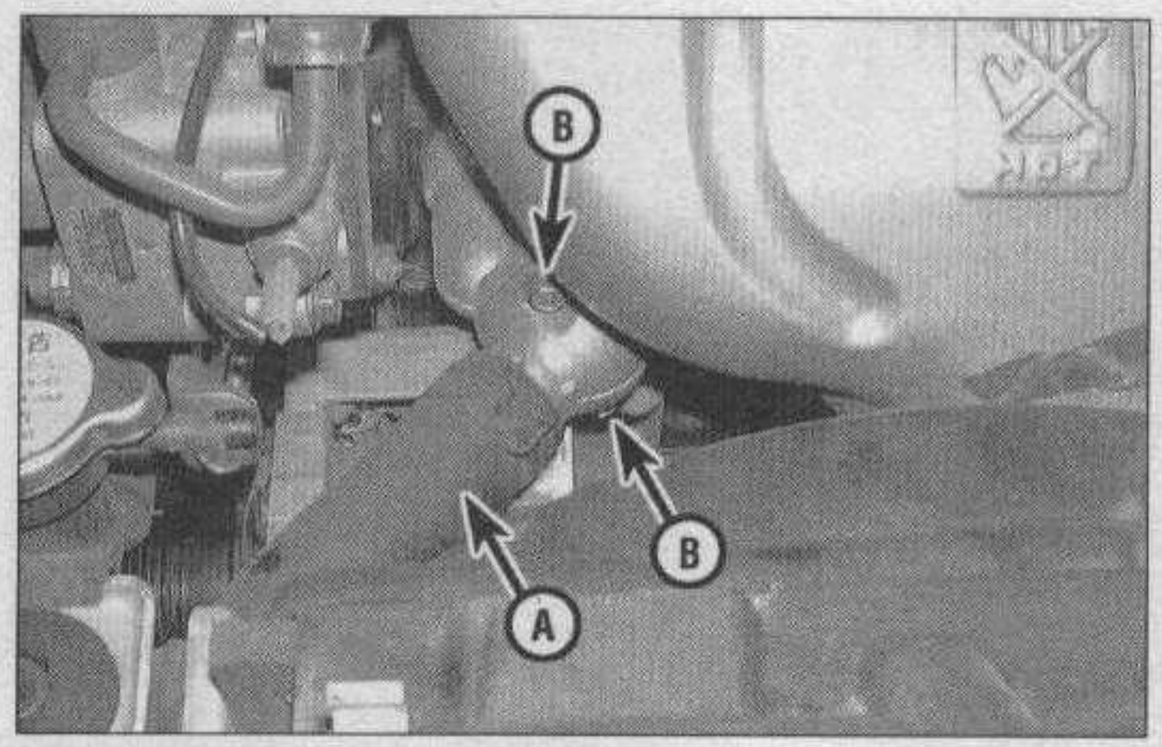
Replacement

Refer to illustrations 3.12a, 3.12b and 3.14

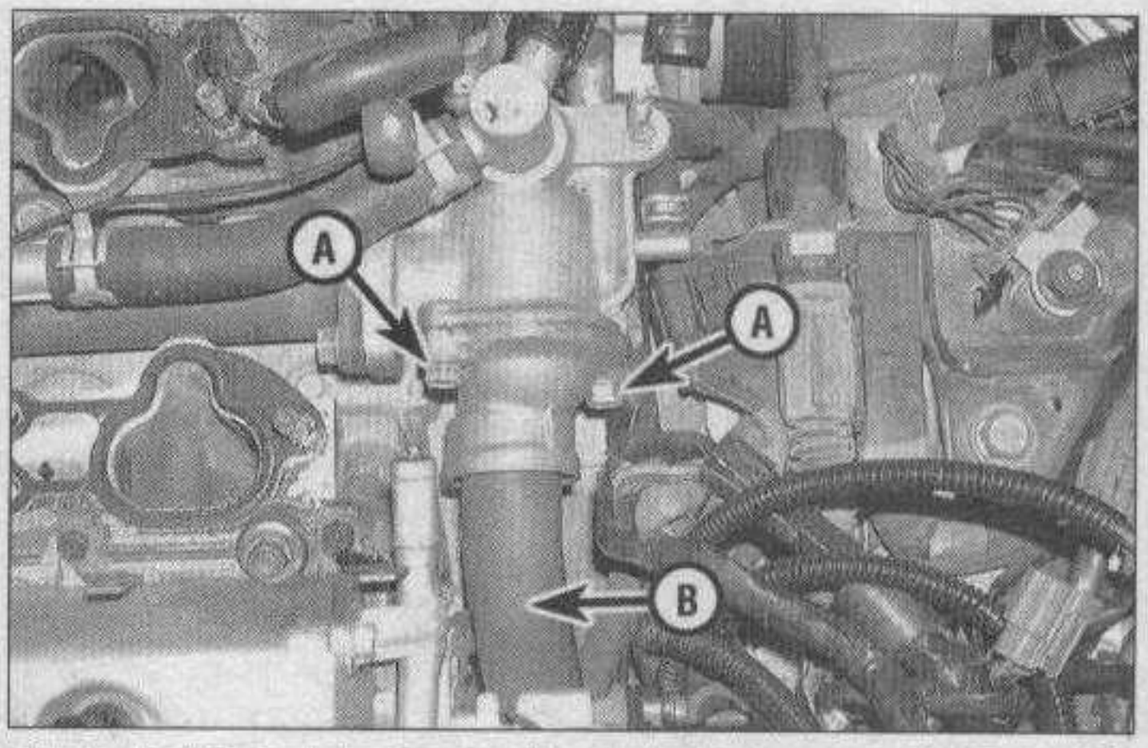
10 Disconnect the negative cable from the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make*



3.7 A thermostat can be accurately checked by heating it in a container of water with a thermometer and observing the opening and fully-open temperature



3.12a Remove the radiator hose (A) and the thermostat mounting bolts (B) from the thermostat cover - four-cylinder engine



3.12b On V6 models, remove the coolant pipe mounting bolts (B), pull the coolant pipe out of the cover and remove the cover bolts (A)

sure you have the correct activation code before disconnecting the battery.

11 Drain the coolant from the radiator (see Chapter 1). On V6 models, remove the engine air intake duct.

12 Loosen the radiator hose clamp (use hose-clamp pliers on original-equipment spring-type clamps) and remove the radiator hose from the thermostat cover (four-cylinder) or coolant pipe (V6) **(see illustrations)**. On V6 models, remove the coolant pipe mounting bolts and pull the coolant pipe out of the thermostat cover.

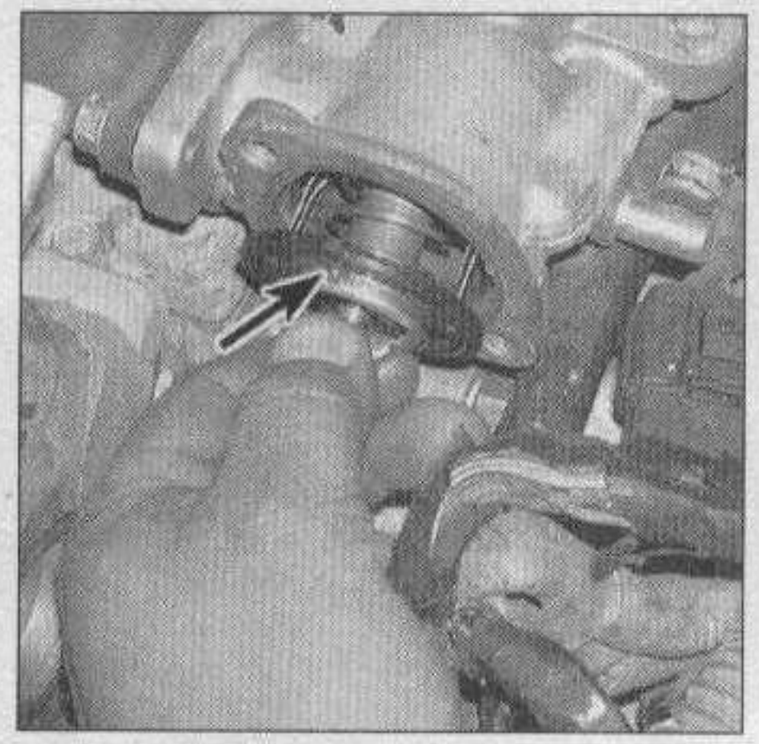
13 Detach the thermostat cover from the engine. Be prepared for some coolant to spill as the gasket seal is broken.

14 Remove the thermostat, noting the direction in which it was installed in the block **(see illustration)**.

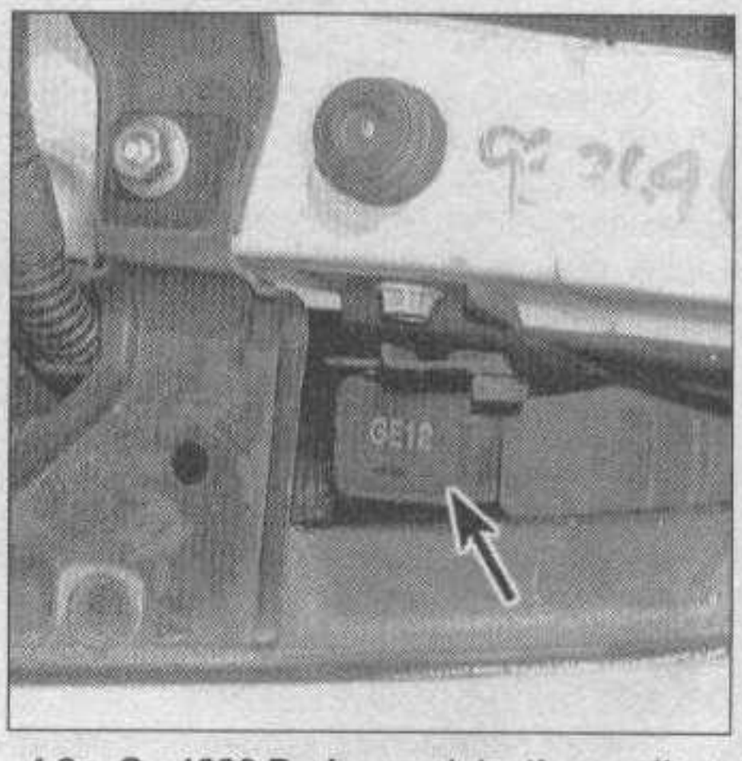
15 Thoroughly clean the sealing surfaces. Fit a new rubber seal on the thermostat.

16 Installation is the reverse of removal. Tighten the thermostat cover fasteners to the torque listed in this Chapter's Specifications.

17 Refill the cooling system, run the engine and check for leaks and proper operation.



3.14 Align the tab of the thermostat with the notch in the housing and install the thermostat with the spring end into the engine



4.3a On 1993 Probe models, the cooling fan relays (arrows) are located in front of the radiator (on 1994 and later Probe models, the low speed relay is located here and the high speed relay is located at the left rear corner of the engine compartment)

4 Engine cooling fans and circuit - check and replacement

Warning: *To avoid possible injury, keep clear of the fan blades, as they may start turning at any time!*

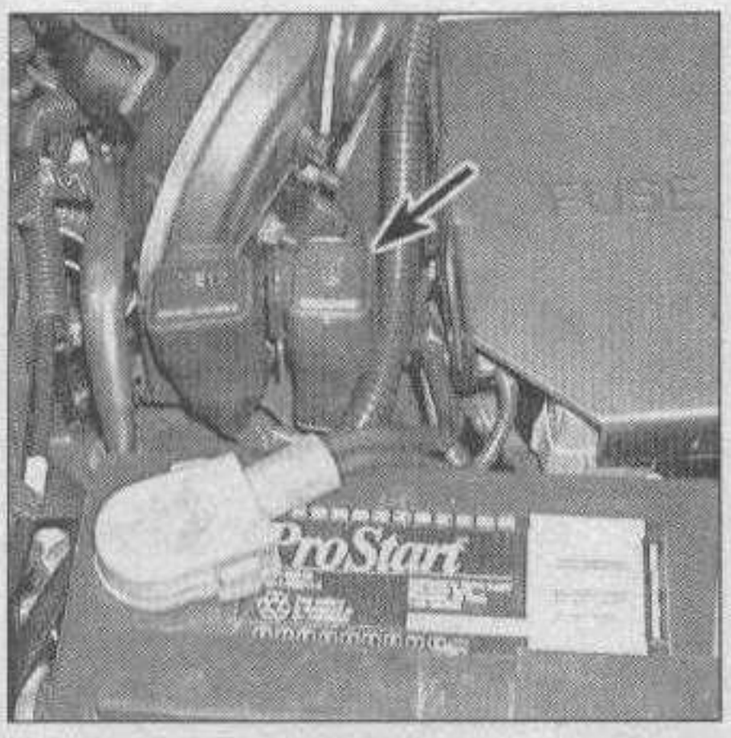
Check

Refer to illustrations 4.3a and 4.3b

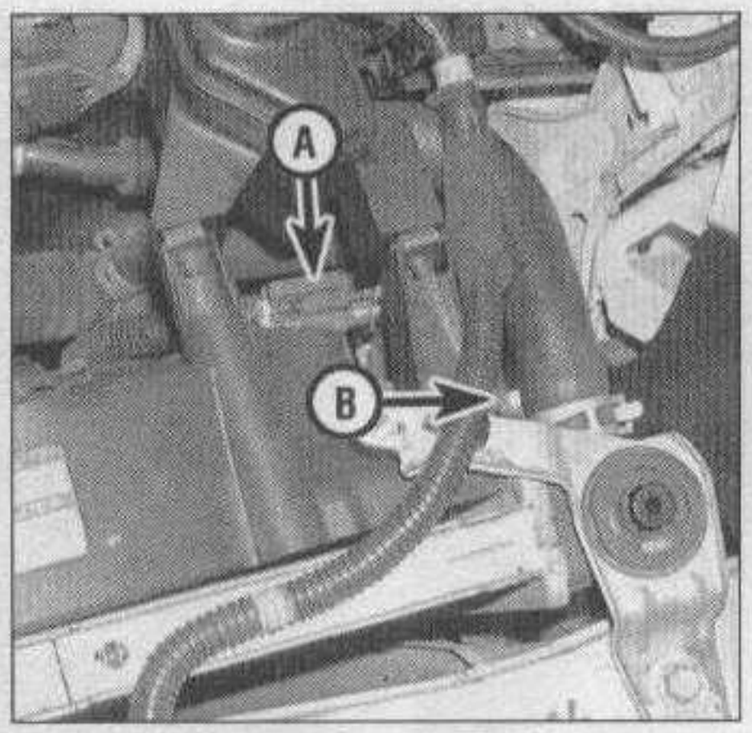
1 To test an inoperative fan motor (one that doesn't come on when the engine gets hot or when the air conditioner is on), first check the 40-amp Cooling Fan fuse in the underhood fuse/relay box and the 15-amp Engine fuse in the interior fuse panel (see Chapter 12). Models with air conditioning are equipped with a main engine cooling fan and a second, condenser fan at the right side of the radiator. The condenser fan operates when the air conditioning is switched on.

2 Disconnect the electrical connector at the fan motor and use fused jumper wires to connect the fan directly to the battery. Some models have single-speed cooling fans (two terminals) while others have two-speed fans (three terminals). On single-speed models, the fan should run when you connect ground to one terminal and battery power to the other. On two-speed fans, connect the black wire terminal to ground, and battery power to one of the other terminals. The fan should operate at High or Low speed. Switching battery power to the other terminal should change the fan speed. If the fan still does not work, or works only at one speed, replace the fan motor. **Warning:** *Do not allow the test clips to contact each other or any metallic part of the vehicle.*

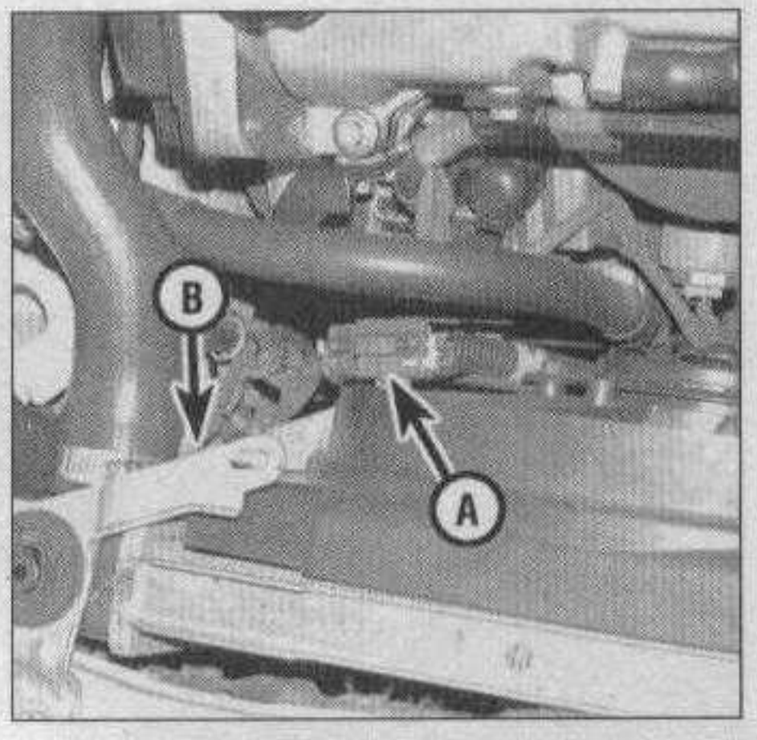
3 If the fan motor tested OK in the previous test but is inoperative under normal conditions, then the fault lies in the fuse, relay, coolant temperature sensor, PCM or wiring. The number and location of the cooling fan and condenser fan relays vary, depending on model. On 1993 through 1997 Mazda models, the cooling fan relays are located in the main fuse/relay box and the condenser fan relays are located at the right front corner of the engine compartment (V6) or in the main fuse box (four-cylinder). On 1998 and later Mazda models, the relays are located at the left side of the engine compartment next to the fuse/relay box. On Probe models the cooling fan relays are located in front of the radiator or in the left rear corner of the engine compartment. The condenser fan relays are located left side of the engine compartment next to the fuse/relay box **(see illustrations)**. All of the relays can be tested easily (see Chapter 12). **Note:** *The cooling fan relay is controlled by the PCM with information supplied by the engine coolant temperature sensor. See Chapter 6 for testing the coolant temperature sensor. If the fan motor, relay and related circuits all test good and the cooling fan fails to operate normally, the fault may lie with the PCM. Have the PCM diagnosed by a dealer service department or other qualified repair facility.*



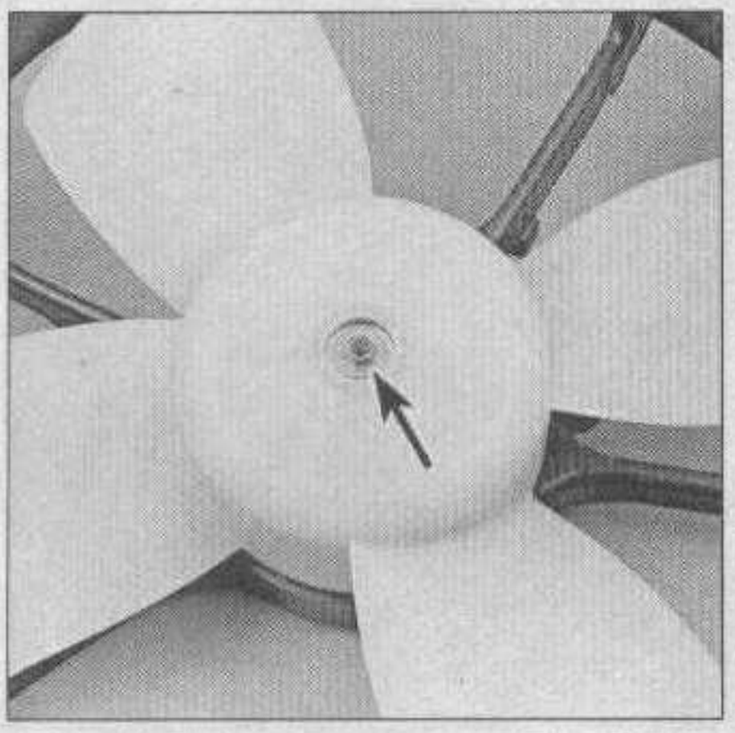
4.3b On Probe models, the condenser fan relays are located next to the fuse/relay box



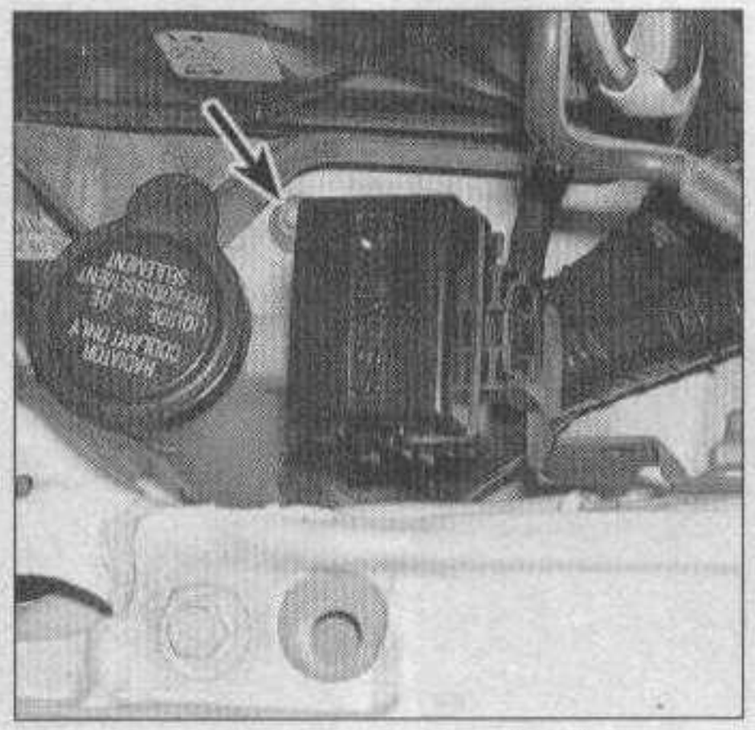
4.6a The main engine cooling fan connector (A) and the upper left shroud mounting bolt (B)



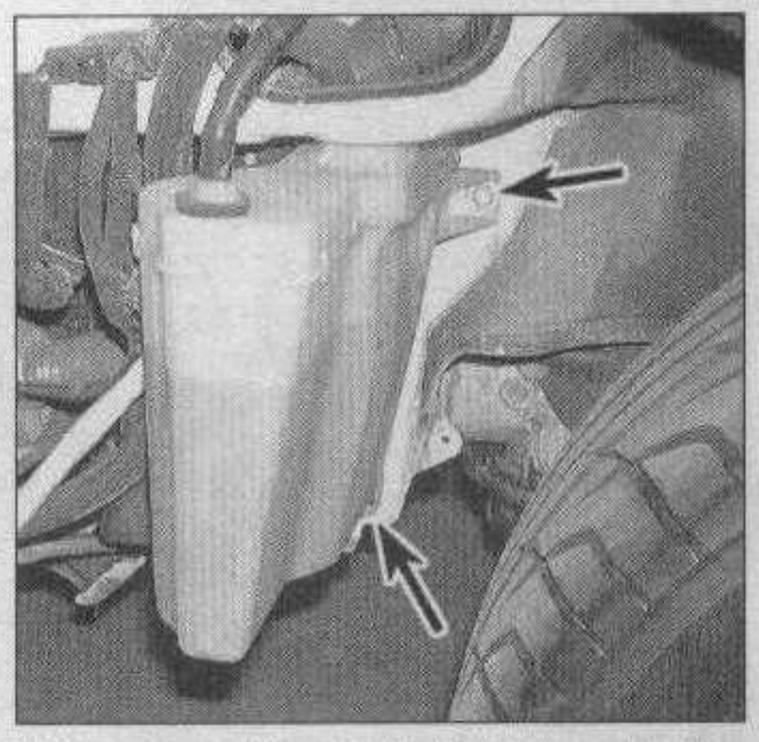
4.6b The condenser fan connector (A) and the upper right shroud mounting bolt (B)



4.8 Hold the cooling fan blades and remove the fan retaining nut or clip



5.1a On Probe models, remove the reservoir mounting bolt (arrow) in the engine compartment . . .



5.1b . . . and the two bolts (arrows) in the fenderwell (fender removed for clarity)

Replacement

Refer to illustrations 4.6a, 4.6b and 4.8

4 Disconnect the negative battery cable. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

5 Remove the air intake duct (see Chapter 4)).

6 Disconnect the wiring connector at the fan motor **(see illustrations)**. Unclip any wiring harnesses attached to the fan shroud.

7 Unbolt the fan shroud (both fans are attached to a single shroud) and lift the fan assembly from the engine compartment **(see illustrations 4.6a and 4.6b)**. **Note:** *There are four shroud mounting bolts, two upper and two lower.*

8 While holding the fan blades, remove the fan retaining nut **(see illustration)**. Remove the fan from the fan motor.

9 Remove the three bolts (on the engine side of the shroud) and remove the fan motor from the shroud.

10 Installation is the reverse of removal. When installing the fan shroud and the air intake duct, tighten the mounting bolts securely.

5 Radiator and coolant reservoir - removal and installation

Warning: *Do not start this procedure until the engine is completely cool.*

Coolant reservoir

Refer to illustrations 5.1a and 5.1b

1 Disconnect the radiator overflow hose from the coolant reservoir. Undo the mounting bolts and lift the reservoir out **(see illustrations)**. Dump the coolant into a container and check the reservoir for cracks.

Radiator

Refer to illustrations 5.5, 5.6 and 5.7

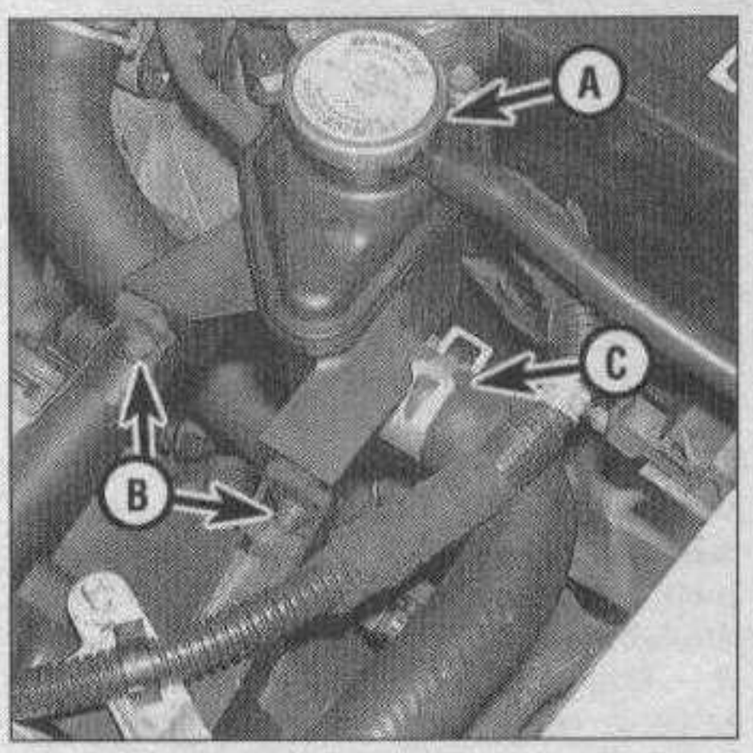
2 Disconnect the negative battery cable. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

3 Drain the engine coolant into a container (see Chapter 1).

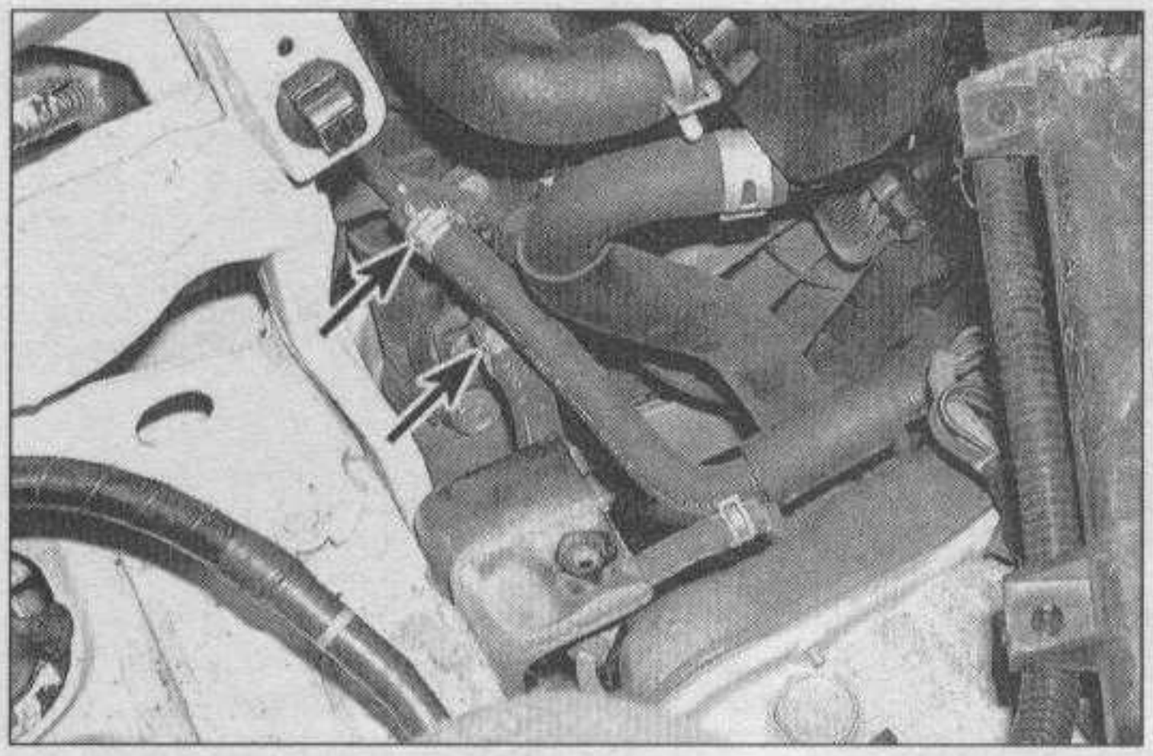
4 Remove the cooling fans (Section 4).

5 Disconnect the reservoir hose from the filler neck, loosen the radiator hose clamps and remove the upper radiator hose **(see illustration)**. Loosen the hose clamps and remove the lower radiator hose.

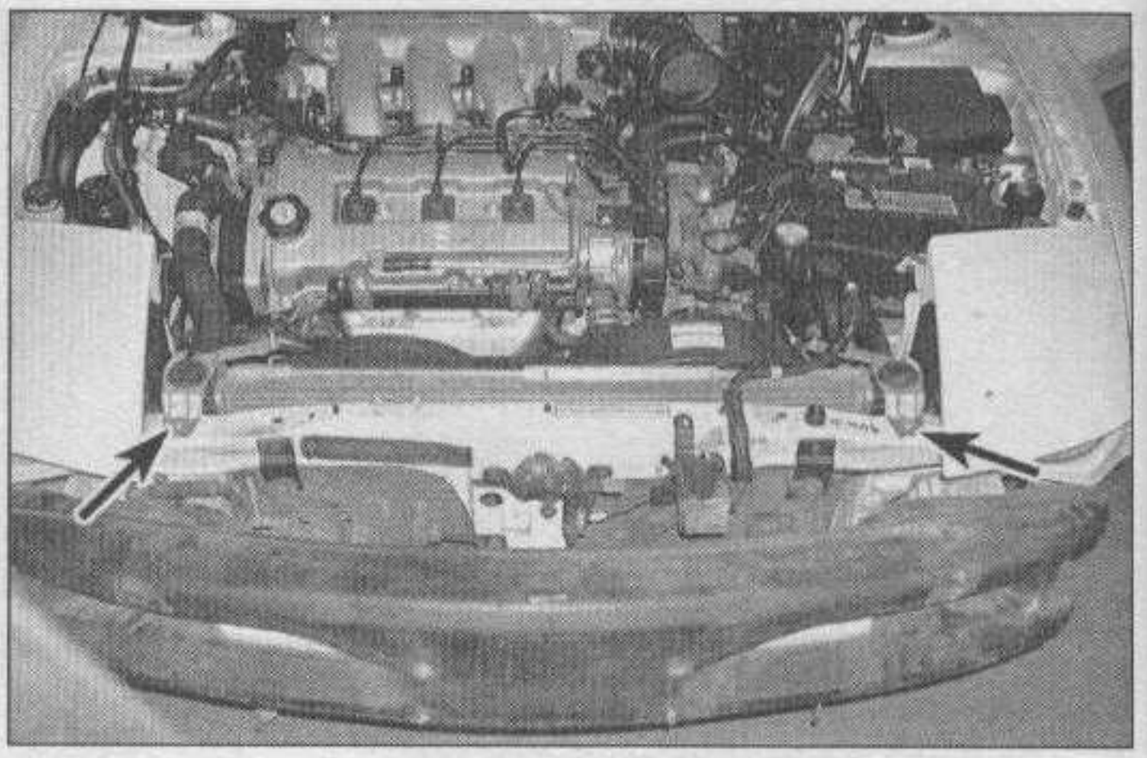
6 If equipped with an automatic transaxle, disconnect the oil cooler hoses from the radi-



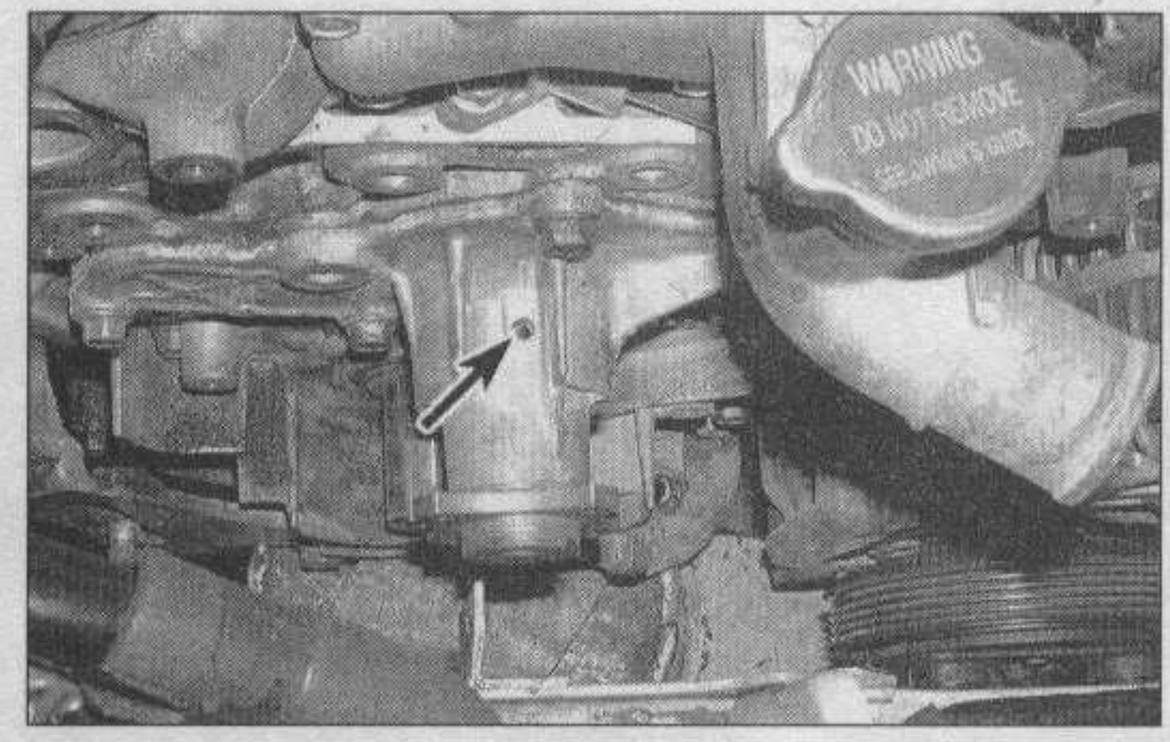
5.5 On four-cylinder models, the radiator cap is on the right side, directly on the radiator, and the upper hose on the left, while on V6 models, the cap is on the left on an expansion tank (A) - remove the mounting bolts (B) at the fan shroud, and disconnect the hose (C)



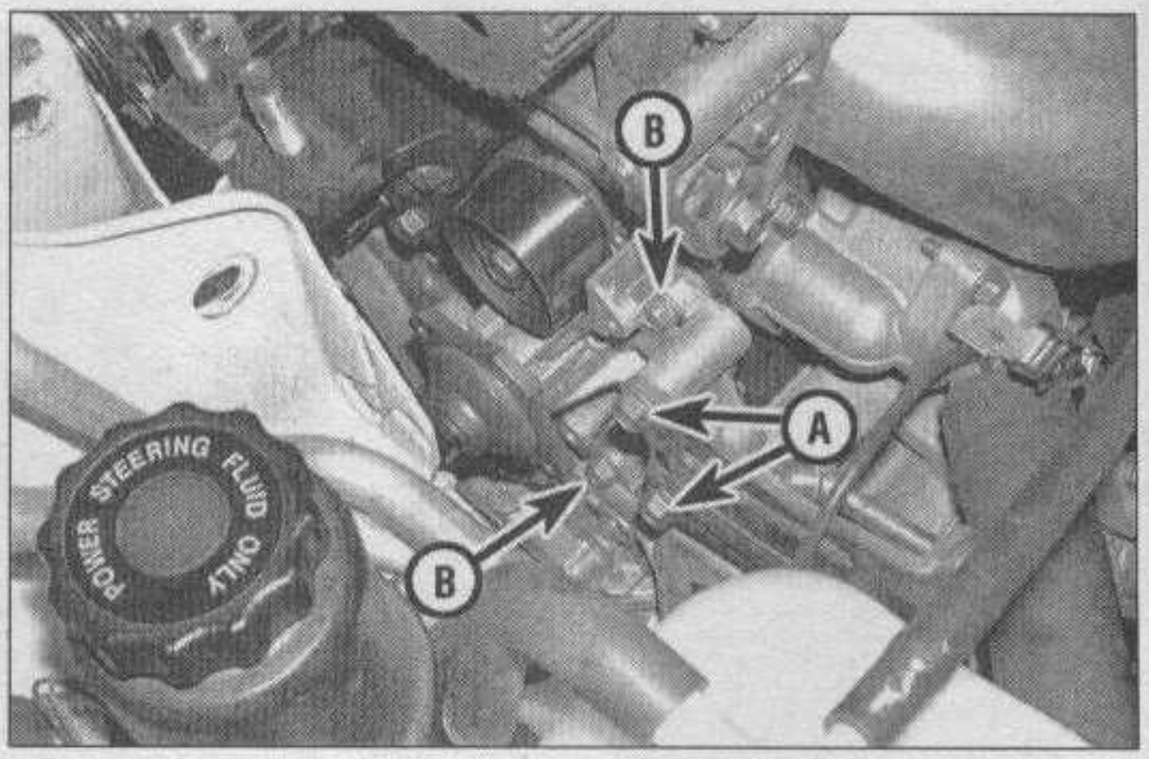
5.6 Disconnect the transaxle cooler lines (arrows)



5.7 Remove the upper mounting bolt on each side (arrows)



6.3 Check the water pump weep hole (arrow) for signs of leakage - some staining is normal, but a large damp stain indicates the pump seal has failed



7.6a On four-cylinder engines, remove the power steering bracket bolts (A), the water pump bolts (B) from above . . .

ator **(see illustration)**. Place a drip pan to catch the transaxle fluid and cap the fittings.

7 Remove the radiator mounting bolts (one on each side) and lift the radiator up and out **(see illustration)**. Be aware of dripping fluids and the sharp fins. **Note:** *The bottom of the radiator is retained, without bolts, by the radiator support frame.*

8 With the radiator removed, it can be inspected for leaks, damage and internal blockage. If in need of repairs, have a professional radiator shop or dealer service department perform the work as special techniques are required.

9 Bugs and dirt can be cleaned from the radiator with compressed air and a soft brush. Don't bend the cooling fins as this is done. **Warning:** *Wear eye protection when using compressed air.*

10 Installation is the reverse of the removal procedure. Be sure the bottom of the radiator is located properly. When installing the radiator fan shroud and the air intake duct, tighten the mounting bolts securely.

11 After installation, fill the cooling system with the proper mixture of antifreeze and water. Refer to Chapter 1 if necessary.

12 Start the engine and check for leaks. Allow the engine to reach normal operating temperature, indicated by both radiator hoses becoming hot. Recheck the coolant level and add more if required.

13 On automatic transaxle equipped models, check and add automatic transaxle fluid as needed.

14 Installation is the reverse of removal.

6 Water pump - check

Refer to illustration 6.3

1 A failure in the water pump can cause serious engine damage due to overheating. If the pump is defective, it should be replaced with a new or rebuilt unit.

2 Remove the timing belt cover(s) (see Chapter 2, Part A or B).

3 Water pumps are equipped with weep or vent holes **(see illustration)**. If a failure occurs in the pump seal, coolant will leak from the hole. In most cases you'll need a flashlight to find the hole on the water pump to check for leaks.

4 Check the water pump shaft bearing for wear by grasping the pump hub and gently rocking the hub and shaft from side to side. If any looseness is apparent, excessive water pump shaft/bearing wear is possible.

5 If the water pump shaft bearings fail, there may be a howling sound at the drivebelt end of the engine while it's running. Don't mistake drivebelt slippage, which causes a squealing sound, for water pump bearing failure. If a squealing sound is heard, check belt condition and belt tension.

7 Water pump - replacement

Refer to illustrations 7.6a, 7.6b and 7.6c

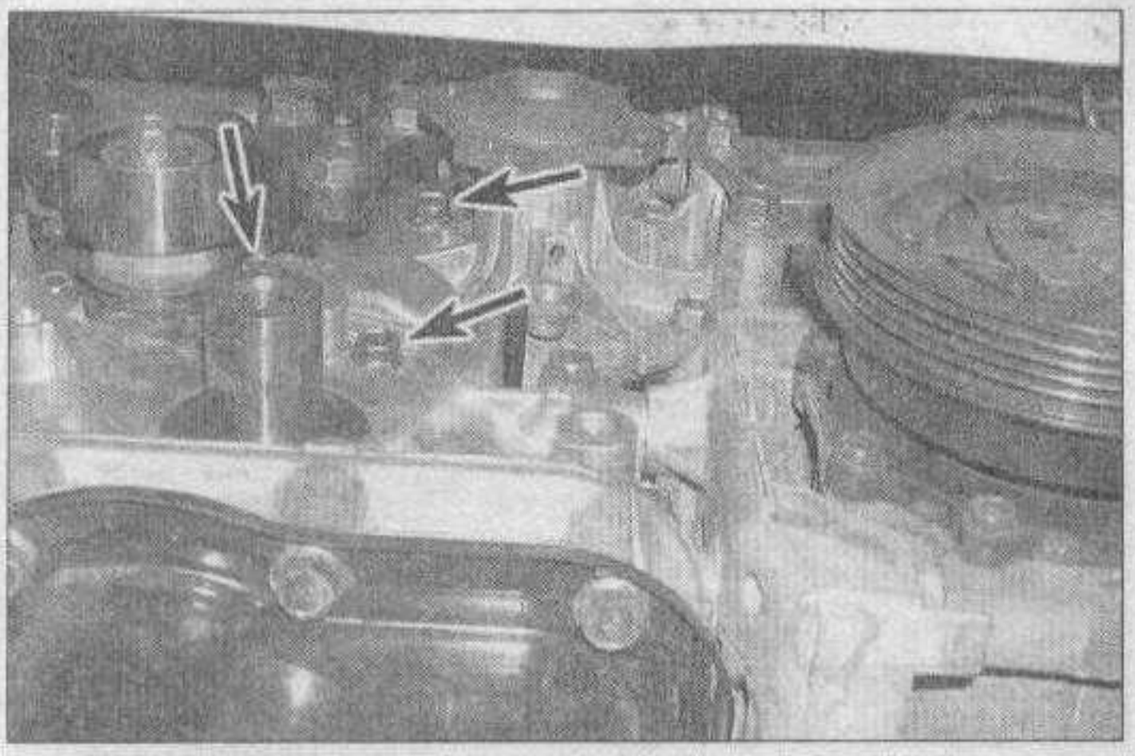
1 Disconnect the negative battery cable from the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Drain the cooling system (see Chapter 1). If the coolant is relatively new or in good condition, save it and reuse it.

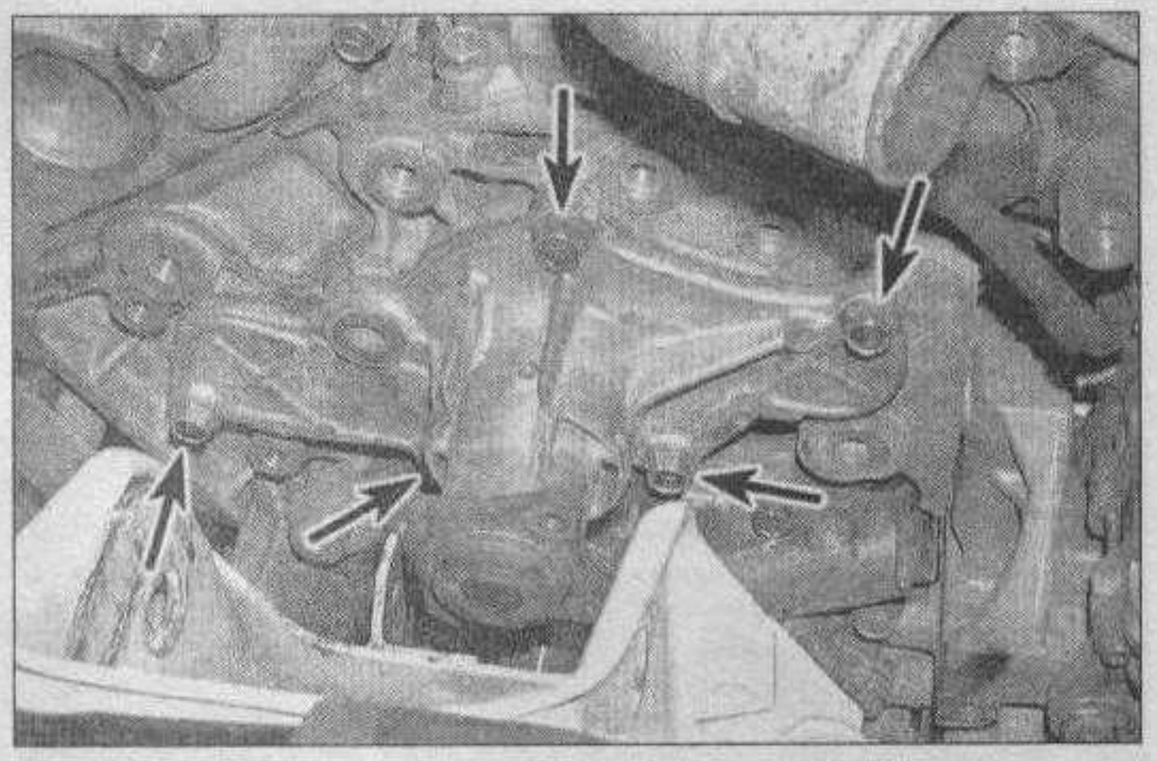
3 Remove the drivebelts.

4 On four cylinder models, remove the power steering pump mounting bolts and position the power steering pump aside, without disconnecting the hoses.

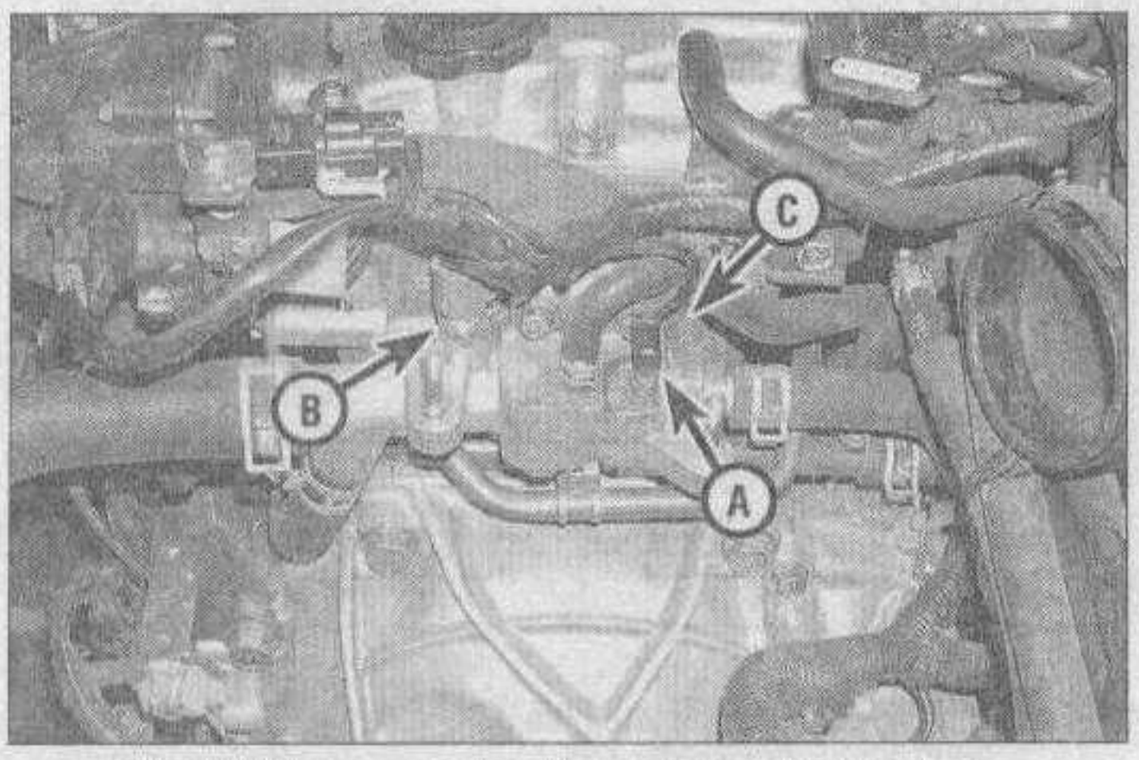
5 Remove the water pump pulley, timing



7.6b . . . and the water pump bolts from below (arrows)

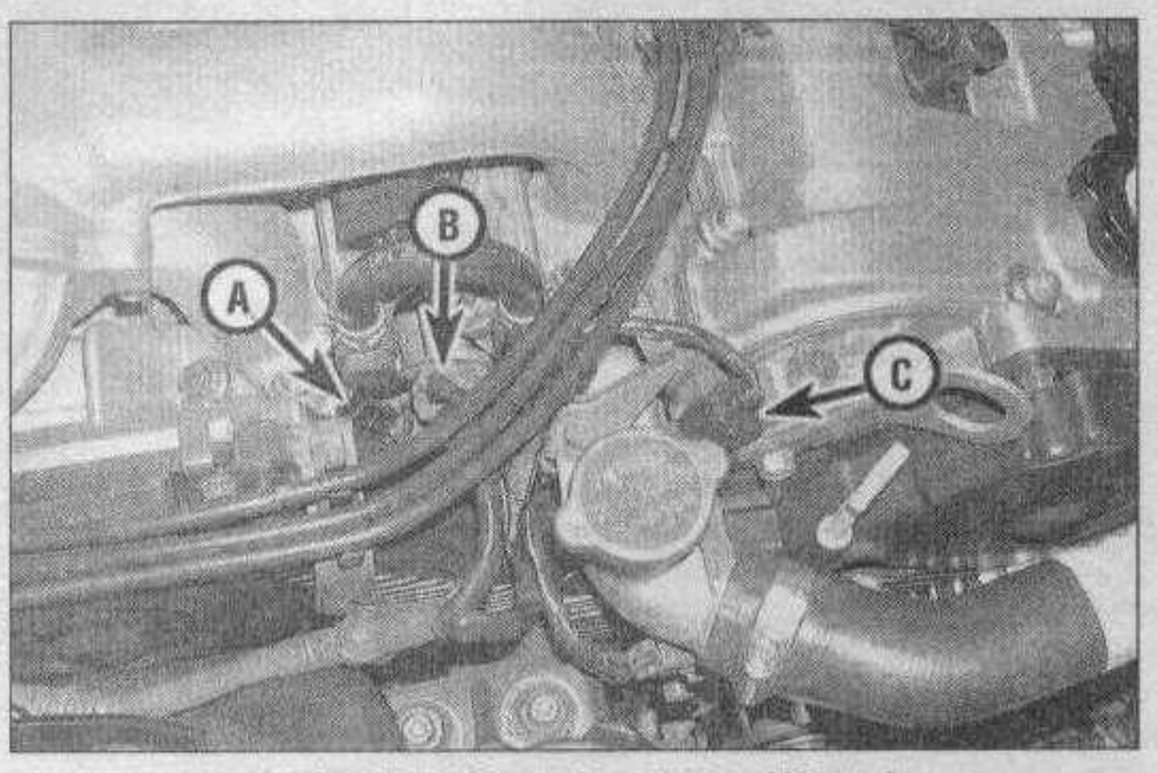


7.6c Water pump mounting bolts (arrows) - V6 engine



8.3a Coolant sensor locations - four-cylinder engine

A Temperature gauge sending unit
B Engine coolant temperature sensor (PCM)
C Fan control sensor



8.3b Coolant sensor locations - V6 engine

A Temperature gauge sending unit
B Engine coolant temperature sensor (PCM)
C Fan control sensor (C)

belt cover(s) and timing belt (see Chapter 2, Part A or B).

6 Remove the water pump mounting bolts **(see illustrations)** and detach the water pump from the engine. If the water pump is stuck, gently tap it with a soft-faced hammer to break the seal.

7 Clean the bolt threads and the threaded holes in the engine to remove corrosion and sealant.

8 Remove all traces of old gasket material from the sealing surfaces.

9 Compare the new water pump to the old one to make sure they are identical.

10 Apply a thin film of RTV sealant to the new gasket and install it on the water pump.

11 Carefully mate the water pump to the engine.

12 Install the water pump mounting bolts. Tighten them to the torque listed in this Chapter's Specifications. Don't over-tighten them or the pump may be damaged.

13 Reinstall all parts removed for access to the water pump.

14 Refill the cooling system (see Chapter 1) and check the timing belt tension (see Chapter 2, Part A or B). Run the engine and check for leaks.

8 Coolant temperature gauge sending unit - check and replacement

Warning: *Do not start this procedure until the engine is completely cool.*

Check

Refer to illustrations 8.3a and 8.3b

1 If the coolant temperature gauge is inoperative, check the fuses first (see Chapter 12).

2 If the temperature gauge indicates excessive temperature after running awhile, see the *Troubleshooting* Section in the front of the manual.

3 If the temperature gauge indicates HOT as soon as the engine is started cold, disconnect the electrical connector at the coolant gauge sending unit **(see illustrations)**. If the gauge reading drops, replace the sending unit. If the reading remains high, the wire to the gauge may be shorted to ground or the gauge is faulty.

4 If the coolant temperature gauge fails to show any indication after the engine has been warmed up, (approximately 10 minutes) and the fuses are good, shut off the engine. Disconnect the electrical connector at the sending unit and, using a jumper wire, connect the wire to a clean ground on the engine. Briefly turn on the ignition without starting the engine. If the gauge now indicates HOT, replace the sending unit.

Replacement

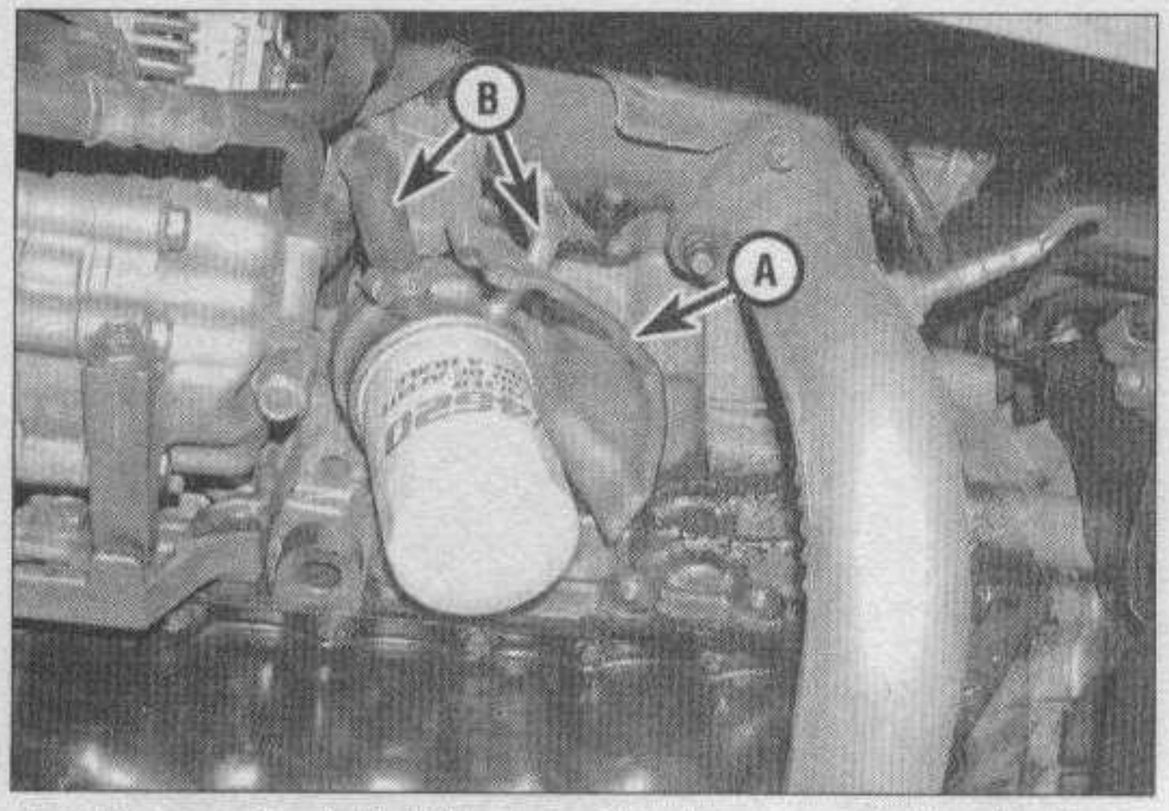
5 Drain the coolant (see Chapter 1).

6 Disconnect the wiring connector from the sending unit.

7 Using a deep socket or a wrench, remove the sending unit.

8 Install the new sending unit, and tighten it securely. Do not use thread sealer as it may electrically insulate the sending unit. Connect the electrical connector.

9 Refill the cooling system and check for coolant leakage and proper gauge operation.



9.3 Remove the bolt at the top of the housing retaining the heat shield (A), then disconnect the two cooler hoses (B) - remove the oil filter and the large nut that holds the cooler to the oil filter adapter

9 Engine oil cooler (V6 models) - removal and installation

Refer to illustration 9.3

1 The engine oil cooler on V6 engines is mounted between the oil filter and the oil filter adapter. Coolant flows through the cooler via two hoses connected to the cooling system.

2 To replace the oil cooler, remove the oil filter and drain the cooling system (see Chapter 1).

3 Disconnect the hose clamps and two coolant hoses from the oil cooler **(see illustration)**.

4 Use a deep socket to remove the nut holding the oil cooler housing to the oil filter adapter on the engine. Remove the oil cooler.

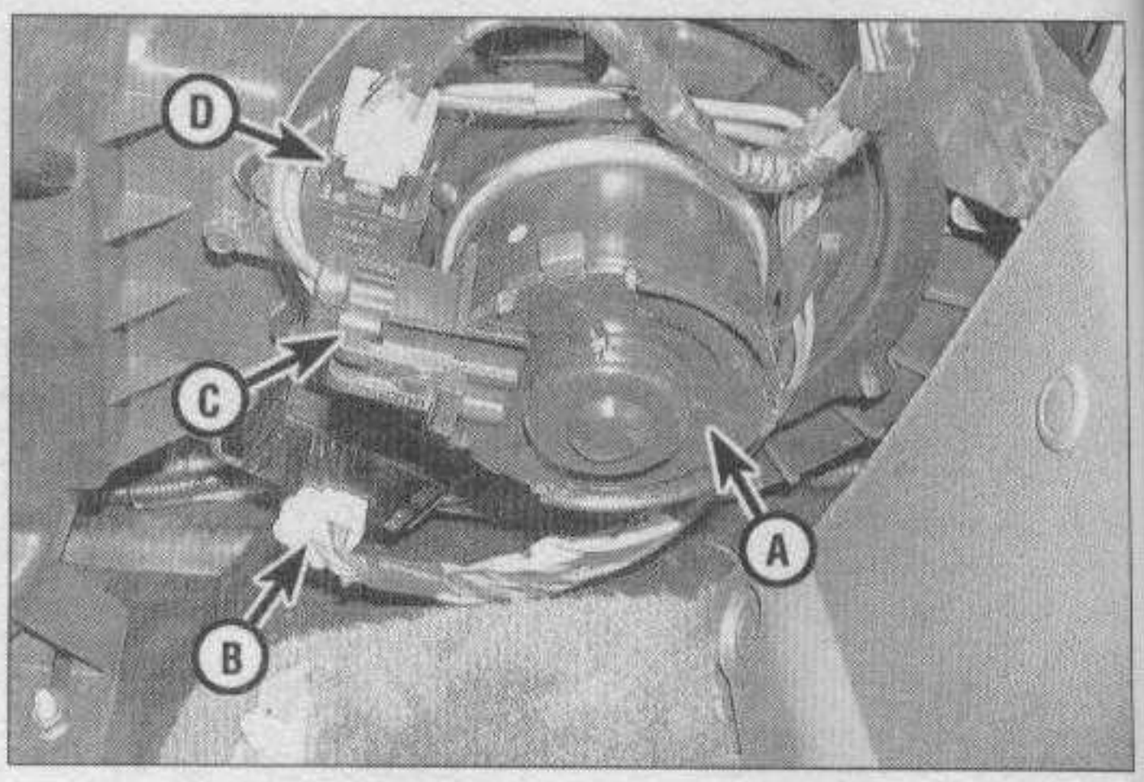
5 Installation is the reverse of removal. Make sure the block mounting surface is clean and install a new, lightly-oiled seal between the cooler and the oil filter adapter.

10 Blower motor circuit - check

Refer to illustrations 10.4, 10.9, 10.10a and 10.10b

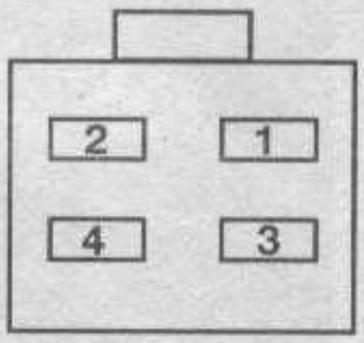
1 If the blower motor doesn't operate, first check all connections in the circuit for looseness and corrosion. Make sure the battery is fully charged. Check the 15-amp Engine and 15-amp Meter fuses in the interior fuse panel and the 40-amp Heater fuse in the underhood fuse/relay panel.

2 Locate the blower motor relay. On Mazda models, the blower relay is located at the right front corner of the engine compartment. Ford Probe models use two relays - on 1993 models, the low-speed blower relay is mounted just in front of the radiator on the right side, and on later models in the left rear corner of the engine compartment, between the shock tower and the firewall. The high-speed blower relay is mounted in the blower housing under the right side of the dashboard



10.4 Blower motor housing components - Probe models

A Blower motor
B Blower motor resistor
C Blower motor electrical connector
D High-speed blower relay



RESISTANCE	BETWEEN TERMINALS
0.38 ohms	3 and 4
0.69 ohms	3 and 2
1.69 ohms	1 and 2
2.76 ohms	1 and 4

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10.9 Blower motor resistor tests

(see illustration 10.4). Remove the relays and test them for proper operation (see Chapter 12). If a relay fails the test, replace it.

3 With the transaxle in Park, the parking brake securely set, turn the ignition switch to the ON position. It isn't necessary to start the vehicle.

4 The blower motor is located under the glove compartment area of the dash, near the firewall **(see illustration)**.

5 Switch the heater controls to FLOOR and the blower speed to HI. Listen at the ducts to hear if the blower is operating. If it is, then switch the blower speed to LO and listen again. Try all the speeds.

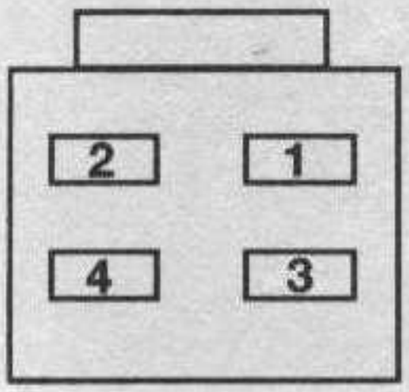
6 If the blower didn't operate, and you have checked the fuses and relays, test the blower. Locate the electrical connector at the blower motor **(see illustration 10.4)**. Backprobe the blue/red (Mazda) or white (Ford) wire terminal; there should be at least 10 volts with the mode switch in any position other than Off and the ignition switch On. If not, there is a problem in the circuit from the fuse panel to the blower motor, including the blower relay (Mazda) or low speed blower relay (Ford).

7 If there is voltage at the feed wire, but the blower does not operate, backprobe the blue/white (Mazda) or black/orange (Ford) wire and connect it to a known good chassis ground with a jumper wire. If it still doesn't operate, replace the blower motor. If the blower now operates there is a problem in the circuit from the blower motor through the blower resistor and speed switch to ground.

8 If the blower operates, but not at all speeds, check the blower resistor. It's located on the blower housing under the right side of the dash **(see illustration 10.4)**. There are resistor elements mounted on the resistor board to provide different blower speeds.

9 With the resistor removed from the vehicle, visually check the resistor for damage, indicated by the material melting out between the contacts. Check the resistor block with an ohmmeter **(see illustration)**. If the resistance is not as specified, replace the blower resistor.

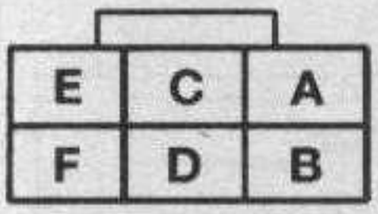
10 If the blower operates, but not at all speeds and you have already checked the blower resistor, refer to Section 12 and remove the heater/air conditioning control panel. On Probe models, disconnect the electrical connector from the back of the blower speed switch and test the terminals for continuity. On Mazda models, do not disconnect the electrical connector. Backprobe the terminals with a voltmeter or test light and check for battery power at the indicated terminals. If the switch fails any of the tests, replace the blower speed switch **(see illustrations)**.



SWITCH POSITION	CONTINUITY BETWEEN TERMINALS
Lo	None
2nd	2 and 3 (only)
3rd	2 and 3 2 and 4 3 and 4
Hi	2 and 4 2 and 1 4 and 1

61042-3-10.10a HAYNES

10.10a Blower speed switch terminal designations and tests - Probe models



SWITCH POSITION	TERMINAL
Any	F
Fan in first position	E
Fan in second position	C
Fan in third position	A or D
Fan in fourth position	B or D

61042-3-10.10b HAYNES

10.10b Blower speed switch tests - Mazda models (with pushbuttons) - there should be NO voltage in these tests

11 Blower motor - removal and installation

Refer to illustration 11.5

Warning: *The models covered by this manual are equipped with Supplemental Restraint systems (SRS), more commonly known as airbags. Always disable the air bag system before working in the vicinity of any air bag system components to avoid the possibility of accidental deployment of the airbag, which could cause personal injury (see Chapter 12).*

1 Remove the trim panel underneath the glove box.

2 Disconnect the electrical connector from the blower motor, blower resistor and blower high-speed relay (if equipped).

3 Remove the three screws retaining the blower motor to the housing.

4 Withdraw the blower motor straight down and out of the housing.

5 To remove the blower fan, remove the fastener from the shaft and withdraw the fan from the motor **(see illustration)**. **Note:** *On some models, the blower fan is not available as a separate item, the blower motor and fan must be replaced as a unit.*

6 Installation is the reverse of removal.

12 Heater and air conditioning control assembly - removal and installation, cable adjustment and electrical checks

Warning: *The models covered by this manual are equipped with Supplemental Restraint systems (SRS), more commonly known as airbags. Always disable the air bag system before working in the vicinity of any air bag system components to avoid the possibility of accidental deployment of the airbag, which could cause personal injury (see Chapter 12).*

Removal and installation

Refer to illustrations 12.4 and 12.5

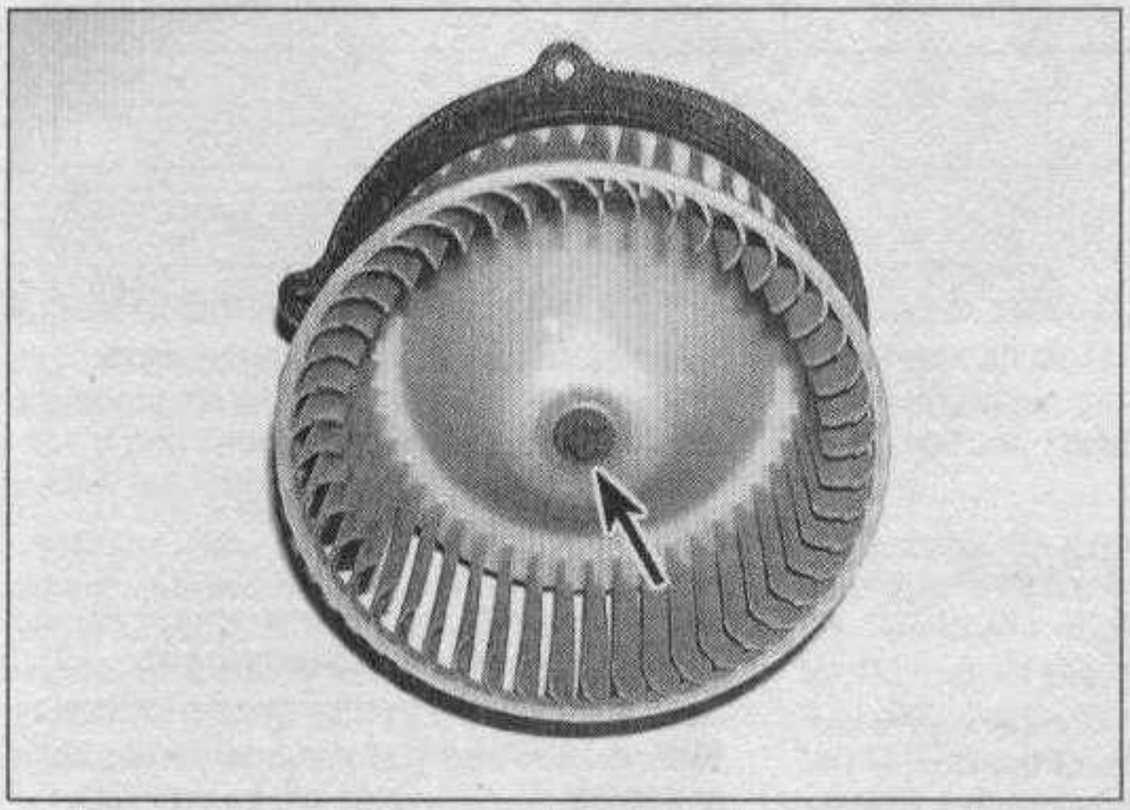
1 Disconnect the negative battery cable. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 On Probe models, remove the console (see Chapter 11).

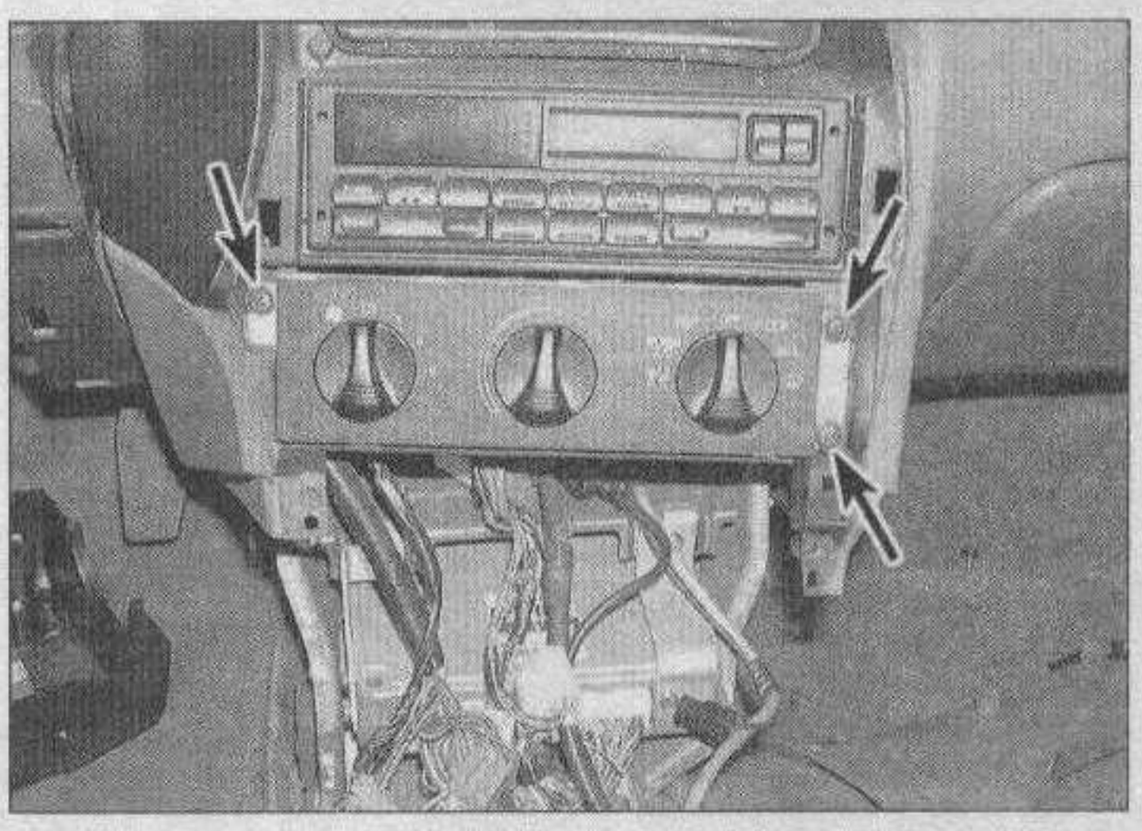
3 Remove the center dashboard trim panel (see Chapter 11).

4 Remove the heater control assembly screws **(see illustration)**.

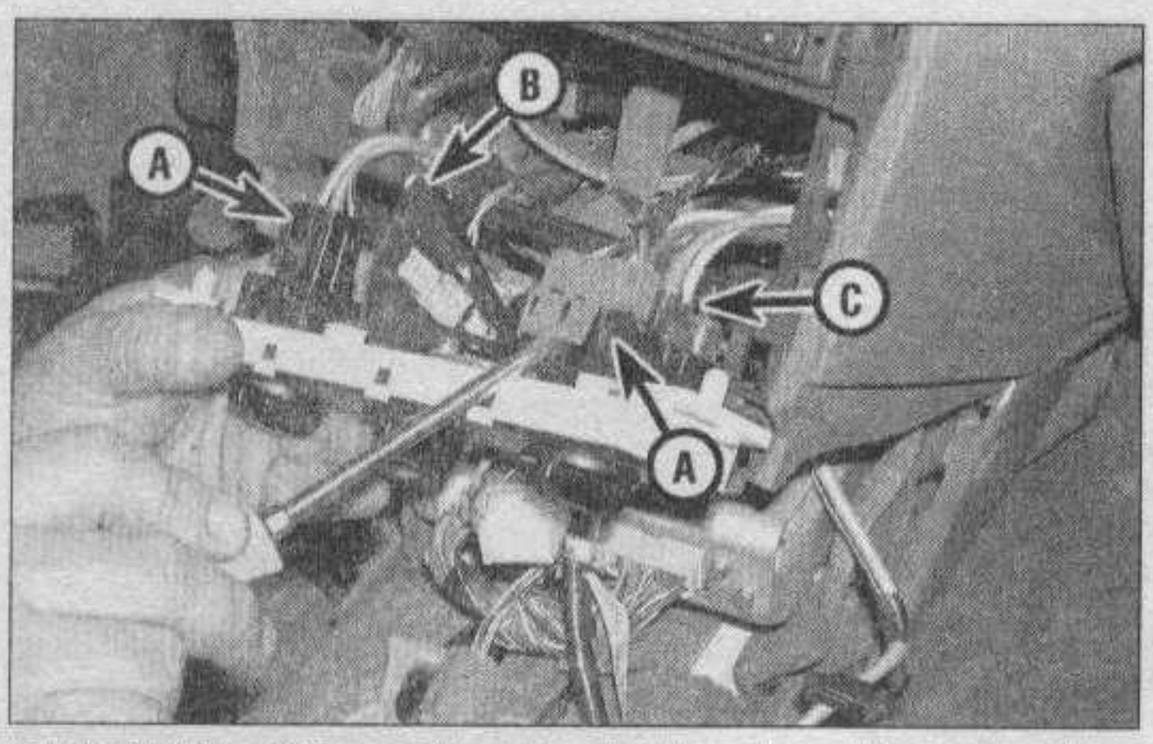
5 Pull the assembly out of the dash and



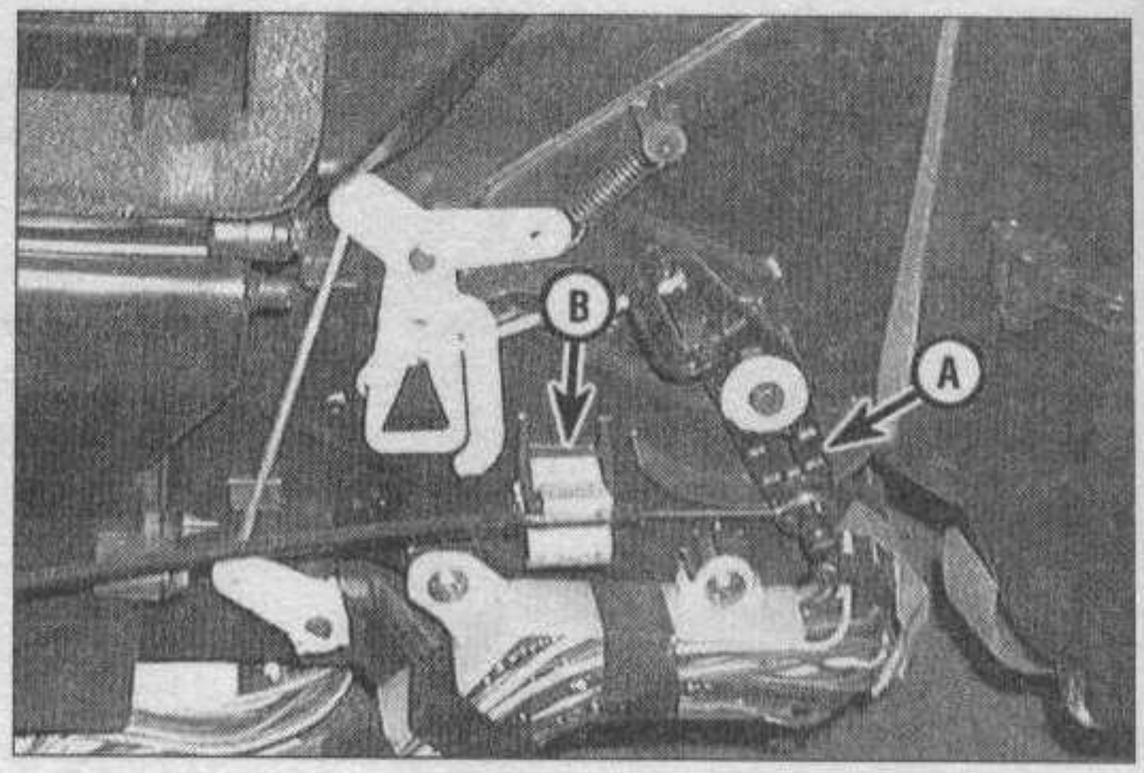
11.5 Remove the nut in the center of the fan to separate the fan from the motor



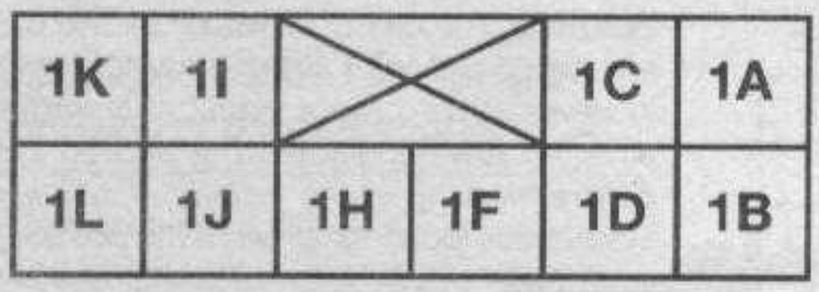
12.4 Remove the screws (arrows) retaining the heater/ air conditioning control panel



12.5 Pull the unit away from the dashboard and disconnect the electrical connectors (A), the temperature control cable (B) and the vacuum connector (C) - Probe model shown, Mazda models have no cable or vacuum harness



12.7 Push the temperature door lever (A) down, then tighten the clamp (B) on the cable



12.8a Voltage checks for the Mazda 10-pin connector

CONTROL POSITION	TERMINAL	VOLTAGE
Air mix in any position	1A	@ 6.0
Air mix in any position	1B	none
Air mix moved to COLD	1C	B+
Temp lever at HOT	1D	5
Temp lever at COLD	1D	@1
Air mix at HOT Temp lever moved from cold to hot	1F	B+
Vent switch ON Mode selector moving from DEF to VENT	1H	B+
DEF switch ON Mode selector moving from VENT to DEF	1I	B+
Any position	1J	none
Ignition switch ON	1L	B+

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disconnect the electrical connectors and control cable **(see illustration)**.

6 Installation is the reverse of the removal procedure. On Probe models, adjust the temperature control cable as follows.

Cable adjustment (Probe models)

Refer to illustration 12.7

7 To adjust the temperature control cable, set the control to the warmest temperature. Below the dashboard, pull the carpeting back to access the door-operating lever at the other end of the cable **(see illustration)**. Release the cable from its clamp, pull the door lever down to its lowest position, then tighten the clamp.

Electrical checks (Mazda models)

Refer to illustrations 12.8a and 12.8b

8 The control panel on Mazda models has three electrical connectors at the rear, a 10-pin, a 14-pin and a 6-pin connector. The 6-pin is the blower speed connector, which is inspected in Section 10. The various switches can be tested, with the connectors in place **(see illustrations)**. Backprobe the connectors with suitable probes and a voltmeter Use the voltmeter to check for voltage at the designated terminals.

13 Heater core - replacement

Refer to illustrations 13.4, 13.6a, 13.6b, 13.7a and 13.7b

Warning: *The models covered by this manual are equipped with Supplemental Restraint*

2O	2M	2K			2E	2C	2A
2P	2N	2L	2J	2H	2F	2D	2B

12.8b Voltage checks for the Mazda 14-pin connector

CONTROL POSITION	TERMINAL	VOLTAGE
DEF switch ON Mode selector moving from VENT to DEF	2A	none
Light switch at Max Light switch at Min	2B	None @10
Vent switch ON Mode selector moving from DEF to VENT	2C	B+
Light switch ON	2D	B+
Fan switch OFF	2E	B+
AC switch ON Fan switch ON	2F	none
Fresh switch ON	2H	B+
Recirc switch ON	2J	B+
Defrost switch ON	2K	none
Heat/Def switch ON	2L	none
Heat switch ON	2M	none
Vent switch ON	2N	none
Bi-level switch ON	2O	none
Ignition switch ON	2P	B+
Swing switch ON	2P	@ 1

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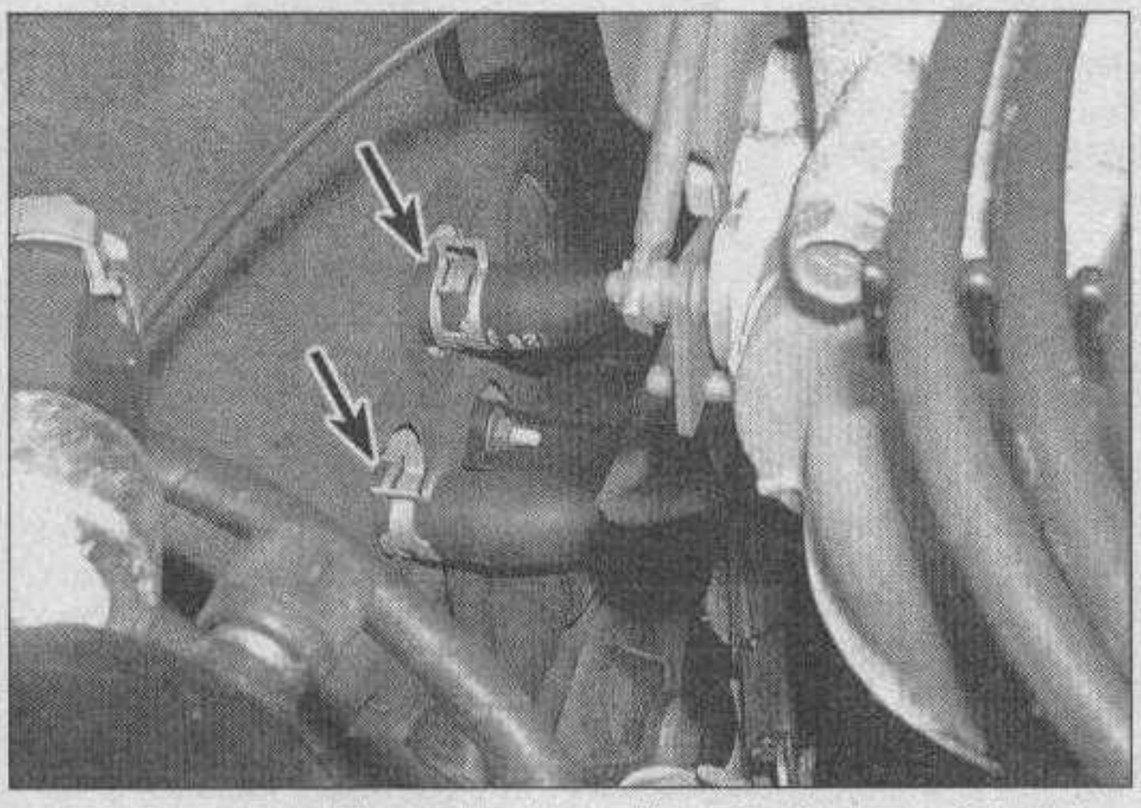
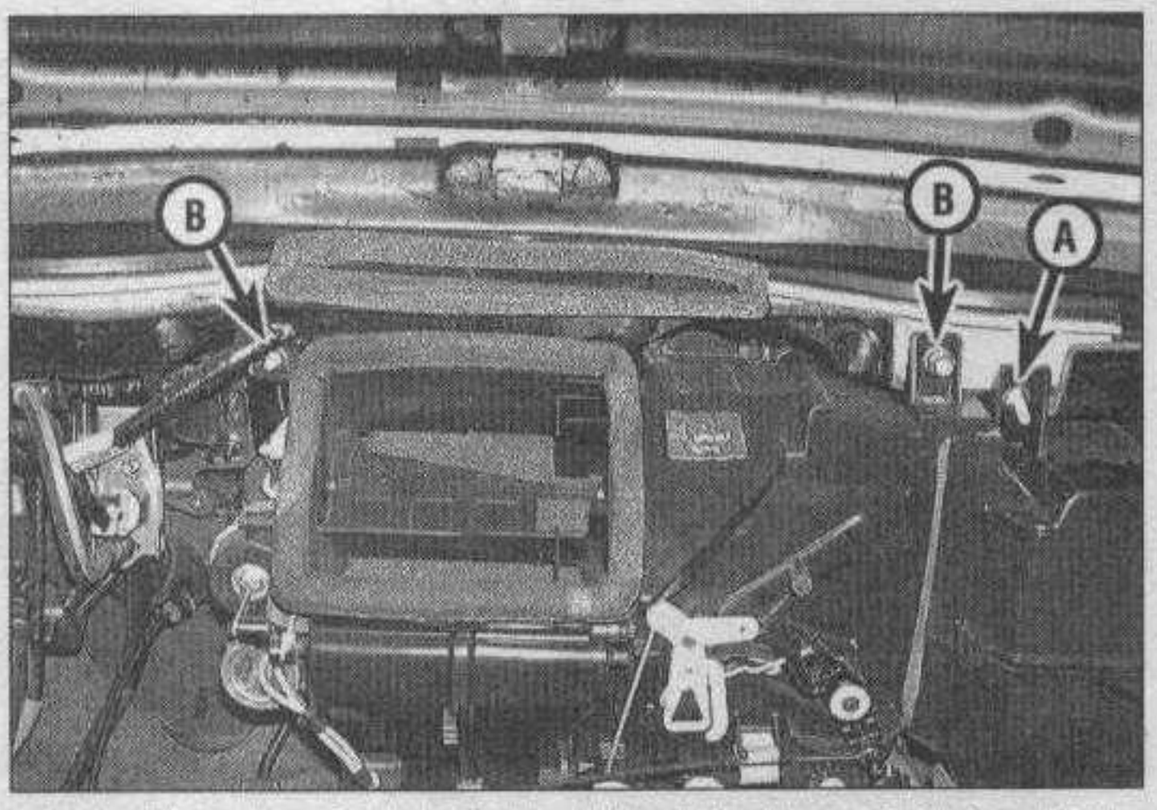


13.4 Disconnect the heater hoses from the heater unit in the engine compartment - these spring-clip type hose clamps can be removed with pliers



13.6a Remove or loosen the nut (A) at the blower housing, then remove the two upper heater case nuts (B) . . .

systems (SRS), more commonly known as airbags. Always disable the air bag system before working in the vicinity of any air bag system components to avoid the possibility of accidental deployment of the airbag, which could cause personal injury (see Chapter 12).

1 Disconnect the cable from the negative battery terminal. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

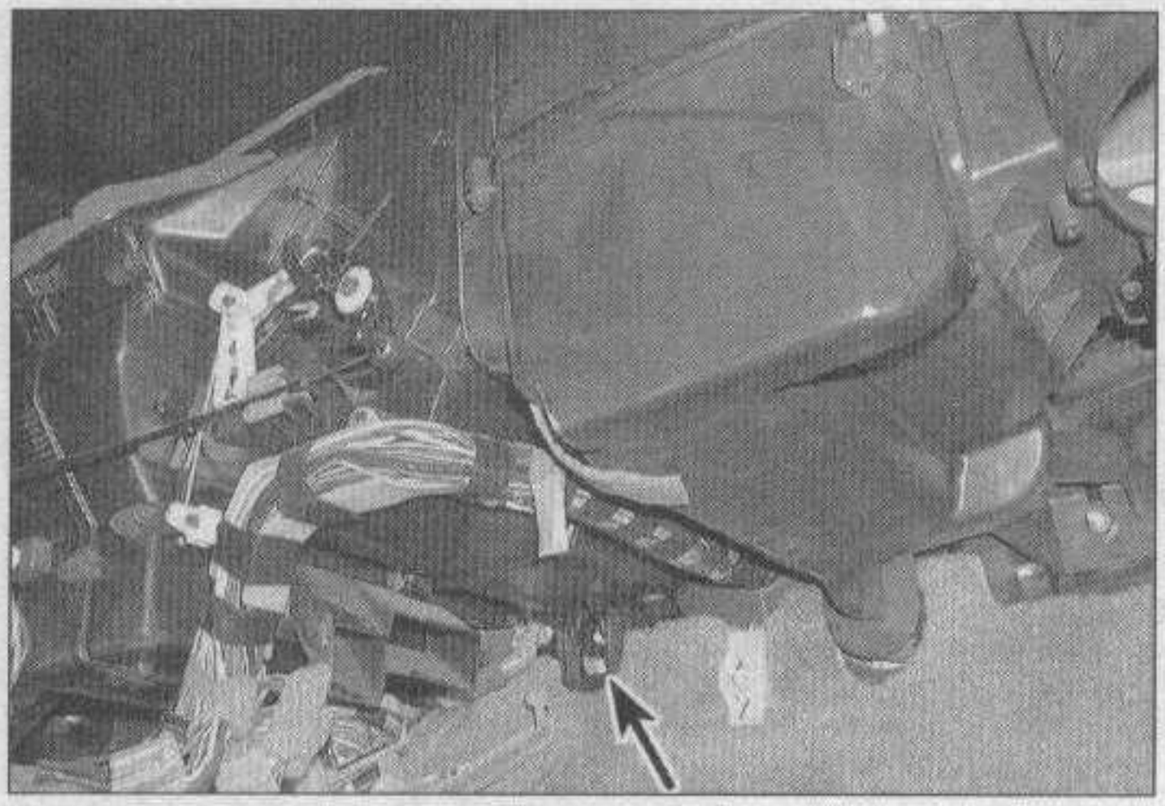
2 Drain the engine coolant (see Chapter 1).

3 Remove the center console (see Chapter 11). Remove the instrument panel (see Chapter 11).

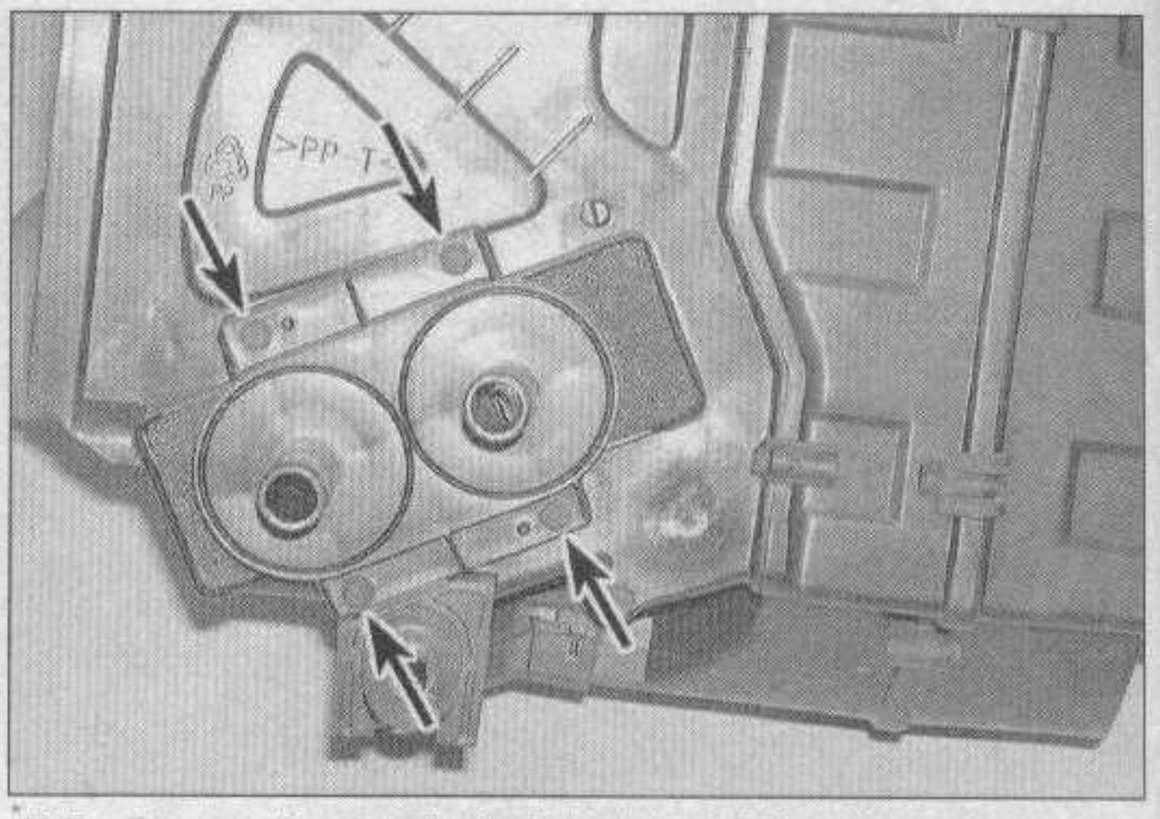
4 Disconnect the heater hoses from the heater core by undoing the hose connections at the firewall **(see illustration)**.

5 Remove the evaporator/blower motor unit mounting bolts/nuts and position the unit to the side as far as possible to allow for removal of the heater unit (see Section 19). Be careful not to bend the refrigerant lines.

6 Remove the nuts from the studs retaining the heater unit to the dashboard **(see illustrations)**. Remove the heater unit from



13.6b . . . and the heater case lower nut (arrow)

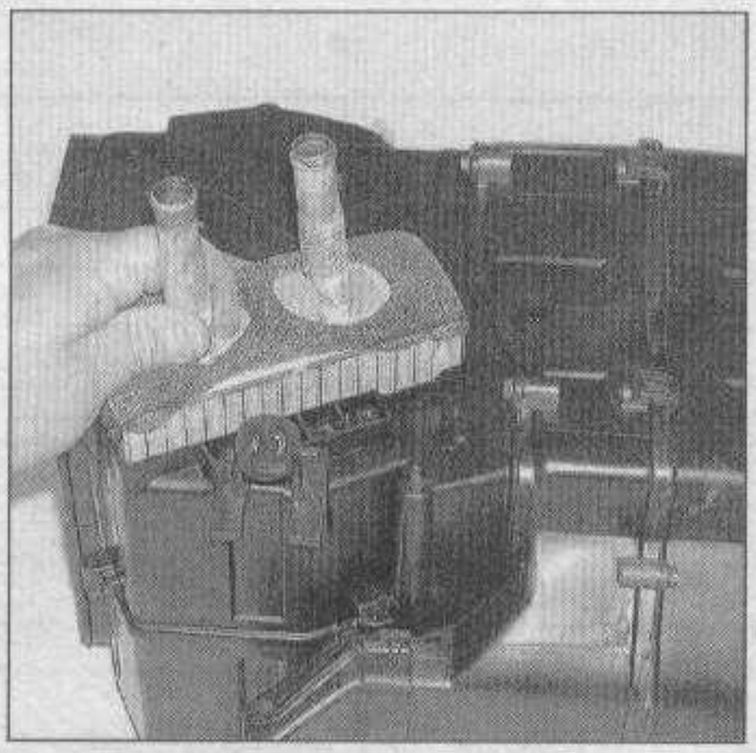


13.7a Remove the four bolts (arrows) retaining the core cover . . .

under the dashboard. Keep plenty of towels or rags on the carpeting to catch any coolant that may drip.

7 Remove the heater core from the heater unit **(see illustrations)**.

8 Reassembly is the reverse of removal. When installing the heater hoses on the heater core, make sure the hose clamps are securely positioned.



13.7b . . . then pull the heater core out of the housing - when reinstalling the core, make sure the foam insulation is intact and in place

14.8 Check the temperature of the output air in the center register with a thermometer

14 Air conditioning and heating system - check and maintenance

Air conditioning system

1 The following maintenance checks should be performed on a regular basis to ensure that the air conditioner continues to operate at peak efficiency.

a) *Inspect the condition of the compressor drivebelt. If it is worn or deteriorated, replace it (see Chapter 1).*
b) *Check the drivebelt tension and, if necessary, adjust it (see Chapter 1).*
c) *Inspect the system hoses. Look for cracks, bubbles, hardening and deterioration. Inspect the hoses and all fittings for oil bubbles or seepage. Leaks are usually indicated by oily stains. If there is any evidence of wear, damage or leakage, replace the hose(s) and/or O-rings.*
d) *Inspect the condenser fins for leaves, bugs and any other foreign material that may have embedded itself in the fins. Use a "fin comb" or compressed air to remove debris from the condenser.*
e) *Make sure the system has the correct refrigerant charge.*

2 It's a good idea to operate the system for about ten minutes at least once a month. This is particularly important during the winter months because long term non-use can cause hardening, and subsequent failure, of the seals.

3 Because of the complexity of the air conditioning system and the special equipment necessary to service it, in-depth troubleshooting and repairs are beyond the scope of this manual. However, simple component replacement procedures are provided in this Chapter.

4 The most common cause of poor cooling is simply a low system refrigerant charge. If a noticeable drop in system cooling ability occurs, one on the following quick checks will help you determine whether the refrigerant level is low.

Check

Refer to illustration 14.8

5 Warm the engine up to normal operating temperature.

6 Place the air conditioning temperature selector at the coldest setting and put the blower at the highest setting. Open the doors (to make sure the air conditioning system doesn't cycle off as soon as it cools the passenger compartment).

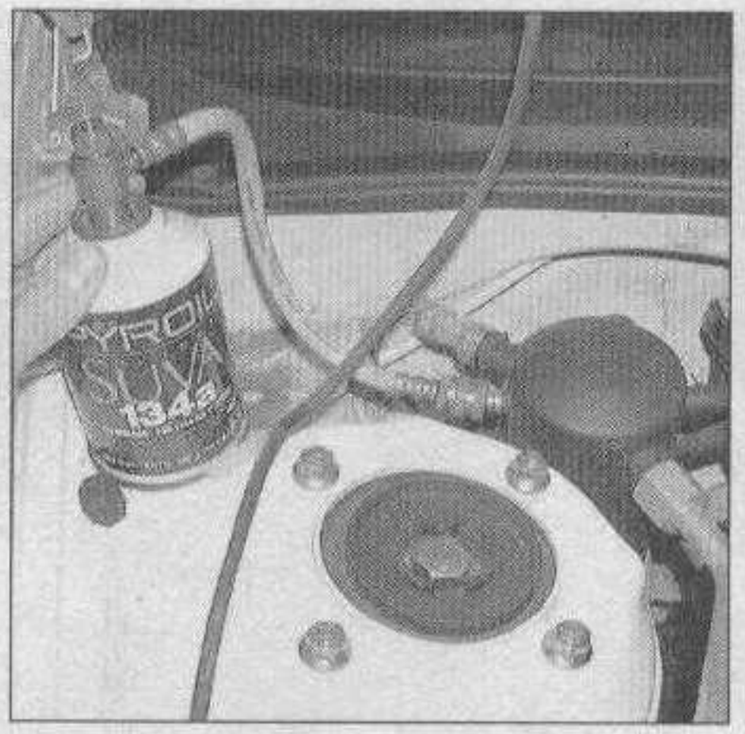
7 After the system reaches operating temperature, feel the two pipes connected to the evaporator at the firewall.

8 The pipe (thinner tubing) leading from the condenser outlet to the evaporator should be cold, and the evaporator outlet line (the thicker tubing that leads back to the compressor) should be slightly colder (3 to 10 degrees F). If the evaporator outlet is considerably warmer than the inlet, the system needs a charge. Insert a thermometer in the center air distribution duct **(see illustration)** while operating the air conditioning system - the temperature of the output air should be 35 to 40 degrees F below the ambient air temperature (down to approximately 40 degrees F). If the ambient (outside) air temperature is very high, say 110 degrees F, the duct air temperature may be as high as 60 degrees F, but generally the air conditioning is 35 to 40 degrees F cooler than the ambient air. If the air isn't as cold as it used to be, the system probably needs a charge. Further inspection or testing of the system is beyond the scope of the home mechanic and should be left to a professional.

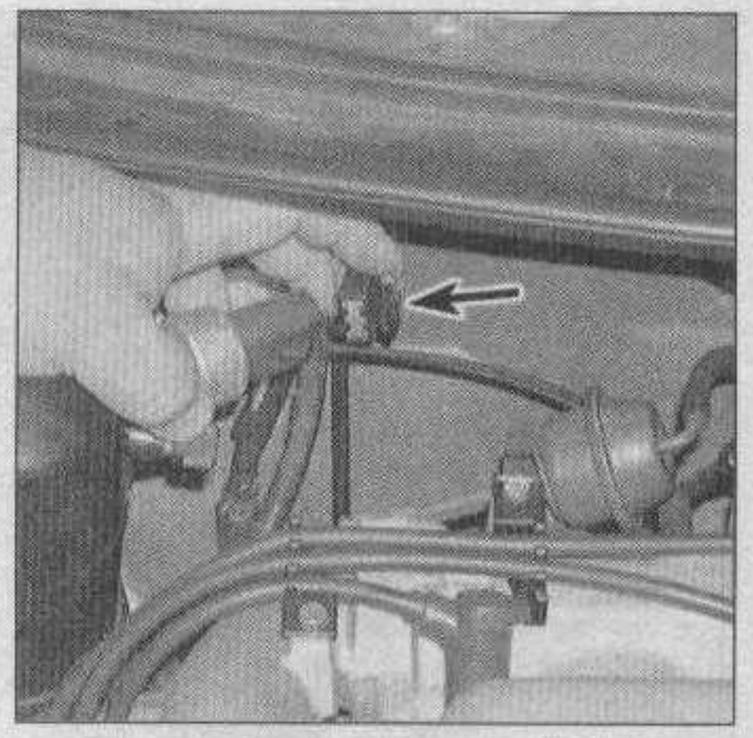
Adding refrigerant

Caution: *Refrigerant has changed from the use of R-12 on 1993 models, to the "environ-*

14.9a Typical refrigerant recharging kit for R-134a systems



14.9b Connect the hose to the service valve on the refrigerant line or accumulator/drier



14.12 Bridge the pressure-switch connector terminals (arrow) with a jumper wire to keep the compressor running while adding refrigerant

mentally friendly" R-134a used in 1994 and later models. The two refrigerants and their respective oils are not compatible. Special fittings and manifold gauge sets are used on the different refrigerant types so that an accidental hook-up of the two systems cannot be made. When replacing entire components, additional refrigerant oil should be added equal to the amount that is removed with the component being replaced. Refrigerant oils, just like refrigerant R-12 vs. R-134a, are not compatible. Be sure to read the can before adding any oil to the system, to make sure it is compatible with the type of system being repaired.

Note: *Because of Federal regulations by the Environmental Protection Agency, R-12 refrigerant is not available for home-mechanic use, however, cans of R-134 refrigerant are commonly available in auto parts stores. Models with R-12 systems will have to be serviced at a dealership or air conditioning shop.*

1994 and later models (R-134a systems)

Refer to illustrations 14.9a, 14.9b and 14.12

9 Buy an automotive charging kit at an auto parts store **(see illustration)**. A charging kit includes a 14-ounce can of R-134a refrigerant, a tap valve and a short section of hose that can be attached between the tap valve and the system low side service valve . The system low side service valve (charging port) is located on the larger air conditioning tubing line going to the firewall **(see illustration)**. Because one can of refrigerant may not be sufficient to bring the system charge up to the proper level, it's a good idea to buy an additional can. **Caution:** *Never add more than two cans of refrigerant to the system. The entire system capacity is only about two cans (see this Chapter's Specifications).*

10 Connect the charging kit by following the manufacturer's instructions. Back off the valve handle on the charging kit and screw the kit onto the refrigerant can, making sure first that the O-ring or rubber seal inside the threaded portion of the kit is in place. **Warning:** *Wear protective eye wear when dealing with pressurized refrigerant cans.*

11 Remove the dust cap from the low-side charging port and attach the quick-connect fitting on the kit hose. **Warning:** *DO NOT hook the charging kit hose to the system high side! The fittings on the charging kit are designed to fit only on the low side of the system.*

12 Warm the engine to normal operating temperature and turn on the air conditioner. Keep the charging kit hose away from the fan and other moving parts. If the refrigerant is low enough, the low-pressure switch on the accumulator/drier may keep the compressor clutch from engaging, so disconnect the connector and bridge the two terminals in the connector with a jumper wire **(see illustration)**.

13 Turn the valve handle on the kit until the stem pierces the can, then back the handle out to release the refrigerant. You should be able to hear the rush of gas. Add refrigerant to the low side of the system until both the outlet and the evaporator inlet pipe feel about the same temperature. Allow stabilization time between each addition. **Warning:** *Never add more than two cans of refrigerant to the system. The can may tend to frost up, slowing the procedure. Wrap a shop towel wet with hot water around the bottom of the can to keep it from frosting.*

14 If you have an accurate thermometer, you can place it in the center air conditioning duct inside the vehicle to monitor the air temperature **(see illustration 14.8)**. A charged system that is working properly, should output air down to approximately 40 degrees F.

15 When the can is empty, turn the valve handle to the closed position and release the connection from the low-side port. Replace the dust cap.

16 Remove the charging kit from the can and store the kit for future use with the piercing valve in the UP position, to prevent inadvertently piercing the can on the next use.

Heating systems

Refer to illustration 14.21

17 If the air coming out of the heater vents isn't hot, the problem could stem from any of the following causes:

a) *The thermostat is stuck open, preventing the engine coolant from warming up enough to carry heat to the heater core. Replace the thermostat* (see Section 3).

b) *A heater hose is blocked, preventing the flow of coolant through the heater core. Feel both heater hoses at the firewall. They should be hot. If one of them is cold, there is an obstruction in one of the hoses or in the heater core, or the heater control valve is shut. Detach the hoses and back flush the heater core with a water hose. If the heater core is clear but circulation is impeded, remove the two hoses and flush them out with a garden hose.*

c) *If flushing fails to remove the blockage from the heater core, the core must be replaced.* (see Section 12).

18 If the blower motor speed does not correspond to the setting selected on the blower switch, the problem could be a bad fuse, circuit, blower relay, speed switch or blower resistor (see Section 10).

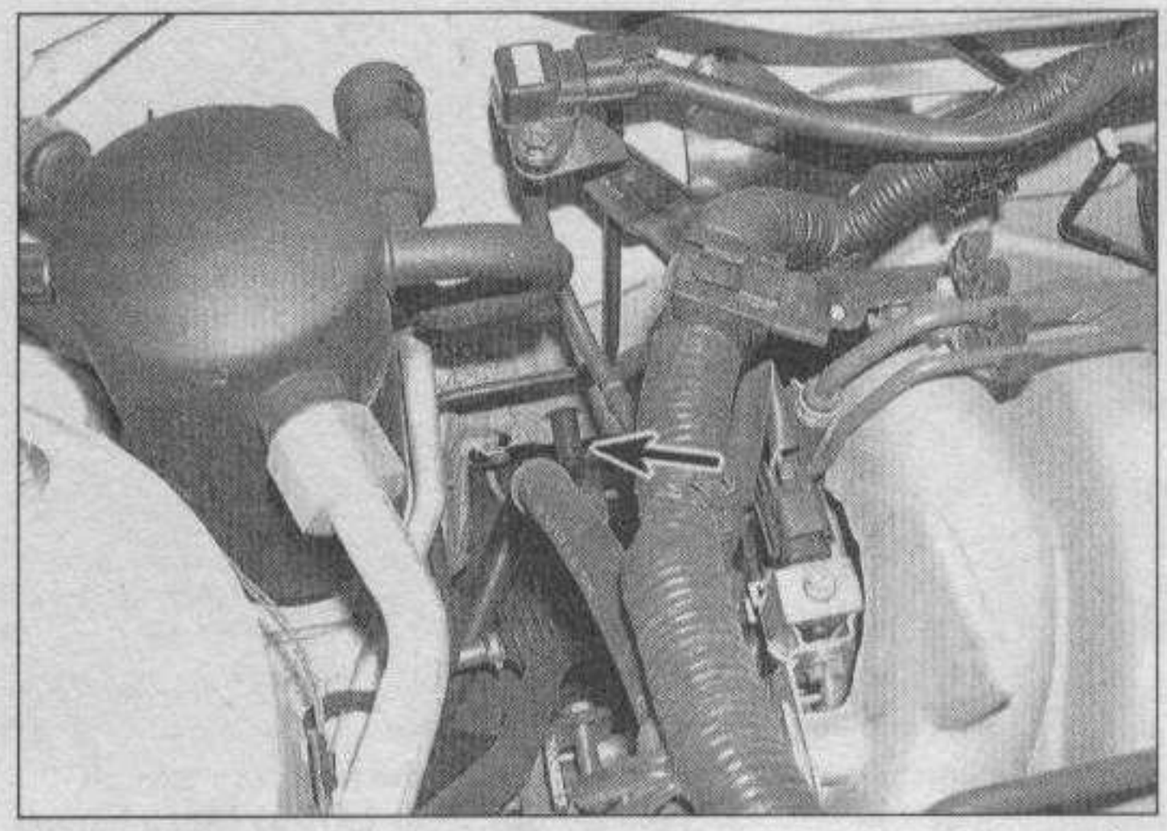
19 If there isn't any air coming out of the vents:

a) *Turn the ignition ON and activate the fan control. Place your ear at the heating/air conditioning register (vent) and listen. Most motors are audible. Can you hear the motor running?*

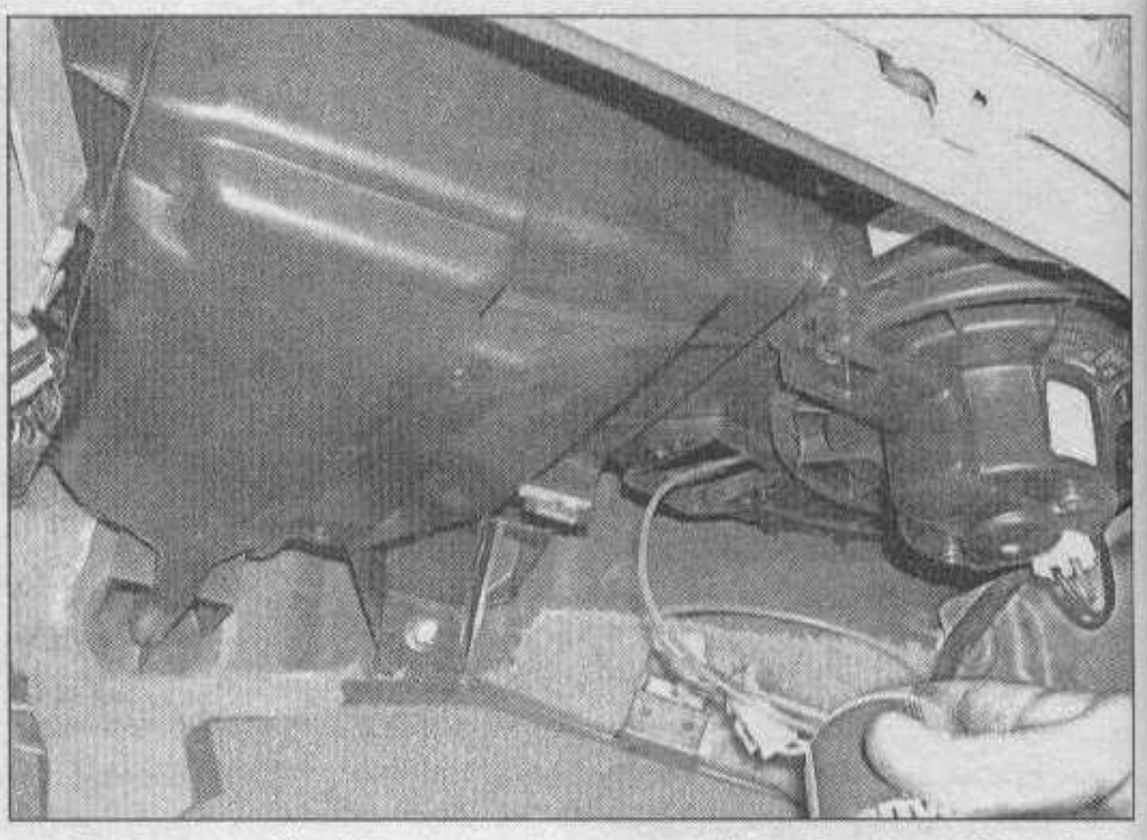
b) *If you can't (and have already verified that the blower switch and the blower motor resistor are good), the blower motor itself is probably bad* (see Sections 10 and 11).

20 If the carpet under the heater core is damp, or if antifreeze vapor or steam is coming through the vents, the heater core is leaking. Remove it (see Section 13) and install a new unit (most radiator shops will not repair a leaking heater core).

21 Inspect the drain hose from the heater/evaporator assembly at the right side



14.21 Inspect the evaporator drain hose (arrow) by poking a wire inside to make sure it is clear of any debris



14.25 Remove the blower motor resistor (see Section 10) and aim the disinfectant nozzle towards the evaporator core

of the firewall, make sure it is not clogged **(see illustration)**. If there is a humid mist coming from the system ducts, this hose may be plugged with leaves or road debris.

Eliminating air-conditioning odors

Refer to illustration 14.25

22 Unpleasant odors that often develop in air-conditioning systems are caused by the growth of a fungus, usually on the surface of the evaporator core. The warm, humid environment there is a perfect breeding ground for mildew to develop.

23 The evaporator core on most models is difficult to access, and factory dealerships have a lengthy, expensive process for eliminating the fungus by opening up the evaporator case and using a powerful disinfectant and rinse on the core until the fungus is gone. You can service your own system at home, but it takes something much stronger than basic household germ-killers or deodorizers.

24 Aerosol disinfectants for automotive air-conditioning systems are available in most auto parts stores, but remember when shopping for them that the most effective treatments are also the most expensive. The basic procedure for using these sprays is to start by running the system in the RECIRC mode for ten minutes with the blower on its highest speed. Use the highest heat mode to dry out the system and keep the compressor from engaging by disconnecting the wiring connector at the compressor (see Section 16).

25 The disinfectant can usually comes with a long spray hose. Remove the blower motor resistor (see Section 9), point the nozzle inside the hole and to the left towards the evaporator core, and spray according to the manufacturer's recommendations **(see illustration)**. Try to cover the whole surface of the evaporator core, by aiming the spray up, down and sideways. Follow the manufacturer's recommendations for the length of spray and waiting time between applications.

26 Once the evaporator has been cleaned, the best way to prevent the mildew from coming back again is to make sure your evaporator housing drain tube is clear **(see illustration 14.21)** and to run the defrost cycle briefly to dry the evaporator out after a long drive with the air conditioning on.

15 Air conditioning compressor clutch circuit - check

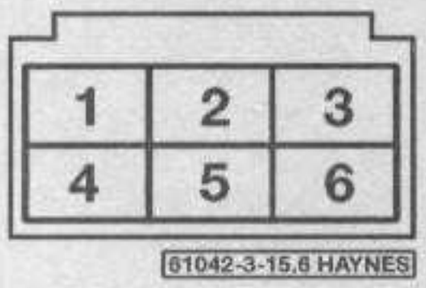
Refer to illustration 15.6

1 Proper operation of the compressor clutch is essential to the function of the air conditioning system. If your system doesn't seem to get cold, first check the clutch operation.

2 With the engine running, set the air conditioning temperature selector on the coldest setting and the fan on high.

3 Have an assistant push the A/C switch button while you observe the front of the compressor. The clutch will make an audible click and the center of the clutch should rotate. If it doesn't, shut the engine off and disconnect the air conditioning system pressure switch. Bridge the terminals in the connector with a jumper and try the air conditioning again **(see illustration 14.12)**. If it works now, the system pressure is too high or too low. Have your system tested by a dealer service department or air conditioning shop. **Note:** *On 1993 through 1995 Mazda models, the pressure switch is located in the refrigerant line leading to the receiver/drier, not on the receiver/drier (both are located between the front bumper and the radiator on these models).*

4 If the clutch doesn't engage, use a voltmeter or test light to check for battery power at the clutch connector with the ignition switch and A/C switch On. If battery power is present at the connector, turn the ignition switch Off and disconnect the electrical connector at the compressor. Connect a fused



15.6 A/C relay engine compartment fuse box terminal identification

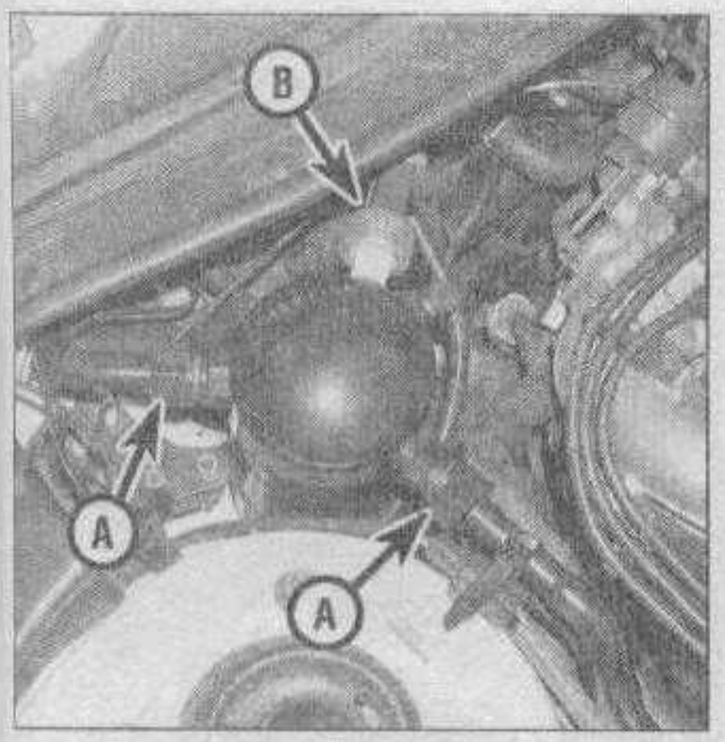
1 To PCM
2 To compressor clutch
3 Battery power (hot at all times)
4 Not used
5 Battery power (hot with ignition On)
6 Ground

jumper wire to the positive terminal of the battery and the compressor clutch terminal. If the clutch doesn't engage, the clutch is defective and must be replaced.

5 If no power is present at the compressor clutch connector, check the appropriate fuses in the interior fuse box and the under hood fuse box. If the fuses are good, remove the A/C relay from the underhood relay/fuse box and test it (see Chapter 12).

6 With the relay removed and the ignition switch On, check for battery power at terminals 3 and 5 of the A/C relay fuse box terminals **(see illustration)**. There should be battery power at both terminals. Connect terminals 2 and 3 with a jumper wire and listen for the clutch to engage as you make the connection.

7 If the clutch still doesn't operate, and the fuses, relay and compressor clutch are good, check for an open in the circuit between the relay box and the compressor clutch connector. If it has continuity, check for an open in the circuit from the PCM to the relay box. If the circuits are good , have the PCM checked at a dealership or other properly equipped repair facility.



16.3a Use backup wrenches to disconnect the two refrigerant lines (A) at the accumulator/drier, then disconnect the electrical connector (B) at the cycling switch (Probe model shown, Mazda connection similar, but located in front of radiator)

16.3b Where spring-lock couplings are used in refrigerant lines, use a spring-lock coupling tool - clamp the tool over the connection while pushing the two lines toward each other, then pull outward to release (typical example shown)

16 Air conditioning accumulator/drier - removal and installation

Warning: *The air conditioning system is under high pressure. Do not loosen any hose fittings or remove any components until the system has been discharged. Air conditioning refrigerant should be properly discharged into an EPA-approved recovery/recycling unit by a dealer service department or an automotive air conditioning repair facility. Always wear eye protection when disconnecting air conditioning system fittings.*

Removal

Refer to illustrations 16.3a and 16.3b

1 Have the refrigerant discharged and recovered by a qualified repair facility.

2 Disconnect the battery negative cable. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

3 Disconnect the refrigerant lines from the accumulator/drier **(see illustrations)**. Cap the open fittings immediately to prevent entry of moisture. **Note:** *On 1997 and earlier Mazda models, the receiver/drier is located on a bracket in front of the radiator. On 1998 and later Mazda models and all Probe models, it's located near the right-rear corner of the engine compartment.*

4 Remove the two bolts from the accumulator/drier mounting bracket and remove the accumulator/drier.

Installation

5 Installation is the reverse of removal. Replace any O-rings with new ones specifically made for the type of refrigerant in your system and lubricate them with refrigerant oil prior to installation. **Warning:** *Do not apply compressor oil to the fitting nuts.* If a new accumulator/drier is being installed, add 1 ounce on Probe models or 0.33 ounce on Mazda models of refrigerant oil into the new accumulator/drier. Use only refrigerant oil compatible with your system (see Section 14). Tighten the accumulator/drier inlet and outlet fittings securely. If installing a new accumulator/drier, transfer the cycling switch from the old unit to the new one.

6 Have the system evacuated, charged and leak tested by the shop that discharged it.

17 Air conditioning compressor - removal and installation

Warning: *The air conditioning system is under high pressure. Do not loosen any hose fittings or remove any components until the system has been discharged. Air conditioning refrigerant should be properly discharged into an EPA-approved recovery/recycling unit by a dealer service department or an automotive air conditioning repair facility. Always wear eye protection when disconnecting air conditioning system fittings.*

Caution: *Whenever the compressor is replaced, replace the accumulator/drier (see Section 16) and if equipped, the orifice tube (see Section 20).*

Removal

Refer to illustration 17.5

1 Have the refrigerant discharged and recovered by a qualified repair facility.

2 Disconnect the negative cable from the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

3 Remove the drivebelt from the compressor (see Chapter 1).

4 Block the rear wheels so the vehicle can't roll. Jack up the front end at least one foot and place it securely on jackstands. Remove the splash shields from under the front of the vehicle.

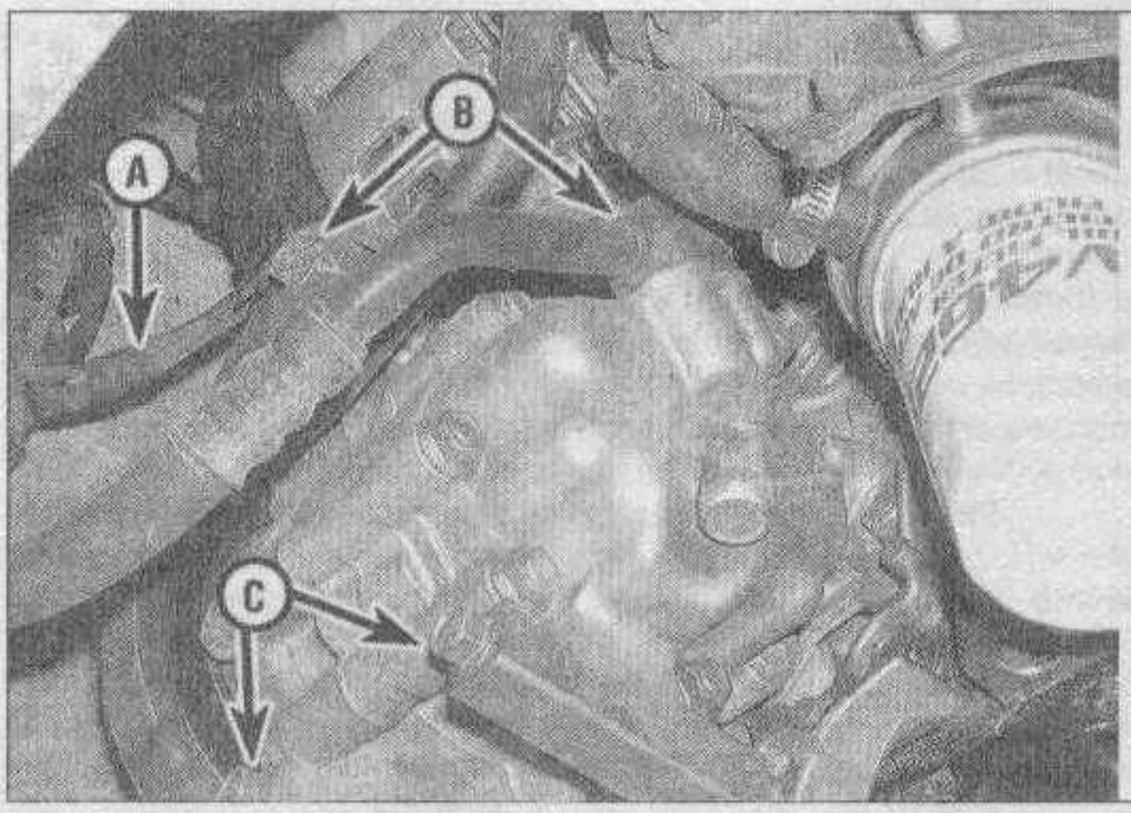
5 Disconnect the refrigerant lines and compressor electrical connector **(see illustration)**. Remove the compressor mounting bolts and remove the compressor from the engine.

Installation

6 If a new or rebuilt compressor is being installed, drain the oil from the new compressor. Drain the oil from the old compressor into a graduated container. Add that amount of new oil, plus 0.67 ounces into the new compressor. Use only refrigerant oil compatible with your system (see Section 14).

7 Installation is the reverse of removal. Tighten the compressor mounting bolts securely. Replace any O-rings with new ones specifically for the type of refrigerant in your system and lubricate them with refrigerant oil prior to installation. **Warning:** *Do not apply compressor oil to the fitting nuts.* Tighten the refrigerant line bolts securely.

8 Have the system evacuated, recharged and leak tested by the shop that discharged it.



17.5 Disconnect the wiring harness connector (A) at the compressor, then remove the refrigerant line mounting bolts (B) and the compressor mounting bolts (C) indicates two lower bolts) - Probe model shown, Mazda models similar

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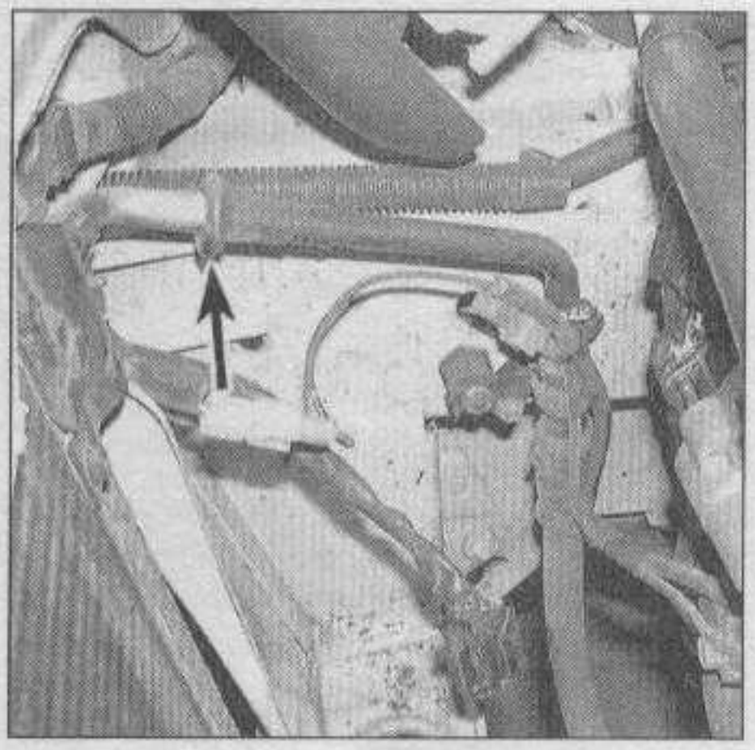
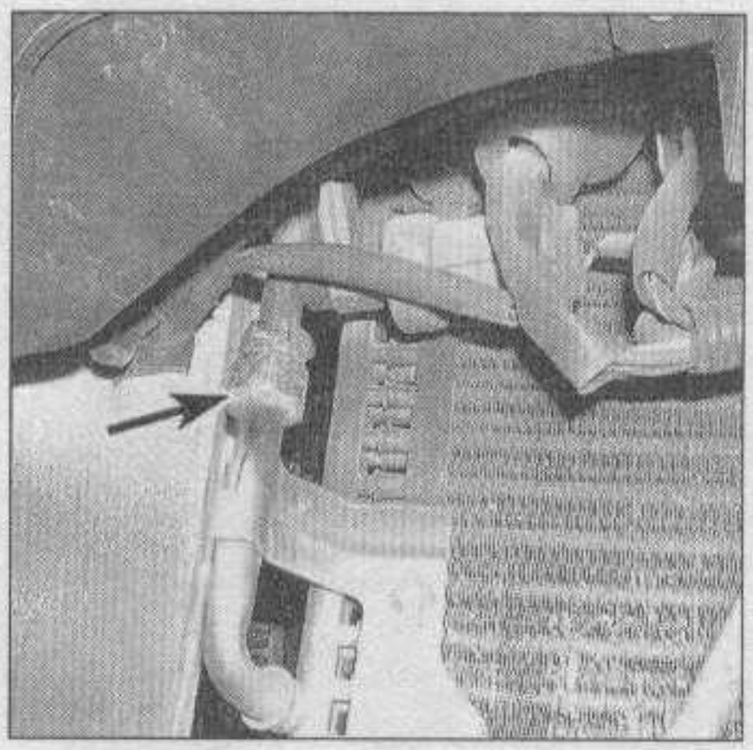
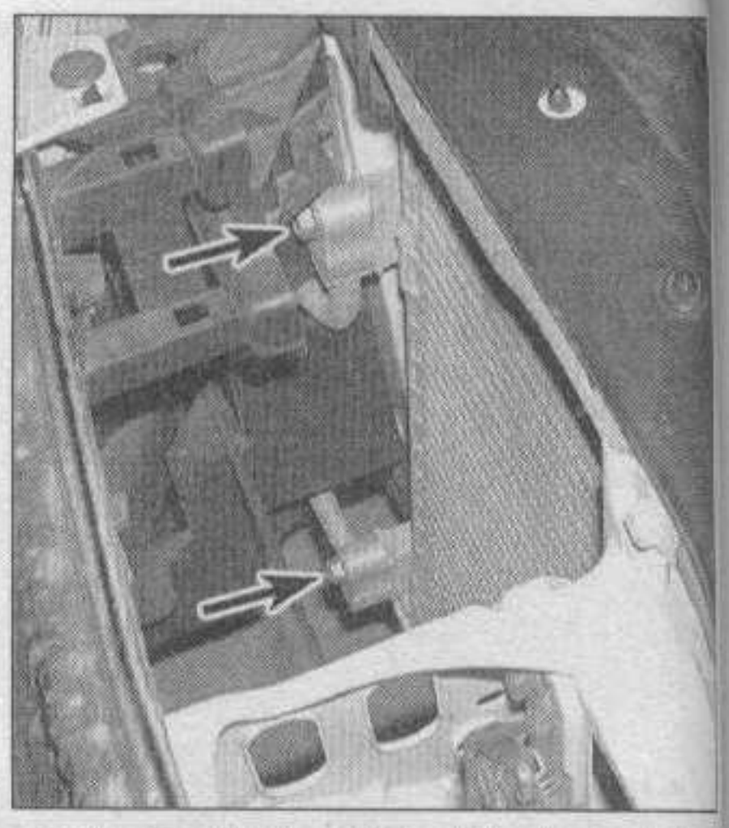


18.4a On Probe models, disconnect the high-pressure refrigerant line coupling (arrow) with a spring-lock coupling tool



18.4b Disconnect the refrigerant line (arrow) in front of the condenser - on 1997 and earlier Mazda models, both refrigerant line fittings are in front of the condenser, near the top-center



18.4c On 1998 and later Mazda models, the refrigerant lines (arrows) bolt to the top and bottom of the condenser

18 Air conditioning condenser - removal and installation

Warning: *The air conditioning system is under high pressure. Do not loosen any hose fittings or remove any components until the system has been discharged. Air conditioning refrigerant should be properly discharged into an EPA-approved recovery/recycling unit by a dealer service department or an automotive air conditioning repair facility. Always wear eye protection when disconnecting air conditioning system fittings.*

Removal

Refer to illustrations 18.4a, 18.4b, 18.4c and 18.5

1 Have the refrigerant discharged and recovered by a qualified repair facility.

2 On Probe models, remove the radiator to access the condenser refrigerant line coupling.

3 On Mazda models, remove the radiator mounting brackets.

4 Disconnect the refrigerant lines from the condenser **(see illustrations)**. Immediately cap the open fittings to keep moisture and contamination out of the system.

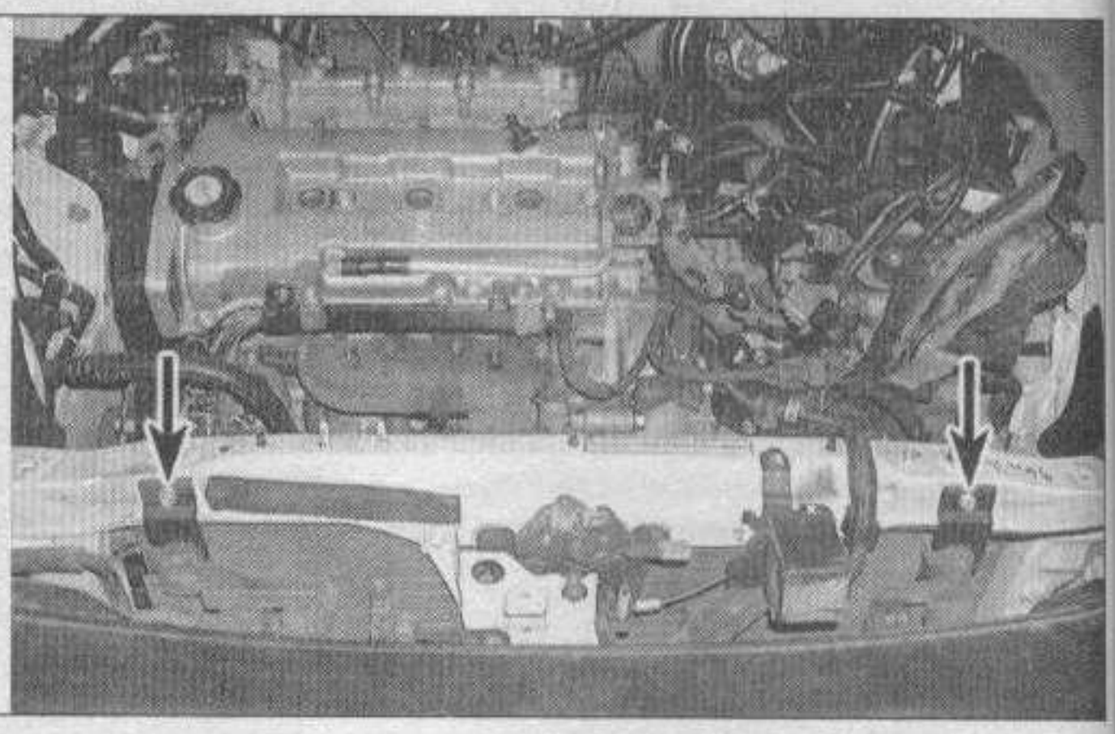
5 Remove the condenser mounting nuts/bolts and brackets and remove the condenser **(see illustration)**. On Mazda models, insert a section of cardboard between the condenser and radiator to protect the radiator from damage, tilt the condenser back and remove it from the vehicle.

6 Check the condenser for cracks, damage, refrigerant leakage, bent fins, and distorted or damaged condenser inlet and outlet. Repair or replace the condenser as necessary.

Installation

7 Installation is the reverse of removal. Replace any O-rings with new ones specifically for the type of refrigerant in your system and lubricate them with refrigerant oil prior to installation. **Warning:** *Do not apply compressor oil to the fitting nuts. Tighten the condenser inlet and outlet fittings securely.*

8 Have the system evacuated, recharged and leak tested by the shop that discharged it. If the condenser was replaced, 1.0 ounce of new refrigerant oil should be added to the high pressure side of the compressor. Use only refrigerant oil compatible with your system (see Section 14).



18.5 Remove the condenser mounting brackets (arrows)

19 Air conditioning evaporator - removal and installation

Warning 1: *The models covered by this manual are equipped with Supplemental Restraint systems (SRS), more commonly known as airbags. Always disable the air bag system before working in the vicinity of any air bag system components to avoid the possibility of accidental deployment of the airbag, which could cause personal injury (see Chapter 12).*

Warning 2: *The air conditioning system is under high pressure. Do not loosen any hose fittings or remove any components until the system has been discharged. Air conditioning refrigerant should be properly discharged into an EPA-approved recovery/recycling unit by a dealer service department or an automotive air conditioning repair facility. Always wear eye protection when disconnecting air conditioning system fittings.*

Removal

Refer to illustrations 19.2 and 19.5

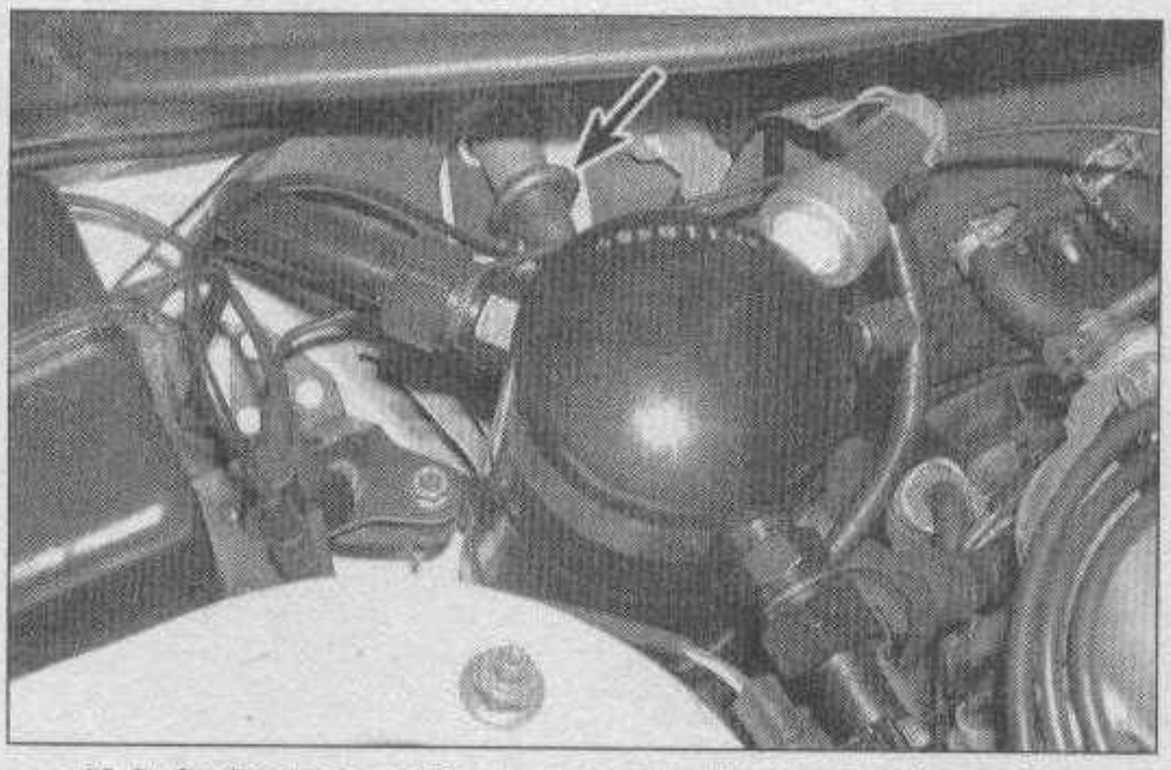
1 Have the refrigerant discharged and recovered by a qualified repair facility.

2 Disconnect the air conditioning evaporator refrigerant lines at the firewall. Depending on model, use a wrench (and a back-up wrench) or a spring-lock-coupling tool to disconnect the fittings **(see illustration)**. Cap the open fittings after disassembly to prevent the entry of air or dirt.

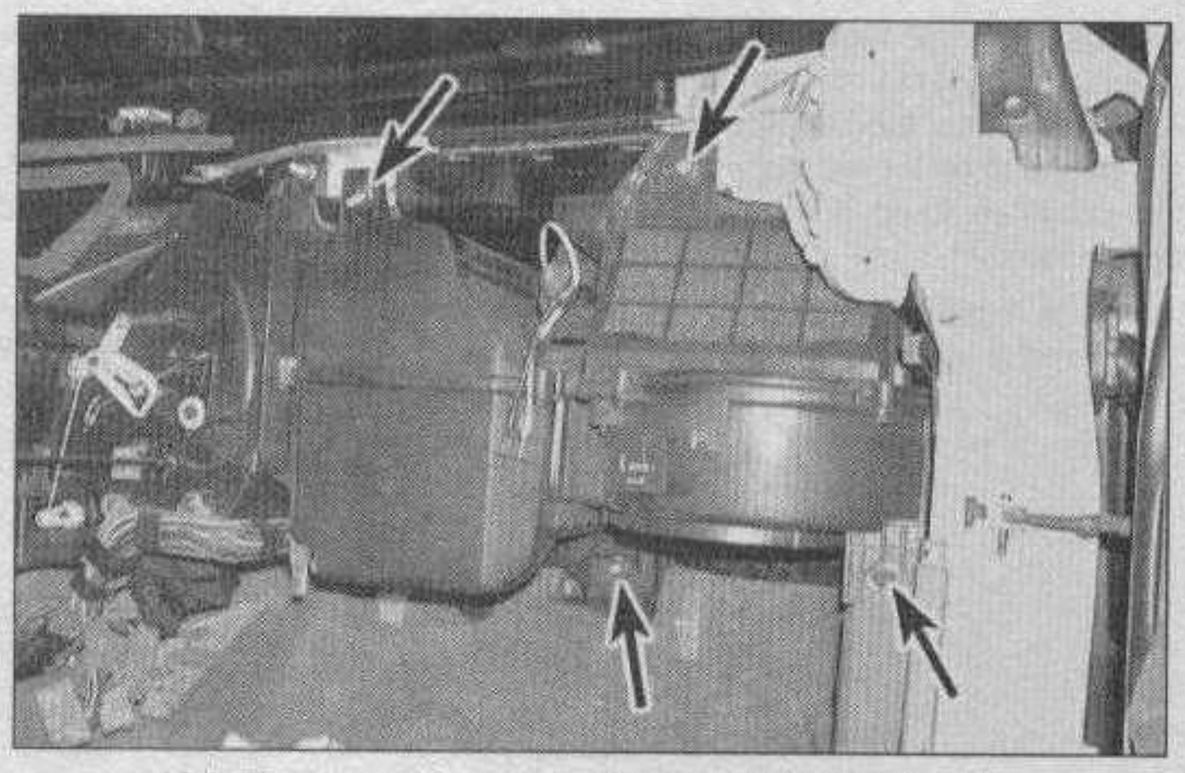
3 On Mazda models, refer to Chapter 11 and remove the glove compartment and the passenger side lower dashboard panel. On Probe models, refer to Chapter 11 and remove the instrument panel.

4 Disconnect any electrical connectors and wiring from the evaporator and blower motor housings. On Probe models, disconnect the temperature control cable at the door linkage arm.

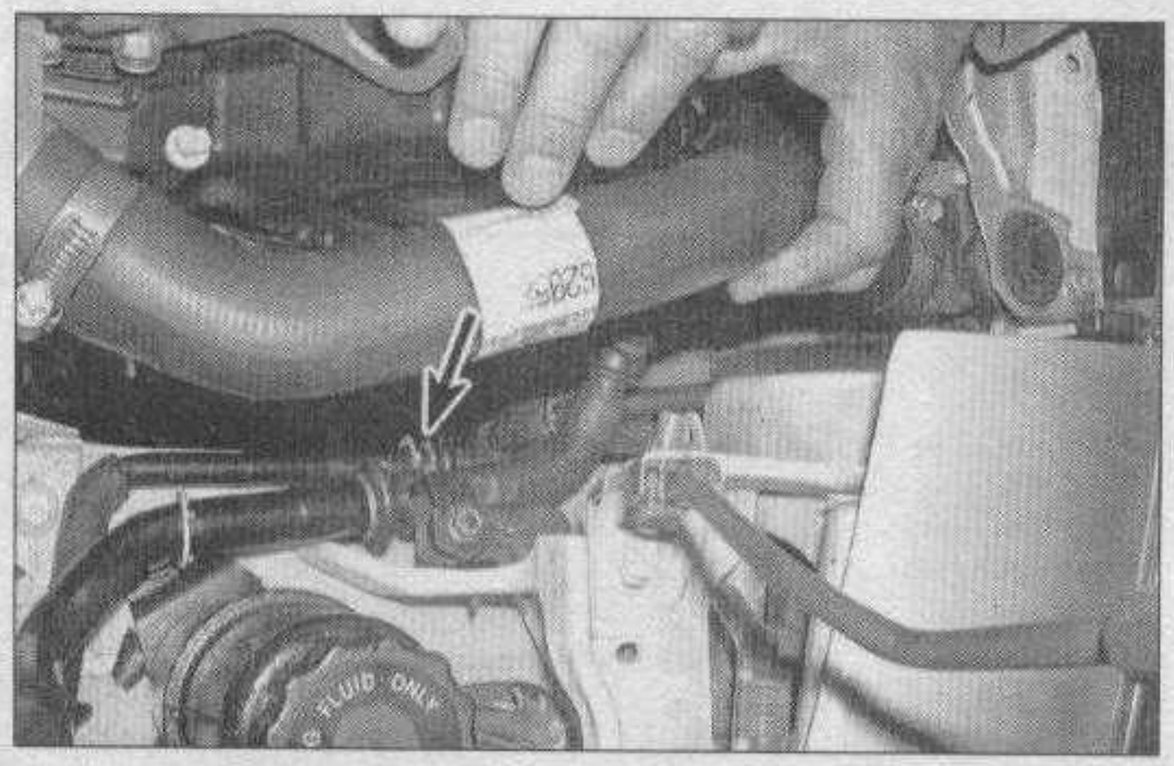
5 Remove the fasteners holding the evaporator housing to the firewall **(see illustration)**. On Probe models, the blower housing and evaporator housing are removed



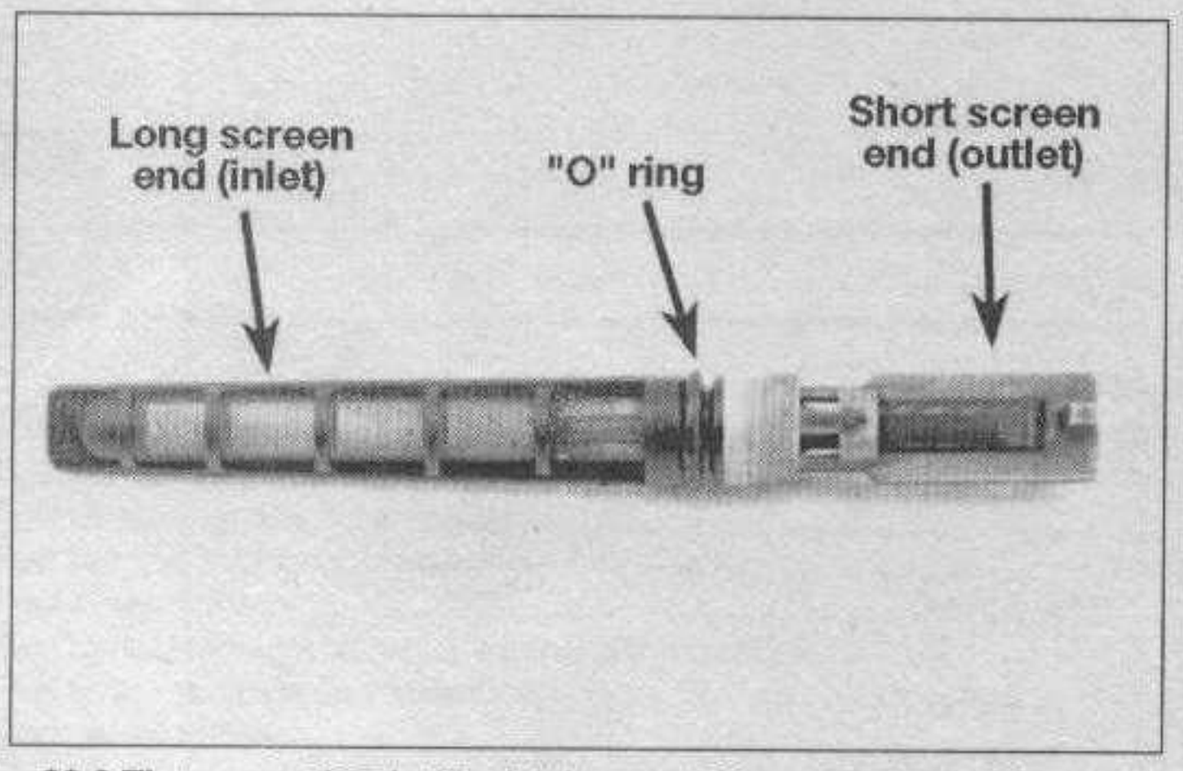
19.2 On Probe models, use a spring-lock-coupling tool to disconnect the evaporator refrigerant lines (arrow indicates one line, the other is below)



19.5 Remove the nuts/bolts (arrows) retaining the evaporator/blower housing to the firewall (Probe model shown)



20.2 On Probe models, use a spring-lock-coupling tool to disconnect the refrigerant line coupling (arrow) - the orifice tube is located in the line leading to the evaporator



20.3 The expansion (orifice) tube contains a precise orifice and several screen filters - it should be replaced whenever a compressor is replaced

together, while on Mazda models, the evaporator housing can be removed without removing the blower housing.

6 Remove the screws and separate the two halves of the evaporator case, then remove the evaporator core.

7 On 1997 and earlier Mazda models, disconnect the expansion valve fittings and remove the expansion valve from the evaporator. Be carefully not to damage the delicate copper heat sensing tubing connected to the expansion valve. Immediately cap the open fittings to keep moisture and contamination out of the system.

8 Check the evaporator core and fittings for stains that could indicate leakage, cracks or any other damage. Replace the evaporator if necessary.

Installation

9 Reinstall the expansion valve, if equipped, replacing the O-rings. Install the sensing tube in the same location as originally installed. Tighten the expansion valve inlet and outlet fittings securely.

10 Installation is the reverse of removal. Replace any O-rings with new ones specifically for the type of refrigerant in your system and lubricate them with refrigerant oil prior to installation. **Warning:** *Do not apply compressor oil to the fitting nuts.* Tighten the evaporator cooling unit inlet and outlet fittings securely.

11 Have the system evacuated, charged and leak tested by the shop that discharged it. If the evaporator is replaced with a new unit, 3 ounces of new refrigerant oil should be added to the high pressure side of the compressor. Use only refrigerant oil compatible with your system (see Section 14).

20 Air conditioning expansion (orifice) tube - removal and installation

Warning: *The air conditioning system is under high pressure. Do not loosen any hose fittings or remove any components until the system has been discharged. Air conditioning refrigerant should be properly discharged into an EPA-approved recovery/recycling unit by a dealer service department or an automotive air conditioning repair facility. Always wear eye protection when disconnecting air conditioning system fittings.*

Note: *The expansion orifice tube is used on all Probe models and on 1998 and later Mazda models.*

Removal

Refer to illustrations 20.2 and 20.3

1 Have the air conditioning system discharged and the refrigerant recovered. Disconnect the cable from the negative terminal of the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 On four-cylinder models, unbolt the power steering pump and move it aside to allow access to the refrigerant line coupling. Disconnect the refrigerant line coupling in the condenser to evaporator line **(see illustration)**.

3 The expansion tube is a tube with a fixed-diameter orifice and a mesh filter at each end **(see illustration)**. When you separate the pipe at the fitting you will see one end of the orifice tube inside the pipe leading to the evaporator. Use needle-nose pliers to

3

carefully remove the orifice tube, noting the direction it faces in the refrigerant line.

4 The orifice tube acts to meter the refrigerant, changing it from high-pressure liquid to low-pressure liquid. It is possible to reuse the orifice tube if:

a) *The screens aren't plugged with grit or foreign material*
b) *Neither screen is torn*
c) *The plastic housing over the screens is intact*
d) *The brass orifice inside the plastic housing is unrestricted*

Installation

5 Installation is the reverse of removal. Be sure to insert the expansion tube with the shorter end in first, toward the evaporator. **Caution:** *Always use a new O-ring when installing the expansion tube.*

6 Retighten the fitting and refrigerant line, then have the system evacuated, recharged and leak-tested by the shop that discharged it.

Chapter 4
Fuel and exhaust systems

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Specifications

Fuel pressure

Ford Probe models

Key on, engine off	35 to 40 psi
Engine running	30 to 45 psi

Mazda models

Engine running, pressure regulator vacuum hose attached	
Four-cylinder	30 to 38 psi
V6	30 to 36 psi
Engine running, pressure regulator vacuum hose disconnected	
Four-cylinder	37 to 46 psi
V6	39 to 45 psi

Injector resistance (approximate) — 12 to 16 ohms

Torque specifications — **Ft-lbs** (unless otherwise indicated)

Throttle body mounting nuts or bolts	
Four-cylinder	14 to 18
V6	
Nuts	15 to 22
Bolts	14 to 18
Fuel rail mounting bolts	14 to 18
Fuel pressure regulator mounting bolts	96 in-lbs

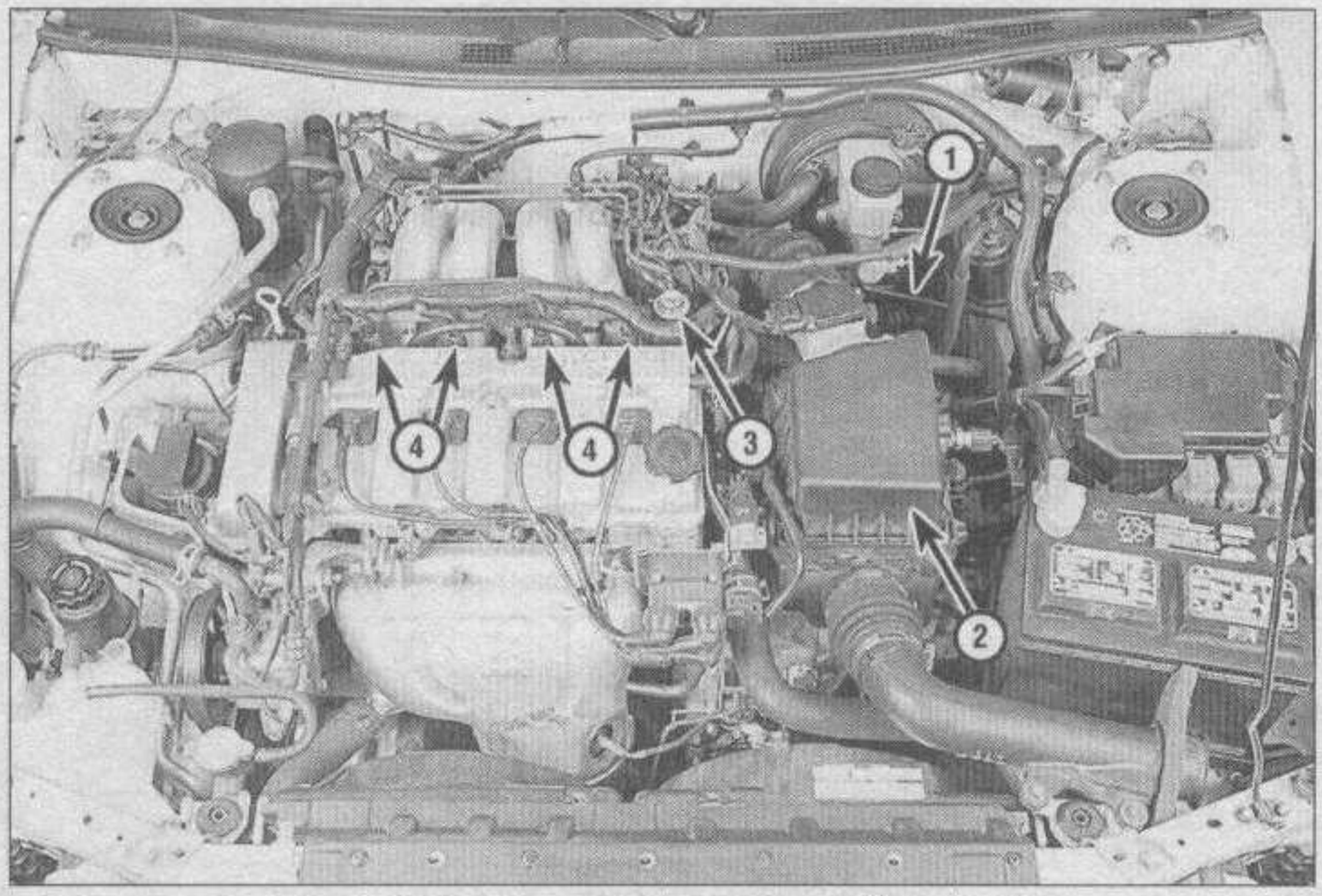
1 General information

Refer to illustrations 1.2a and 1.2b

The fuel system consists of a fuel tank, an electric fuel pump (located in the fuel tank), a fuel pump relay, the fuel rail and fuel injectors, an air cleaner assembly and a throttle body unit. All models are equipped with an electronic fuel injection system.

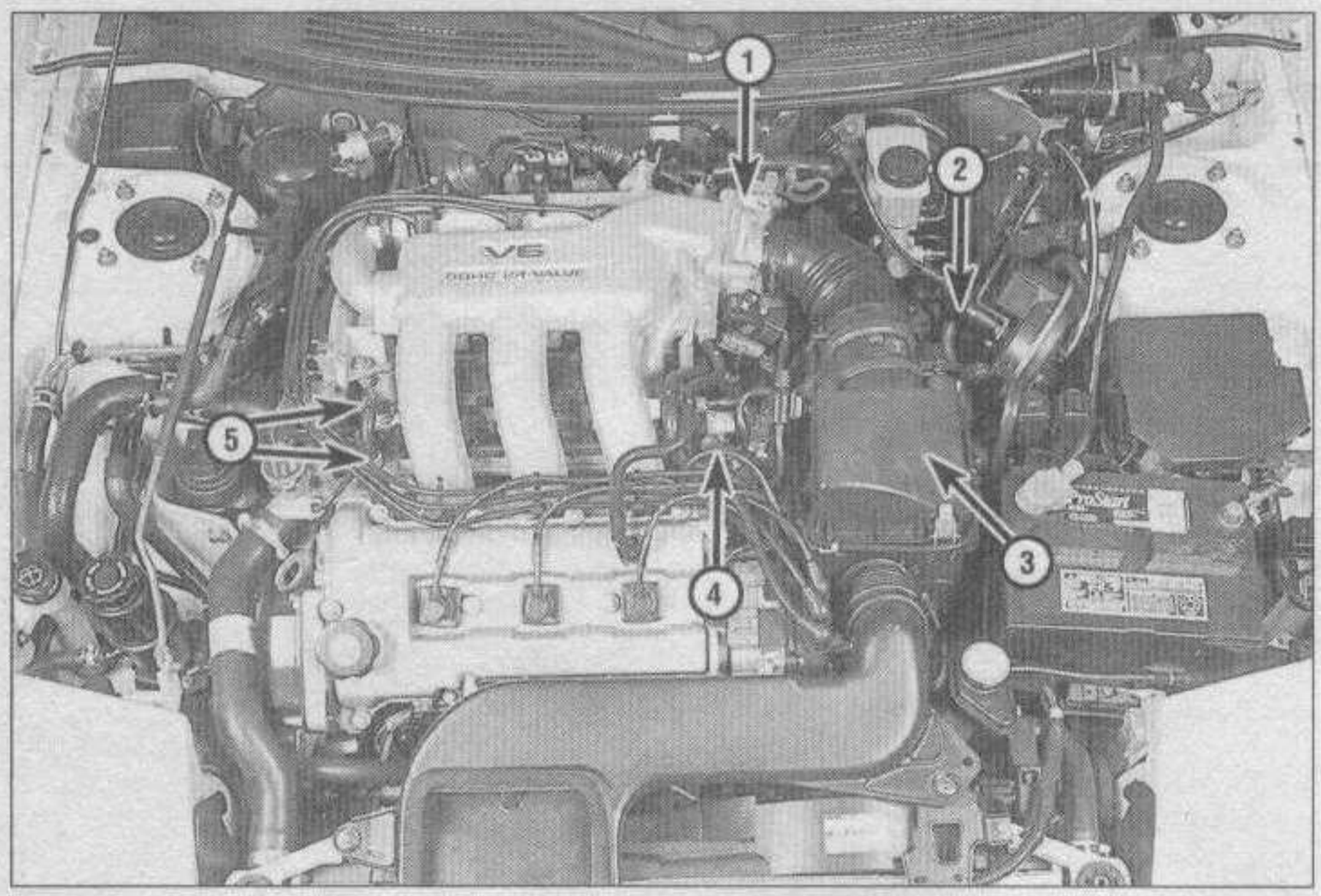
Sequential Fuel Injection (SFI) system

Sequential Fuel Injection uses timed impulses to inject the fuel directly into the intake port of each cylinder according to its firing order. The injectors are controlled by the Powertrain Control Module (PCM). The PCM monitors various engine parameters and delivers the exact amount of fuel required into the intake ports **(see illustrations)**. The throttle body serves only to control the amount of air passing into the system. Because each cylinder is equipped with its own injector, much better control of the fuel/air mixture ratio is possible.



1.2a Fuel injection components - four-cylinder engine

1 *Fuel filter (not visible)*
2 *Air cleaner housing*
3 *Fuel pressure regulator*
4 *Fuel injectors*



1.2b Fuel injection components - V6 engine

1 *Throttle body*
2 *Fuel filter (not visible)*
3 *Air cleaner housing*
4 *Fuel pressure regulator*
5 *Fuel rails*

Fuel pump and lines

Fuel is circulated from the fuel tank to the fuel injection system, and back to the fuel tank, through a pair of metal lines running along the underside of the vehicle. An electric fuel pump and fuel level sending unit is located inside the fuel tank. A vapor return system routes all vapors back to the fuel tank through a separate return line. Access to the fuel pump/sending unit assembly requires removal of the fuel tank.

These models are equipped with a fuel injection system main relay located in the engine compartment, on the main fuse box junction. The relay is controlled by several different circuits. The PCM will ground the relay, completing the fuel pump circuit, with the key in Start, Run and On positions.

Exhaust system

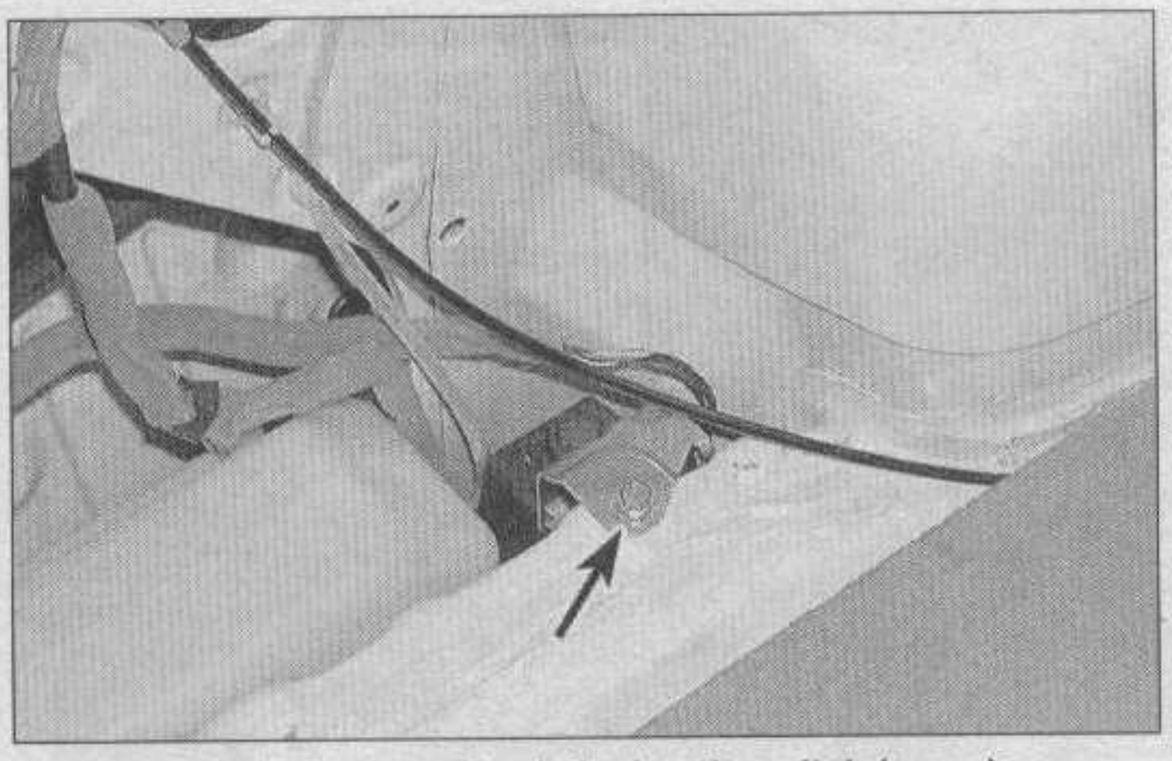
The exhaust system on four-cylinder engines consists of an exhaust manifold, a warm-up catalytic converter (some models), an inlet pipe, catalytic converter, pre-muffler and muffler. The system on six-cylinder engines consists of a pair of exhaust manifolds, a Y-pipe, a main catalytic converter, a pre-muffler and a main muffler.

The catalytic converter (and warm-up catalytic converter if equipped) is an emission control device added to the exhaust system to reduce pollutants. Both the warm-up and main converters are three-way (reduction) catalysts. Refer to Chapter 6 for more information regarding the catalytic converter.

2 Fuel pressure relief

Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. Don't smoke or allow open flames or bare light bulbs near the work area, and don't work in a garage where a natural gas-type appliance (such as a water heater or a clothes dryer) with a pilot light is present. Since gasoline is carcinogenic, wear latex gloves when there's a possibility of being exposed to fuel, and, if you spill any fuel on your skin, rinse it off immediately with soap and water. Mop up any spills immediately and do not store fuel-soaked rags where they could ignite. The fuel system is under constant pressure, so, if any fuel lines are to be disconnected, the fuel pressure in the system must be relieved first. When you perform any kind of work on the fuel system, wear safety glasses and have a Class B type fire extinguisher on hand.*

1 Before servicing any fuel system component, you must relieve the fuel pressure to minimize the risk of fire or injury.



3.2 On Probes, check the inertia switch (arrow) if the fuel pump won't run

3.4 This aftermarket fuel pressure testing kit contains all the necessary fittings and adapters, along with the fuel pressure gauge, to test most automotive fuel systems

2 Unscrew the fuel filler cap to relieve any pressure that has built up in the fuel tank.

3 Remove the fuel pump relay from the fuse block in the engine compartment (see Chapter 12).

4 Start the engine, allow it to run until it stops, then crank it several times to relieve any residual pressure in the fuel lines. Disconnect the cable from the negative terminal of the battery before working on the fuel system. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

5 The fuel system pressure is now relieved. **Note:** *Place a rag around the fuel line before removing any hose clamp or fitting to prevent any residual fuel from spilling onto the engine.* When you're finished working on the fuel system, reinstall the fuel pump relay and connect the negative cable to the battery.

3 Fuel pump/fuel pressure - check

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.*

Note: *In order to perform the fuel pressure test, you will need to obtain a fuel pressure gauge capable of measuring high fuel pressure and an adapter set for the fuel injection system being tested.*

General checks

Refer to illustration 3.2

1 Check that there is adequate fuel in the fuel tank.

2 Verify the fuel pump actually runs. Have an assistant turn the ignition switch to ON - you should hear a brief whirring noise (approximately two seconds) as the pump comes on and pressurizes the system. **Note:** *The fuel pump is easily heard through the gas tank filler neck.* If there is no response from the fuel pump (makes no sound) proceed to Step 10 and check the fuel pump electrical circuit. **Note:** *On Probe models, first check the inertia switch mounted in the trunk* **(see illustration)**. *The switch is designed to shut off the fuel pump in a collision. If it's been tapped accidentally (something was dropped on it or the car was bumped in a parking lot) it may have shut off the pump.*

Fuel pump output and pressure check

Refer to illustrations 3.4, 3.6, 3.7 and 3.8

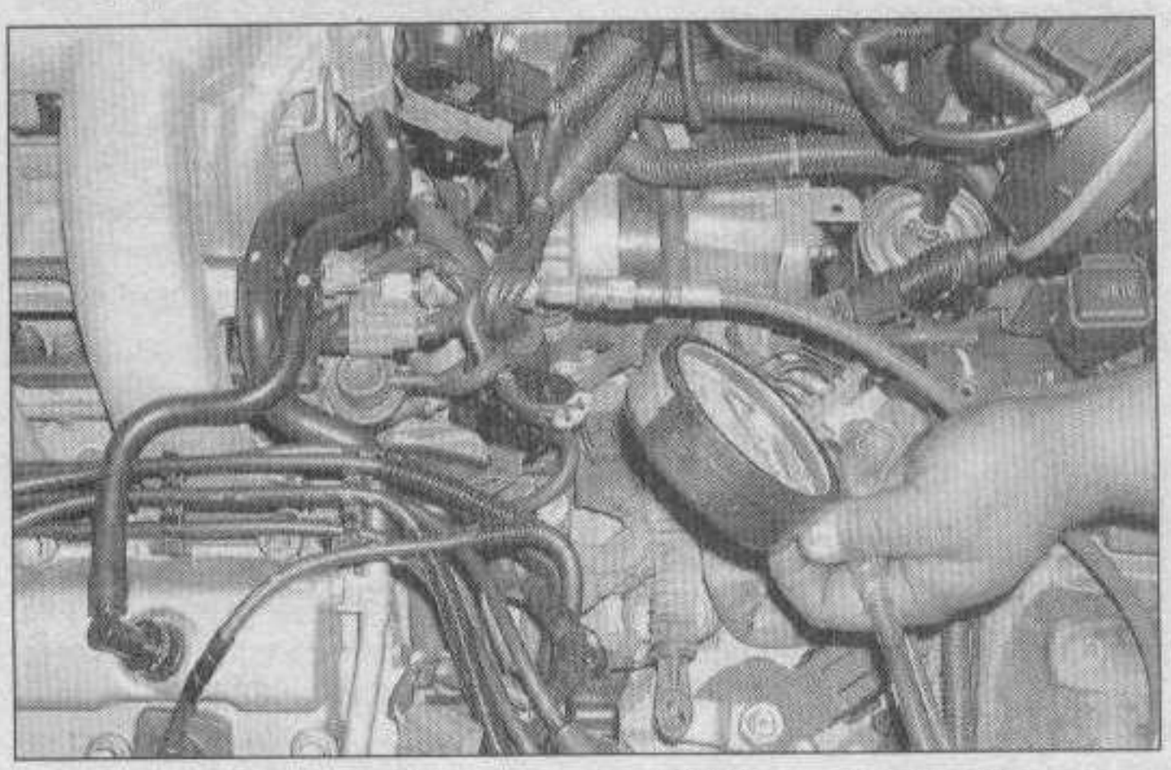
3 If you're working on a four-cylinder model with cruise control, detach the cruise control actuator, leaving its cable and wires connected, and position it out of the way.

4 Install a fuel pressure gauge in the hose coming from the fuel filter (four-cylinder) or between the fuel rails **(see illustration)**.

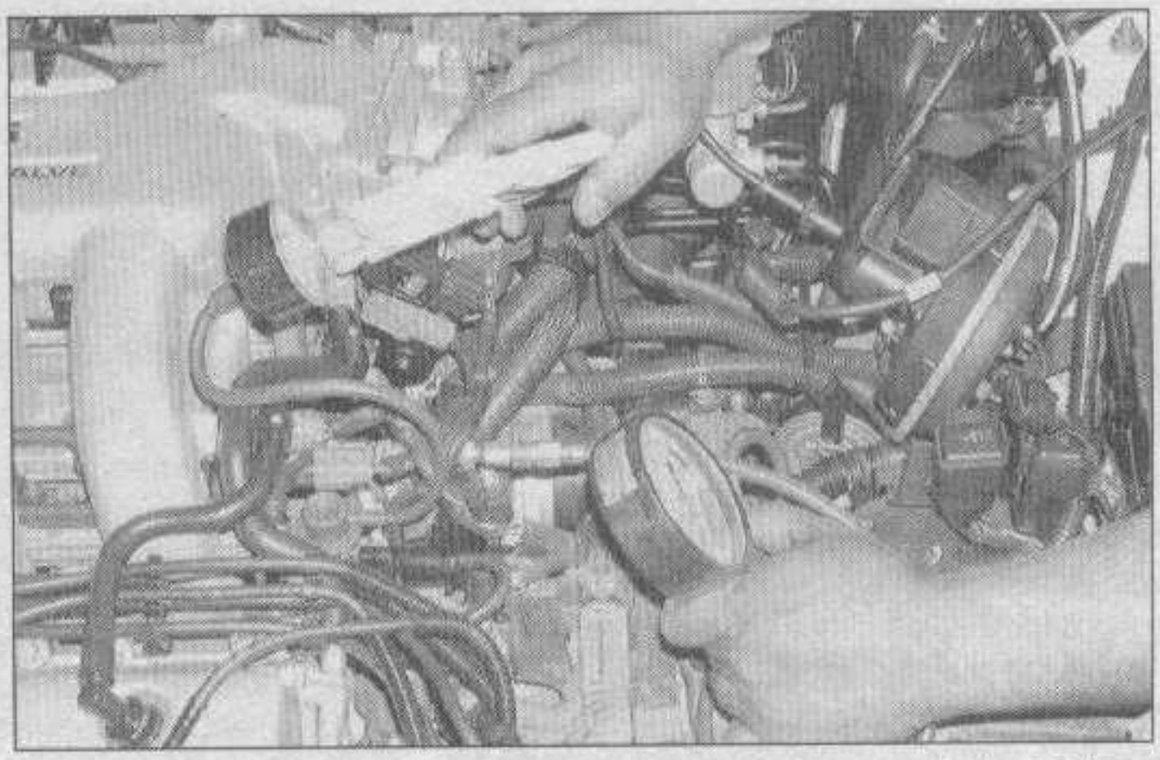
5 Turn the ignition switch ON (engine not running) with the air conditioning off. The fuel pump should run for about two seconds - pressure should register on the gauge and should hold steady.

6 Start the engine and let it idle at normal operating temperature. Compare the pressure reading with the value listed in this Chapter's Specifications **(see illustration)**. Now, disconnect the vacuum hose from the fuel pressure regulator - the pressure should increase immediately. If the pressure readings are correct, the system is operating properly.

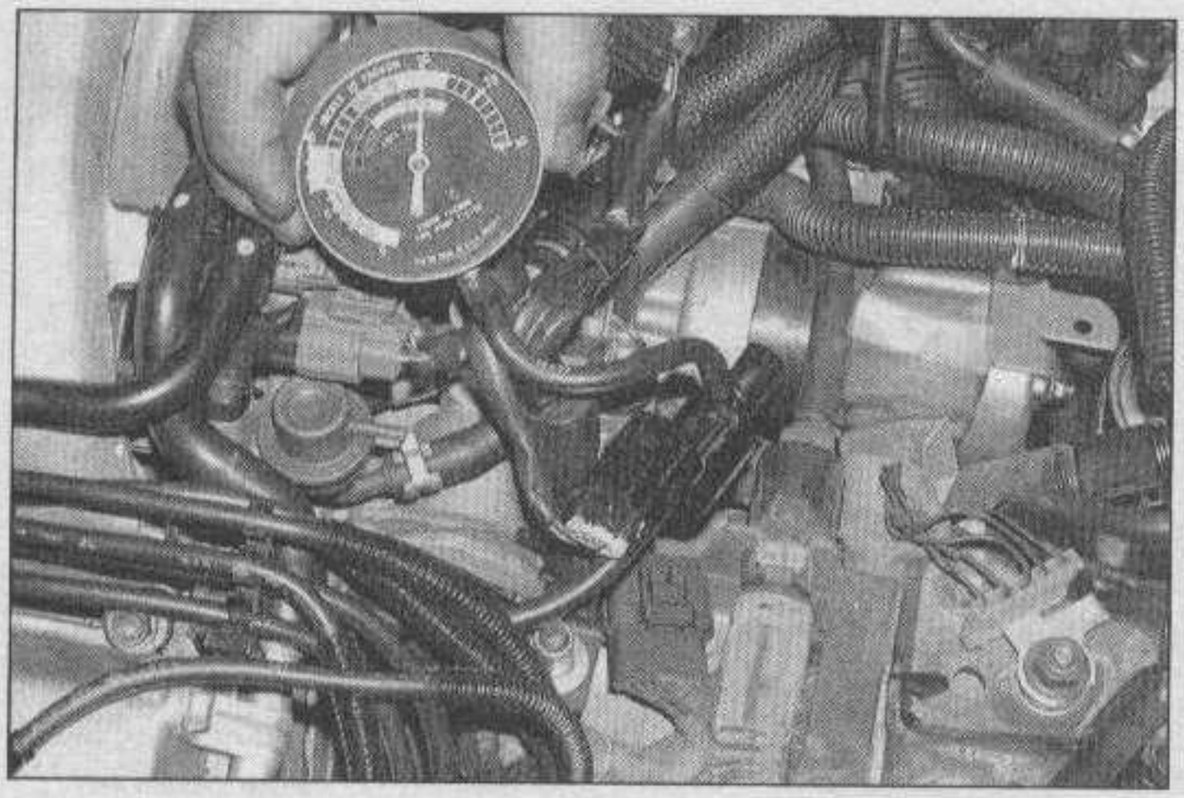
7 If the pressure did not increase when the vacuum hose was disconnected, apply vacuum to the pressure regulator using a hand-held vacuum pump **(see illustration)**. If



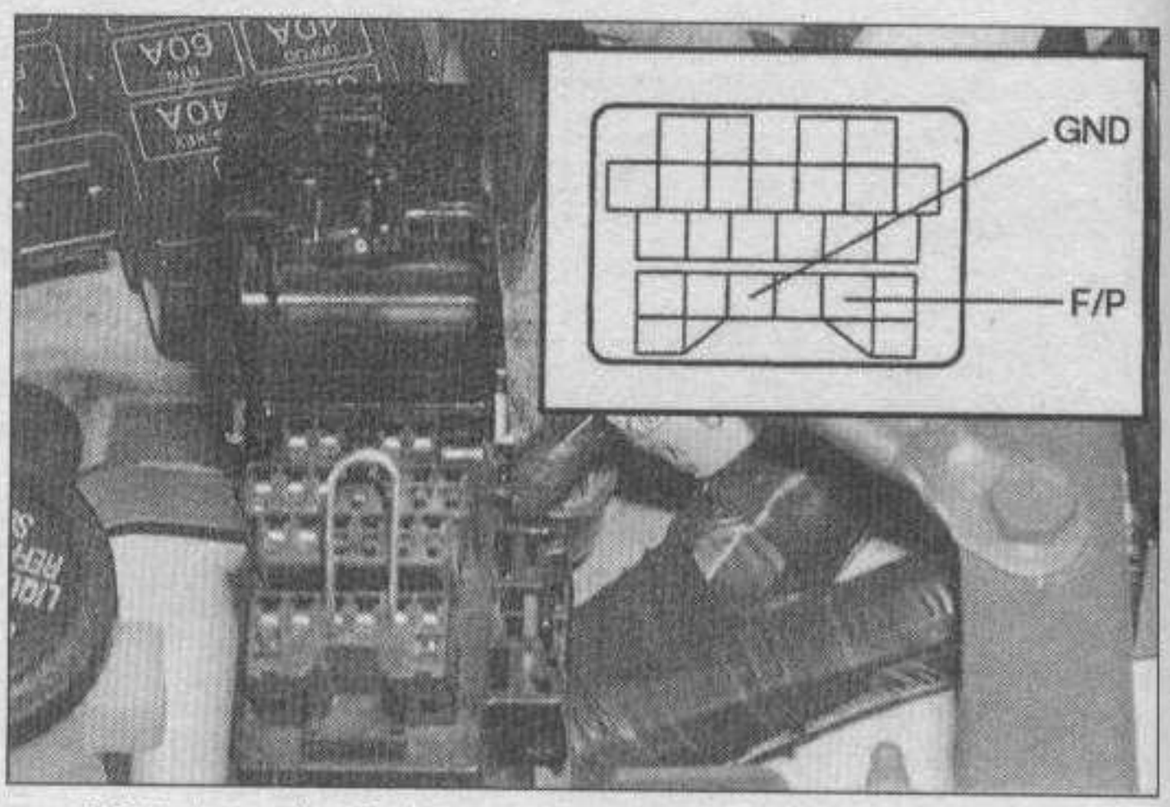
3.6 Check the fuel pressure with the engine at idle



3.7 Apply vacuum to the fuel pressure regulator and check the fuel pressure - the fuel pressure should decrease as the vacuum increases



3.8 Make sure there's vacuum to the fuel pressure regulator



3.11 Jump the fuel pump test terminals with a short wire

the pressure drops, repair the vacuum source to the regulator (also check the regulator control solenoid as described later in this Section). If the pressure does not drop, replace the regulator.

8 If the fuel pressure is not within specifications, check the following:

a) *If the pressure is higher than specified, check for vacuum to the fuel pressure regulator* **(see illustration)**. *Vacuum must fluctuate with the increase or decrease in the engine rpm. If vacuum is present, check for a pinched or clogged fuel return hose or pipe. If the return line is OK, replace the regulator.*

b) *If the pressure is lower than specified, change the fuel filter to rule out the possibility of a clogged filter. To replace the inline filter, refer to Chapter 1. There's also a filter screen on the fuel pump inlet (see Section 5). If the pressure is still low, start the engine (if possible) and slowly pinch the return hose shut. If the pressure rises above 47 psi, replace the regulator* (see Section 14). **Warning:** *Don't allow the fuel pressure to exceed 60 psi.*

c) *If the pressure is still low with the fuel return line restricted, an injector (or injectors) may be leaking (see Section 15) or the in-tank fuel pump may be faulty.*

9 After the testing is done, relieve the fuel pressure (see Section 2) and remove the fuel pressure gauge.

Fuel pump electrical circuit check

Refer to illustration 3.11

Note: *Refer to Chapter 12 for additional wiring schematics that detail the fuel pump relay and circuit.*

10 If the pump does not turn on (makes no sound) with the ignition switch in the ON position, check the fuel pump fuse located in the engine compartment fuse block. If the fuse is blown, replace the fuse and see if the pump works. If the pump now works, check for a short in the circuit between the main relay and the fuel pump.

1993 through 1997 models

11 If the pump still does not work, remove the cover from the data link connector in the engine compartment and bridge the fuel pump and ground connectors with a short jumper wire **(see illustration)**. The fuel pump should run.

1998 and later models

12 If the pump still does not work, remove the fuel pump relay from the relay block in the engine compartment. On 1998 and 1999 models, connect terminals 30 and 87. On 2000 and later models connect terminals 30 and the ground (GND). **Caution:** *Be sure to connect the correct terminals.*

All models

13 If the fuel pump does not activate, check for power to the fuel pump at the fuel tank (see the wiring diagrams at the end of the manual). If voltage is present at the fuel pump connector, the circuit to the pump is good. Check for continuity between the ground terminal in the fuel pump connector and body ground. If there's no continuity, check the ground circuit for a break or poor connection.

14 If there's power to the pump and the ground circuit is good, replace the pump (see Section 5).

Regulator control solenoid check

15 This solenoid, present on some models, cuts off vacuum to the fuel pressure regulator under certain operating conditions. This allows fuel pressure to increase, which prevents percolation of the fuel, also known as "vapor lock."

16 Test the solenoid if there's no vacuum to the fuel pressure regulator in Step 8.

17 Locate the solenoid by following the vacuum hose from the fuel pressure regulator. Disconnect its vacuum lines **(see illustration 3.8)**.

18 Connect a piece of rubber tubing to the vacuum supply fitting on the solenoid and try to blow air through it. Air should flow.

19 Disconnect the solenoid's electrical connector. Energize the solenoid by applying battery voltage to the power terminal and connecting the other terminal to ground. It should now be impossible to blow air through the solenoid.

20 If the solenoid doesn't perform as described, replace it.

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 (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 pump pick-up unit (see Section 5) for damage and deterioration.

Steel tubing

4 If replacement of a fuel line or emission line is called for, use welded steel tubing meeting the manufacturer's specifications.

5 Don't use copper or aluminum tubing to replace steel tubing. These materials cannot withstand normal vehicle vibration.

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

7 Some fuel lines have threaded fittings

with O-rings. Any time the fittings are loosened to service or replace components:

a) *Use a back-up wrench while loosening and tightening the fittings to prevent twisting the line.*
b) *Check all O-rings for cuts, cracks and deterioration. Replace any that appear hardened, worn or damaged.*
c) *If the lines are replaced, always use original equipment parts, or parts that meet original equipment standards.*

Flexible hose

Warning: *Use only original equipment replacement hoses or their equivalent. Others may fail from the high pressures generated by this system.*

8 Don't route fuel 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 4.11a, 4.11b and 4.12

9 Relieve the fuel pressure (see Section 2).

10 Remove all fasteners attaching the lines to the vehicle body.

11 Most fittings where rubber hoses join metal lines use spring clamps **(see illustration)**. To undo this type of clamp, squeeze it with pliers and slide it up the hose. Don't reuse a clamp if it has become distorted or has lost its tension; replace it with a new one. Be sure to slide the rubber hose at least one inch onto the metal tube and position it correctly in relation to the tube **(see illustration)**.

12 Some connections use quick-disconnect fittings **(see illustration)**. To detach one of these, squeeze the retainer tabs and pull the fitting apart, sliding it along the tube as necessary. **Caution:** *Don't take the retainer portion of the fitting off the metal tube unless necessary. This will weaken it and you'll have to install a new one.*

13 Installation is the reverse of removal. On quick-disconnect fittings, align the retainer locking pawls with the connector grooves. Push the fitting together until both retaining pawls lock with a clicking sound.

Repair

14 In the event of any fuel line damage (metal or flexible lines) it is necessary to replace the damaged lines with factory replacement parts. Others may fail from the high pressures of this system.

5 Fuel pump - removal and installation

Refer to illustrations 5.5, 5.6, 5.7, 5.8 and 5.9

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 Detach the cable from the negative battery terminal. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

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

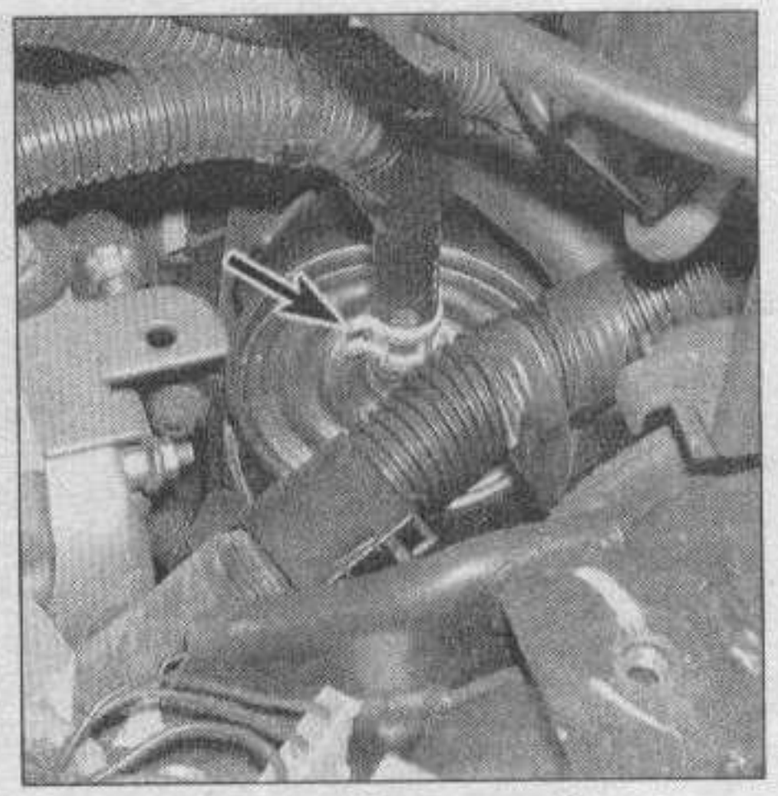
3 Remove the fuel tank (see Section 7).

4 Unplug the electrical connector from the fuel pump, open and slide back the clamps on the fuel lines and detach the fuel lines.

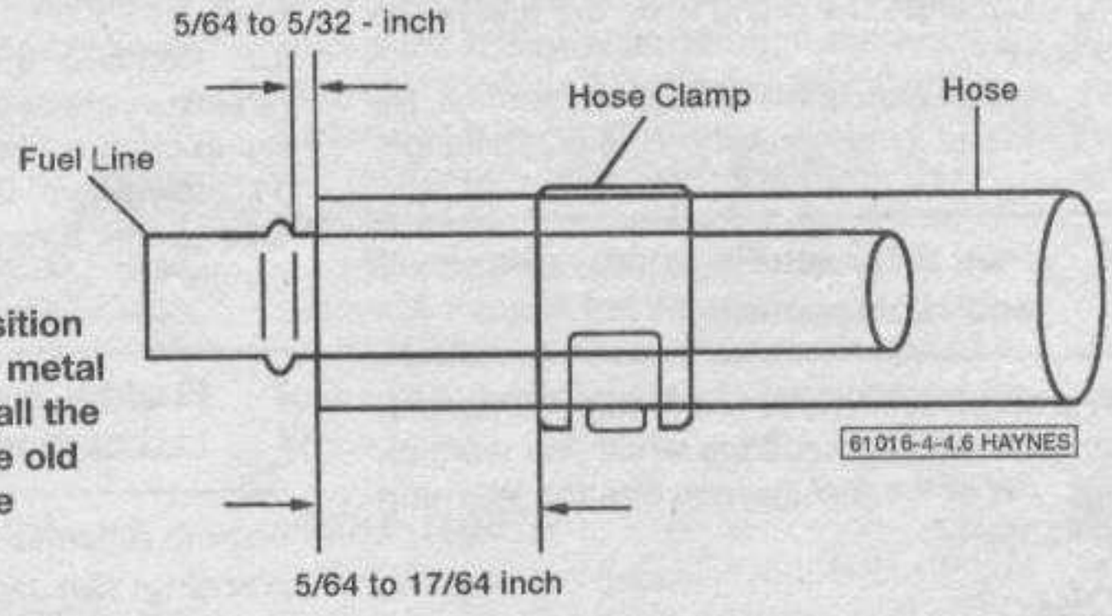
5 Remove the fuel pump lock-ring with a brass punch **(see illustration)**. **Warning:** *Don't use a steel punch - it may produce sparks that could cause an explosion.*

6 Remove the fuel pump from the tank **(see illustration)**.

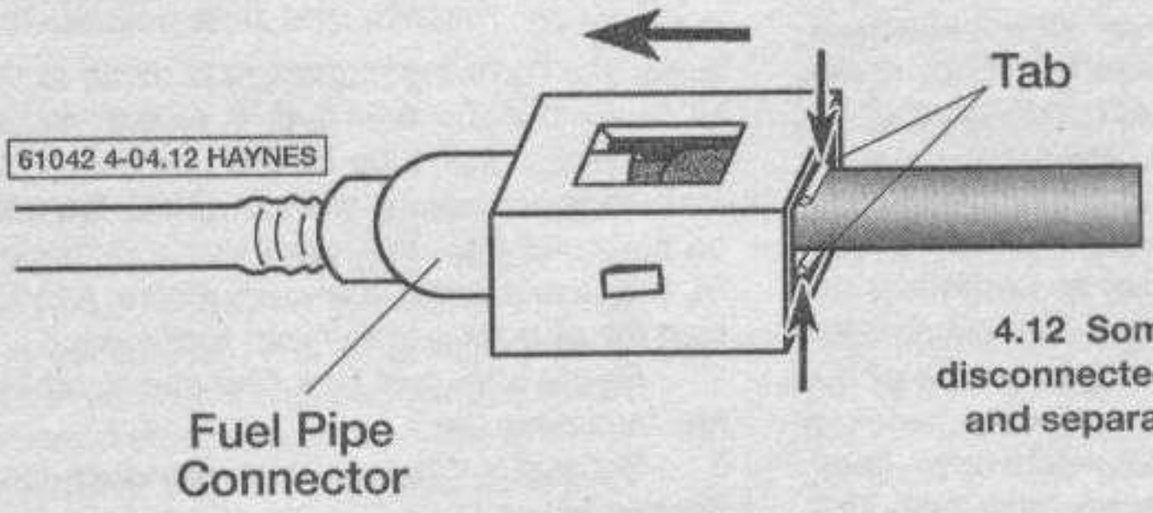
7 Loosen the hose clamps with a screwdriver - remove the upper clamp from the hose and slide the lower clamp half-way up the hose, off the fuel pump inlet **(see illustration)**.



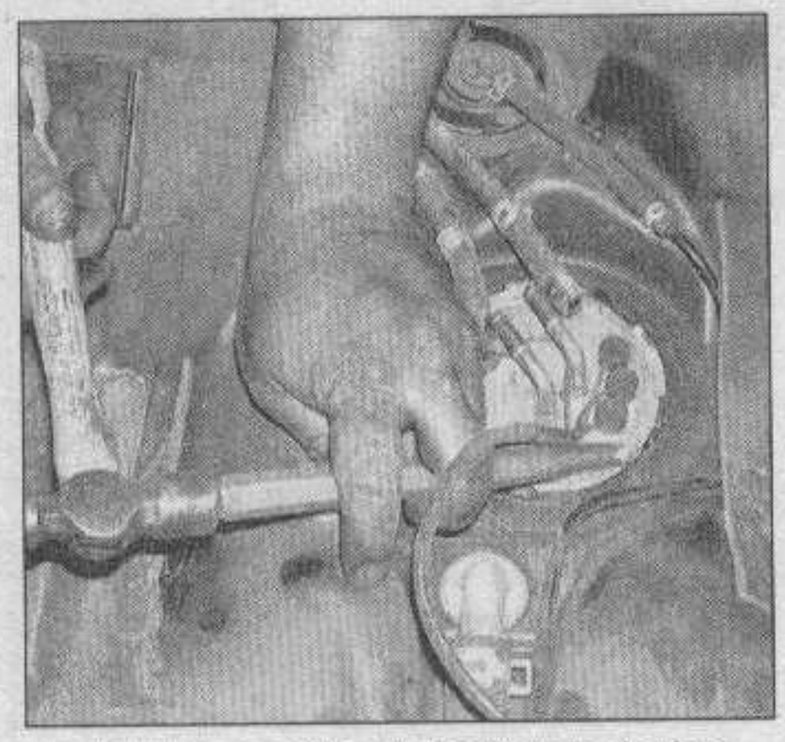
4.11a Most fuel line connections use spring clamps (arrow) . . .



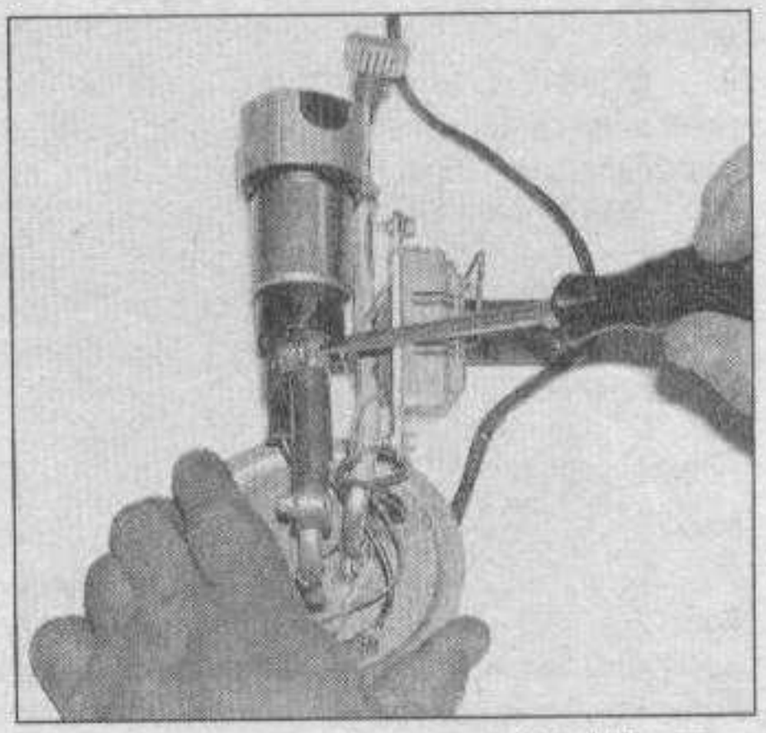
4.11b . . . be sure to position the hose correctly on the metal tube, and DO NOT reinstall the clamp exactly where the old one was on the hose



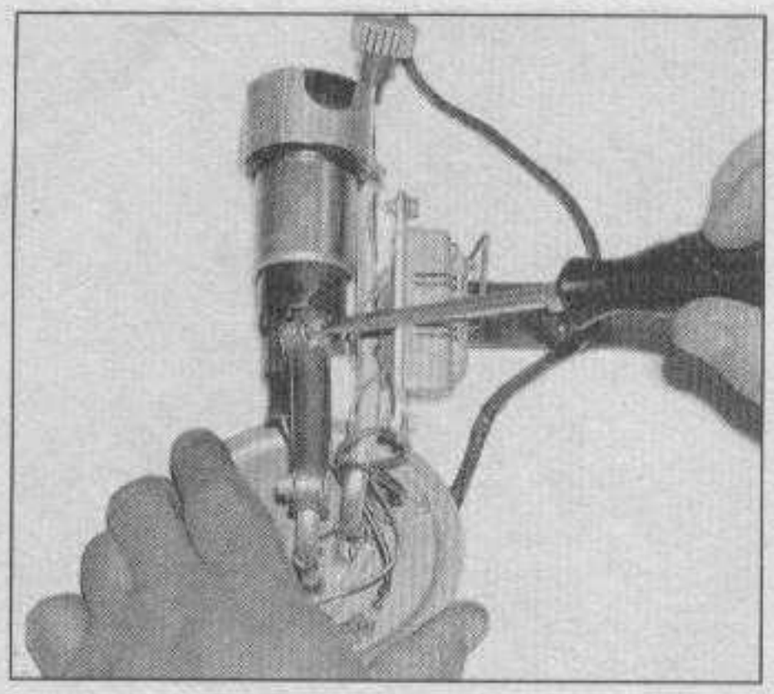
4.12 Some fuel lines can be disconnected by pinching the tabs and separating each connector



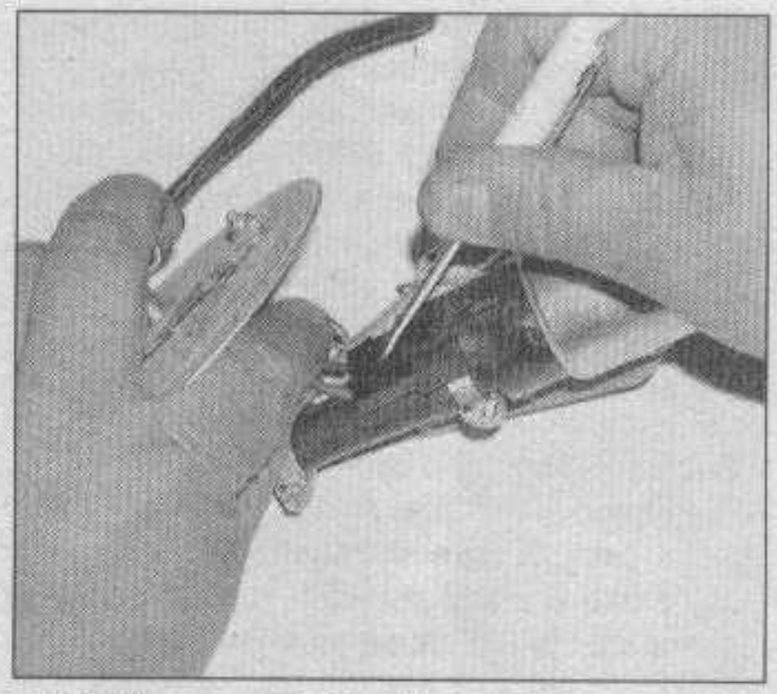
5.5 Unscrew the fuel pump lock-ring with a brass punch



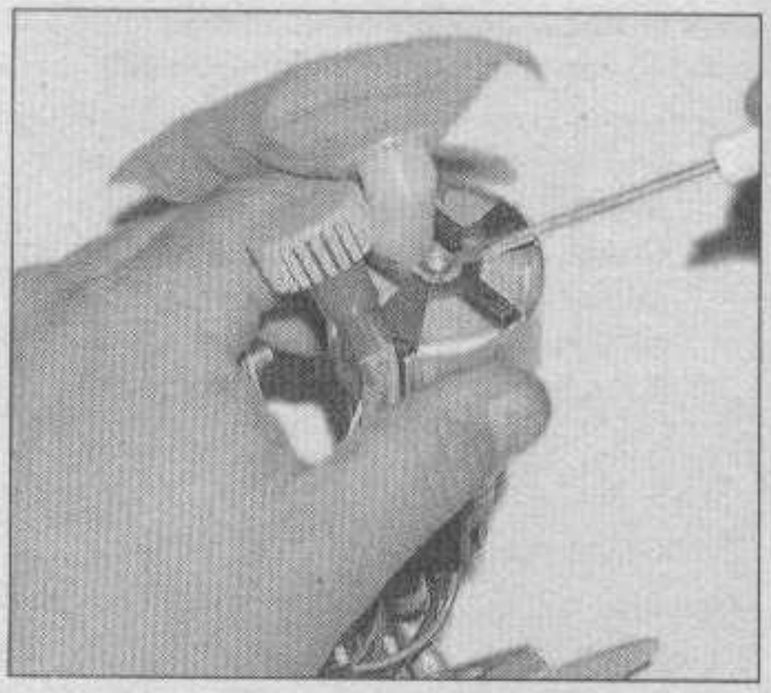
5.6 Lift the fuel pump and fuel level sending unit out of the tank



5.7 Loosen the clamps and detach the hose



5.8 Disconnect the electrical connector



5.9 Pry off the retaining clip with a small screwdriver and detach the filter (sock) from the pump

8 Remove the electrical connector from the fuel pump **(see illustration)**.
9 Remove the sock filter from the end of the pump **(see illustration)**.
10 Separate the pump from the fuel pump bracket.
11 Installation is the reverse of removal. Be sure to use a new gasket on the pump flange.

6 Fuel level sending unit - check 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.*

Check

1 Disconnect the negative battery cable.
Caution: *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*
2 Remove the fuel pump/fuel level sending unit from the fuel tank (see Section 5).
3 Position the probes of an ohmmeter on the connector terminals and check the resistance. Use the 200-ohm scale on the ohmmeter. Check the resistance of the sending unit with the float arm completely down (tank empty) and with the arm up (tank full). The resistance should change steadily from empty to full.
4 When the tank is nearly empty, the resistance of the sending unit should be high; approximately 105 ohms.
5 With the fuel tank completely full, the resistance should be low; approximately 3 to 6 ohms (Mazda) or 7 ohms (Ford).
6 If the readings are incorrect, replace the sending unit.

Replacement

Refer to illustrations 6.9 and 6.10

7 Disconnect the negative battery cable.
Caution: *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*
8 Remove the fuel pump/fuel level sending unit from the fuel tank (see Section 5).
9 Disconnect the sending unit electrical connector from the base of the fuel pump/fuel level sending unit **(see illustration)**.
10 Remove the fuel level sending unit retaining screws and separate it from the fuel pump bracket **(see illustration)**.
11 Installation is the reverse of removal. Be sure to use a new gasket under the sealing flange.

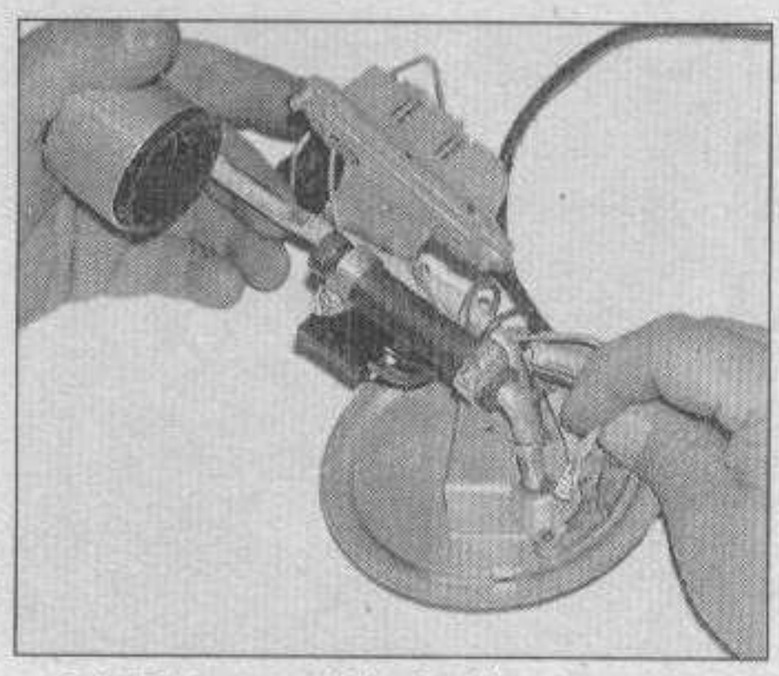
7 Fuel tank - removal and installation

Refer to illustration 7.11

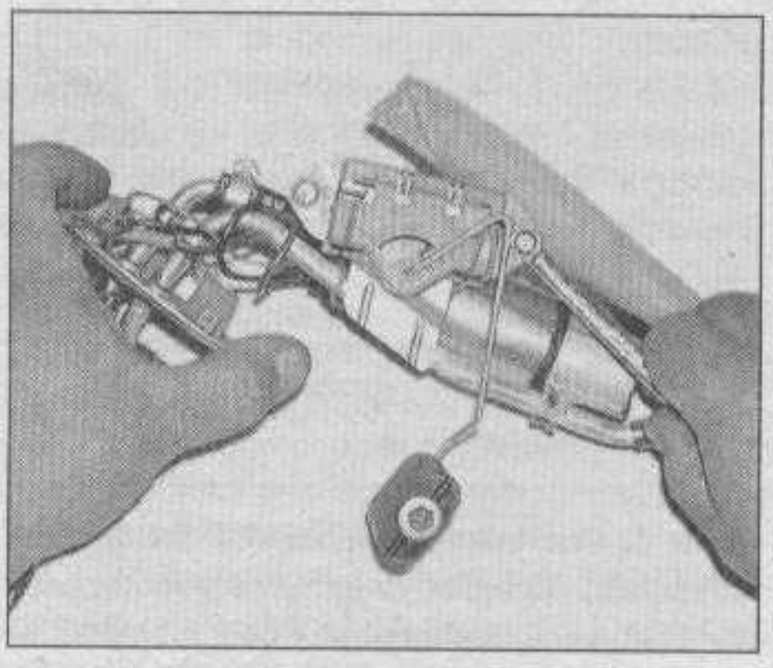
Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the* **Warning** *in Section 2.*

Note: *The following procedure is much easier to perform if the fuel tank is empty. Some tanks have a drain plug for this purpose. If the tank does not have a drain plug, the fuel can be siphoned from the tank using a siphoning kit, available at most auto parts stores. NEVER start the siphoning action with your mouth!*

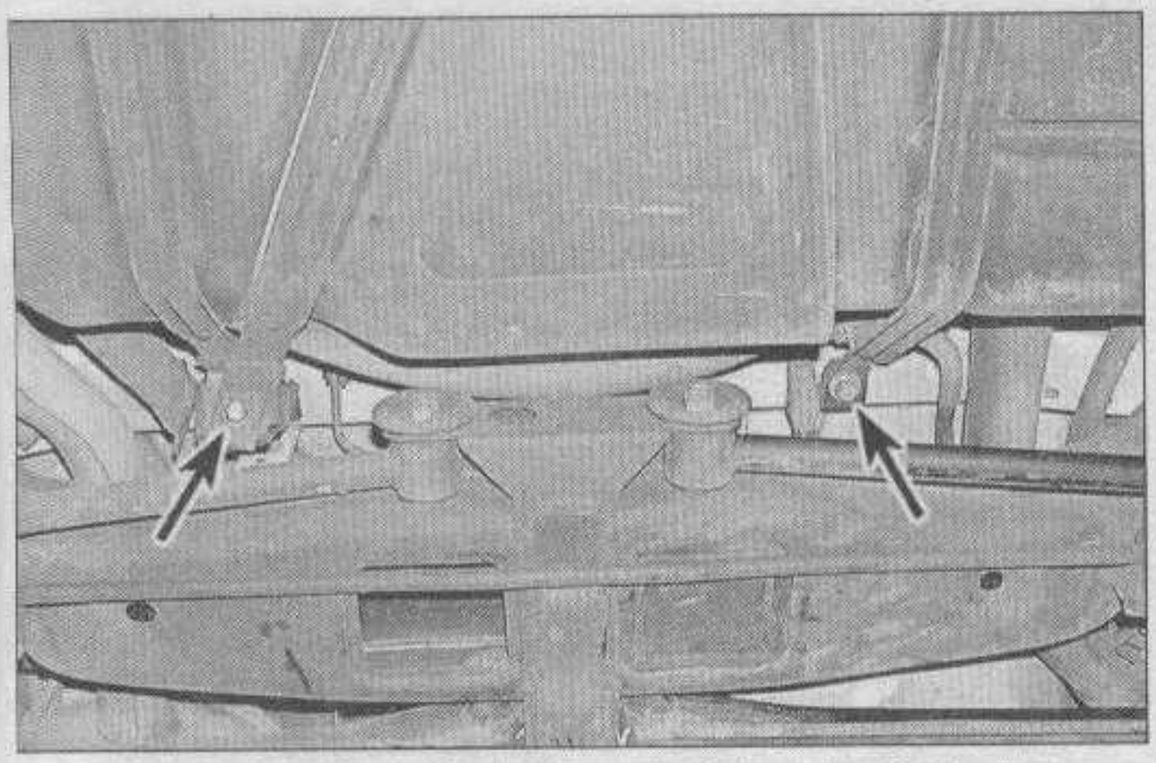
1 Remove the fuel tank filler cap to relieve fuel tank pressure.
2 Relieve the fuel system pressure (see Section 2).
3 Detach the cable from the negative terminal of the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*
4 If the tank has a drain plug, remove it and drain the fuel into an approved gasoline container. If it doesn't have a drain plug, siphon the fuel into an approved gasoline container, using a siphoning kit (available at most auto parts stores).
5 Disconnect the fuel level sending unit and fuel pump electrical connectors (see Section 5).
6 Loosen the rear wheel lug nuts, raise the vehicle and support it securely on jackstands.
7 Remove the exhaust system behind the catalytic converter (see Section 16). Remove the heat shield that's installed above the pre-muffler.
8 Remove the EVAP hoses, pressure control valve and fuel tank pressure sensor (see Chapter 6).
9 Label and disconnect the fuel supply and return hoses from the metal fuel lines. Disconnect the fuel filler hose and vent hose.
10 Support the fuel tank with a floor jack. Position a wood plank between the jack head and the fuel tank to protect the tank.
11 Disconnect both fuel tank retaining straps and move them out of the way **(see illustration)**.
12 Remove the tank protector and the tank from the vehicle.
13 Installation is the reverse of removal.



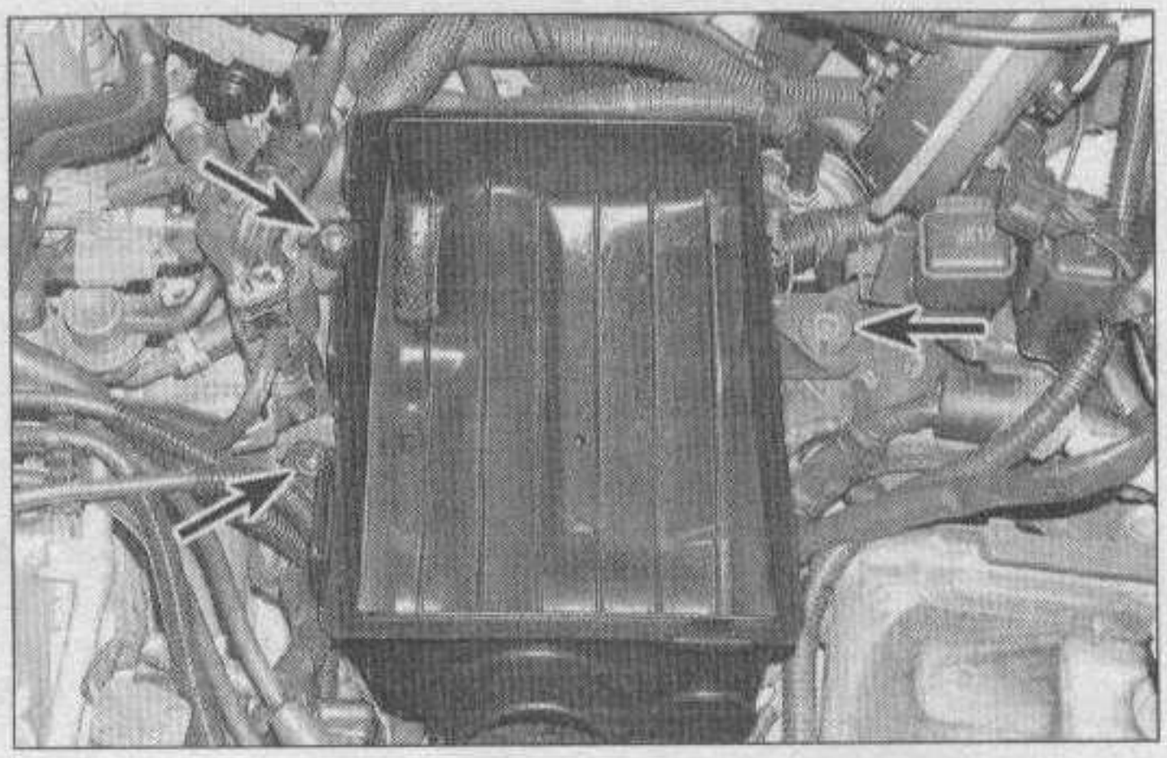
6.9 Disconnect the fuel level sending unit electrical connector



6.10 Remove the screws and detach the sending unit



7.11 Remove the bolts (arrows) to detach the fuel pump mounting straps



9.6 Remove the bolts (arrows) from the air cleaner housing

8 Fuel tank cleaning and repair - general information

1 All repairs to the fuel tank or filler neck should be carried out by a professional who has experience in this critical and potentially dangerous work. Even after cleaning and flushing of the fuel system, explosive fumes can remain and ignite during repair of the tank.

2 If the fuel tank is removed from the vehicle, it should not be placed in an area where sparks or open flames could ignite the fumes coming out of the tank. Be especially careful inside garages where a natural gas-type appliance is located, because the pilot light could cause an explosion.

9 Air cleaner housing - removal and installation

Refer to illustration 9.6

1 Detach the cable from the negative terminal of the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Remove the nuts that secure the air cleaner intake duct. Detach the air intake duct and fresh air tube from the air cleaner housing.

3 Disconnect the electrical connectors for the mass air flow (MAF) sensor and intake air temperature (IAT) sensor.

4 Unbolt the brackets for the EGR boost sensor and switch from the air cleaner housing.

5 Unlatch the housing cover spring clips, then lift off the air cleaner cover and remove the air filter (see Chapter 1).

6 Remove the air cleaner housing mounting bolts **(see illustration)**. Remove the housing from the vehicle.

7 Installation is the reverse of removal.

10 Accelerator cable - removal, installation and adjustment

Refer to illustrations 10.2, 10.3 and 10.7

Replacement

1 Detach the cable from the negative battery terminal. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Rotate the throttle shaft bellcrank until the cable is lined up with the slot in the bellcrank, then detach the cable from the bellcrank **(see illustration)**.

3 Squeeze the retainer prongs together, then push the retainer through the bracket hole and remove the accelerator cable from its bracket **(see illustration)**.

4 Working underneath the dash, detach the cable from the accelerator pedal arm.

5 Working in the engine compartment, pull the cable through the firewall.

6 Installation is the reverse of removal. Make sure the grommet seats properly in the firewall.

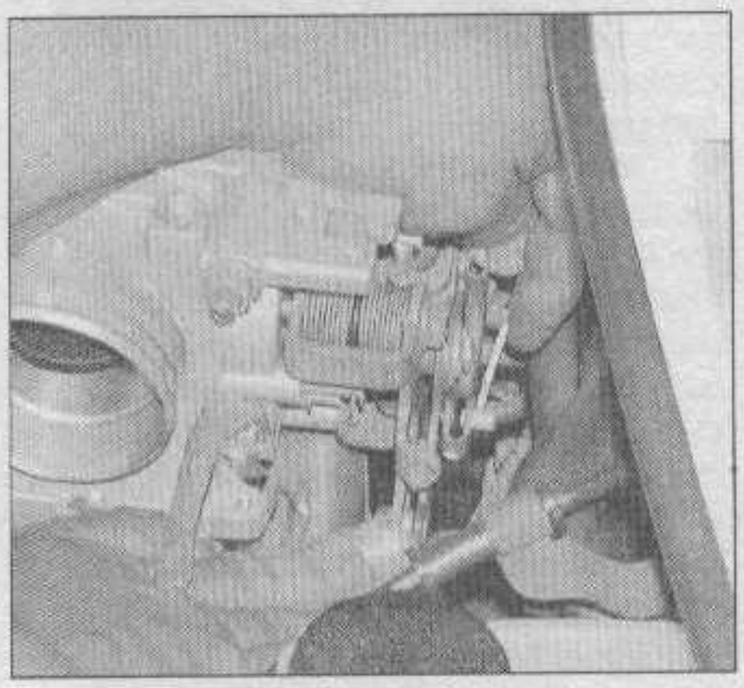
Adjustment

7 To adjust the cable:

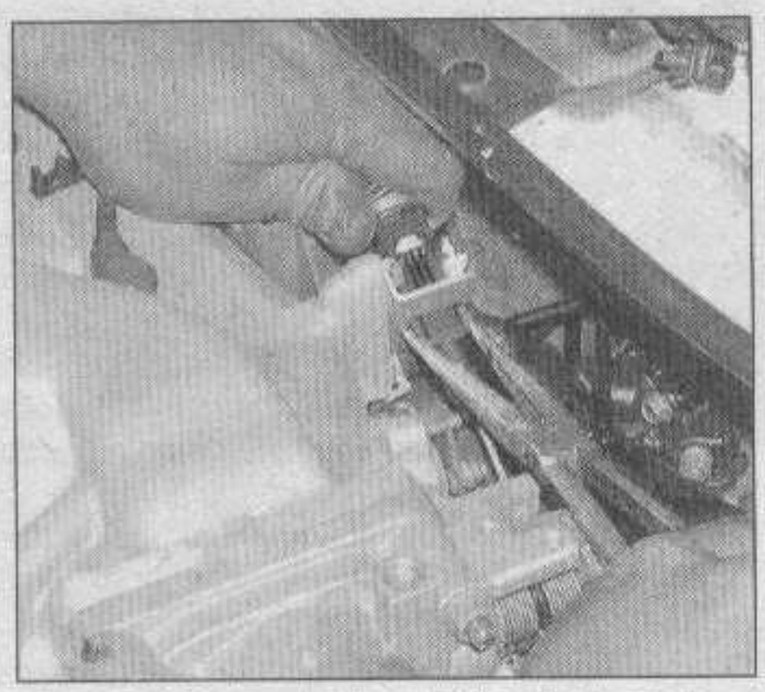
a) *Check pedal freeplay. It should be 1/16 to 3/16 inch. You can make a precise measurement by marking the cable just where it exits the housing, then pulling it out until freeplay is used up and measuring the length of the exposed cable.*

b) *Push in the lock button to release the cable lock, then turn the stopper to the unlocked position* **(see illustration)**.

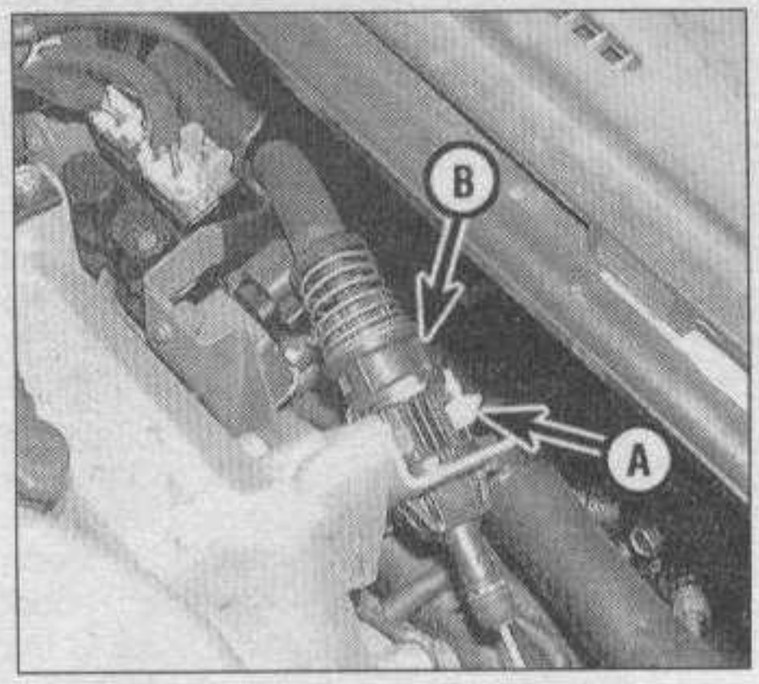
c) *Push the cable housing toward the stopper or pull it away to adjust the cable. Once freeplay is correct, turn the stopper back to the lock position and secure it with the lock button.*



10.2 Detach the cable end from the bellcrank



10.3 Squeeze the retainer tabs and separate it from the bracket



10.7 Push the button (A) and unlock the stopper (B), then push or pull the cable housing to adjust freeplay

d) After you have adjusted the throttle cable, have an assistant help you verify that the throttle valve opens all the way when you depress the accelerator pedal to the floor and that it returns to the idle position when you release the accelerator, and that the cable has the proper amount of freeplay. If the throttle valve doesn't open all the way, loosen the locknut on the stop block at the accelerator pedal. Reposition the stop block to change the wide open throttle position, then tighten the locknut.

e) Verify the cable operates smoothly. It must not bind or stick.

11 Electronic fuel injection system - general information

The Sequential Multiport Fuel Injection (SFI) system consists of three sub-systems: air intake, electronic control and fuel delivery. The system uses a Powertrain Control Module (PCM) along with the sensors (coolant temperature sensor, Throttle Position Sensor (TPS), Manifold Absolute Pressure (MAP) sensor etc.) to determine the proper air/fuel ratio under all operating conditions.

The fuel injection system and the emissions control system are closely linked in function and design. For additional information, refer to Chapter 6.

Air intake system

The air intake system consists of the air cleaner, the air intake ducts, the mass airflow (MAF) sensor, the throttle body, the idle control system and the intake manifold. The Variable Resonance Induction System (VRIS) is built into the intake manifold on V6 engines. Refer to Chapter 2A or 2B for intake manifold replacement procedures and Chapter 6 for VRIS service procedures.

The throttle body is a single barrel, side-draft design. The lower portion of the throttle body is heated by engine coolant to prevent icing in cold weather. A throttle position sensor is attached to the throttle shaft to monitor changes in the throttle opening. The idle Air Control Bypass Air (IAC BPA) valve is mounted on the top of the four-cylinder throttle body and on the bottom of the V6 throttle body.

When the engine is idling, the air/fuel ratio is controlled by the Idle Air Control (IAC) system, which consists of the Powertrain Control Module (PCM), the Electronic Coolant Temperature (ECT) sensor, the IAC BPA valve and other various sensors (IAT, TPS, MAP, etc.) working in conjunction with the EFI system (see Chapter 6). The IAC BPA valve is controlled by the PCM depending upon the running conditions of the engine (air conditioning system, power steering, cold and warm running etc.). This valve regulates the amount of airflow past the throttle plate and into the intake manifold. The PCM receives information from the sensors (vehicle speed, coolant temperature, air conditioning, power steering load etc.) and adjusts the idle according to the demands of the engine and driver. Finally, to prevent rough running after the engine starts, the IAC BPA valve is opened during cranking and immediately after starting to provide additional air into the intake manifold.

Electronic control system

The electronic control system and the Powertrain Control Module (PCM) are explained in detail in Chapter 6.

Fuel delivery system

The fuel delivery system consists of these components: The fuel pump, the pressure regulator, the fuel injectors and fuel rail, and the fuel relay.

The fuel pump is an in-line, direct drive type. Fuel is drawn through a filter into the pump, flows past the armature through the one-way valve, passes through an in-line filter and is delivered to the injectors. A relief valve prevents excessive pressure build-up by opening in the event of a blockage in the discharge side and allowing fuel to flow from the high to the low pressure side.

The pressure regulator maintains a constant fuel pressure to the injectors. Excess fuel is routed back to the fuel tank through the return line.

The injectors are solenoid-actuated, constant stroke, pintle types consisting of a solenoid, plunger, needle valve and housing. When current is applied to the solenoid coil, the needle valve raises and pressurized fuel fills the injector housing and squirts out the nozzle. The injection quantity is determined by the length of time the valve is open (the length of time during which current is supplied to the solenoid coils).

The fuel pump relay is located on the relay block in the engine compartment.

12 Electronic fuel injection (EFI) system - check

Refer to illustrations 12.7, 12.9, 12.10a and 12.10b

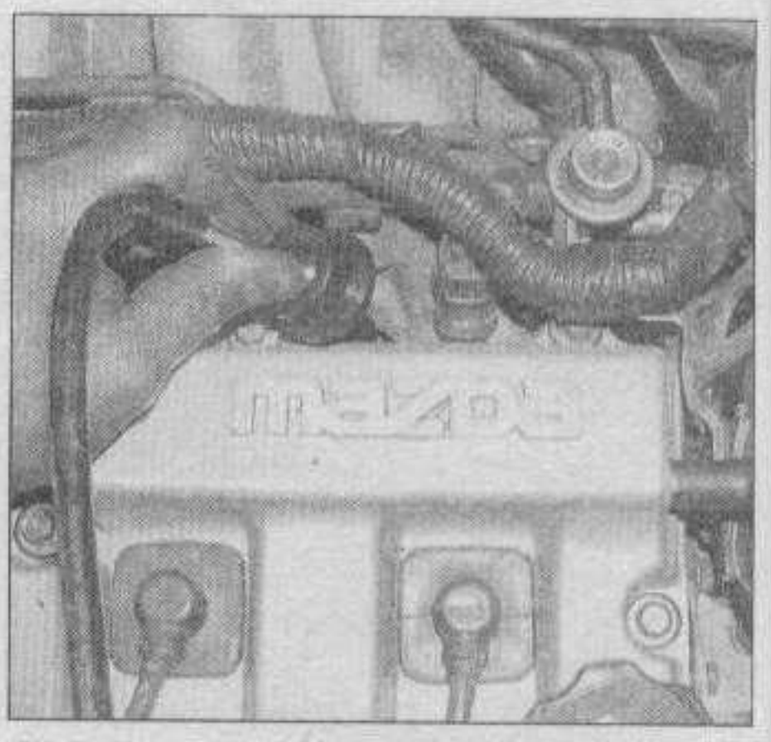
Warning: *Gasoline is extremely flammable, so take extra precautions when you work on any part of the fuel system. See the* **Warning** *in Section 2.*

1 Check all electrical connectors - especially ground connections - for the system. Loose connectors and poor grounds are common causes of engine control system problems.

2 Verify that the battery is fully charged because the Powertrain Control Module (PCM) and sensors cannot operate properly without adequate supply voltage.

3 Refer to Chapter 1 and check the air filter element. A dirty or partially blocked filter will reduce performance and economy.

4 Check fuel pump operation (see Section 3). If the fuel pump fuse is blown, replace it and see if it blows again. If it does, refer to Chapter 12 and the wiring diagrams and look



12.7 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

for a grounded wire in the harness to the fuel pump.

5 Inspect the vacuum hoses connected to the intake manifold for damage, deterioration and leakage.

6 Remove the air intake duct from the throttle body and check for dirt, carbon, varnish, or other residue in the throttle body, particularly around the throttle plate. If it's dirty, refer to Chapter 6 and troubleshoot the PCV and EGR systems for the cause of excessive buildup.

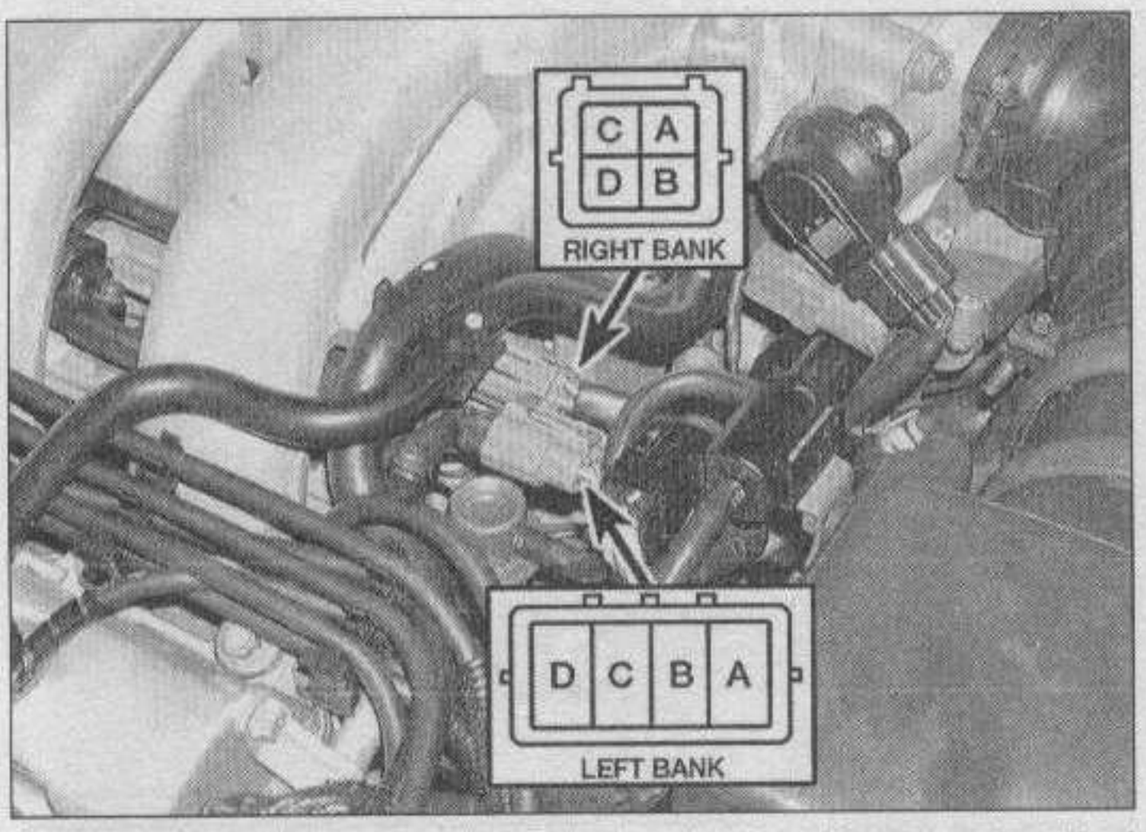
7 With the engine running, place an automotive stethoscope against each injector, one at a time, and listen for a clicking sound that indicates operation **(see illustration)**. If you don't have a stethoscope, you can place the tip of a long screwdriver against the injector and listen through the handle.

8 If an injector does not seem to be operating electrically (not clicking), purchase a special injector test light (sometimes called a "noid" light) and install it into the injector wiring harness connector. **Note:** *This will not be possible on V6 engines due to the mounting arrangement of the injectors.* Start the engine and see if the noid light flashes. If it does, the injector is receiving proper voltage. If it doesn't flash, further diagnosis is necessary. You might want to have it checked by a dealership service department or other qualified repair shop.

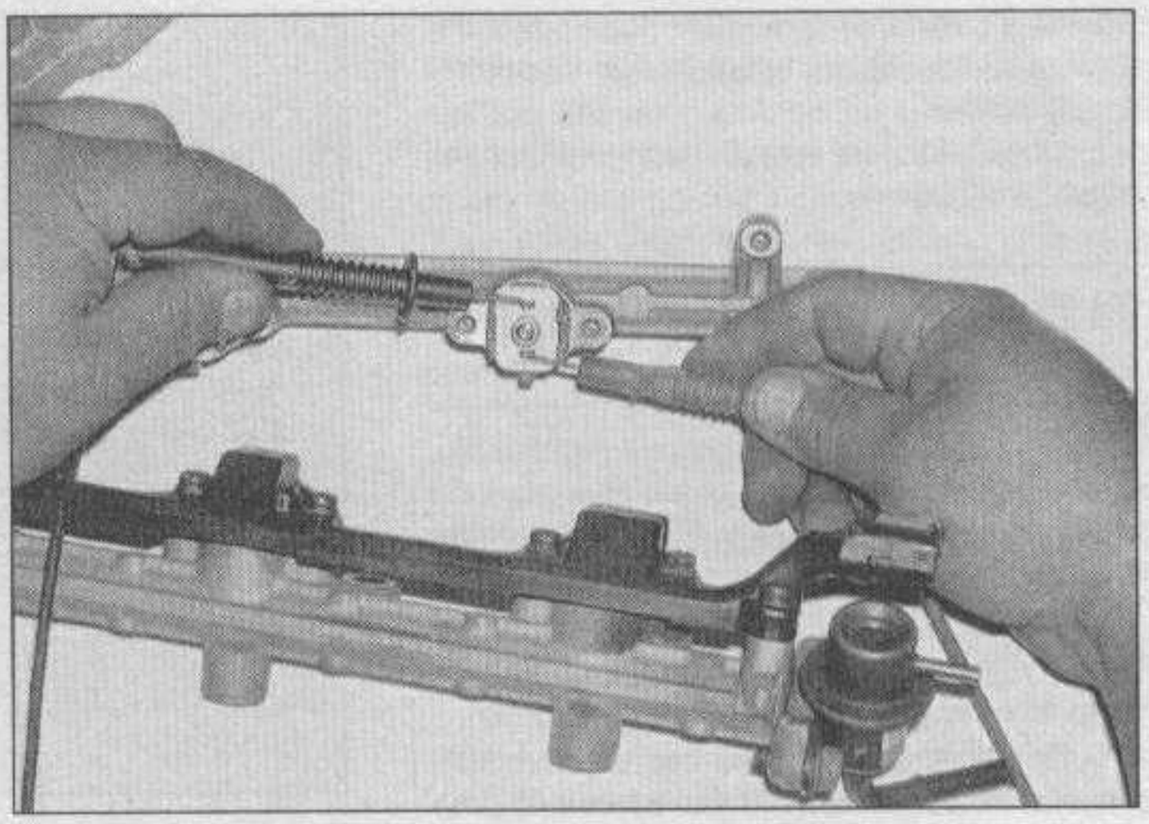
9 With the engine off and the fuel injector electrical connectors disconnected, measure the resistance of each injector with an ohmmeter and compare the readings with the resistance values listed in this Chapter's Specifications. If you're working on a four-cylinder model, measure directly at each injector. If you're working on a V6, measure at the wiring harness terminals **(see illustration)**. The terminals of the connectors correspond to the injectors as follows:

Right bank

A, B = cylinder no. 1 injector
A, C = cylinder no. 5 injector
A, D = cylinder no. 3 injector



12.9 On V6 models, disconnect the fuel injector harness electrical connectors and measure the resistance of each injector between terminal A and each of the other terminals in turn (right bank) and between terminal D and each of the others (left bank)



12.10a Measure injector resistance between the injector terminals (V6 shown)

Left bank
D, C = cylinder no. 2 injector
D, B = cylinder no. 4 injector
D, A = cylinder no. 6 injector

10 If the resistance is incorrect, you'll need to remove the injectors (see Section 15). Once this is done, you can check the resistance of each injector and the wiring harness separately to isolate the cause of high resistance **(see illustrations)**.

11 Refer to Chapter 6 for other system checks.

13 Throttle body - removal and installation

Refer to illustration 13.6

Warning: *Wait until the engine is completely cool before beginning this procedure.*

1 Detach the cable from the negative battery terminal. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Remove the air intake duct that connects the air cleaner assembly to the throttle body.

3 Disconnect the Throttle Position Sensor (TPS) connector from the throttle body (see Chapter 6). Also label and detach all vacuum hoses from the throttle body.

4 Detach the accelerator cable (see Section 10) and if equipped, the cruise control cable.

5 Detach the coolant hoses from the throttle body. Plug the lines to prevent coolant loss.

6 Remove the four mounting nuts or bolts **(see illustration)** and remove the throttle body and gasket. Remove all traces of old gasket material from the throttle body and air intake plenum.

7 Installation is the reverse of removal. Be sure to use a new gasket. Adjust the accelerator cable (see Section 10). Check the coolant level and add some, if necessary (see Chapter 1).

14 Fuel pressure regulator - removal and installation

Refer to illustration 14.4

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.*

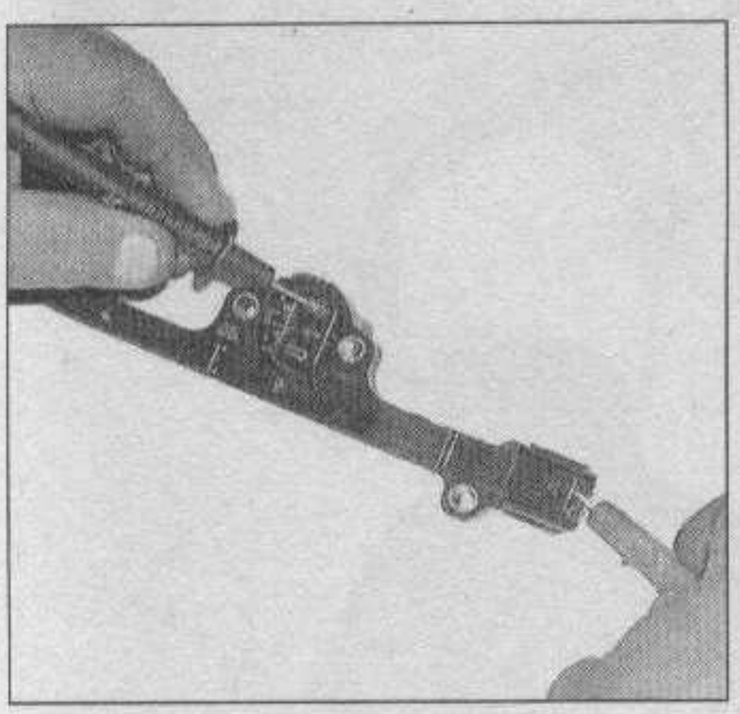
1 Relieve the system fuel pressure (see Section 2).

2 Detach the cable from the negative battery terminal. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

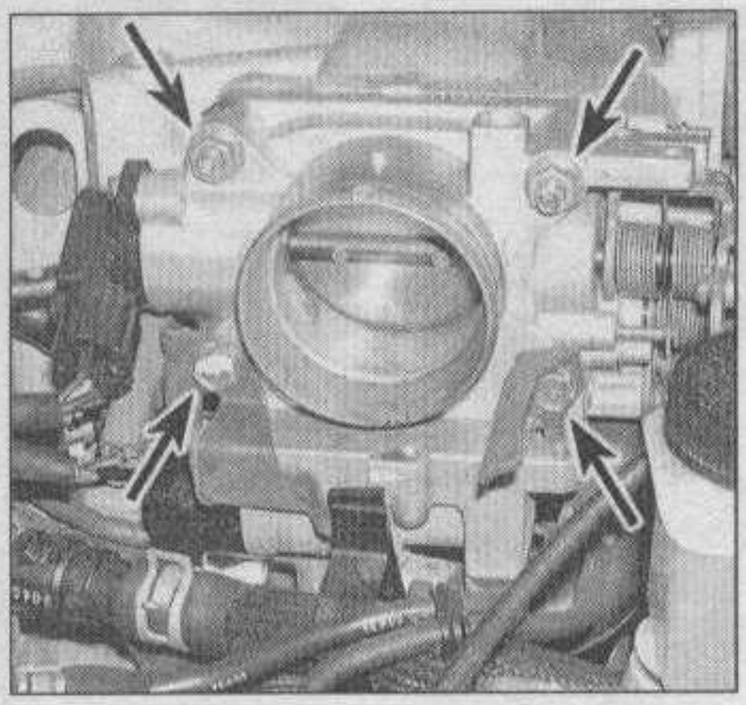
3 Detach the vacuum hose and fuel hose from the pressure regulator.

4 Remove the mounting bolts from the fuel pressure regulator **(see illustration)**.

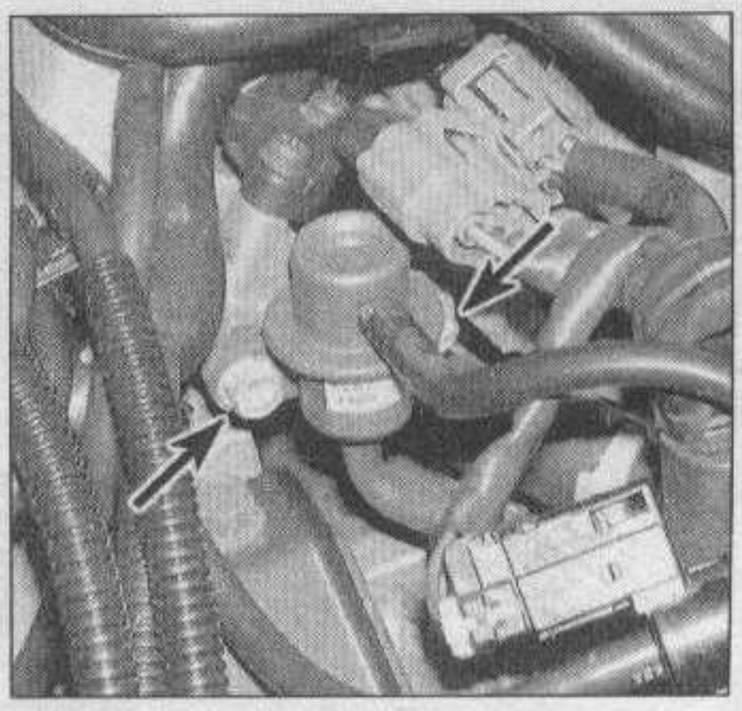
5 Installation is the reverse of removal. Be sure to use a new O-ring. Lubricate the O-ring with a light coat of clean engine oil before installation. Tighten the fuel pressure



12.10b Measure the resistance of the injector wiring harness



13.6 Remove the four nuts or bolts (arrows) and separate the throttle body from the air intake plenum (V6 shown)



14.4 Remove the fuel pressure regulator mounting bolts (arrows) (V6 shown)

regulator mounting bolts (four-cylinder engine) to the torque listed in this Chapter's Specifications.

6 Check for fuel leaks after installing the pressure regulator.

15 Fuel rail and injectors - removal and installation

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.*

Removal

Refer to illustrations 15.6, 15.8a and 15.8b

1 Detach the cable from the negative battery terminal. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Relieve the fuel pressure (see Section 2).

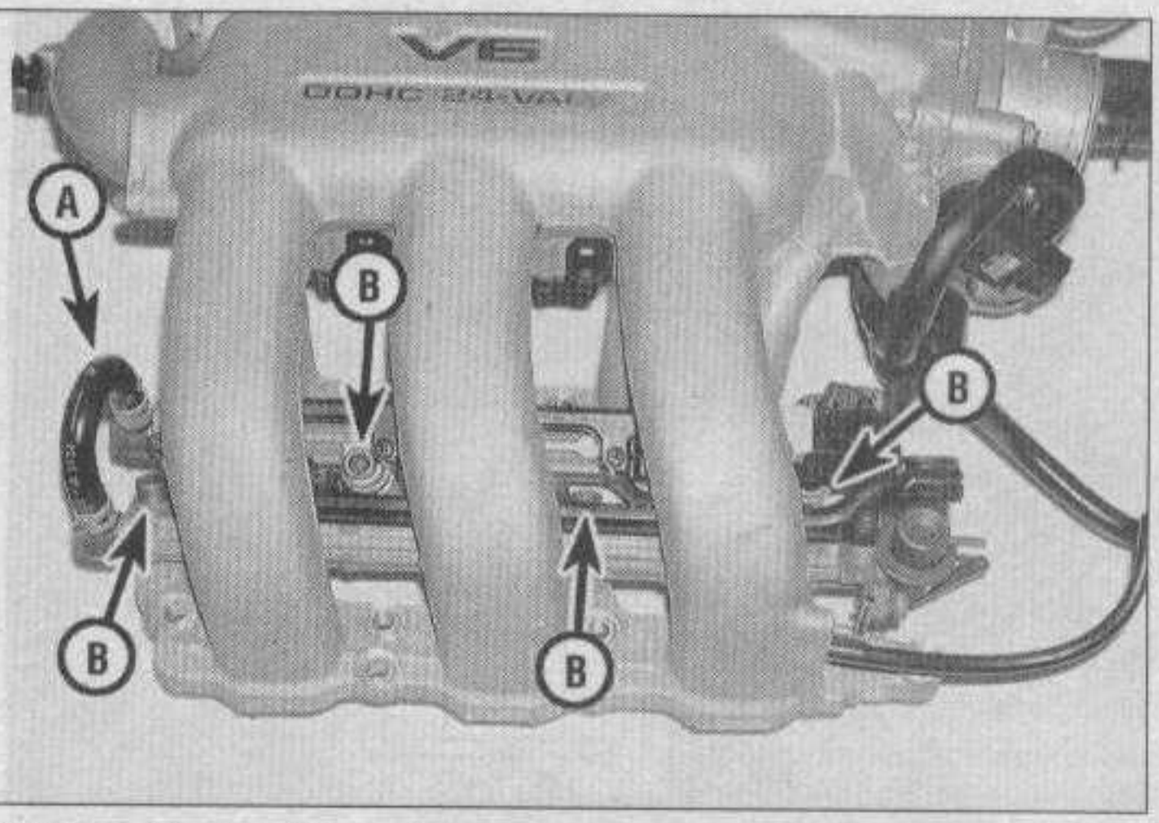
3 Disconnect the injector electrical connectors **(see illustration 12.9)**.

4 Detach the fuel return hose from the fuel pressure regulator (see Section 14). **Note:** *The fuel return line is smaller and is clamped to the fuel pressure regulator using a small spring clamp while the fuel feed hose (pressure line) is bolted to the fuel rail.*

5 Detach any ground cables from the fuel rail.

6 Unbolt the fuel feed line from the fuel rail and discard the sealing washers. If you're working on a V6, disconnect the crossover tube from the bank of injectors being removed **(see illustration)**. Also if you're working on a V6, remove the air cleaner housing (see Section 9).

7 Remove the mounting bolts and lift the fuel rail(s) from the engine **(see illustration 15.6)**. On V6 models it will be necessary to guide the fuel rail(s) out towards the driver's side of the vehicle. Remove the cushion ring that's installed under each fuel rail bolt. Remove the screws and separate the fuel injector wiring harness from the fuel rail.



15.6 Disconnect the crossover hose (A) on V6 models, then remove the fuel rail mounting bolts (B) (intake manifold removed for clarity)

8 Remove the injector(s) from the bore(s) in the fuel rail and remove and discard the O-rings and cushion ring **(see illustrations)**. **Note:** *Whether you're replacing an injector or a leaking O-ring, it's a good idea to remove all the injectors from the fuel rail and replace all the O-rings.*

Installation

9 install the new cushion rings in the fuel rail bolt holes.

10 Coat the new O-rings with clean engine oil and install them on the injector(s), then insert each injector into its corresponding bore in the fuel rail.

11 Install the injectors and fuel rail assembly on the intake manifold. Tighten the fuel rail mounting bolts to the torque listed in this Chapter's Specifications.

12 The remainder of installation is the reverse of removal.

13 After the injector/fuel rail assembly installation is complete, turn the ignition switch to ON, but don't operate the starter (this activates the fuel pump for about two seconds, which builds up fuel pressure in the fuel lines and the fuel rail). Repeat this about two or three times, then check the fuel lines, rail and injectors for fuel leakage.

16 Exhaust system servicing - general information

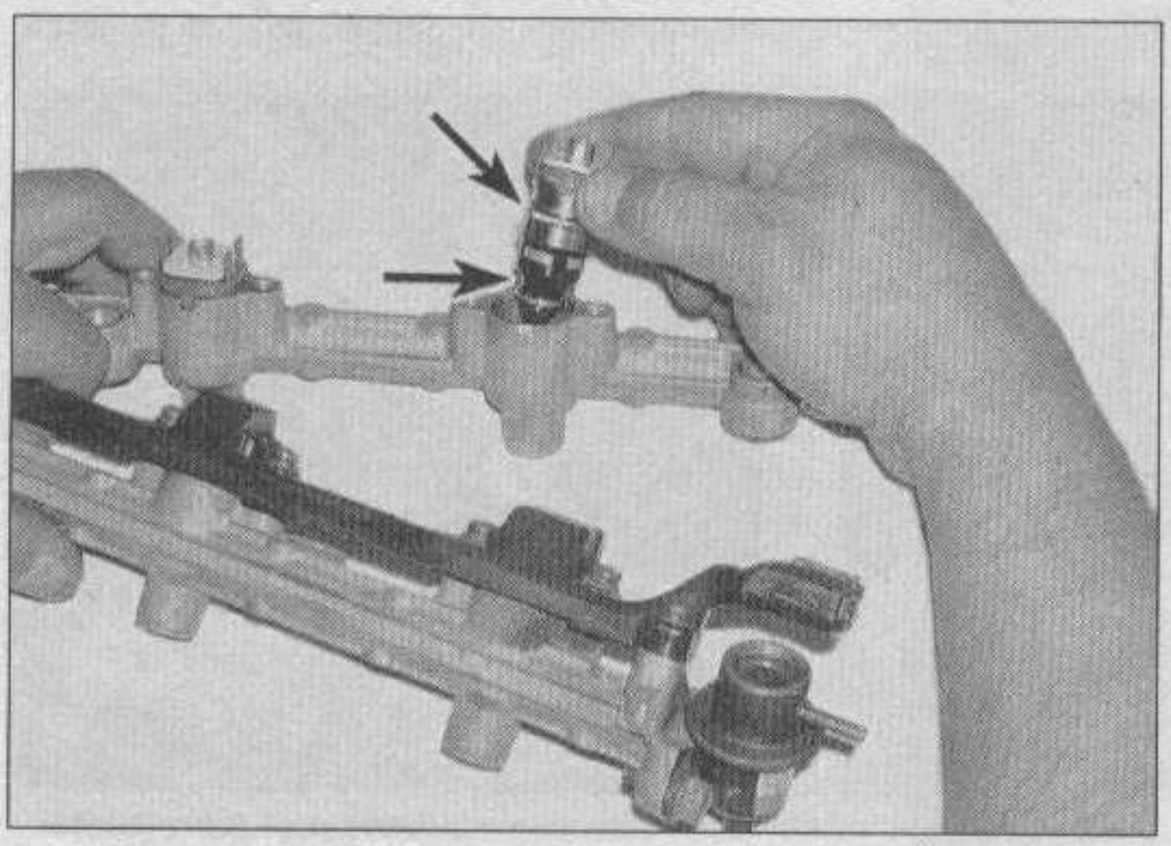
Refer to illustrations 16.4a, 16.4b and 6.4c

Warning: *Inspection and repair of exhaust system components should be done only after enough time has elapsed after driving the vehicle to allow the system components to cool completely. Also, when working under the vehicle, make sure it is securely supported on jackstands.*

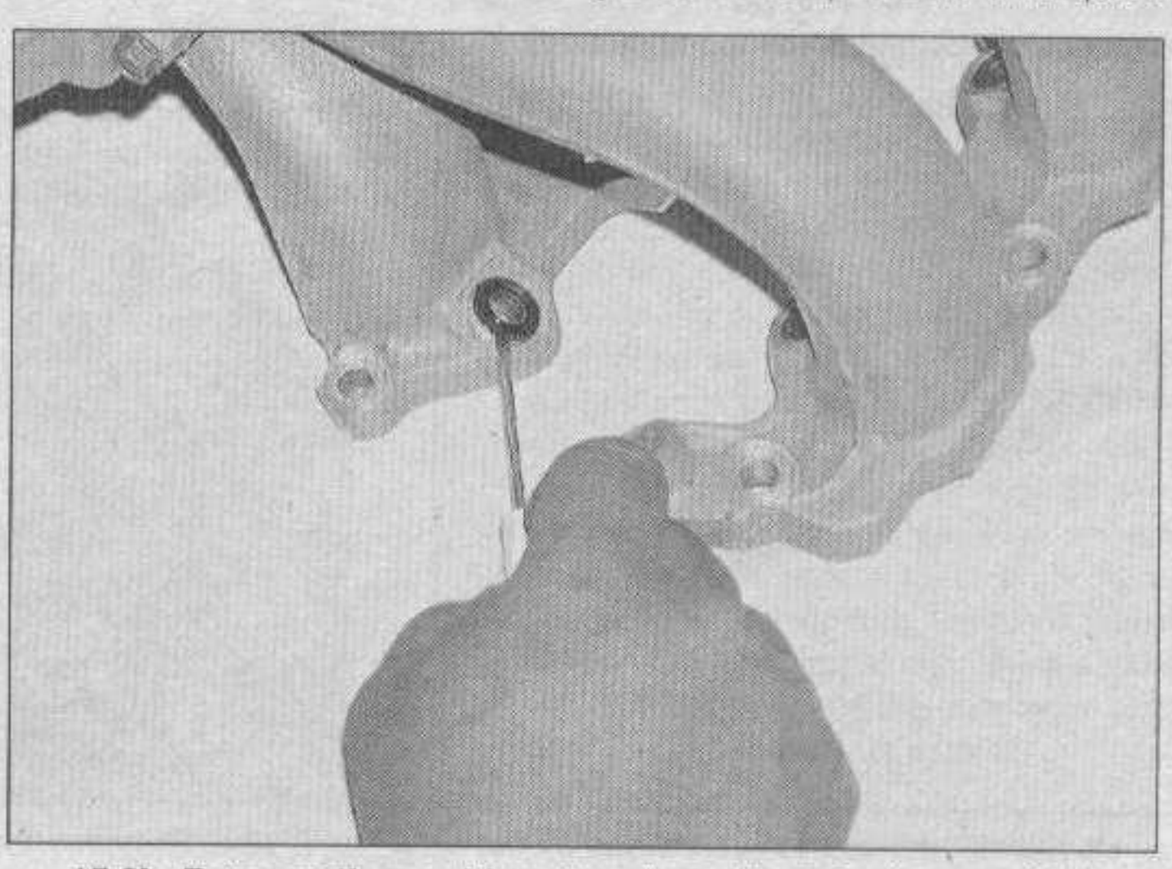
Caution: *All models covered by this manual are equipped with an exhaust system flex tube which is extremely sensitive to sharp bends. Do not allow the flex tube to hang downward during servicing or damage will occur.*

1 The exhaust system consists of the exhaust manifold(s), the catalytic converter, the muffler, the tailpipe and all connecting pipes, brackets, hangers and clamps. The exhaust system is attached to the body with mounting brackets and rubber hangers. If any of the parts are improperly installed, excessive noise and vibration will be transmitted to the body.

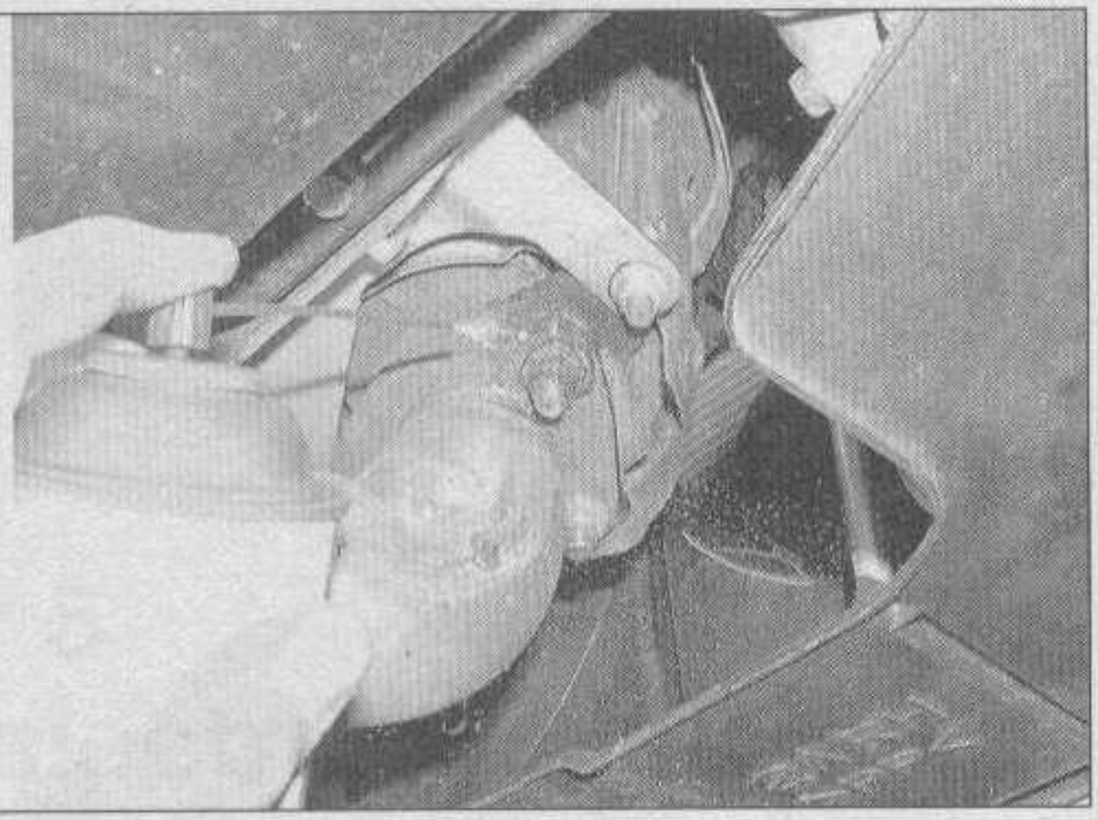
2 Conduct regular inspections of the exhaust system to keep it safe and quiet.



15.8a Remove the injectors from the fuel rail and carefully remove the injector O-rings (arrows)



15.8b Remove the cushion rings from the injector manifold



16.4a Use penetrating oil on all exhaust system mounting bolts and fasteners to ease removal at the manifold . . .

Look for any damaged or bent parts, open seams, holes, loose connections, excessive corrosion or other defects which could allow exhaust fumes to enter the vehicle. Deteriorated exhaust system components should not be repaired; they should be replaced with new parts.

3 If the exhaust system components are extremely corroded or rusted together, welding equipment will probably be required to remove them. The convenient way to accomplish this is to have a muffler repair shop remove the corroded sections with a cutting torch. If, however, you want to save money by doing it yourself (and you don't have a welding outfit with a cutting torch), simply cut off the old components with a hacksaw. If you have compressed air, special pneumatic cutting chisels can also be used. If you do decide to tackle the job at home, be sure to wear safety goggles to protect your eyes from metal chips and work gloves to protect your hands.

4 Here are some simple guidelines to follow when repairing the exhaust system:

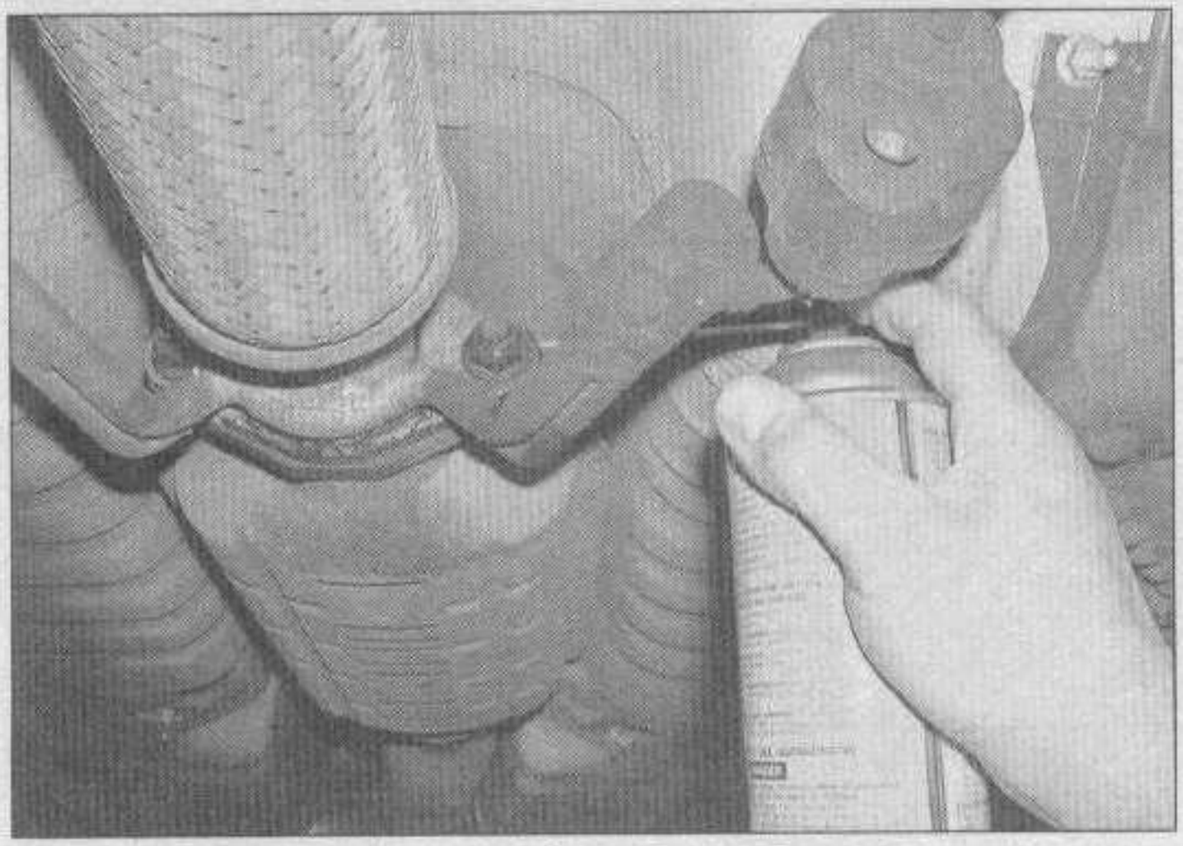
a) *Work from the back to the front when removing exhaust system components.*

b) *Apply penetrating oil to the exhaust system component fasteners to make them easier to remove* **(see illustrations).**

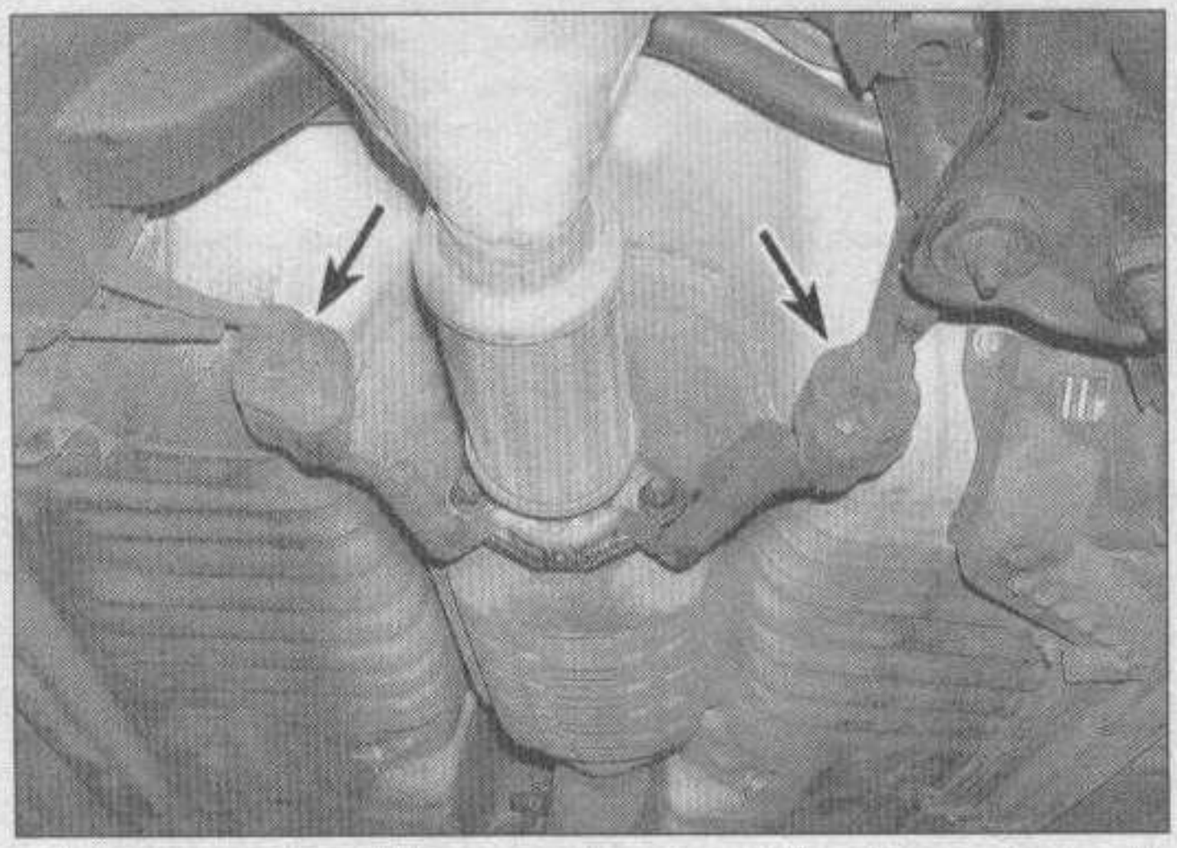
c) *Use new gaskets, hangers and clamps when installing exhaust systems components* **(see illustration).**

d) *Apply anti-seize compound to the threads of all exhaust system fasteners during reassembly.*

e) *Be sure to allow sufficient clearance between newly installed parts and all points on the underbody to avoid overheating the floor pan and possibly damaging the interior carpet and insulation. Pay particularly close attention to the catalytic converter and heat shield.*



16.4b . . . and at the catalytic converter



16.4c Check for any broken or missing rubber hangers (arrows)

Chapter 5
Engine electrical systems

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Battery - check and replacement	3
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Specifications

General

Battery voltage	
Engine off	11.5 to 12 volts
Engine running	13.5 to 15 volts

Ignition system

System type	
1993	Distributor, integral coil and ICM
1994 Probe	
Four-cylinder	Distributor, separate coil and ICM
V6	Distributor, integral coil and ICM
1994 Mazda	
Four-cylinder	
Automatic	Distributor, separate coil and ICM
Manual	Distributor, integral coil and ICM
V6 (all)	Distributor, integral coil and ICM
1995 Probe	
Four-cylinder	Distributor, separate coil and ICM
V6	Distributor, integral coil and ICM
1995 Mazda	
Four-cylinder	
Automatic	Distributor, separate coil and ICM
Manual	Distributor, integral coil and ICM
V6 (all)	Distributor, integral coil and ICM
1996 and 1997 Probe	
Four-cylinder	Distributor, separate coil, ICM integral with PCM
V6	Distributor, integral coil and ICM
1996 and 1997 Mazda	
Four-cylinder	
Automatic	Distributor, separate coil and ICM
Manual	Distributor, integral coil and ICM
V6 (all)	Distributor, integral coil and ICM
1998 and later Mazda	Distributorless

Ignition system (continued)

Ignition coil resistance (distributor ignition)	
1993 Mazda	
Primary resistance	0.6 to 1.1 ohms
Secondary resistance	11.5 to 18.5 K-ohms
1994 Mazda (integral coil)	
Primary resistance	0.6 to 1.1 ohms
Secondary resistance	11.5 to 18.5 K-ohms
1994 Mazda (separate coil)	
Primary resistance	0.4 to 0.73 ohms
Secondary resistance	8.7 to 11.5 K-ohms
1995 through 1997 Mazda (integral coil)	
Primary resistance	0.4 to 0.73 ohms
Secondary resistance	20 to 31 K-ohms
1995 through 1997 Mazda (separate coil)	
Primary resistance	0.4 to 0.73 ohms
Secondary resistance	8.7 to 11.5 K-ohms
Ignition coil pack resistance (distributorless ignition)	
Primary	0.45 to 0.55 ohms
Secondary	11.5 to 15.5 K-ohms
Spark plug wire resistance	5,000 ohms per foot (approximate)

1 General information

Refer to illustrations 1.1a and 1.1b

The engine electrical systems include all ignition, charging and starting components **(see illustrations)**. Because of their engine-related functions, these components are considered separately from chassis electrical devices like the lights, instruments, etc.

Be very careful when working on the engine electrical components. They are easily damaged if checked, connected or handled improperly. The alternator is driven by an engine drivebelt which could cause serious injury if your hands, hair or clothes become entangled in it with the engine running. Both the starter and alternator are connected directly to the battery and could arc or even cause a fire if mishandled, overloaded or shorted out.

Never leave the ignition switch on for long periods of time with the engine off. Don't disconnect the battery cables while the engine is running. Correct polarity must be maintained when connecting battery cables from another source, such as another vehicle, during jump starting. Always disconnect the negative cable first and hook it up last or the battery may be shorted by the tool being used to loosen the cable clamps.

Additional safety related information on the engine electrical systems can be found in *Safety first* near the front of this manual. It should be referred to before beginning any operation included in this Chapter.

2 Battery - emergency jump starting

Refer to the *Booster battery (jump) starting procedure* at the front of this manual.

3 Battery - check and replacement

Caution 1: *Always disconnect the negative cable first and hook it up last or the battery may be shorted by the tool being used to loosen the cable clamps.*

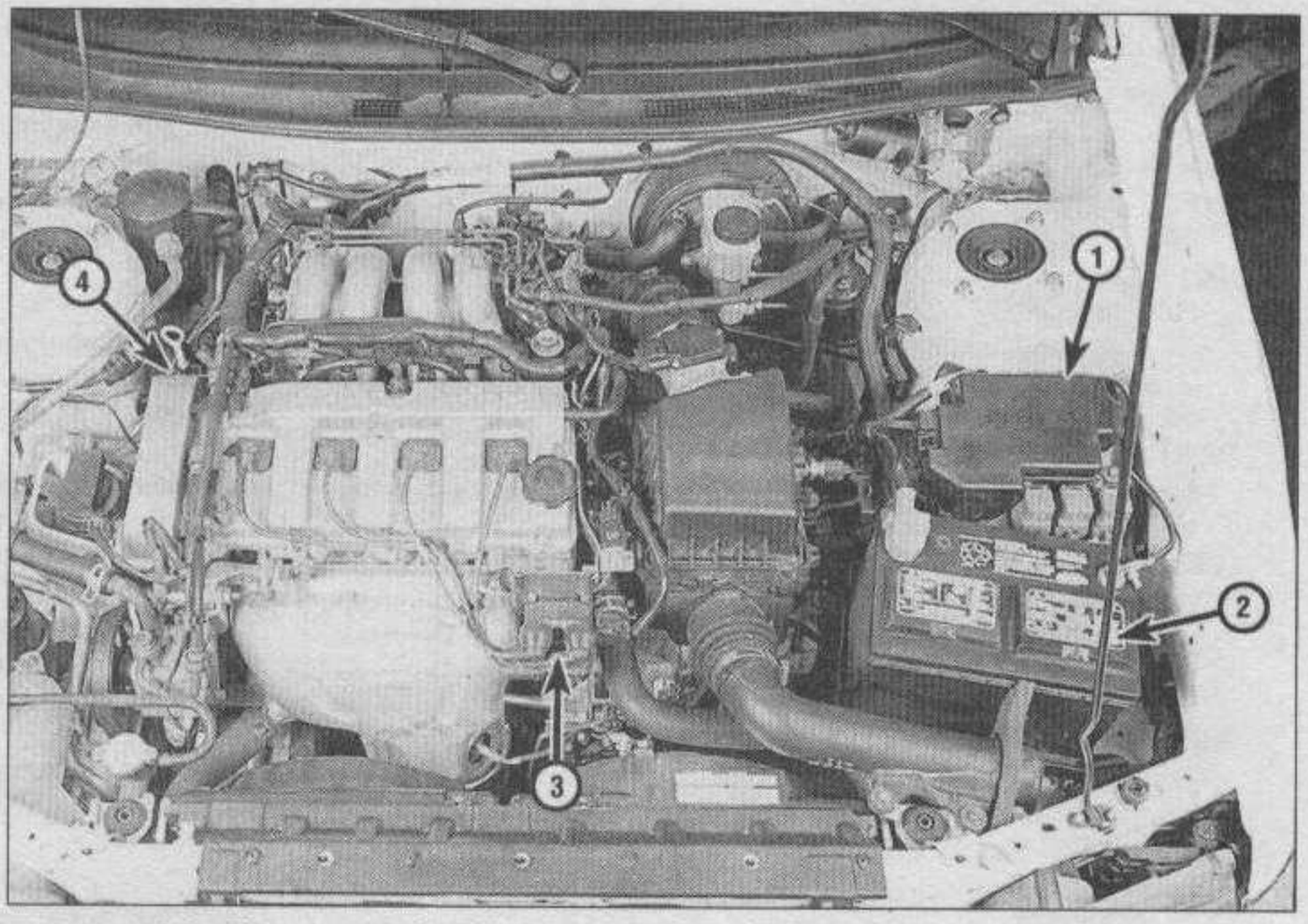
Caution 2: *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

Check

Refer to illustrations 3.2 and 3.3

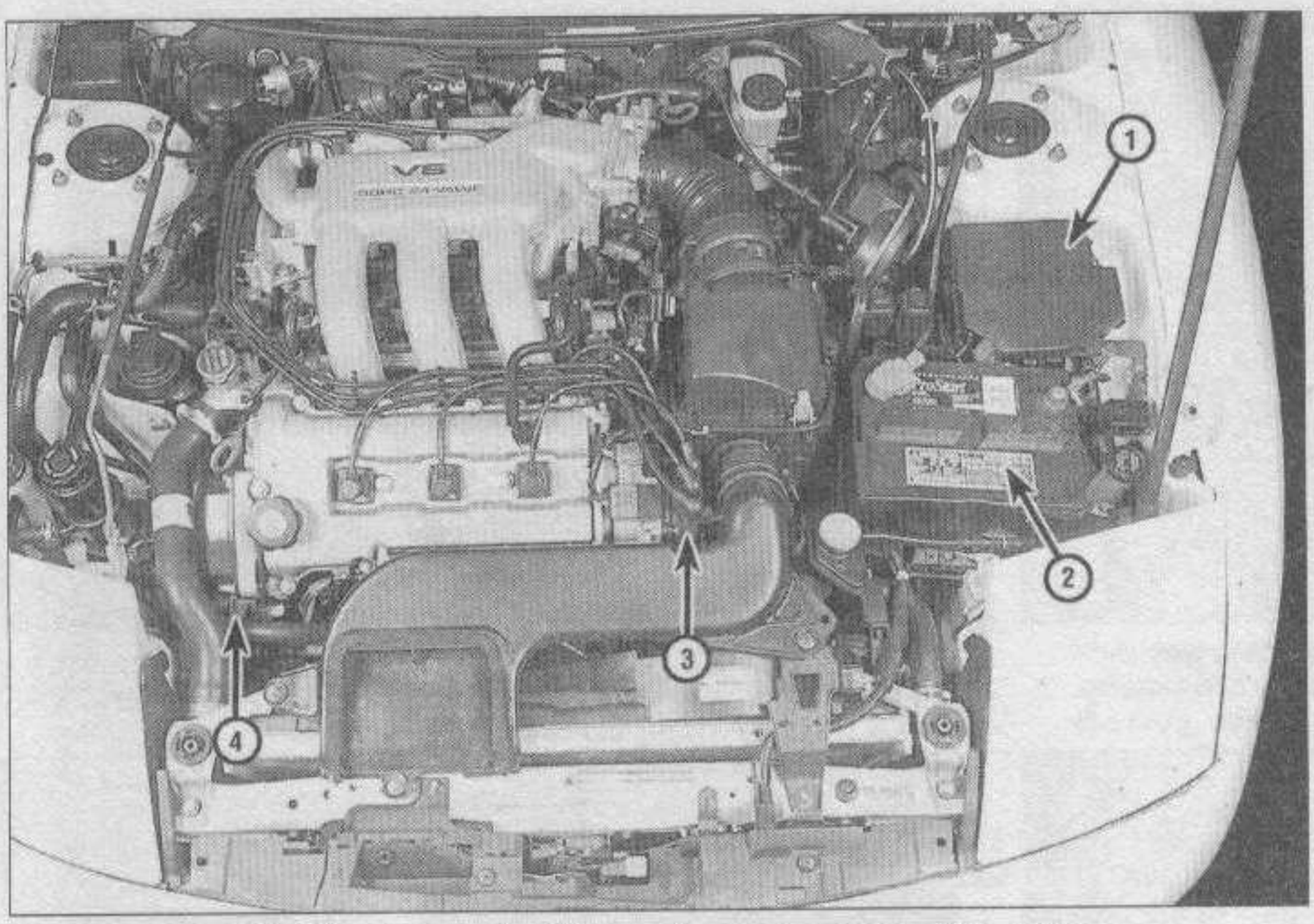
1 Disconnect the negative battery cable, then the positive cable from the battery.

2 Check the battery state of charge. Visually inspect the indicator eye on the top of the battery. If the indicator eye is black in color, charge the battery as described in Chapter 1. Next perform an open circuit voltage test using a digital voltmeter **(see illustration)**. **Note:** *The battery's surface charge must be removed before accurate voltage measurements can be made. Turn on the high beams for ten seconds, then turn them off and let the vehicle stand for two minutes.* With the engine and all accessories Off, touch the negative probe of the voltmeter to the negative terminal of the battery and the positive



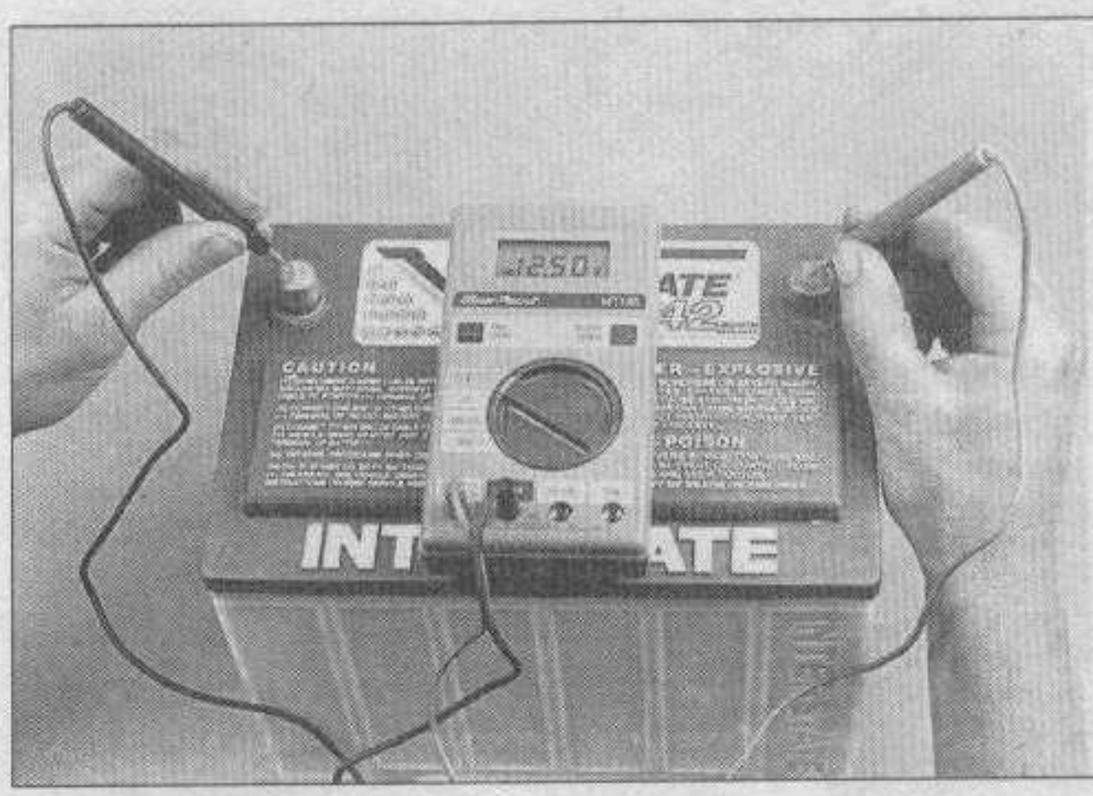
1.1a Charging and ignition system components - four-cylinder engine

1 *Underhood fuse/relay box*
2 *Battery*
3 *Distributor or coil pack*
4 *Alternator*



1.1b Charging and ignition system components - V6 engine

1 *Underhood fuse/relay box*
2 *Battery*
3 *Distributor or coil pack*
4 *Alternator*



3.2 To test the open circuit voltage of the battery, simply touch the black probe of the voltmeter to the negative terminal and the red probe to the positive terminal of the battery - a fully charged battery should read between 11.5 to 12.5 volts depending on the outside air temperature

probe to the positive terminal of the battery. The battery voltage should be 11.5 to 12.5 volts or slightly above. If the battery is less than the specified voltage, charge the battery before proceeding to the next test. Do not proceed with the battery load test unless the battery charge is correct.

3 Perform a battery load test. An accurate check of the battery condition can only be performed with a load tester (available at most auto parts stores). This test evaluates the ability of the battery to operate the starter and other accessories during periods of heavy amperage draw (load). Install a special battery load testing tool onto the terminals **(see illustration)**. Load test the battery according to the manufacturer's instructions for the particular tester. This tool utilizes a carbon pile to increase the load demand (amperage draw) on the battery. Maintain the load on the battery for 15 seconds or less and check that the battery voltage does not drop below 9.6 volts. If the battery condition is weak or defective, the tester will indicate this condition immediately. **Note:** *Cold temperatures will cause the minimum voltage requirements to drop slightly. Follow the chart given in the manufacturer's instructions to compensate for cold climates. Minimum load voltage for freezing temperatures (32 degrees F) should be approximately 9.1 volts.*

Replacement

Refer to illustrations 3.4 and 3.8

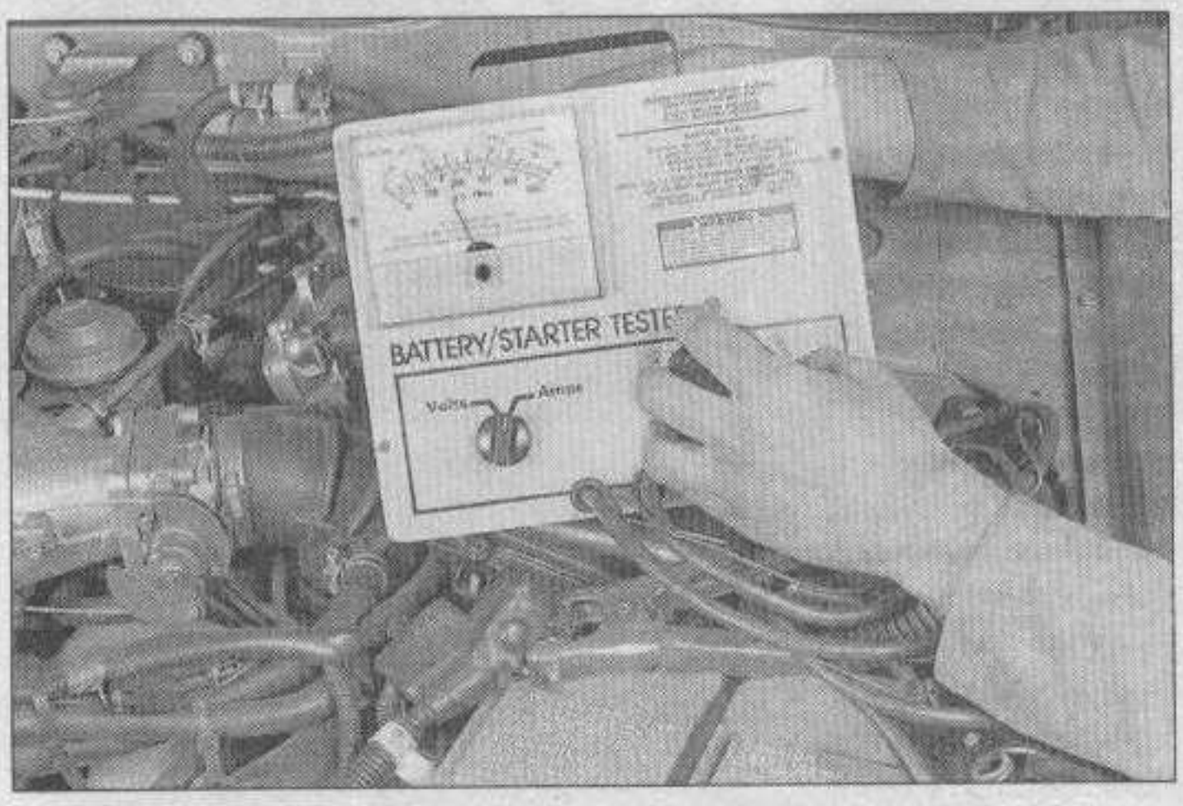
4 Disconnect the negative battery cable, then the positive cable from the battery **(see illustration)**.

5 Remove the battery hold-down wedge **(see illustration 3.4)**.

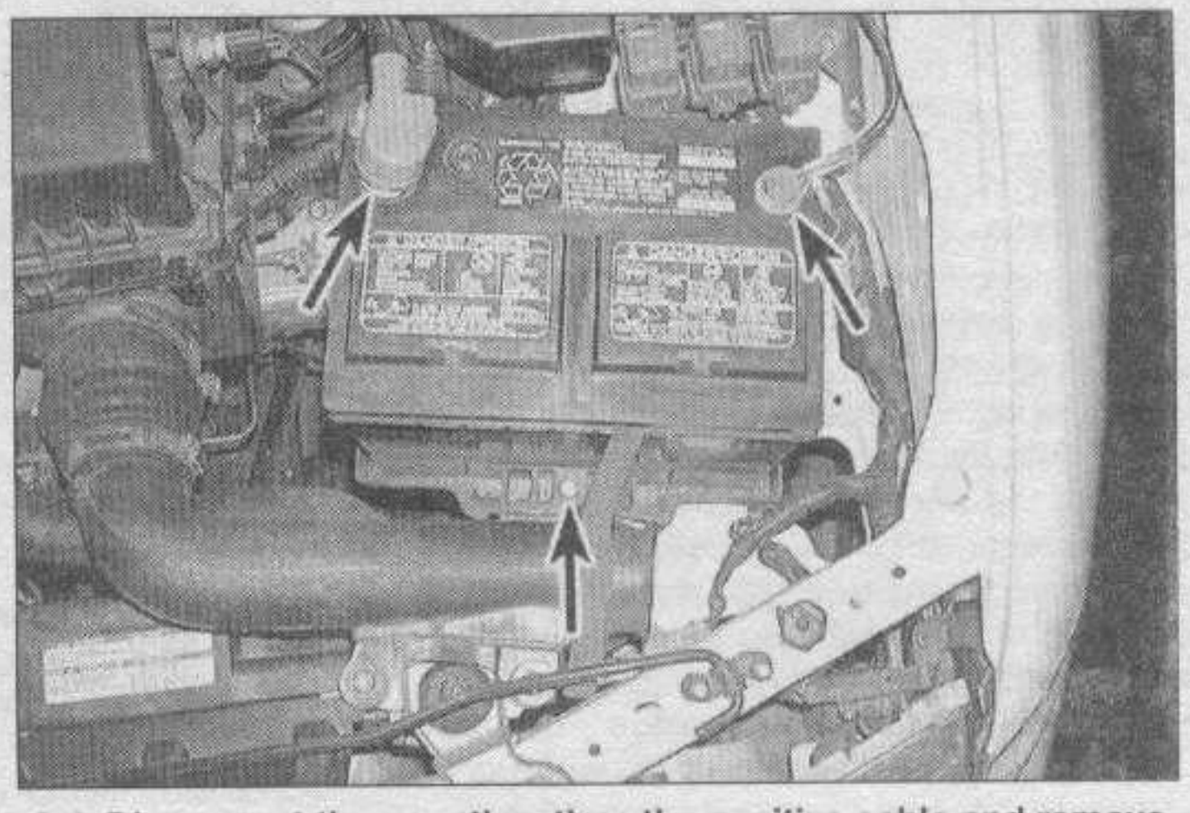
6 Lift out the battery. Be careful - it's heavy. **Note:** *Battery straps and handlers are available at most auto parts stores for a reasonable price. They make it easier to remove and carry the battery.*

7 While the battery is out, inspect the battery tray for corrosion.

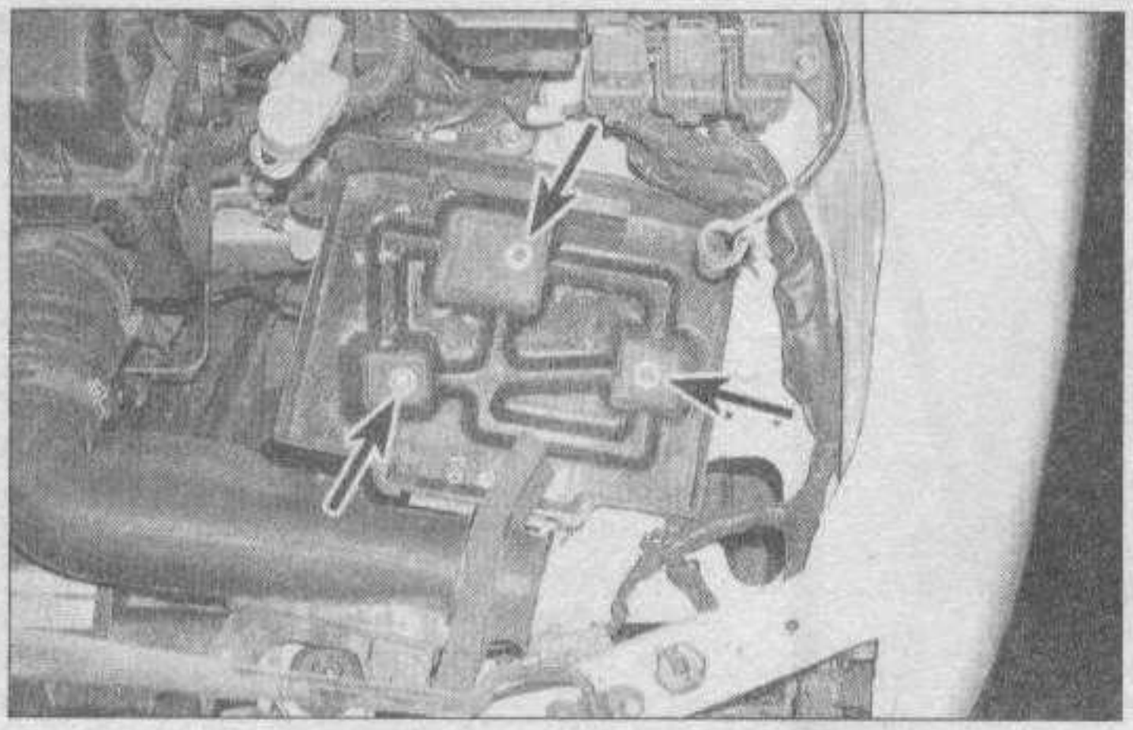
8 If corrosion exists on the battery tray,



3.3 Some battery load testers are equipped with an ammeter which enables the battery load to be precisely dialed in, as shown - less expensive testers have a load switch and a voltmeter only

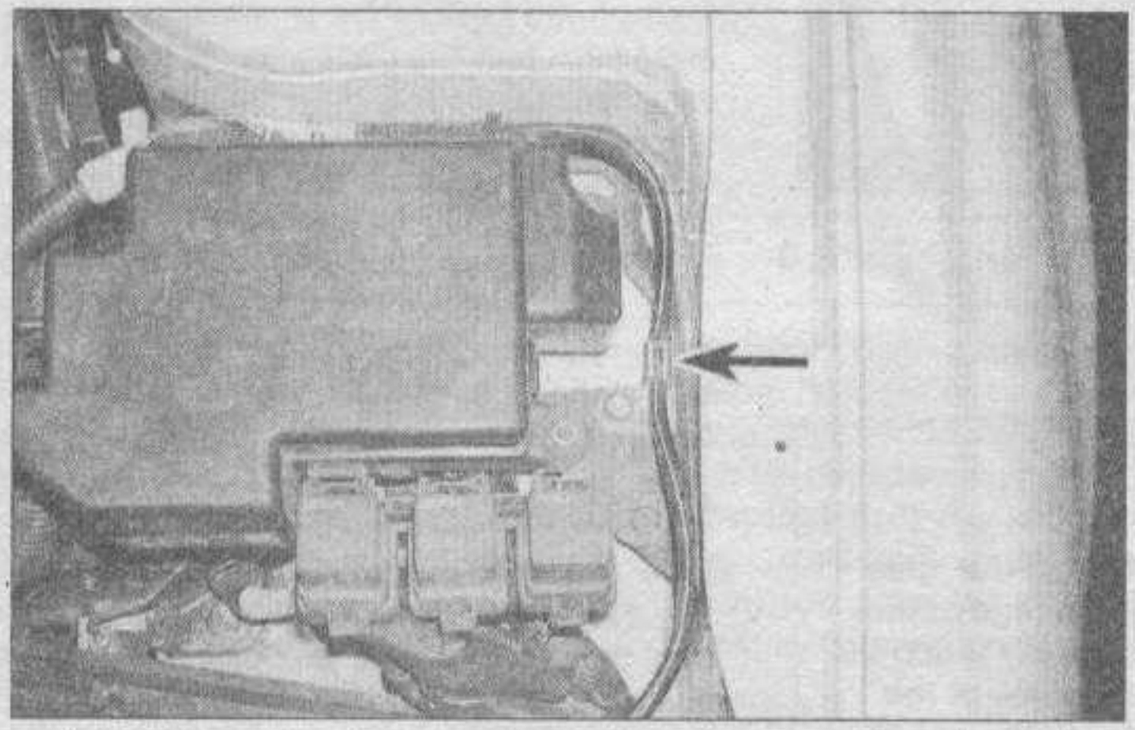


3.4 Disconnect the negative, then the positive cable and remove the hold-down wedge (arrows)

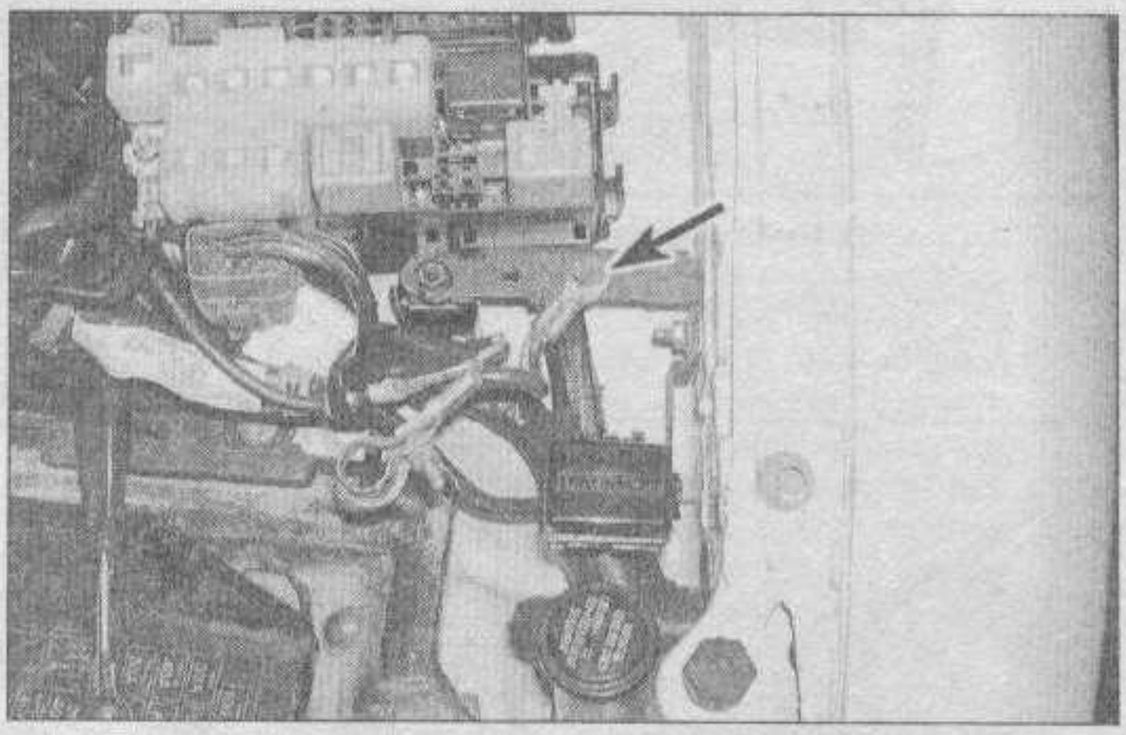


3.8 Remove the bolts and lift out the battery tray

4.4a Removing the cable from a battery post with a wrench - always remove the negative cable first and hook it up last!



4.4b Detach any battery cable ties or retaining clips (arrow)



4.4c The negative battery cable is fastened to this bracket in the engine compartment (arrow) . . .

detach the bolts and remove the tray from the engine compartment **(see illustration)**. Clean the deposits from the tray and the metal under the tray to prevent further corrosion.

9 If you are replacing the battery, make sure you get one that's identical, with the same dimensions, amperage rating, cold cranking rating, etc.

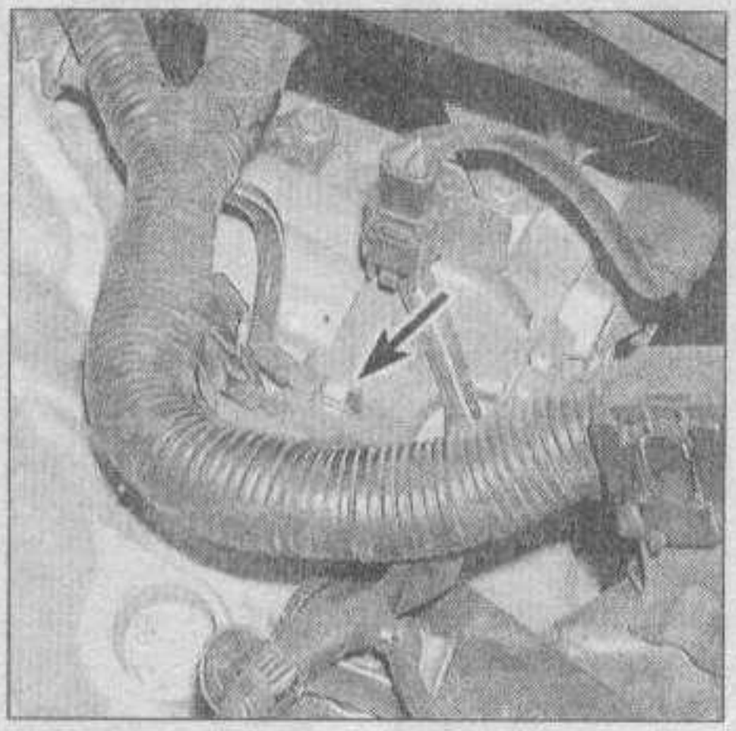
10 Installation is the reverse of removal.

4 Battery cables - check and replacement

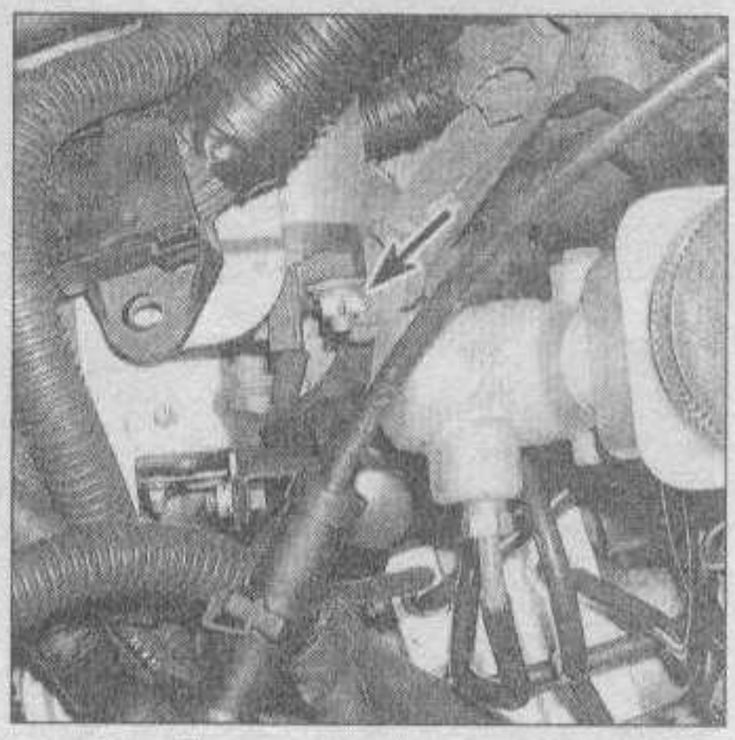
Refer to illustrations 4.4a, 4.4b, 4.4c, 4.4d, 4.4e and 4.4f

1 Periodically inspect the entire length of each battery cable for damage, cracked or burned insulation and corrosion. Poor battery cable connections can cause starting problems and decreased engine performance.

2 Check the cable-to-terminal connections at the ends of the cables for cracks, loose wire strands and corrosion. The presence of white, fluffy deposits under the insulation at the cable terminal connection is a sign that the cable is corroded and should be replaced. Check the terminals for distortion, missing mounting bolts and corrosion.



4.4d . . . and at the transaxle (arrow)

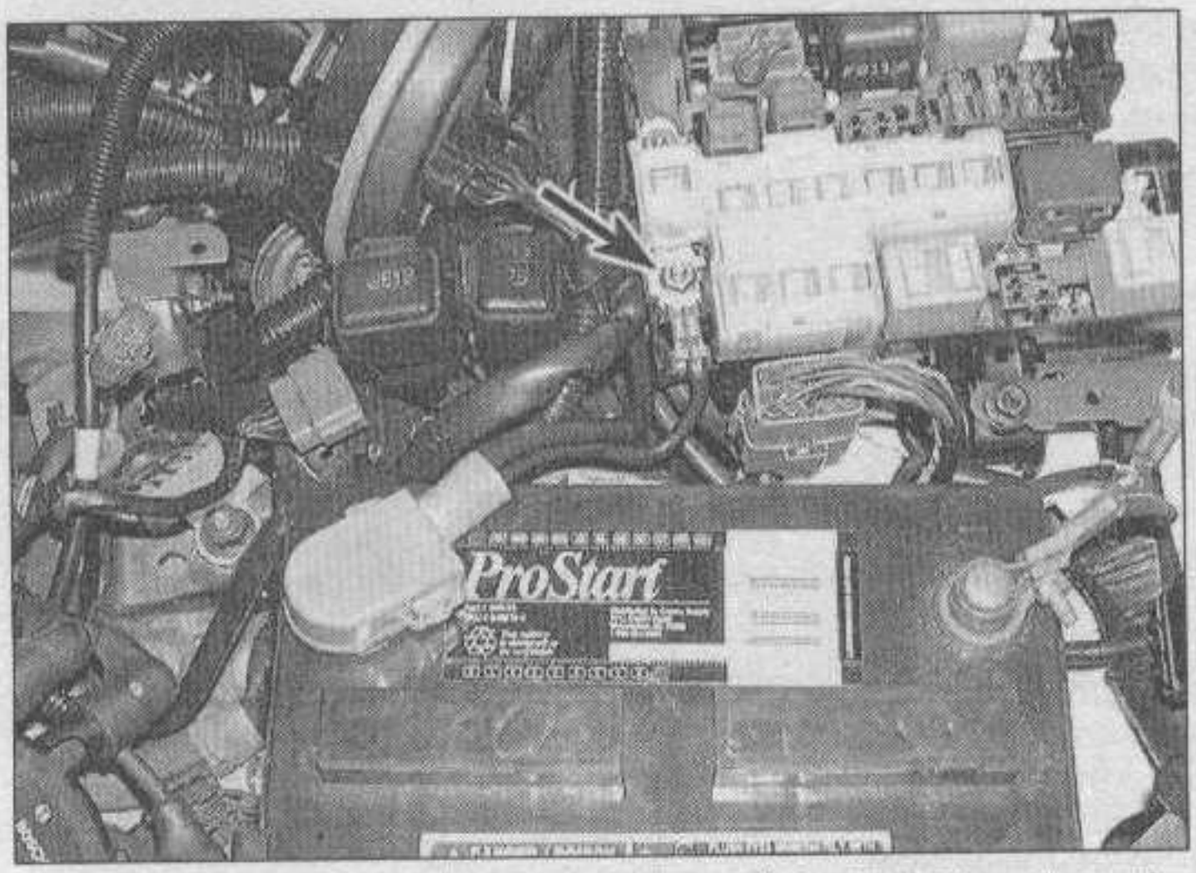


4.4e The positive battery cable is fastened to the starter (arrow) . . .

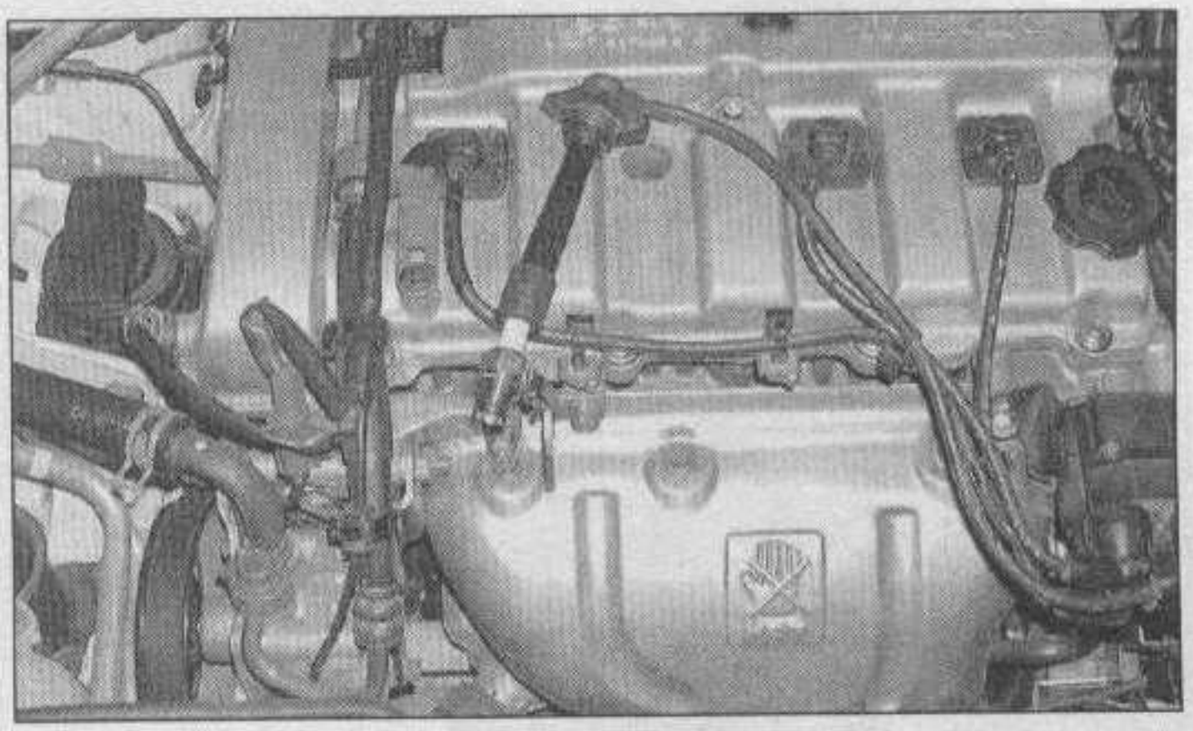
3 When removing the cables, always disconnect the negative cable first and hook it up last or the battery may be shorted by the tool used to loosen the cable clamps. Even if only the positive cable is being replaced, be sure to disconnect the negative cable from the battery first (see Chapter 1 for further information regarding battery cable removal).

Caution: *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

4 Disconnect the old cables from the battery, then trace each of them to their opposite ends and detach them from the starter



4.4f . . . and at the engine compartment fuser/relay box (arrow)



6.2 To use a calibrated ignition tester, simply disconnect a spark plug wire, connect it to the tester, clip the tester to a convenient ground and operate the starter - if there is enough power to fire the plug, sparks will be visible between the electrode tip and the tester body

solenoid and ground terminals. Note the routing of each cable to ensure correct installation **(see illustrations)**.

5 If you are replacing either or both of the old cables, take them with you when buying new cables. It is vitally important that you replace the cables with identical parts. Cables have characteristics that make them easy to identify: positive cables are usually red and larger in cross-section; negative cables are usually black and smaller in cross section.

6 Clean the threads of the solenoid or ground connection with a wire brush to remove rust and corrosion. Apply a light coat of battery terminal corrosion inhibitor, or petroleum jelly, to the threads to prevent future corrosion.

7 Attach the cable to the solenoid or ground connection and tighten the mounting nut/bolt securely.

8 Before connecting a new cable to the battery, make sure that it reaches the battery post without having to be stretched.

9 Connect the positive cable first, followed by the negative cable.

5 Ignition system - general information

Warning: *Because of the high voltage generated by the ignition system, extreme care should be taken whenever an operation is performed involving ignition components. This not only includes the igniter, coil, distributor and spark plug wires, but related components such as plug connectors, tachometer and other test equipment.*

1 The ignition system provides complete control of the ignition timing. The computer (PCM) determines the optimum timing in response to engine speed, coolant temperature, throttle position and vacuum (negative pressure) in the intake manifold. These parameters are relayed to the PCM by the crankshaft and camshaft position sensors, Throttle Position Sensor (TPS), Engine Coolant Temperature (ECT) sensor and Manifold Absolute Pressure (MAP) sensor. Ignition timing is altered during warm-up, idling and warm running conditions by the PCM. Testing and replacement of the various sensors is covered in Chapter 6.

Distributor ignition system

2 A distributor ignition system is used on all except 1998 and later models. This system consists of the ignition switch, battery, coil, distributor, ignition control module, spark plug wires and spark plugs. The distributor is driven by the camshaft.

3 Locations of the ignition coil and ignition control module vary according to model year, engine (four-cylinder or V6) and transmission (manual or automatic). On some four-cylinder models, both the coil and ICM are inside the distributor; on others, both are outside the distributor, in the engine compartment; and on still others, the coil is in the engine compartment and the ICM is integral with the Powertrain Control Module (PCM). On all V6 models, both the coil and the ICM are inside the distributor.

Distributorless ignition system (DIS) (1998 and later models only)

4 This system consists of a coil pack with a spark plug terminal for each cylinder, as well as related sensors and the PCM.

6 Ignition system - check

Warning: *Because of the high voltage generated by the ignition system, extreme care should be taken whenever an operation is performed involving ignition components. This not only includes the distributor and ICM (if equipped), coil and spark plug wires, but related components such as plug connectors, the tachometer and other test equipment.*

Distributor ignition system

Refer to illustrations 6.2 and 6.8

1 If a malfunction occurs in the ignition system, do not immediately assume that the distributor is causing the problem. First, check the following items:

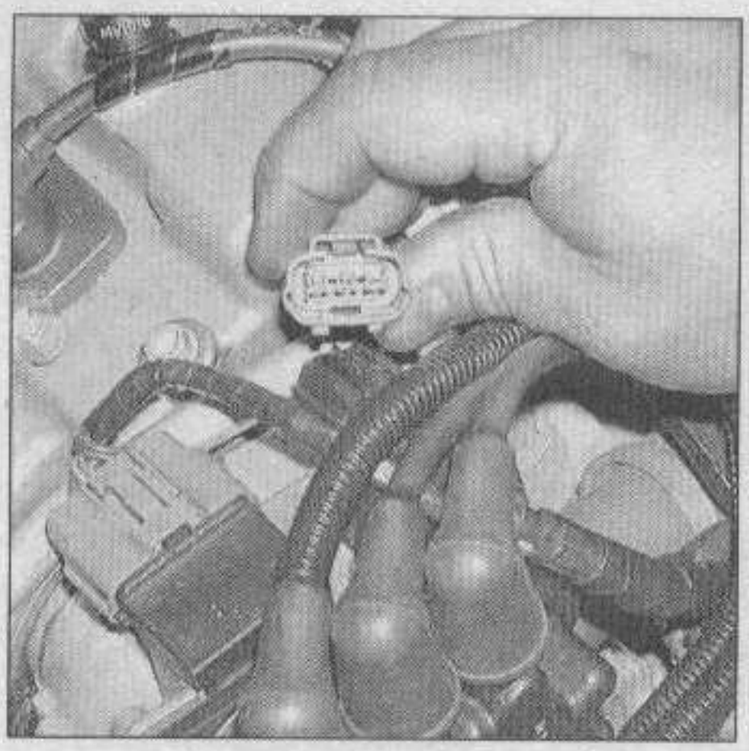
a) *Make sure the battery cable clamps, where they connect to the battery, are clean and tight.*
b) *Test the condition of the battery (see Section 3). If it does not pass all the tests, replace it with a new battery.*
c) *Check the external wiring and connections at the distributor and ignition coil.*
d) *Check the fusible links (if equipped) exiting the engine compartment fuse box (see Chapter 12). If they're burned, determine the cause and repair the circuit. Some fusible links look like large fuses and are located inside the engine compartment fuse box.*

2 Check the ignition spark at the plug. If the engine turns over but won't start, disconnect the spark plug wire from any spark plug and attach it to a calibrated tester (available at most auto parts stores) **(see illustration)**. Connect the clip on the tester to a bolt or metal bracket on the engine. Crank the engine and watch the end of the tester to see if bright blue, well-defined sparks occur.

3 If sparks occur, sufficient voltage is reaching the plug to fire it (repeat the check at the remaining plug wires to verify that the distributor cap and rotor are OK). However, the plugs themselves may be fouled, so remove and check them as described in Chapter 1.

4 If no sparks or intermittent sparks occur, check the cap, rotor and spark plug wires for damage and corrosion as described in Chapter 1. If moisture is present, dry out the cap and rotor, then reinstall the cap and repeat the spark test.

5 If there's still no spark, detach the coil secondary wire from the distributor cap and hook it up to the tester (reattach the plug wire



6.8 Unplug the ignition coil electrical connector and check for battery voltage with the ignition key ON (engine not running)

to the spark plug), then repeat the spark check.

6 If there's still no spark, check the condition of the spring and carbon button inside the distributor cap for burn marks or damage. Replace the cap if necessary.

7 If sparks now occur, the distributor cap, rotor or plug wire(s) may be defective.

8 If no sparks occur, check the primary wire connections at the coil to make sure they're clean and tight. Check for voltage to the coil on the primary circuit from the ignition switch **(see illustration)**. Use the wiring diagrams at the end of this manual to identify the correct terminal. Make any necessary repairs, then repeat the check.

9 If voltage exists at the ignition coil and there still are no sparks, check the primary and secondary resistance of the ignition coil (see Section 7). If an open is found (verified by an infinite reading), replace the coil.

10 If the coil is okay, check the Ignition Control Module (ICM) for proper operation (see Section 8).

11 Additional checks on the ignition system should be performed by a dealer service department or other qualified repair shop.

Distributorless ignition system

12 Check spark at each of the plugs as described in Step 2 above.

13 If there's no spark at any plug, check the coil primary and secondary resistance (see Section 7). Also check the circuit to the coil, referring to the wiring diagrams at the end of this manual.

14 If there's a weak spark or no spark at one or more plugs, check the resistance of that plug's wire with an ohmmeter and compare it to the value listed in this Chapter's Specifications. Replace as necessary.

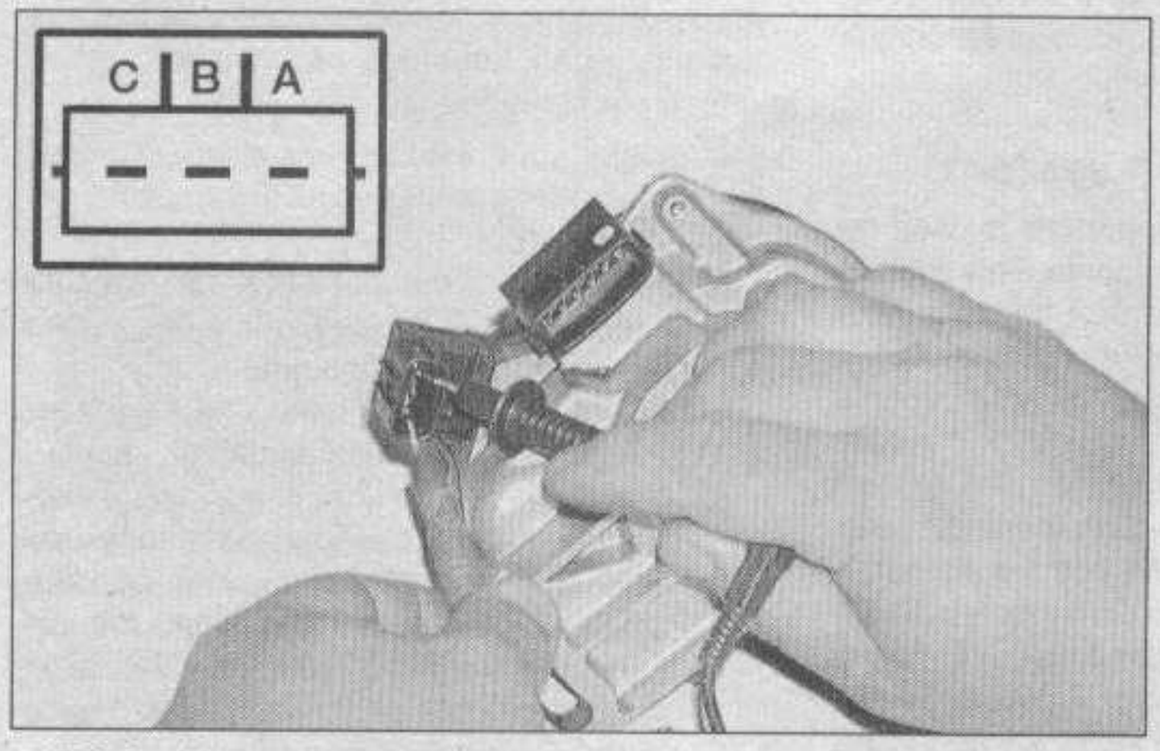
7 Ignition coil - check and replacement

Distributor ignition systems

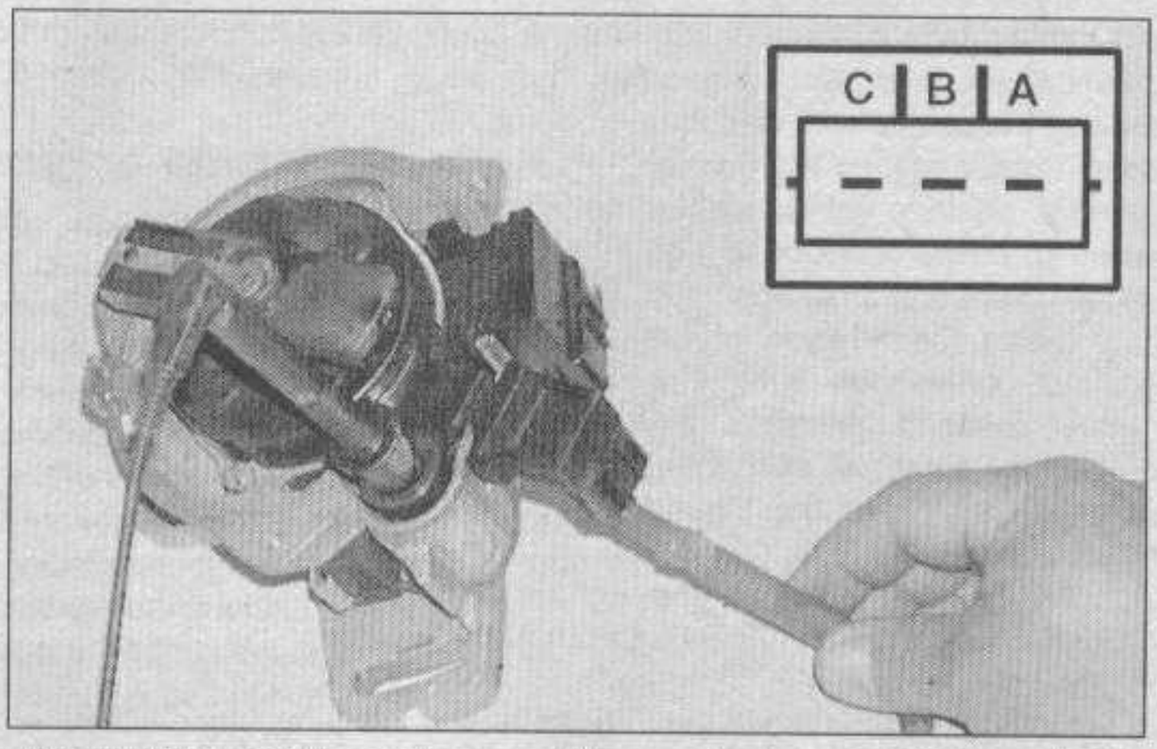
Check

Refer to illustrations 7.4 and 7.5

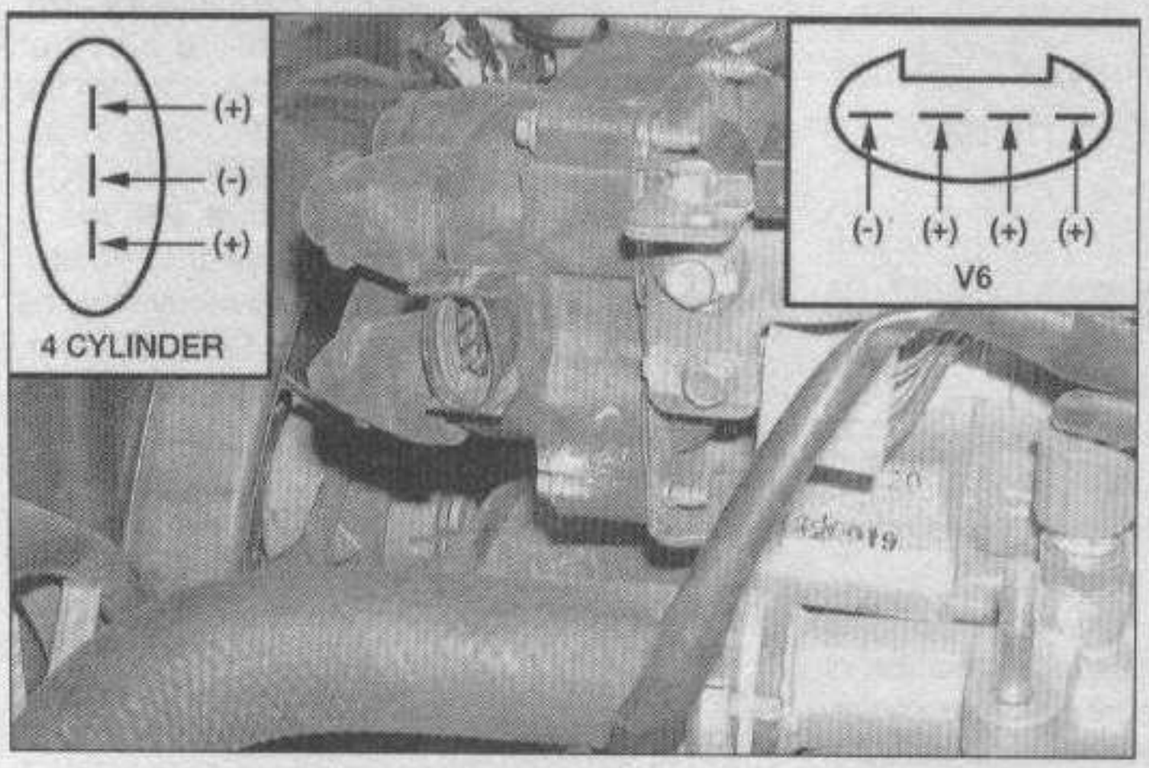
1 Make sure the ignition switch is turned OFF for the following checks.



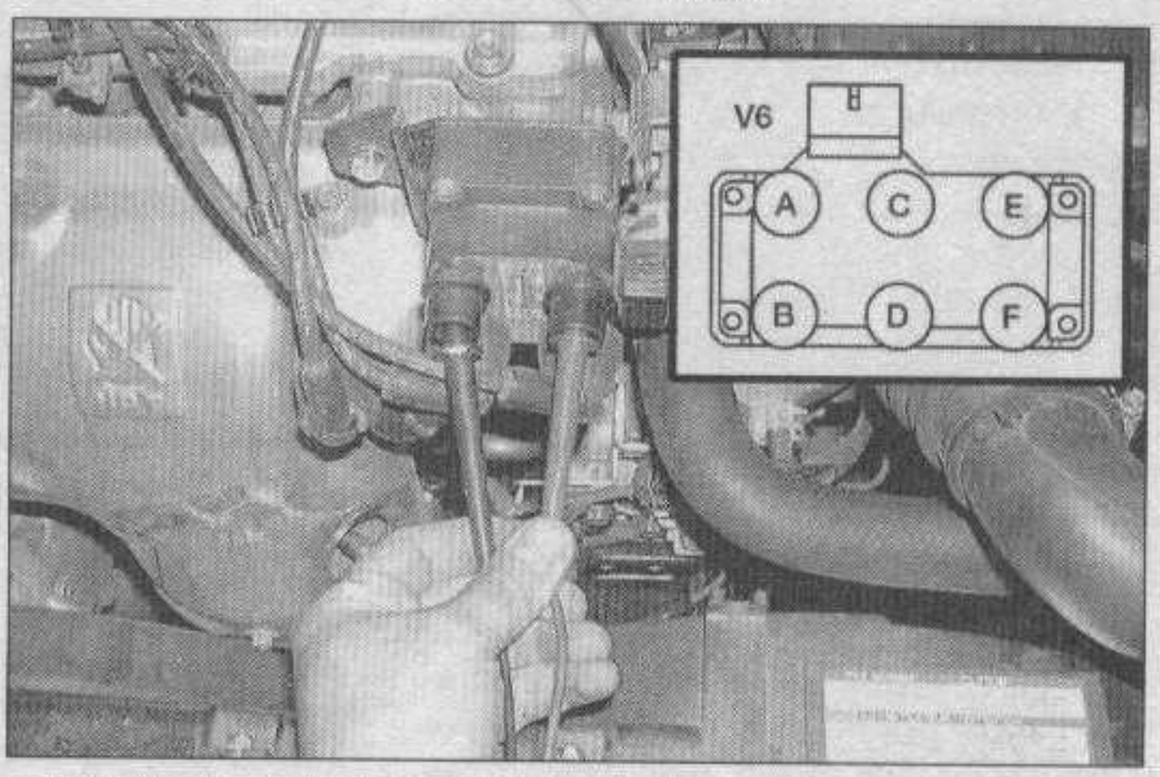
7.4 Ignition coil primary resistance check - on 1993 and 1994 models, check the primary resistance between terminals A and C; on 1995 through 1997 models check the primary resistance between terminals A and B



7.5 Ignition coil secondary resistance check - on 1993 and 1994 models, check the secondary resistance between terminal C and the coil high tension terminal; on 1995 through 1997 models check the secondary resistance between terminal A and the coil high tension terminal



7.12 Coil pack primary resistance check - distributorless ignition (four-cylinder shown)



7.13 Check secondary resistance between the upper and lower coil pairs on four-cylinder engines (shown) and between pairs A-B, C-D and E-F on V6 engines (inset)

2 If you're working on a vehicle with the ignition coil mounted inside the distributor, remove the distributor (see Section 9).
3 If you're working on a vehicle with an externally mounted ignition coil, detach the electrical connectors from the ignition coil primary terminals.
4 Using an ohmmeter, touch the probes to the primary terminals of the coil, measure the primary resistance and compare your reading to the value listed in this Chapter's Specifications **(see illustration)**.
5 Touch the probes to the secondary terminal and the positive primary terminal (C), measure the secondary resistance and compare your reading to the resistance value listed in this Chapter's Specifications **(see illustration)**.
6 The figures in the specifications will vary somewhat with the temperature of the coil. The specified resistance values are for a coil temperature of about 70-degrees F.
7 If the coil fails either check, replace it with a new part.

Replacement

8 Detach the cable from the negative terminal of the battery. **Caution:** *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*
9 If you're working on a vehicle with the ignition coil mounted inside the distributor, the manufacturer specifies that the coil must be replaced as a unit with the distributor. Before taking this step, however, check with parts stores to see if the coil is available separately.
10 If you're working on a vehicle with an externally mounted ignition coil, remove the electrical connectors from the ignition coil primary terminals and disconnect the secondary wire. Remove the coil mounting nuts and lift the coil out.
11 Installation is the reverse of removal.

Distributorless ignition

Check

Refer to illustrations 7.12 and 7.13

12 Disconnect the primary connector at the coil **(see illustration)**. Measure the resistance between the coil's ground terminal and each of the primary power terminals. If it's not within the range listed in this Chapter's Specifications, replace the coil.
13 Label the spark plug wires and their terminals at the coil so they don't get mixed up. Disconnect the plug wires from the coil, then measure resistance between each pair of coil terminals with an ohmmeter **(see illustration)**. Compare the readings with the secondary resistance values listed in this Chapter's Specifications and replace the coil if any reading is incorrect.

Replacement

Refer to illustration 7.15

14 Label the spark plug wires and their terminals at the coil so they don't get mixed up. Disconnect the plug wires and primary connector from the coil.
15 Remove the coil mounting bolts and take it off the engine **(see illustration)**.
16 Installation is the reverse of removal.

8 Ignition Control Module (ICM) - check and replacement

Check

1 The ignition control module acts as a switch that cuts off the ignition coil ground circuit, triggering the production of spark in the coil.
2 There's no specific test for the ignition control module; it's checked by process of elimination. If the circuit is good (both power and ground), and there's no spark, the module may be at fault. However, electrical parts usually can't be returned once bought. On some models, it's an integral part of the distributor, and the manufacturer specifies replacing the distributor and ICM as a unit. Before buying an expensive part that you may not need and can't return, it's a good idea to have the ICM tested by a qualified electrical shop.
3 Check for battery voltage to the ignition module. Disconnect the harness connector from the ICM unit. With the ignition key turned ON (engine not running), check for voltage at the ICM power terminal (use the wiring diagrams at the end of the book to identify it).
4 If there is no voltage to the ignition module, check the circuit from the ignition module to the ignition switch. First check the ignition switch fuses in the underhood fuse/relay box. Follow the circuit carefully and make sure the ignition switch delivers battery voltage to the ICM with the key ON. Refer to the wiring diagrams at the end of Chapter 12 for additional information.
5 If the ignition coil and circuits are good and there is still no spark, the ICM may be at fault. Have it tested by a dealer service department or other qualified electrical shop.

Replacement

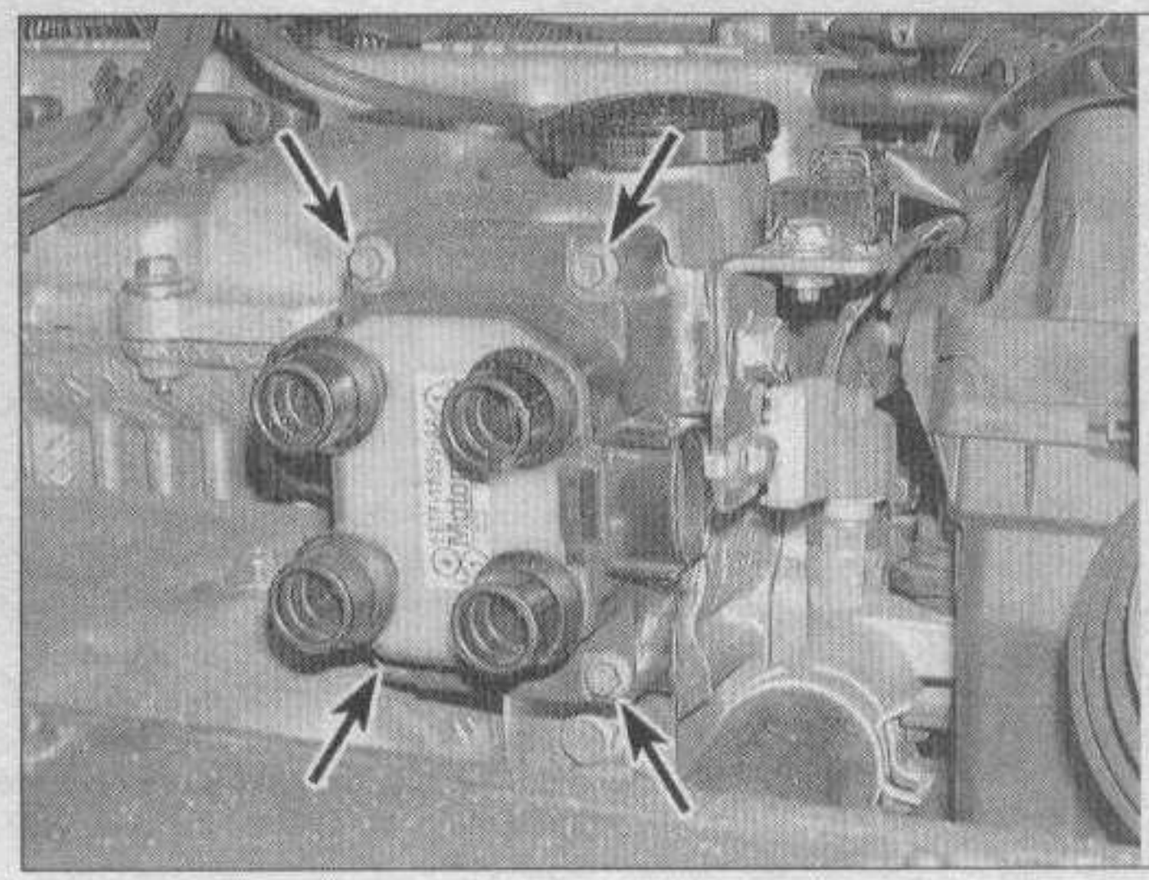
6 This section applies to vehicles equipped with separate ICMs. If the ICM is integral with the distributor, the distributor must be replaced (see Section 9).
7 Disconnect the negative battery cable from the battery terminal. **Caution:** *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*
8 Remove all the electrical connectors from the ICM unit (it's mounted next to the battery or on the left front shock tower in the engine compartment).
9 Remove the mounting screws or nuts and lift the ICM out.
10 Installation is the reverse of removal.

9 Distributor - removal and installation

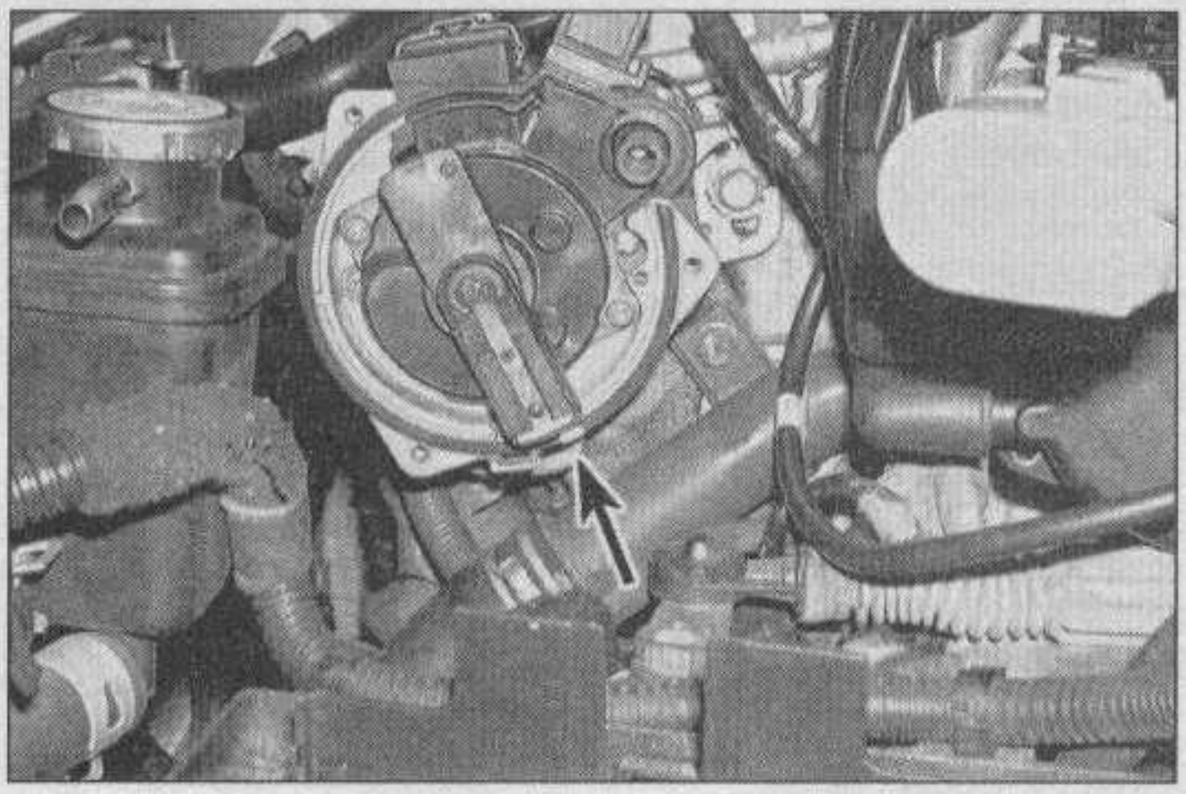
Removal

Refer to illustrations 9.5a and 9.5b

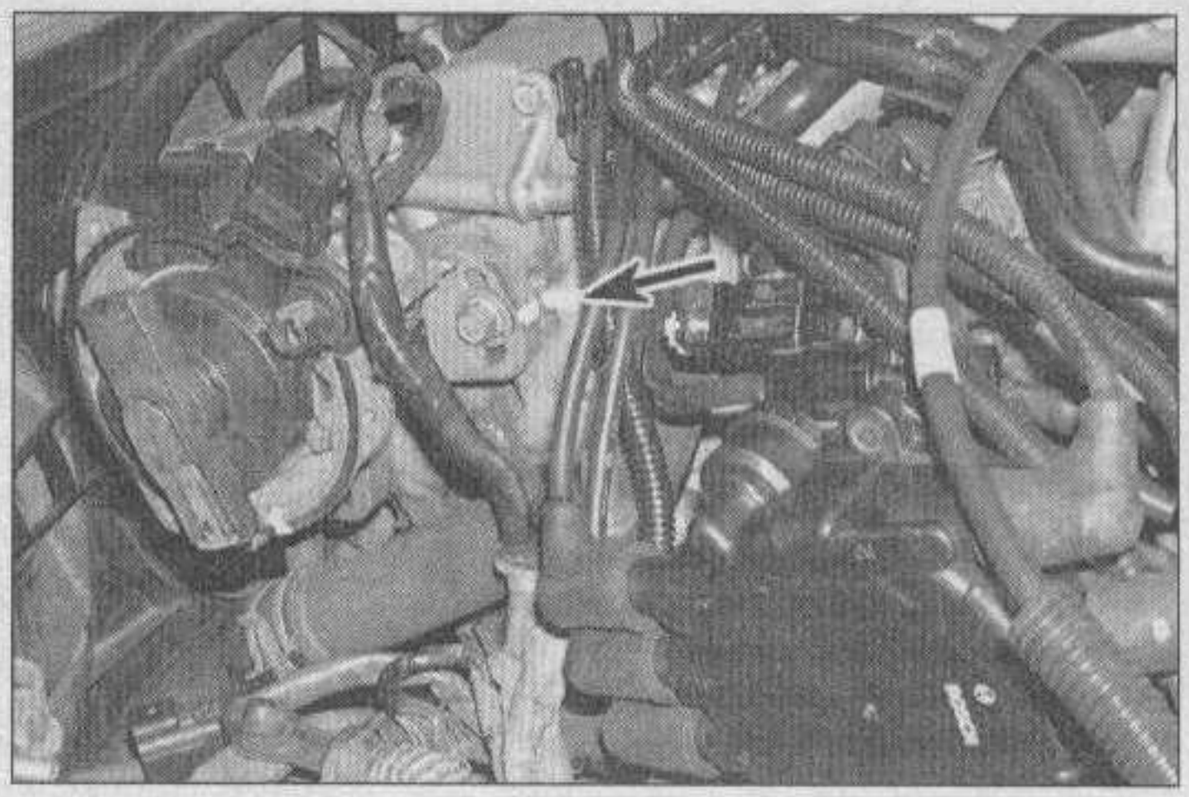
1 Detach the cable from the negative battery terminal. **Caution:** *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*
2 Detach any clamps and electrical connectors on the distributor. Mark the wires and hoses so they can be returned to their original locations.
3 Look for a raised number or letter on the distributor cap. This marks the location for the number-one cylinder spark plug wire terminal. If the cap does not have a mark for the number-one terminal, locate the number-one spark plug and trace the wire back to the terminal on the cap.
4 Remove the distributor cap (see Chapter 1) and turn the engine over until the rotor is pointing toward the number-one spark plug terminal (see the TDC locating procedure in Chapter 2A or 2B).
5 Make a mark on the edge of the distributor base directly below the rotor tip **(see**



7.15 Coil pack mounting bolts (four-cylinder engine shown, V6 similar)



9.5a Make a mark on the distributor body directly underneath the rotor tip



9.5b Mark the position of the distributor body in relation to the cylinder head (arrows) using white paint

illustration) and in line with it. Also, mark the distributor base and the cylinder head to ensure the distributor is installed correctly **(see illustration)**.

6 If not already done, unplug the distributor connector.

7 Remove the distributor hold-down bolt(s) and pull out the distributor. **Caution:** *Do not turn the crankshaft while the distributor is out of the engine, or the alignment marks will be useless.*

Installation

Note: *If the crankshaft has been moved while the distributor is out, the number-one piston must be repositioned at TDC. This can be done by feeling for compression pressure at the number-one plug hole as the crankshaft is turned. Once compression is felt, align the ignition timing mark with the pointer.*

8 Install a new O-ring on the distributor housing.

9 Insert the distributor into the cylinder head in exactly the same relationship to the head that it was when removed. **Note:** *The lugs on the end of the distributor and the corresponding notches in the camshaft end are offset to eliminate the possibility of installing the distributor 180-degrees out of phase.*

10 Recheck the alignment marks between the distributor base and the cylinder head to verify the distributor is in the same position it was in before removal. Also check the rotor to see if it's aligned with the mark you made on the distributor.

11 Loosely install the hold-down bolt(s).

12 The remainder of installation is the reverse of removal. Check the ignition timing and tighten the distributor hold-down bolt(s) securely.

10 Charging system - general information and precautions

The charging system includes the alternator, an internal voltage regulator, a charge indicator light, the battery, a fusible link and the wiring between all the components. The charging system supplies electrical power for the ignition system, the lights, the radio, etc. The alternator is driven by a drivebelt at the one end of the engine.

The alternator control system changes the voltage generated at the alternator in accordance with driving conditions. Depending upon electric load, vehicle speed, engine coolant temperature, accessories (air conditioning system, radio, cruise control etc.) and the intake air temperature, the system will adjust the amount of voltage generated, creating less load on the engine.

The purpose of the voltage regulator is to limit the alternator's voltage to a preset value. This prevents power surges, circuit overloads, etc., during peak voltage output.

The charging system doesn't ordinarily require periodic maintenance. However, the drivebelt, battery and wires and connections should be inspected at the intervals outlined in Chapter 1.

The dashboard warning light should come on when the ignition key is turned to On, but it should go off immediately after the engine is started. If it remains on, there is a malfunction in the charging system. Some vehicles are also equipped with a voltmeter. If the voltmeter indicates abnormally high or low voltage, check the charging system (see Section 11).

Be very careful when making electrical circuit connections to a vehicle equipped with an alternator and note the following:

a) When reconnecting wires to the alternator from the battery, be sure to note the polarity.

b) Before using arc welding equipment to repair any part of the vehicle, disconnect the wires from the alternator and the battery terminals.

c) Never start the engine with a battery charger connected.

d) Always disconnect both battery leads before using a battery charger.

e) The alternator is turned by an engine drivebelt which could cause serious injury it your hands, hair or clothes become entangled in it with the engine running.

f) Because the alternator is connected directly to the battery, it could arc or cause a fire if overloaded or shorted out.

g) Wrap a plastic bag over the alternator and secure it with rubber bands before steam cleaning the engine.

11 Charging system check

Refer to illustration 11.1

1 If a malfunction occurs in the charging circuit, do not immediately assume that the alternator is causing the problem. First, check the following items:

a) Make sure the battery cable clamps, where they connect to the battery, are clean and tight.

b) Test the condition of the battery (see Section 3). If it does not pass all the tests, replace it with a new battery.

c) Check the external alternator wiring and connections.

d) Check the drivebelt condition and tension (see Chapter 1).

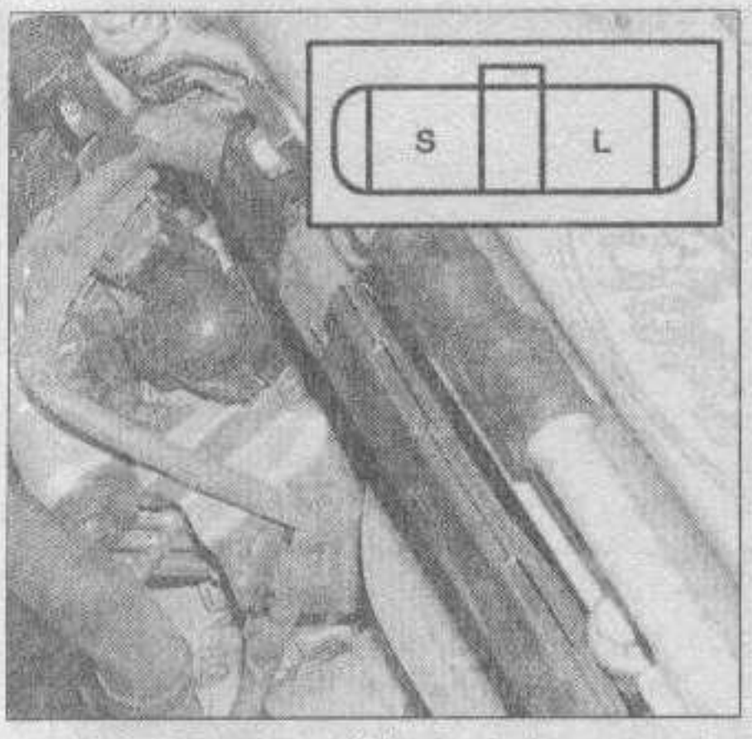
e) Check the alternator mounting bolts for tightness.

f) Run the engine and check the alternator for abnormal noise.

g) Check the MAIN (100 amp) and ENG INJ (30 amp) fuses in the engine compartment fuse box (see Chapter 12). If they're burned, determine the cause and repair the circuit.

h) Check the charge light on the dash. It should illuminate when the ignition key is turned ON (engine not running). If it does not, disconnect the 2-terminal connector from the back of the alternator and ground terminal L. The charge light should illuminate **(see illustration)**. *If it does not, check the 15 amp METER fuse. If it's blown, replace it. If it isn't blown, check the CHARGE light bulb.*

2 With the ignition key ON (engine not run-



11.1 Disconnect the 2-pin harness connector on the back of the alternator and ground the L terminal to activate the charge light - DO NOT ground terminal S

ning), check the voltage at the back of the alternator with no accessories (blower fan, radio, cigarette lighter, cooling fan, etc.) operating.

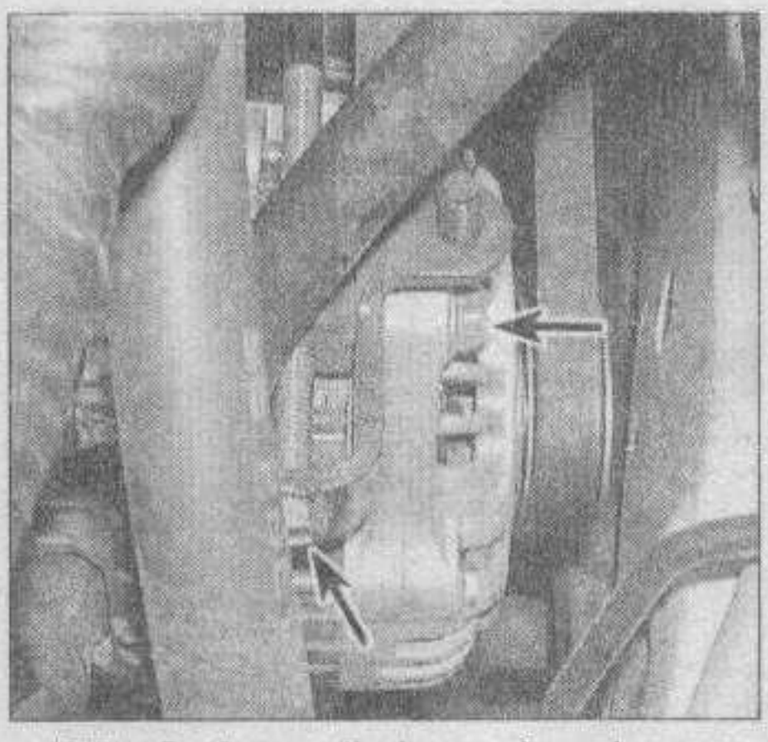
a) B and S terminals: battery voltage.
b) L terminal: approximately 1 volt.

3 Start the engine, let it idle and check the battery voltage again.

a) B and S terminals: 14.1 to 14.7 volts.
b) L terminal: 13.2 to 13.8 volts.

4 Load the battery and observe the charging voltage. Turn on the high beam headlights, the A/C blower on HIGH, the windshield wipers and the radio. The voltage at the B terminal should drop and then come back up as each accessory is selected. If the charging system is working properly the voltage should stay above 13.5 volts. If the voltage drops below 13 volts, the charging system is weak or defective.

5 Lower the engine rpm back to idle and observe the charging voltage. The charging voltage should not drop below 13 volts with the decrease in engine rpm. Apply the brakes and observe the charging voltage at idle. It should remain above 13 volts. **Note:** *Some smaller amperage alternators may drop below 13 volts but, if they are in good condition, they will regulate the charging voltage to normal.*



12.5a On four-cylinder engines, loosen the lock bolt and adjusting bolt located at the top of the alternator . . .

6 Turn off all the electrical loads (headlights, blower motor, the windshield wipers and the radio), run the engine at 1600 rpm and watch the charging voltage rise. It should not rise above 15 volts. **Note:** *Cold temperatures will cause the voltage readings to increase slightly while hot temperatures will lower the charging system voltage readings.*

7 If the charging voltage does not exhibit distinct changes when engine rpm increases and accessory loads are added, the voltage regulator is defective. If the charging voltages are low and the drivebelts and battery are all in good condition, the alternator is defective. In this situation, replace the alternator and voltage regulator as a single unit.

12 Alternator - removal and installation

Removal

Refer to illustrations 12.5a, 12.5b, 12.5c and 12.5d

1 Detach the cable from the negative terminal of the battery. **Caution:** *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

12.5b . . . then loosen the pivot bolt at the bottom (arrows)

2 Mark and detach the electrical connectors and any ground straps from the alternator.

Four-cylinder engine

3 Remove the front transverse crossmember for access (see Chapter 12). On some models it may also be necessary to remove the forward section of the exhaust system (see Chapter 4).

V6 engine

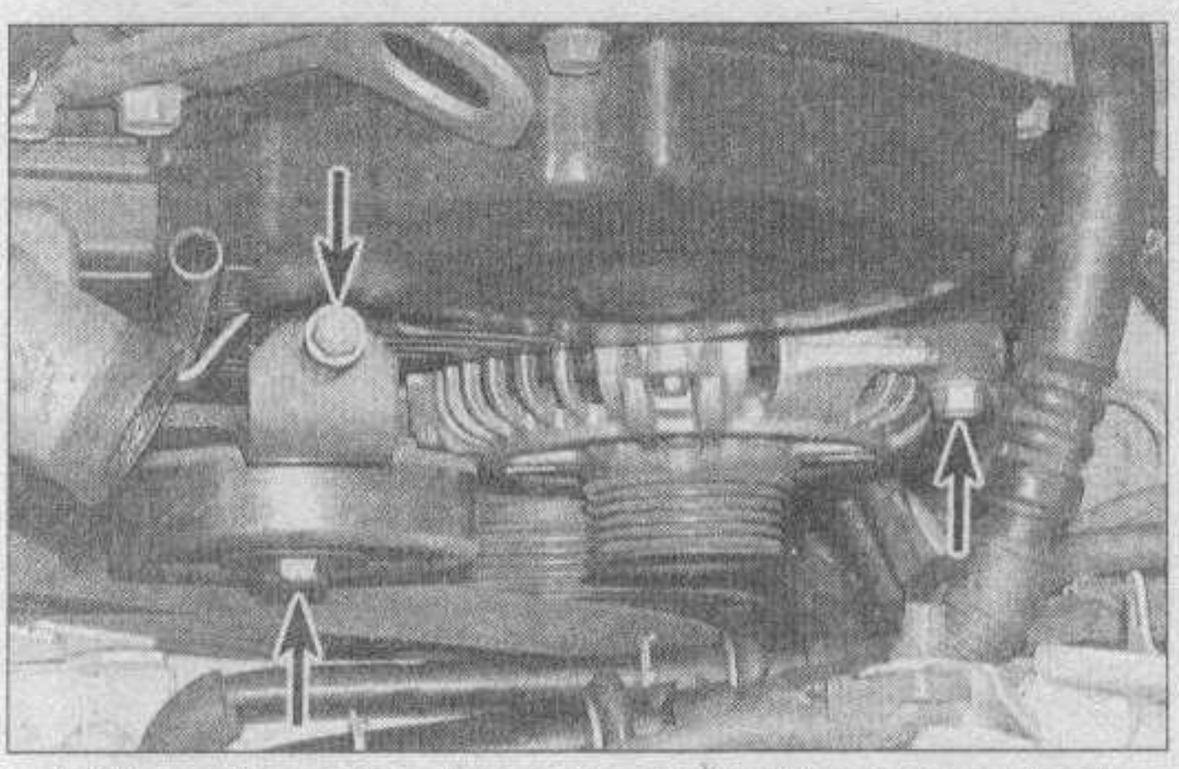
4 Remove the fresh air duct (see Chapter 4) and the splash shield under the front of the vehicle. Unbolt the air conditioning compressor and position it aside, but don't disconnect the hoses (see Chapter 3).

All models

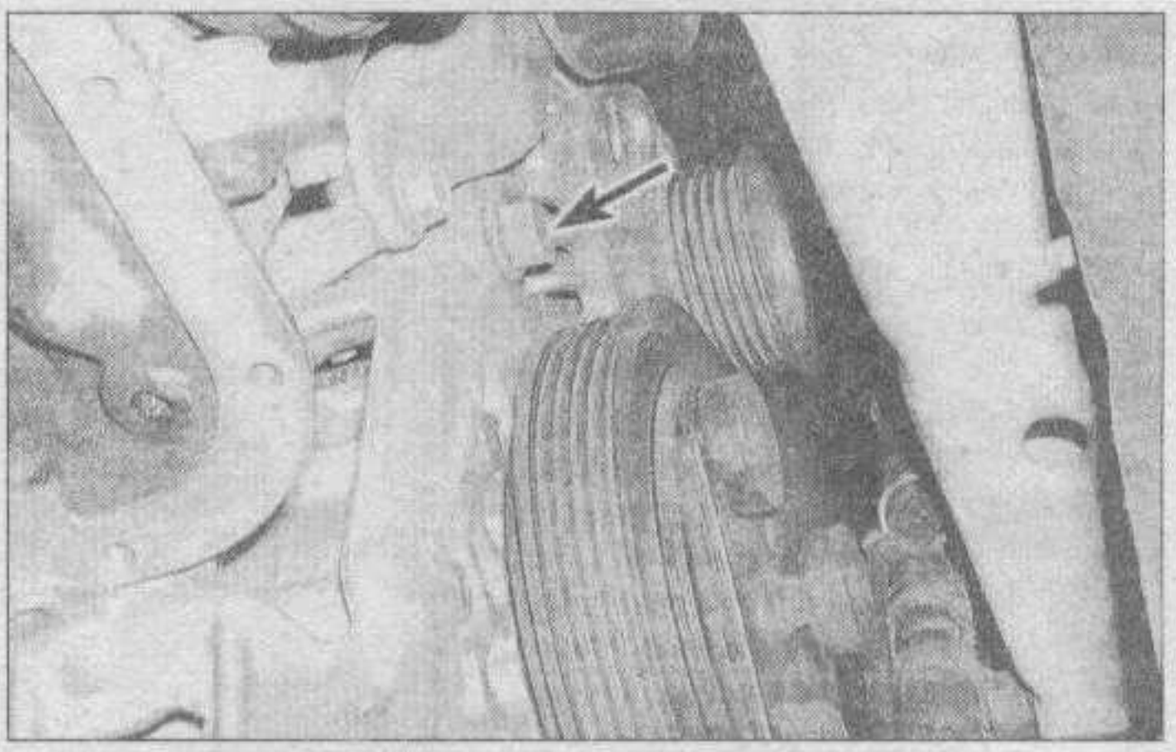
5 Loosen the alternator adjusting bolt and pivot bolts (four-cylinder) or the tensioner nut and adjusting bolt (V6), then detach the drivebelt **(see illustrations)**.

6 Remove the mounting bolts and separate the alternator from the engine.

7 If you are replacing the alternator, take the old one with you when purchasing a



12.5c On V6 engines, loosen the drivebelt tensioner nut and adjuster bolt (left arrows) and the upper mounting bolt (right arrow) . . .



12.5d . . . and the lower mounting bolt (arrow)

replacement unit. Make sure the new/rebuilt unit looks identical to the old alternator. Look at the terminals - they should be the same in number, size and location as the terminals on the old alternator. Finally, look at the identification numbers - they will be stamped into the housing or printed on a tag attached to the housing. Make sure the numbers are the same on both alternators.

8 Many new/rebuilt alternators DO NOT have a pulley installed, so you may have to switch the pulley from the old unit to the new/rebuilt one. When buying an alternator, find out the store's policy regarding pulleys; some stores will perform this service free of charge.

Installation

9 Installation is the reverse of removal.

10 After the alternator is installed, adjust the drivebelt tension (see Chapter 1).

11 Check the charging voltage to verify proper operation of the alternator (see Section 11).

13 Starting system - general information and precautions

The starting system consists of the battery, the starter motor, the starter solenoid and the wires connecting them. The solenoid is mounted directly on the starter motor.

The solenoid/starter motor assembly is installed on the upper part of the engine, next to the transaxle bellhousing.

When the ignition key is turned to the Start position, the starter solenoid is actuated through the starter control circuit. The starter solenoid then connects the battery to the starter. The battery supplies the electrical energy to the starter motor, which does the actual work of cranking the engine.

The starter motor on vehicles equipped with manual transaxles can only be operated when the clutch pedal is depressed; the starter on vehicles equipped with automatic transaxles can only be operated when the selector lever is in Park or Neutral.

Always observe the following precautions when working on the starting system:

a) *Excessive cranking of the starter motor can overheat it and cause serious damage. Never operate the starter motor for more than 15 seconds at a time without pausing to allow it to cool for at least two minutes.*

b) *The starter is connected directly to the battery and could arc or cause a fire if mishandled, overloaded or shorted out.*

c) *Always detach the cable from the negative terminal of the battery before working on the starting system.*

14 Starter motor and circuit - check

Refer to illustration 14.4

1 If a malfunction occurs in the starting circuit, do not immediately assume that the starter is causing the problem. First, check the following items:

a) *Make sure the battery cable clamps, where they connect to the battery, are clean and tight.*

b) *Check the condition of the battery cables* (see Section 4). *Replace any defective battery cables with new parts.*

c) *Test the condition of the battery* (see Section 3). *If it does not pass all the tests, replace it with a new battery.*

d) *Check the starter solenoid wiring and connections. Refer to Chapter 12 wiring diagrams.*

e) *Check the starter mounting bolts for tightness.*

f) *Check the main fuse in the engine compartment fuse box* (see Chapter 12). *If they're burned, determine the cause and repair the circuit. Also, check the ignition switch circuit for correct operation* (see Chapter 12).

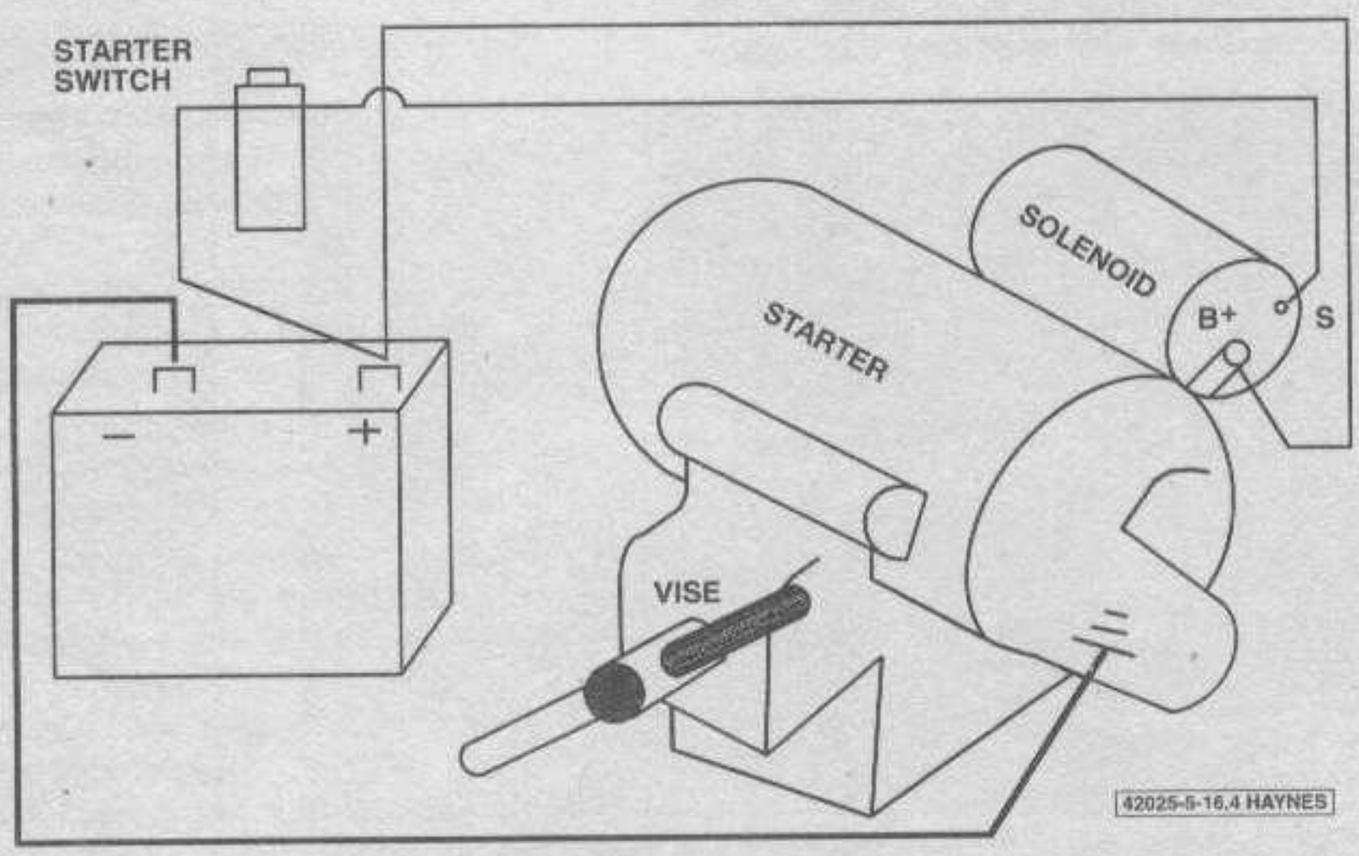
g) *Check the operation of the gear position switch (automatic transaxle) or clutch start circuit (manual transaxle). Make sure the shift lever is in PARK or NEUTRAL. (automatic transaxle) or the clutch pedal is pressed (manual transaxle). Refer to Chapter 7 for the gear position switch check and adjustment procedure. Refer to Chapter 12 wiring diagrams for the necessary circuit checks for the clutch activation system. These systems must operate correctly to provide battery voltage to the starter solenoid.*

h) *Check the operation of the starter interrupt relay. The starter interrupt relay is located in the fuse/relay box inside the engine compartment. Refer to Chapter 12 for relay testing procedures.*

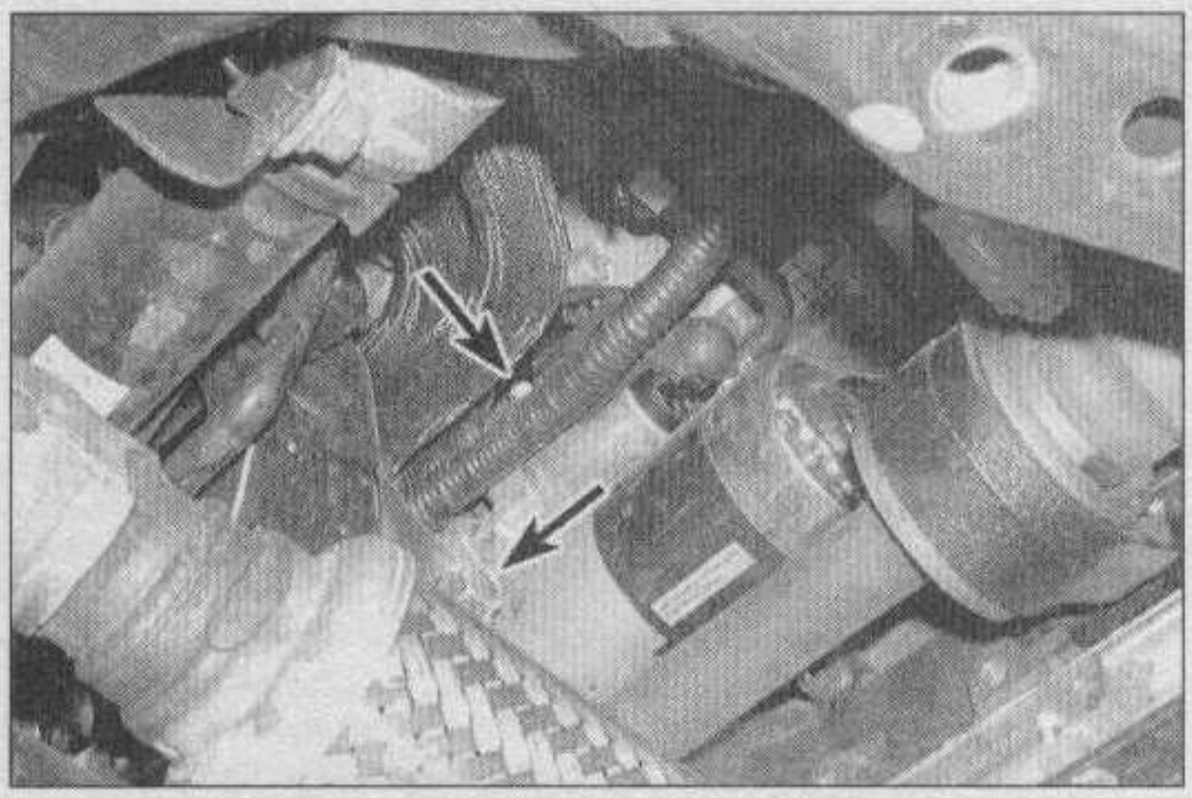
2 If the starter does not activate when the ignition switch is turned to the start position, check for battery voltage to the solenoid. This will determine if the solenoid is receiving the correct voltage signal from the ignition switch. Install a voltmeter to the starter solenoid "S" terminal while an assistant turns the ignition switch to the start position, read the voltmeter. It should indicate approximately battery voltage. If voltage is not available, refer to the wiring diagrams in Chapter 12 and check all the fuses and relays in series with the starting system. Also, check the starter interrupt relay for correct operation. Refer to Chapter 12 for the location of the fuel/relay box along with the relay checks. If voltage is available but there is no movement from the starter motor, remove the starter from the engine (see Section 15) and bench test the starter (see Step 4).

3 If the starter turns over slowly, check the starter cranking voltage and the current draw from the battery. This test must be performed with the starter assembly on the engine. Crank the engine over (for 10 seconds or less) and observe the battery voltage. It should not drop below 8.0 volts. If the starter motor exceeds these values, replace it with a new unit. There are several conditions that may affect the starter cranking potential. The battery must be in good condition and the battery cold-cranking rating must not be under-rated for the particular application. Be sure to check the battery specifications carefully. The battery terminals and cables must be clean and not corroded. Also, in cases of extreme cold temperatures, make sure the battery and/or engine block is warmed before performing the tests.

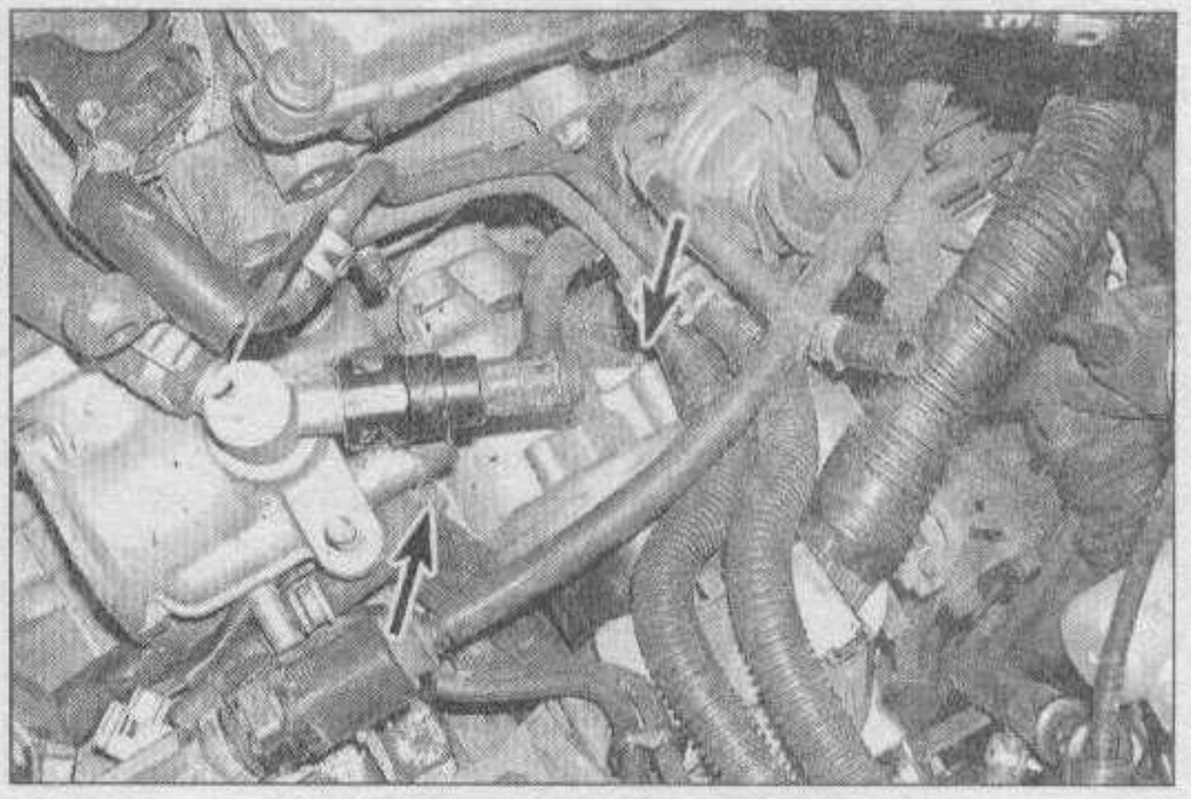
4 If the starter is receiving voltage but does not activate, remove and check the starter/solenoid assembly on the bench. Most likely the solenoid is defective. In some rare cases, the engine may be seized so be sure to try and rotate the crankshaft pulley (see Chapter 2A or 2B) before proceeding. With the starter/solenoid assembly mounted in a vise on the bench, install one jumper cable from the negative terminal (-) to the body of the starter **(see illustration)**. Install another



14.4 Starter motor bench testing details



15.7a Starter motor mounting bolts (arrows) (four-cylinder engine)



15.7b Starter motor mounting bolts (V6 engine with automatic transaxle)

jumper cable from the positive terminal (+) on the battery to the B+ terminal on the starter. Install a starter switch and apply battery voltage to the solenoid S terminal (for 10 seconds or less) and observe the solenoid plunger, shift lever and overrunning clutch extend and rotate the pinion drive. If the pinion drive extends but does not rotate, the solenoid is operating but the starter motor is defective. If there is no movement but the solenoid clicks, the solenoid and/or the starter motor is defective. If the solenoid plunger extends and rotates the pinion drive, the starter/solenoid assembly is working properly.

15 Starter motor - removal and installation

Refer to illustrations 15.7a and 15.7b

1 Detach the cable from the negative terminal of the battery. **Caution:** *The radio in your vehicle is equipped with an anti-theft system. Make sure you have the correct activation code before disconnecting the battery.*

2 Remove the air intake duct and the air cleaner housing (see Chapter 4).

Four-cylinder engines

3 If you're working on a four-cylinder engine, remove the bracket that runs between the intake manifold and the starter motor.

V6 engines with automatic transaxle

4 Detach the shift cable from the lever on the transaxle (see Chapter 7B).

5 Unplug the electrical connectors from the Throttle Position Sensor (TPS), the knock sensor, the fuel injector harness, the distributor, and any other electrical connectors that would interfere with starter removal. Move the wiring harness aside.

6 Remove the transmission shift cable bracket (see Chapter 7B).

All models

7 Clearly label, then disconnect the wires from the terminals on the starter motor solenoid **(see illustrations)**. Disconnect any clips securing the wiring to the starter.

8 Remove the mounting bolts and detach the starter.

9 Installation is the reverse of removal.

16 Starter solenoid - removal and installation

Refer to illustrations 16.3 and 16.4

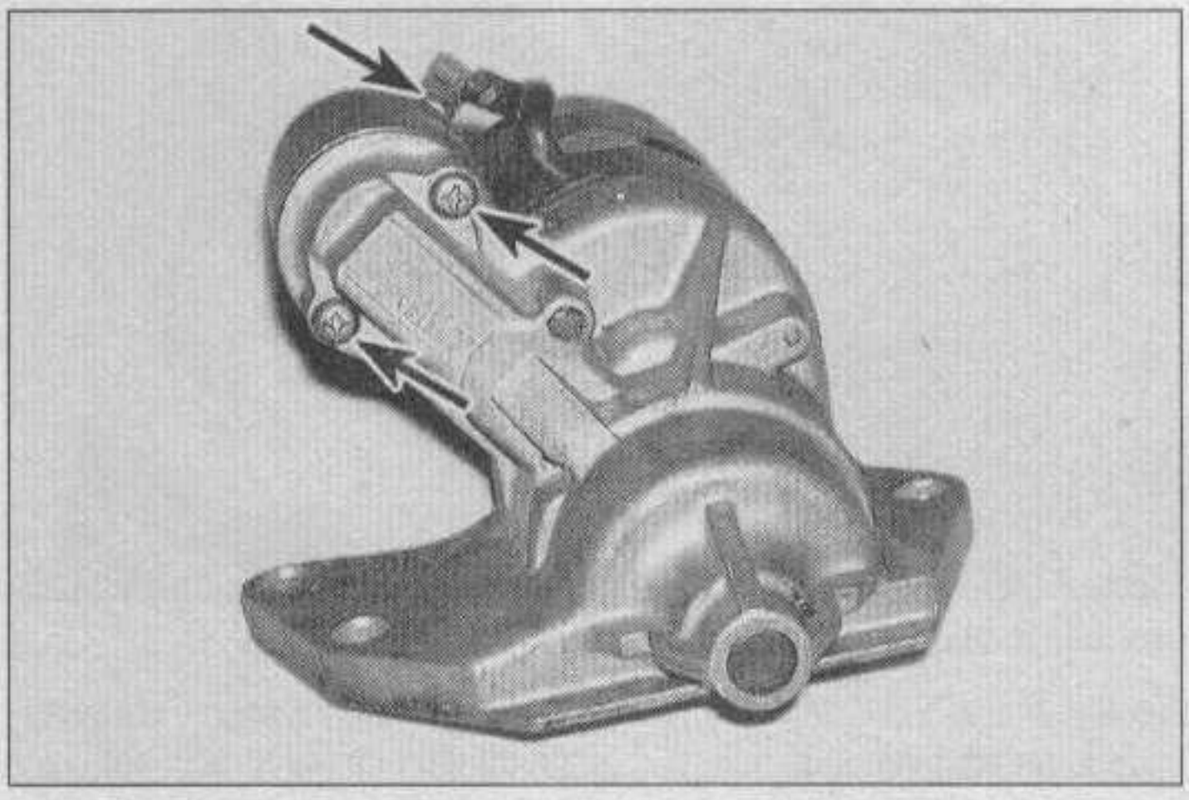
1 Disconnect the cable from the negative terminal of the battery. **Caution:** *The radio in your vehicle is equipped with an anti-theft system. Make sure you have the correct activation code before disconnecting the battery.*

2 Remove the starter motor (see Section 15).

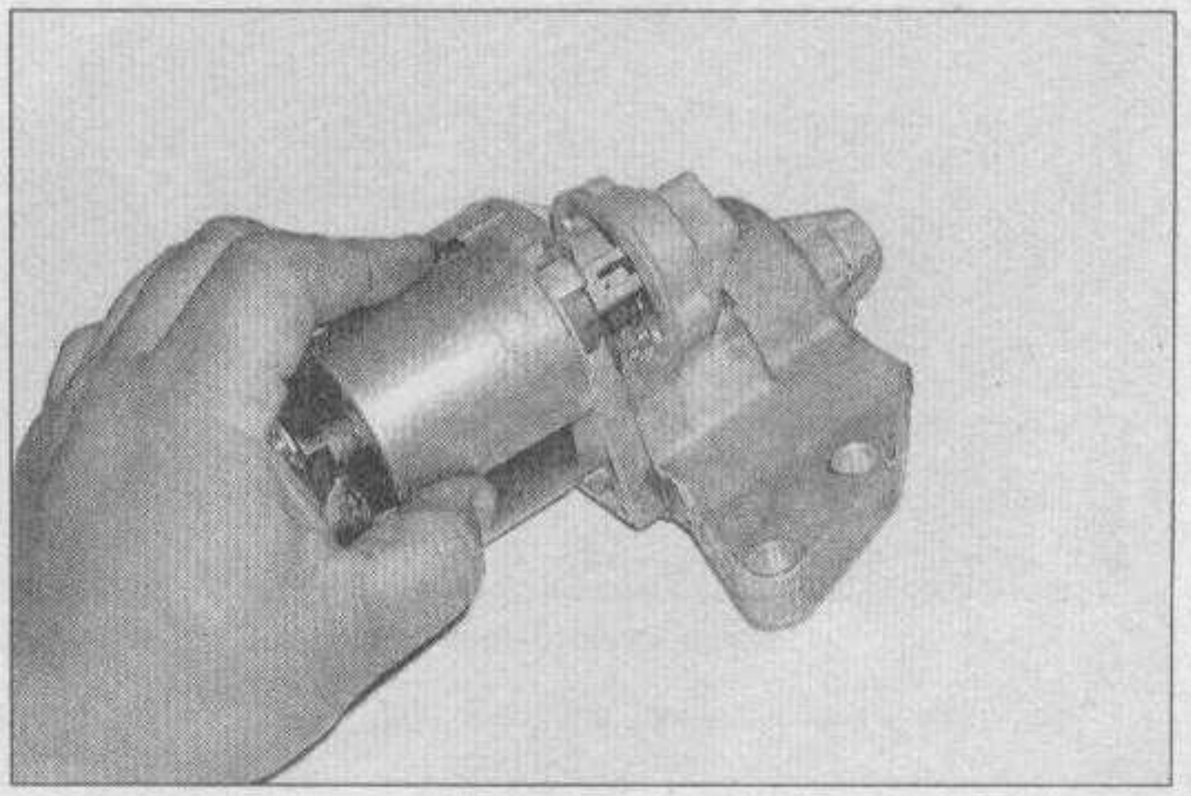
3 Disconnect the large wire from the solenoid to the starter motor terminal **(see illustration)**.

4 Remove the solenoid mounting screws and take the solenoid off the starter motor **(see illustration 16.3 and the accompanying illustration)**.

5 Installation is the reverse of removal. Be sure to apply a slight amount of grease to the solenoid lever and the plunger before installation.



16.3 Remove the screws (arrows) that retain the solenoid to the gear housing . . .



16.4 . . . and pull the solenoid away from the starter

Chapter 6
Emissions and engine control systems

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1 General information

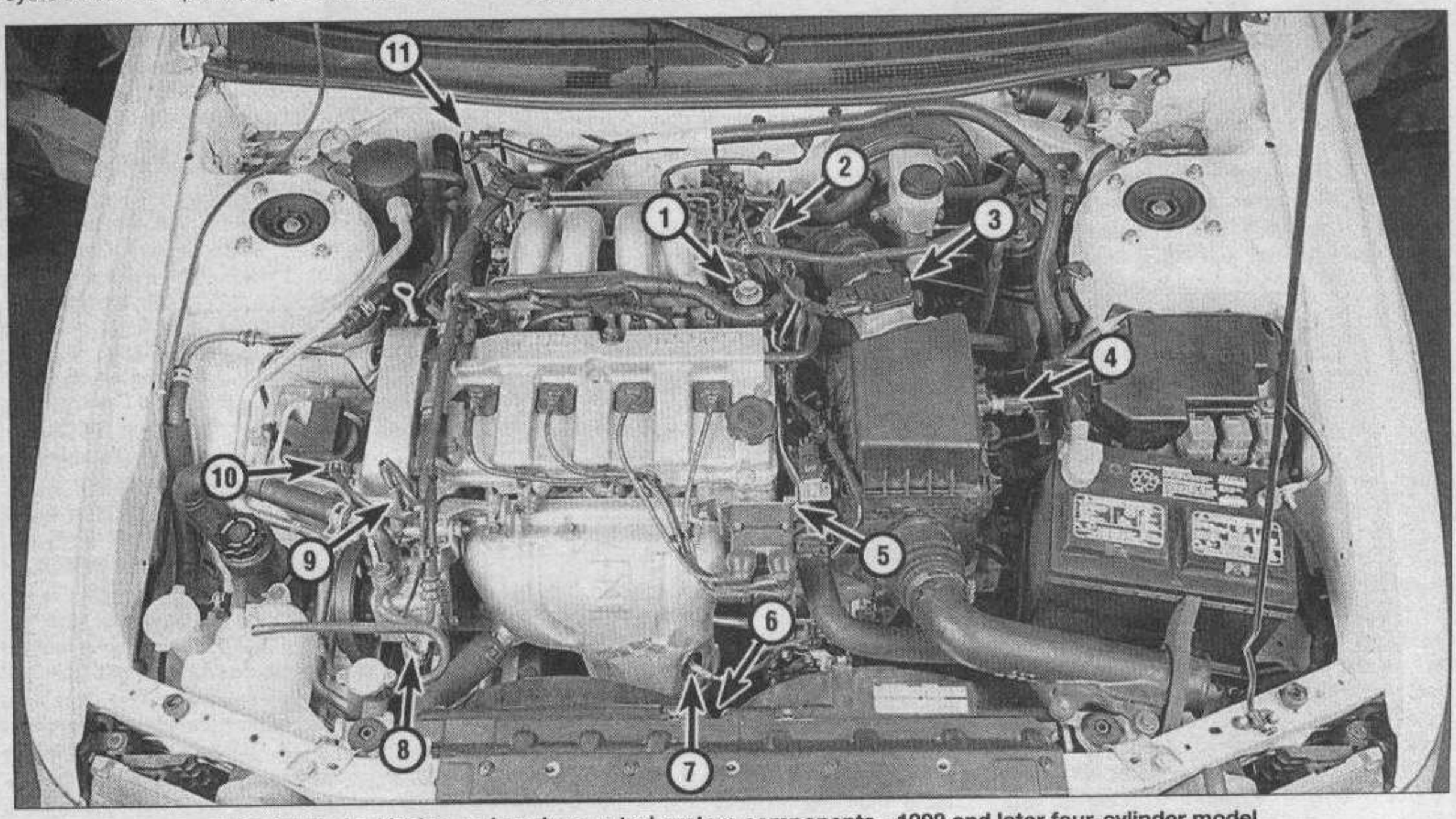
Refer to illustrations 1.1a, 1.1b and 1.5

To prevent pollution of the atmosphere from incompletely burned and evaporating gases, and to maintain good driveability and fuel economy, a number of emission control systems are incorporated **(see illustrations)**. They include the:

On-Board Diagnostic (OBD) system
Electronic engine controls
Exhaust Gas Recirculation (EGR) system
Evaporative Emissions Control (EVAP) system
Positive Crankcase Ventilation (PCV) system
Catalytic converter

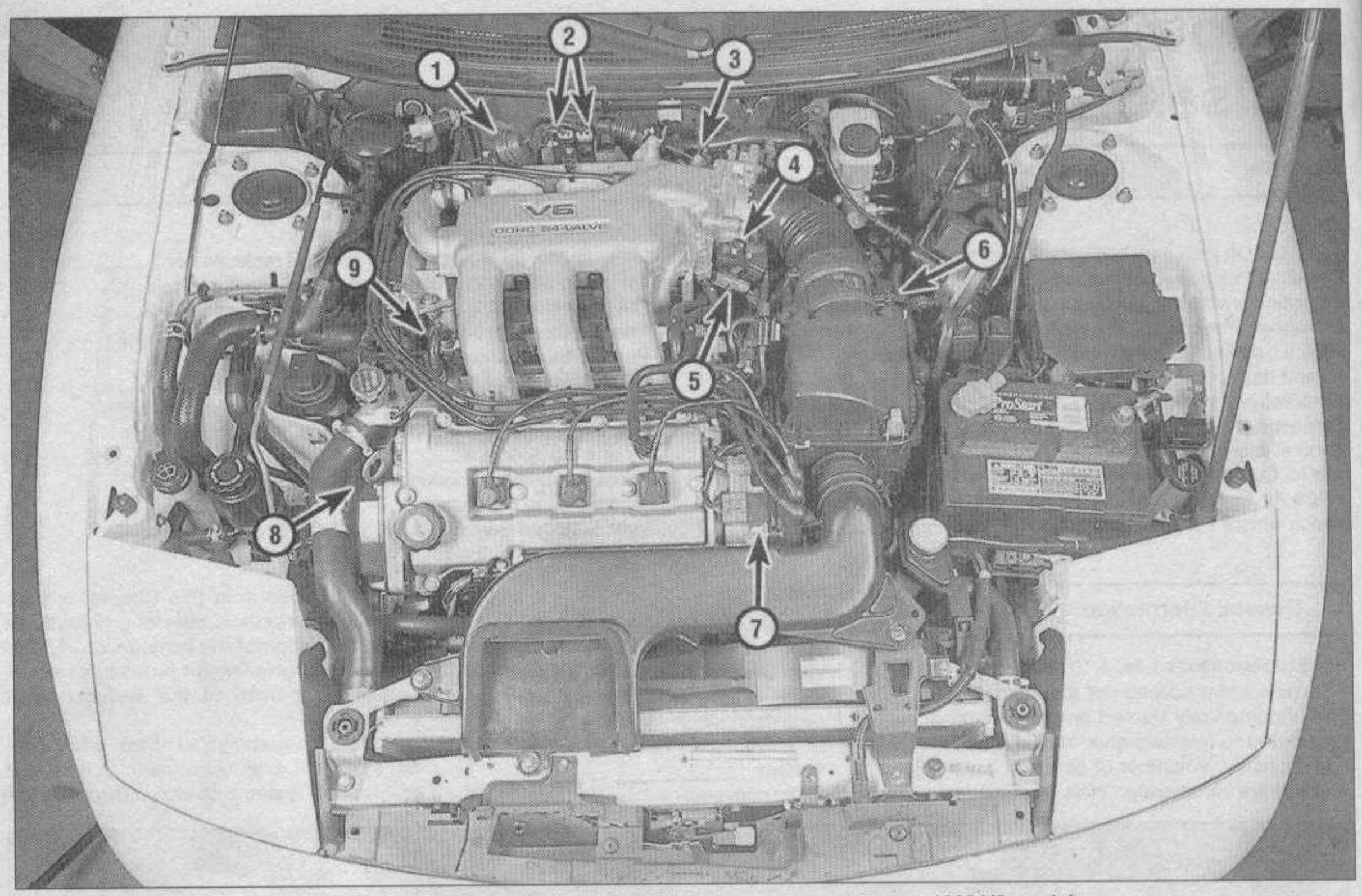
The Sections in this Chapter include general descriptions, checking procedures within the scope of the home mechanic and component replacement procedures (when possible) for each of the systems listed above.

Before assuming that an emissions control system is malfunctioning, check the fuel and ignition systems carefully. The diagnosis



1.1a Typical emission and engine control system components - 1998 and later four-cylinder model

1 *Throttle Position Sensor (TPS) (on the side of the throttle body)*
2 *Idle Air Control (IAC) valve*
3 *Mass Air Flow (MAF) sensor*
4 *Intake Air Temperature (IAT) sensor*
5 *Coolant temperature sensor*
6 *Heated oxygen sensor - downstream*
7 *Heated oxygen sensor - upstream*
8 *Power Steering Pressure (PSP) switch*
9 *Electrical connector for the crankshaft position sensor*
10 *Camshaft position sensor*
11 *Exhaust Gas Recirculation (EGR) boost sensor*



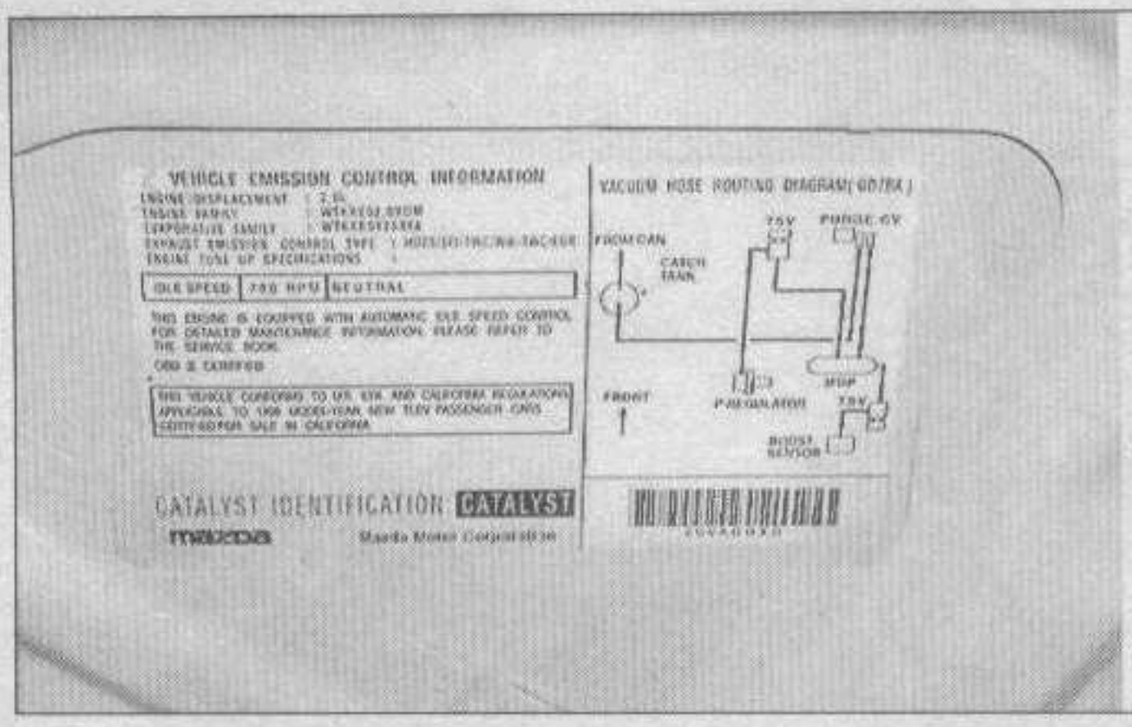
1.1b Typical emission and engine control system components - 1993 V6 model

1 *Variable Resonance Induction System (VRIS) actuator no. 1*
2 *VRIS solenoids*
3 *VRIS actuator no. 2*
4 *Throttle Position Sensor (TPS)*
5 *Idle Air Control (IAC) valve*
6 *Mass Air Flow (MAF) sensor*
7 *Crankshaft position sensor no. 1*
8 *Crankshaft position sensor no. 2 (next to crank pulley)*
9 *Coolant temperature sensor*

of some emission control devices requires specialized tools, equipment and training. If checking and servicing become too difficult or if a procedure is beyond your ability, consult a dealer service department or other repair shop. Remember, the most frequent cause of emissions problems is simply a loose or broken wire or vacuum hose, so always check the hose and wiring connections first.

This doesn't mean, however, that emissions control systems are particularly difficult to maintain and repair. You can quickly and easily perform many checks and do most of the regular maintenance at home with common tune-up and hand tools. **Note**: *Because of a Federally mandated extended warranty which covers the emissions control system components, check with your dealer about warranty coverage before working on any emissions-related systems. Once the warranty has expired, you may wish to perform some of the component checks and/or replacement procedures in this Chapter to save money.*

Pay close attention to any special precautions outlined in this Chapter. It should be noted that the illustrations of the various systems may not exactly match the system installed on your vehicle because of changes made by the manufacturer during production or from year-to-year.



1.5 The Vehicle Emission Control Information (VECI) label in the engine compartment describes your vehicle's emission devices and vacuum line routing

A Vehicle Emissions Control Information (VECI) label is attached to the underside of the hood **(see illustration)**. This label contains important emissions specifications and adjustment information. Part of this label, the Vacuum Hose Routing Diagram, provides a vacuum hose schematic with emissions components identified. When servicing the engine or emissions systems, the VECI label and the vacuum hose routing diagram in your particular vehicle should always be checked for up-to-date information.

2.1 Digital multimeters can be used for testing all types of circuits; because of their high impedance, they are much more accurate than analog meters for measuring low-voltage computer circuits

2 On Board Diagnostic (OBD) system and trouble codes

Diagnostic tool information

Refer to illustrations 2.1 and 2.2

1 A digital multimeter is necessary for checking fuel injection and emission related components **(see illustration)**. A digital volt-ohmmeter is preferred over the older style analog multimeter for several reasons. The analog multimeter cannot display the volts-ohms or amps measurement in hundredths and thousandths increments. When working with electronic circuits which are often very low voltage, this accurate reading is most important. Another good reason for the digital multimeter is the high impedance circuit. The digital multimeter is equipped with a high resistance internal circuitry (10 million ohms). Because a voltmeter is hooked up in parallel with the circuit when testing, it is vital that none of the voltage being measured should be allowed to travel the parallel path set up by the meter itself. This dilemma does not show itself when measuring larger amounts of voltage (9 to 12 volt circuits) but if you are measuring a low voltage circuit such as the oxygen sensor signal voltage, a fraction of a volt may be a significant amount when diagnosing a problem.

2 Hand-held scanners are the most powerful and versatile tools for analyzing engine management systems used on later model vehicles **(see illustration)**. Each brand scan tool must be examined carefully to match the year, make and model of the vehicle you are working on. Often, interchangeable cartridges are available to access the particular manufacturer (Ford, GM, Chrysler, etc.). Some manufacturers will specify by continent (Asia, Europe, North America, etc.).

3 With the arrival of the current Federally mandated emission control system (OBD-II), a specially designed scanner must be used. At this time, several manufacturers offer OBD-II scan tools for the home mechanic. Ask the counterperson at a local auto parts store for additional information concerning availability.

2.2 Scanners like the Actron Scantool and the AutoXray XP240 are powerful diagnostic aids - programmed with comprehensive diagnostic information, they can tell you just about anything you want to know about your engine management system

OBD-I system (1995 and earlier models)

General information

Note: *See the* Troubleshooting *section at the beginning of this manual for some basic diagnostic aids.*

4 The ECM (computer) has a built-in self-diagnosis system, or On Board Diagnosis (OBD) system, which detects malfunctions in the system sensors and alerts the driver by illuminating a CHECK ENGINE warning light on the instrument panel. The On Board Diagnosis (OBD) system is equipped with a computer which stores the failure code until the diagnostic system is cleared or the malfunction is repaired.

5 The CHECK ENGINE warning light should come on when the ignition switch is placed in the ON position, this checks the bulb for proper operation. When the engine is started the warning light should go out. If the light remains on, the diagnostic system has detected a malfunction or abnormality in the system.

Obtaining OBD-I trouble codes

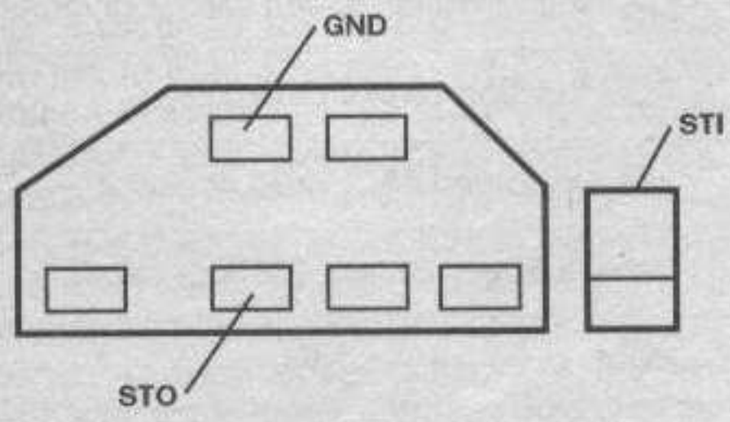
Refer to illustrations 2.6a and 2.6b

6 To access the self-diagnostic system, locate the diagnostic connector on the left (drivers) side inner fender panel, near the battery. Two types of diagnostic connectors are used, depending on model, engine, transaxle, etc. **(see illustrations)**. Connect a short jumper wire to the Self-Test Input (STI) and the Self-Test Ground (GND) terminals of the connector. If desired, an analog voltmeter or 12-volt test light may be connected to the Self-Test Output (STO) terminal and battery ground. The codes will be indicated on the voltmeter (as needle sweeps) or the test light, as well as the CHECK ENGINE light.

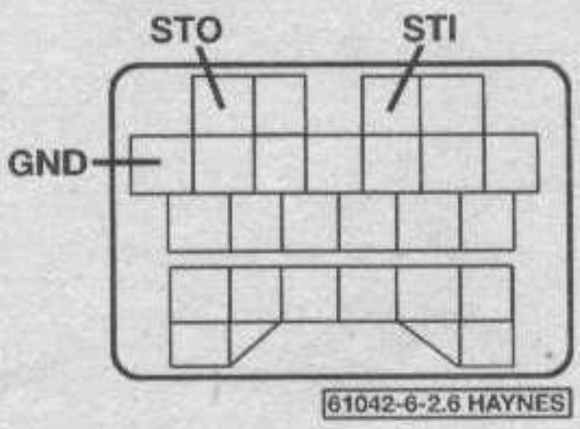
7 Make sure the battery voltage is greater than 11 volts, the transaxle is in Neutral, the accessories are off, the throttle valve is closed and the engine is at normal operating temperature, then turn the ignition switch to the ON position but do not start the engine.

8 The diagnostic code is the number of flashes indicated on the CHECK ENGINE light. If no codes are stored, the CHECK ENGINE light will come on for a few moments, then go out. If any malfunction has been detected, the light will blink the first digit(s) of the code at a long interval(s) and then blink the second digit of the code at short interval(s). For example, a code 34 (IAC valve) will first blink three long flashes and then pause and blink four quick flashes. **Note:** *If the code is simply a single digit number, the CHECK ENGINE light will flash in the quick mode.*

9 The accompanying tables indicate the diagnostic code and the circuit or system affected.



2.6a This type connector is used on four-cylinder models with an automatic transaxle - bridge the STI and GND terminals with a jumper wire to access the three-digit trouble codes (OBD-I system)



2.6b Bridge the STI and GND terminals with a jumper wire to access two-digit OBD-I trouble codes

OBD-I trouble codes (two-digit codes)

Trouble code	Circuit or system
02	Crankshaft Position (CKP) sensor or circuit
03	Camshaft position (CMP) sensor or circuit
08	Mass Airflow (MAF) sensor or circuit
09	Coolant temperature sensor or circuit
11	Intake Air Temperature (IAT) sensor or circuit
12	Throttle Position Sensor (TPS) or circuit
15	Oxygen sensor or circuit
16	EGR valve position sensor or circuit
17	Oxygen sensor (check the fuel and ignition system performance)
25	Fuel Pressure Regulator Control Solenoid or circuit
26	Solenoid valve (purge control) or circuit
28	EGR control solenoid or circuit
29	EGR solenoid vent (California) or circuit
34	Idle Air Control (IAC) valve or circuit
67	Cooling fan relay or circuit

OBD-I trouble codes (three-digit codes)

Trouble code	Circuit or system
111	System pass
112, 113	Intake Air Temperature (IAT) sensor or circuit
116, 117, 118	Engine Coolant Temperature (ECT) sensor or circuit
121, 122, 123	Throttle Position Sensor (TPS) or circuit
157, 158, 159	Mass Air Flow (MAF) sensor or circuit
172, 173, 179, 181	Heated oxygen sensor (HO2S) or circuit
211, 212, 213	Ignition system
214, 244	Camshaft Position (CMP) sensor or circuit
327, 332, 337	EGR function sensor or circuit
411, 412	Idle Air Control (IAC) valve or circuit
452	Vehicle Speed Sensor (VSS) or circuit
511, 512, 513	PCM
519, 521	Power Steering Pressure (PSP) switch or circuit
522	Transmission range sensor or circuit
536	Brake On/Off (BOO) switch or circuit

Trouble code	Circuit or system
538	Dynamic response test
539	A/C sensor or circuit
554	Pressure regulator solenoid valve or circuit
559	A/C relay or circuit
563	Cooling fan relay (high speed) or circuit
564	Cooling fan relay (low speed) or circuit
565	Purge control solenoid valve or circuit
571	EGR solenoid valve (vent) or circuit
572	EGR solenoid valve (vacuum) or circuit
998	PCM

Clearing OBD-I codes

10 After the self-diagnosis check, remove the jumper wire and close the cover on the diagnostic connector. Check the indicated system or component or take the vehicle to a dealer service department or other qualified repair shop to have the malfunction repaired.

11 After repairs have been made, the diagnostic code must be canceled by detaching the cable from the negative terminal of the battery, then depressing the brake pedal for more than five seconds.

12 After cancellation, perform a road test and make sure the warning light does not come on. If the original trouble code is repeated, additional repairs are required.

OBD-II system (1996 and later models)

General information

Refer to illustration 2.13

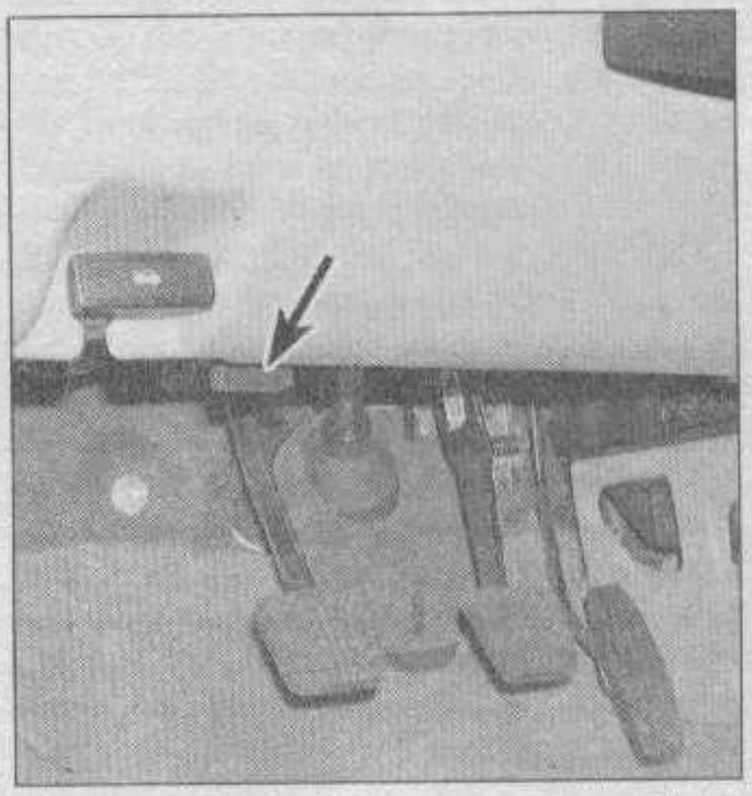
Note 1: *See the* Troubleshooting *section at the beginning of this manual for some basic diagnostic aids.*

Note 2: *This procedure does not include the complete list of diagnostic codes or the code extracting procedure for 1996 or later models equipped with the OBD-II system. The diagnostic system and trouble codes are only accessible using specialized equipment. The OBD-II codes indicated in the text are designed and mandated by the EPA for all 1996 and later OBD-II vehicles produced by automobile manufacturers. These generic trouble codes do not include the manufacturer's specific trouble codes. Consult a dealer service department or other qualified repair shop for additional information on manufacturer-specific trouble codes.*

13 Beginning in 1994, Ford Motor Company began to manufacture a second generation self-diagnosis system specified by the CARB and EPA regulations called On Board Diagnosis (OBD) II. This system incorporates a series of diagnostic monitors that detect and identify emissions systems faults and store the information in the computer memory. This updated system also tests sensors and output actuators, diagnoses drive cycles, freezes data and clears codes. This powerful diagnostic computer must be accessed using the new OBD-II scan tool and 16 pin Data Link Connector (DLC) located under the driver's dash area **(see illustration)**. This system consists of an onboard computer, known as the Powertrain Control Module (PCM), and information sensors, which monitors various functions of the engine and sends data to the PCM. Based on the data and the information programmed into the computer's memory, the PCM generates output signals to control various engine functions via control relays, solenoids and other output actuators. **Note:** *Although Ford started producing OBD-II in 1994, this updated system was first used on models covered by this manual in 1996.*

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

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



2.13 The OBD-II Data Link Connector (DLC) (arrow) is located under the instrument panel on the driver's side

Obtaining OBD-II trouble codes

16 On OBD-II systems, the PCM will illuminate the Malfunction Indicator Light on the dash if it recognizes a component fault for two consecutive drive cycles. It will continue to set the light until the PCM does not detect any malfunction for three or more consecutive drive cycles. Because the OBD-II system requires a scan tool to reset the light, if the tool is not available for diagnostics, have the system checked by a dealer service department or other qualified repair facility.

17 The diagnostic codes for the OBD-II systems can be extracted from the PCM using a special scan tool that is programmed to interface with this system by plugging into the Data Link Connector (DLC). If the tool is not available, have the vehicle checked at a dealer service department or other qualified repair shop.

Clearing OBD-II codes

18 To clear the codes from the PCM memory, install the OBD-II scan tool, scroll the menu for the function that describes "CLEARING CODES' and follow the prescribed method for that particular scan tool. If necessary, have the codes cleared by a dealer service department or other qualified repair facility. **Caution:** *Do not disconnect the battery from the vehicle to clear the codes. This will erase stored operating parameters from the KAM (Keep Alive Memory) and cause the engine to run rough for a period of time while the computer relearns the information.*

OBD-II trouble codes

Trouble code	Circuit or system
P0100, P0102, P0103	Mass Airflow (MAF) sensor or circuit fault
P0110, P0112, P0113	Inlet Air Temperature (IAT) sensor or circuit fault
P0115, P0117, P0118	Engine Coolant Temperature (ECT) sensor or circuit fault
P0120, P0122, P0123	Throttle Position Sensor (TPS) or circuit fault
P0125	Excessive time to enter closed loop
P0130, P0131, P0150	Heated O2 sensor or circuit fault
P0133, P0134, P0140	Heated O2 sensor slow response
P0154, P0160	Heated O2 sensor slow response
P0135, P0141, P0155	Heated O2 sensor heater or circuit fault
P0170, P0171	System fuel too lean
P0172, P0173	System fuel too rich
P0230, P0231, P0232	Fuel pump circuit fault
P0300	Random misfire detected
P0301	Cylinder number 1 misfire detected
P0302	Cylinder number 2 misfire detected
P0303	Cylinder number 3 misfire detected
P0304	Cylinder number 4 misfire detected
P0305	Cylinder number 5 misfire detected
P0306	Cylinder number 6 misfire detected
P0320	Ignition input circuit fault
P0335	Crankshaft position sensor or circuit fault
P0340	Camshaft position sensor or circuit fault
P0400	EGR flow fault
P0420, P0430	Catalyst system efficiency below threshold
P0440	EVAP system fault
P0443	EVAP purge solenoid or circuit fault
P0500, P0503	Vehicle Speed Sensor (VSS) or circuit fault
P0505	Idle Air Control (IAC) valve system fault
P0510	Idle switch fault

Trouble code	Circuit or system
P0552, P0553	Power Steering Pressure (PSP) switch or circuit fault
P0603	ECM Keep Alive Memory test error
P0605	ECM Read Only Memory test error
P0703	Brake On/Off (BOO) switch or circuit fault
P0704	Clutch pedal position switch or circuit fault
P0705	Transmission range sensor or circuit fault
P0710 thru P0760	Electronic transmission control system fault

Information sensors (OBD-I and II systems)

19 **Oxygen sensors (O2S)** - The O2S generates a voltage signal that varies with the difference between the oxygen content of the exhaust and the oxygen in the surrounding air.

20 **Crankshaft Position (CKP1) sensor** - The CKP1 sensor is mounted in the distributor on some models. It provides information on crankshaft position and the engine speed to the PCM. The PCM uses this information to determine fuel injection and ignition timing.

21 **Crankshaft position (CKP2) sensor** - The CKP2 sensor, used on later models, serves the same function as the CKP1 sensor, but its mounted near the crankshaft pulley rather than inside the distributor.

22 **Camshaft Position (CMP) sensor** - The CMP sensor produces a signal in which the PCM uses to identify number 1 cylinder and to time the sequential fuel injection.

23 **Engine Coolant Temperature (ECT) sensor** - The ECT sensor monitors engine coolant temperature and sends the PCM a voltage signal that affects PCM control of the fuel mixture, ignition timing, and EGR operation.

24 **Intake Air Temperature (IAT) sensor** - The IAT provides the PCM with intake air temperature information. The PCM uses this information to control fuel flow, ignition timing, and EGR system operation.

25 **Throttle Position Sensor (TPS)** - The TPS senses throttle movement and position, then transmits a voltage signal to the PCM. This signal enables the PCM to determine when the throttle is closed, in a cruise position, or wide open.

26 **Mass Airflow (MAF) sensor** - The MAF sensor measures the amount (volume) of the intake airflow entering the engine. The MAF sensor, along with the IAT sensor, provide airflow volume and air temperature information for the most precise fuel metering.

27 **Knock sensor** - The knock sensor detects detonation or "spark knock" and signals the PCM accordingly. The PCM will retard the timing until the spark knock is eliminated.

28 **Vehicle Speed Sensor (VSS)** - The vehicle speed sensor provides information to the PCM to indicate vehicle speed.

29 **EGR valve lift sensor** - The EGR valve lift sensor is used to monitor the position of the EGR pintle in relation to the operating conditions of the EGR system.

30 **Fuel tank pressure sensor** - The fuel tank pressure sensor is part of the evaporative emission control system and is used to monitor vapor pressure in the fuel tank. The PCM uses this information to turn on and off the purge valves and solenoids of the evaporative emission control system.

31 **Power Steering Pressure (PSP) switch** - The PSP switch is used to increase transaxle hydraulic line pressure during low-speed vehicle maneuvers.

32 **Transaxle sensors** - In addition to the vehicle speed sensor, the PCM receives input signals from the following sensors inside the transaxle or connected to it: (a) the mainshaft speed sensor and the (b) the countershaft speed sensor.

33 **A/C clutch control switch** - When battery voltage is applied to the air conditioning compressor solenoid, a signal is sent to the PCM, which interprets the signal as an added load created by the compressor and increases engine idle speed accordingly to compensate.

34 **Brake On/Off (BOO) switch** - Essentially, this is the brake light switch. Located on a bracket near the top of the brake pedal, this switch signals the PCM when the brakes are applied. In turn, the PCM shuts off the cruise control (if in use), retards spark timing and changes fuel metering during deceleration.

Output actuators (OBD-I and II systems)

35 **Fuel injectors** - The PCM opens the fuel injectors individually in firing order sequence. The PCM also controls the time the injector is open, called the "pulse width." The pulse width of the injector (measured in milliseconds) determines the amount of fuel delivered. For more information on the fuel delivery system and the fuel injectors, including injector replacement, refer to Chapter 4.

36 **Ignition Control Module (ICM)** - The ICM triggers the ignition coil and determines proper spark advance based on inputs from the PCM. Some models mount the ignition control module within the distributor assembly; others use a separate unit in the engine compartment. Refer to Chapter 5 for more information on the Ignition Control Module.

37 **Idle air control (IAC) valve** - The IAC valve controls the amount of air to bypass the throttle plate when the throttle valve is closed or at idle position. The IAC valve opening and the resulting airflow is controlled by the PCM.

38 **Canister purge control solenoid** - The evaporative emission canister purge control solenoid is operated by the PCM during the OBD-II evaporative emission monitor and during an emission test of the evaporative system.

6

3 Powertrain Control Module (PCM) - removal and installation

Refer to illustration 3.3

Warning: *The models covered by this manual are equipped with Supplemental Restraint systems (SRS), more commonly known as airbags. Always disable the airbag system and wait three minutes before working in the vicinity of the any airbag system components to avoid the possibility of accidental deployment of the airbag, which could cause personal injury* (see Chapter 12).

Caution: *To avoid electrostatic discharge damage to the PCM, handle the PCM only by its case. Do not touch the electrical terminals during removal and installation. If available, ground yourself to the vehicle with a anti-static ground strap, available at computer supply stores.*

1 The Powertrain Control Module (PCM) is located inside the passenger compartment under the dashboard, forward of the center console.

3.3 Disconnect the PCM electrical connectors then remove the mounting bolts (arrows)

2 Disable the airbag system (see Chapter 12). **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

3 Remove the front panel from the center console, forward of the gearshift lever (see Chapter 11). Remove the PCM mounting bolts **(see illustration)**.

4 Unplug the electrical connectors from the PCM. **Caution:** *The ignition switch must be turned OFF when pulling out or plugging in the electrical connectors to prevent damage to the PCM.*

5 Carefully remove the PCM. **Note**: *Avoid any static electricity damage to the computer by grounding yourself to the body before touching the PCM and using a special anti-static pad to store the PCM on once it is removed.*

6 Installation is the reverse of removal.

4 Throttle Position Sensor (TPS) - check, adjustment and replacement

Check

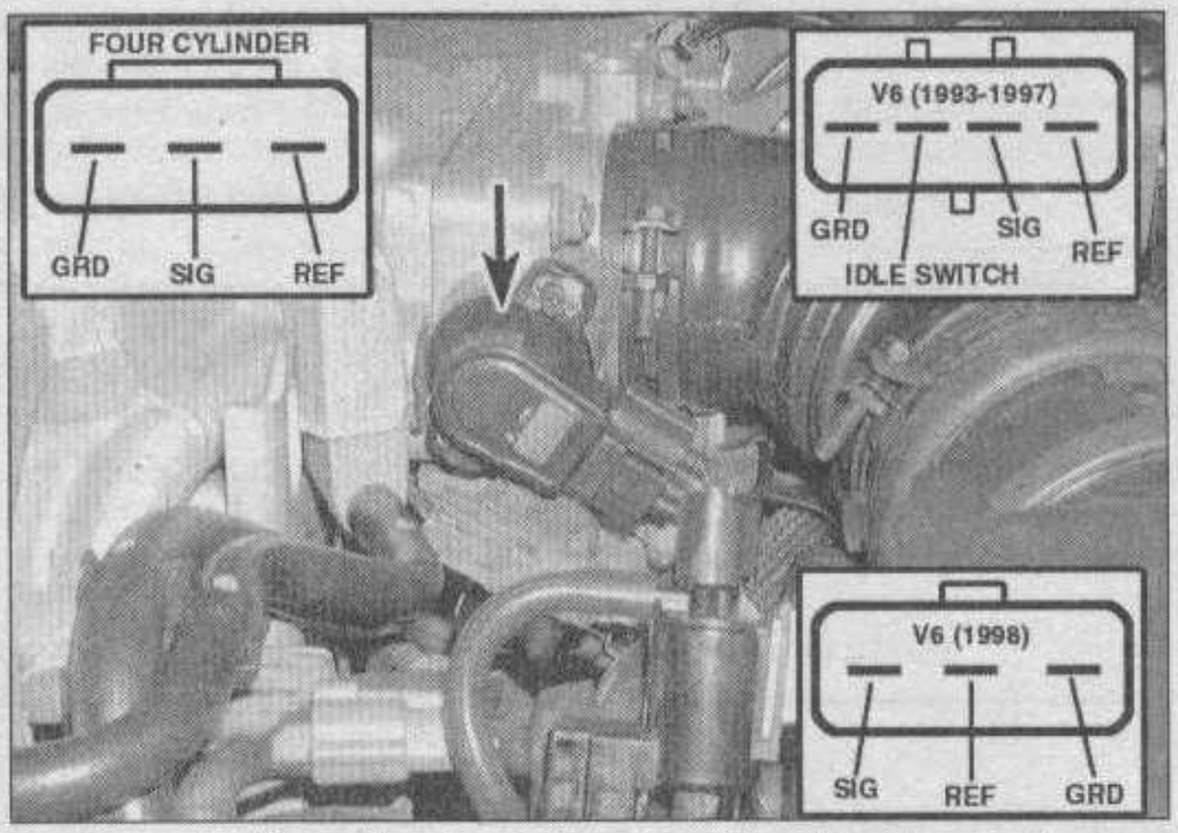
Refer to illustration 4.2

1 The Throttle Position Sensor (TPS) is located on the end of the throttle shaft on the throttle body. By monitoring the output voltage from the TPS, the PCM can determine fuel delivery based on throttle valve angle (driver demand). A broken or loose TPS can cause intermittent bursts of fuel from the injector and an unstable idle because the PCM thinks the throttle is moving. A problem with the TPS will set a trouble code (see Section 2).

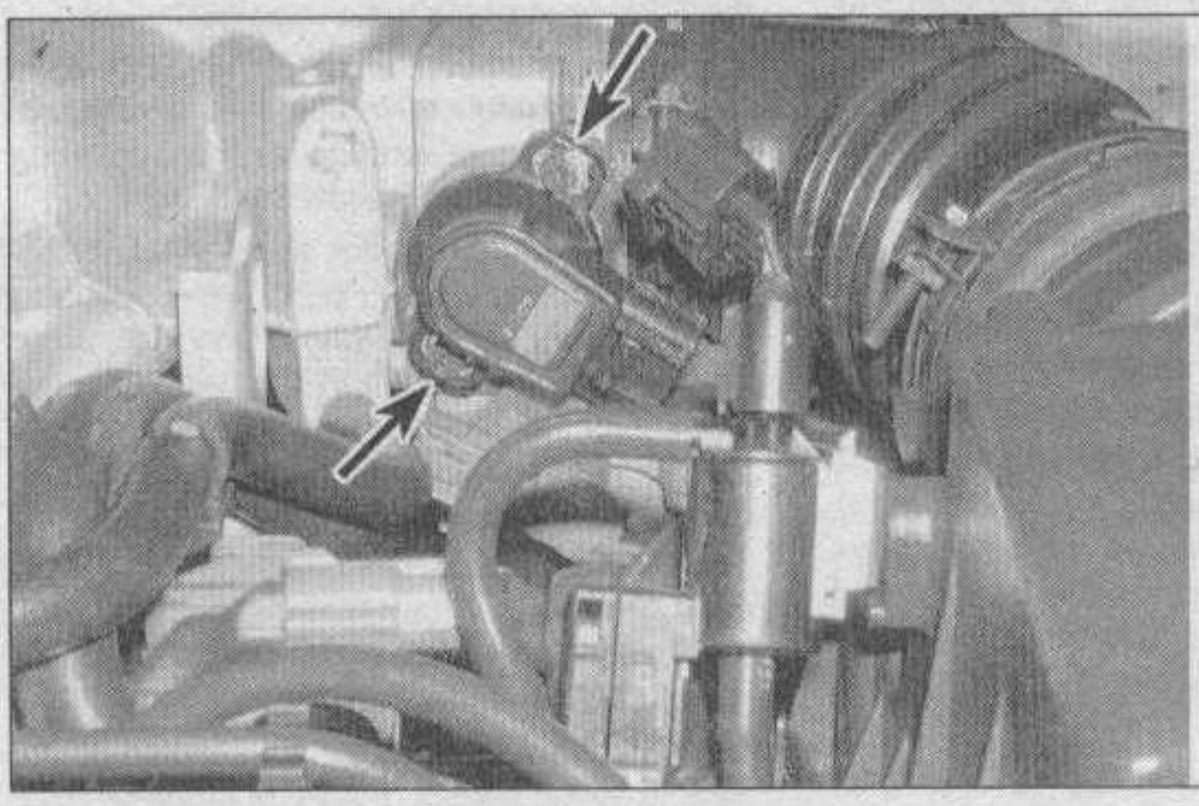
2 Check the reference voltage from the PCM to the TPS. Disconnect the TPS harness connector and attach the probes of a voltmeter to the REF terminal (+) and the GND terminal (-). With the ignition key ON (engine not running), it should read approximately 5.0 volts **(see illustration)**. If reference voltage is not available, there is an open circuit to the PCM or a defective PCM.

3 Next, check the TPS signal voltage. With the TPS harness connected to the sensor, backprobe the electrical connector SIG terminal (+) and the GND terminal (-) using pins. Be very careful not to damage the wiring harness. With the ignition key ON (engine not running) and the throttle fully closed, gradually open the throttle valve and observe the TPS signal voltage. With the throttle valve fully closed, the voltage should read approximately 0.5 to 1.0 volts. Slowly move the throttle valve and see if there is a change in the voltage values as the sensor travels from idle to full throttle. The voltage should increase smoothly to approximately 3.5 to 5.0 volts.

4 The throttle position sensor on 1993 four-cylinder engines is a permanent part of the throttle body and can't be adjusted if it's out of range (the entire throttle body must be replaced). The TPS on all other engines can be adjusted. If the readings are incorrect, try adjusting the TPS. If that doesn't help, replace the TPS.



4.2 The TPS (arrow) is located on the side of the throttle body - the insets show the terminals on the TPS (when checking reference voltage, check the appropriate corresponding terminals of the electrical connector)



4.5 The TPS is secured to the throttle body with two screws

Adjustment

Refer to illustration 4.5

5 Loosen the TPS attaching screws **(see illustration)**.

6 Connect a voltmeter between the throttle position sensor signal and ground terminals **(see illustration 4.2)**.

7 With the throttle valve in the fully closed position, rotate the TPS to get a voltage reading of approximately 0.5 to 1.0 volts. Tighten the mounting screws.

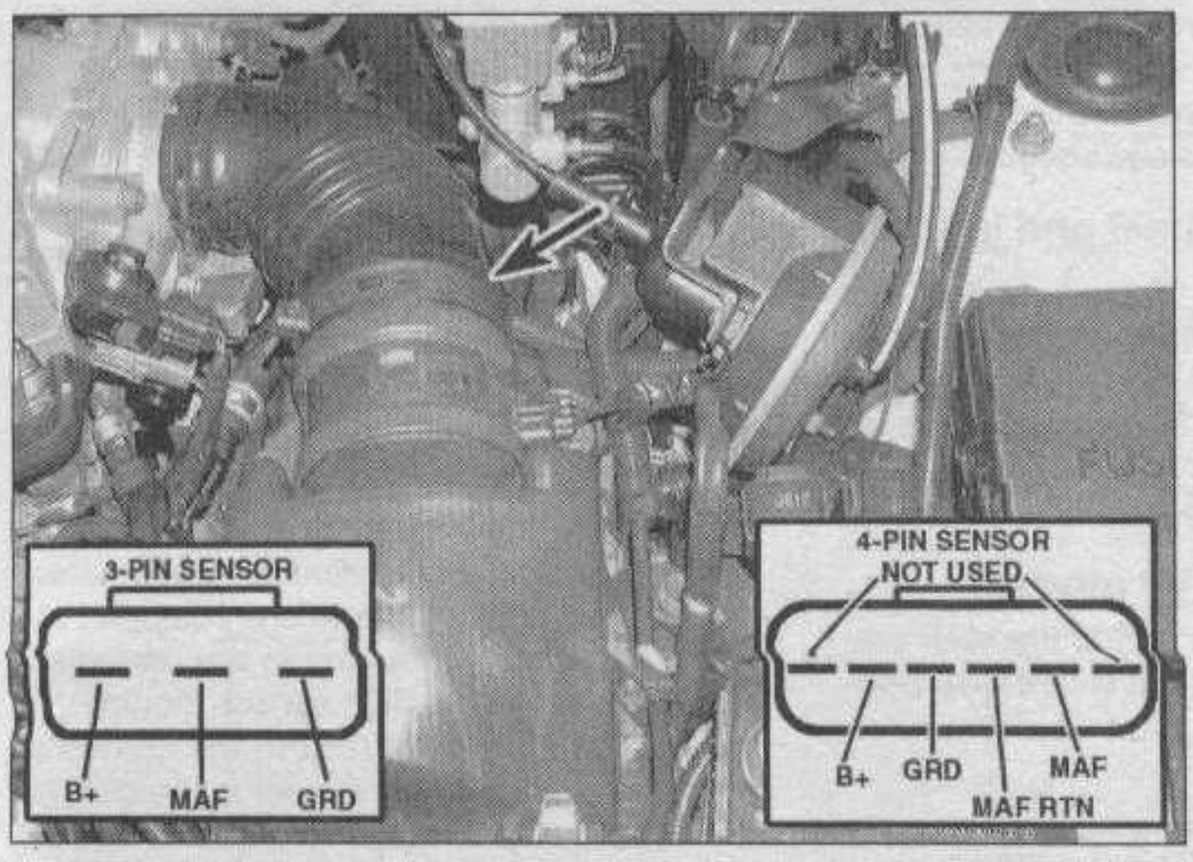
8 Open the throttle valve completely and make sure a value of 3.5 to 5.0 volts can be obtained.

9 If you can't get the TPS to deliver the proper readings at the indicated positions, replace it.

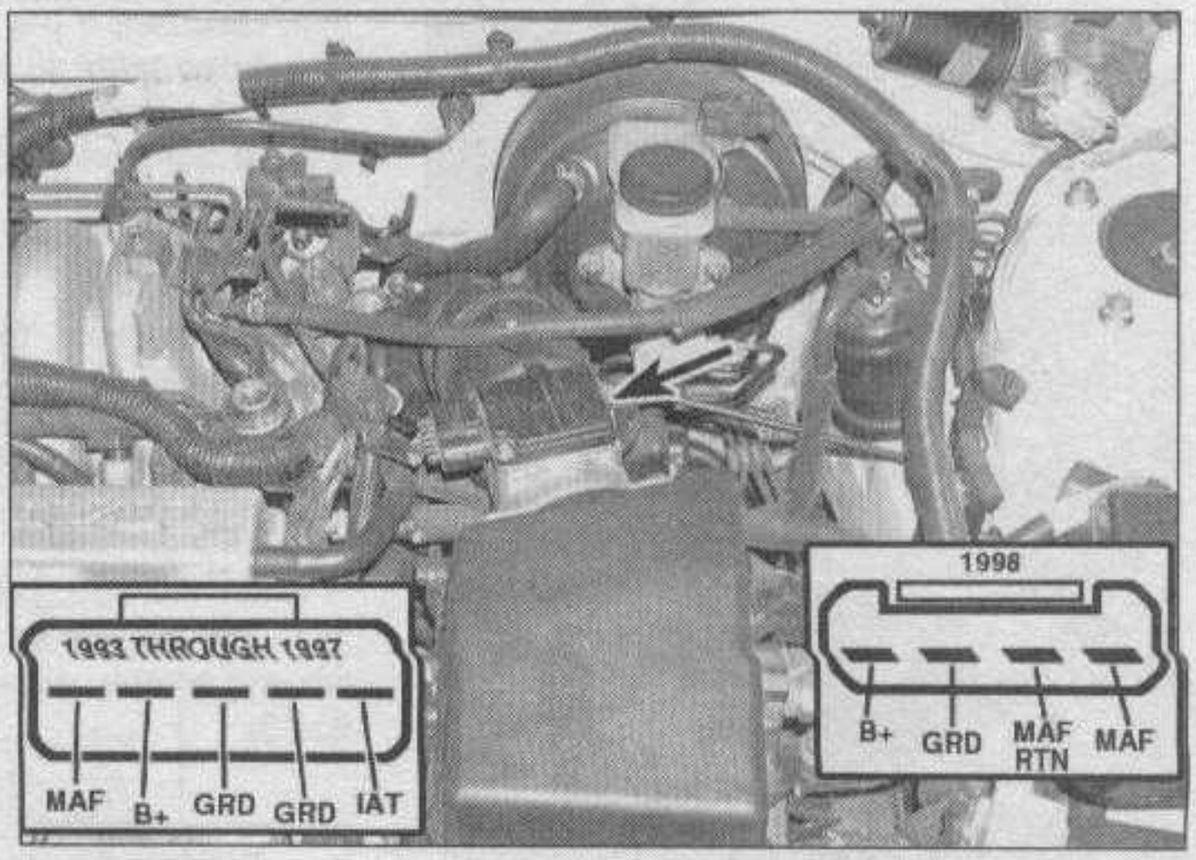
Replacement

10 This procedure applies to all except 1993 four-cylinder models. The TPS on 1993 four-cylinder models is part of the throttle body and is replaced as a unit with it (see Chapter 4).

11 Disconnect the TPS electrical connector. Remove its mounting screws and take it off the throttle body **(see illustration 4.5)**.



5.3a The MAF sensor (arrow) is located in the air intake tract (this is a V6 engine, 1997 and earlier)



5.3b Here's MAF sensor on a 1998 and later four-cylinder engine

12 Installation is the reverse of the removal steps. Align the tabs on the TPS with the slots in the throttle body and align the screw holes in the TPS and throttle body. Install the screws, adjust the TPS as described above and tighten the screws.

5 Mass Airflow (MAF) sensor - check and replacement

Refer to illustrations 5.3a and 5.3b

1 The Mass Airflow (MAF) sensor is located in the air intake duct. The sensor uses a hot wire sending element or potentiometer, depending on model, to measure the amount of air entering the intake system. It sends this information to the PCM as a voltage signal, which in turn, calculates the required fuel injector pulse width.

Check

2 Remove the MAF sensor and check its inlet screen for dirt, especially if the vehicle is an OBD-I model and a Code 158 has been set. Clean away any dirt (also inspect the air filter if you find any). If you're working on a 1993 through 1997 V6 model, push on the inlet side of the sensor and make sure the measuring core moves smoothly into and out of the sensor housing. Reinstall the MAF sensor and make sure it's tightly sealed against air leaks where it fits into the intake ducts.

3 Backprobe the power and ground terminals in the MAF sensor connector with straight pins **(see illustrations)**. With the key on and engine not running, check for battery voltage between the power and ground terminals. If there isn't battery voltage, disconnect the connector and use an ohmmeter to check for continuity to ground at the ground terminal.

a) *No voltage, no continuity to ground: look for an open in the ground side of the circuit.*
b) *No voltage, continuity to ground: look for an open in the power supply side of the circuit.*

Repair the circuits if necessary.

All four-cylinder and 1998 and later V6 models

4 Backprobe the MAF terminal with a straight pin and check voltage, first with the key on and the engine not running, then at idle **(see illustration 5.3b)**.

5 If the sensor connector has three wires, voltage should be 1.0 to 1.5 volts with key On and engine off, and 1.5 to 5.0 volts at idle.

6 If the sensor connector has four wires, voltage should be close to zero with key On and engine off, and 0.6 to 0.7 volts at idle (0.6 to 1.1 volts on 1998 and later models).

7 Raise engine speed and note the voltage change. It should rise slightly (and smoothly) to approximately 2 volts. Any "spikes" (abrupt changes in voltage) indicate a problem with the sensor.

1993 through 1997 V6 models

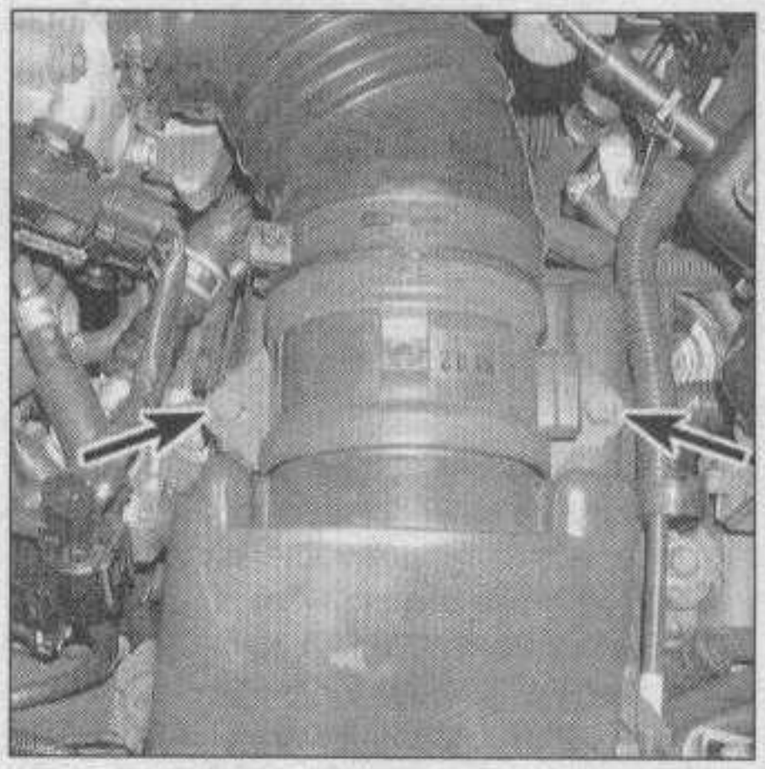
8 Disconnect the air duct from the MAF sensor (you'll need to push on the measuring core for this test). Switch the ignition on, but don't start the engine.

9 Backprobe the MAF and ground terminals with a straight pin and check voltage **(see illustration 5.3a)**. With the measuring core closed, it should be 4.0 volts. Voltage should decrease as you push the measuring core into the housing, in the following increments:

a) *1/4 open - 2.4 volts*
b) *1/2 open - 1.6 volts*
c) *3/4 open - 0.8 volts*
d) *Fully open - 0.4 volts*

All models

10 Remove the backprobe pins and reconnect the air duct (if disconnected). **Note:** *If MAF-related driveability problems persist but these general tests don't indicate a MAF fault, have the sensor tested by an experienced driveability technician. A MAF sensor can develop voltage signal problems that can't be seen on a voltmeter. The PCM can detect such signal faults and a driveability problem will result.*



5.13 Remove the MAF sensor mounting bolts (arrows)

Replacement

Refer to illustration 5.13

11 Disconnect the negative battery terminal. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

12 Disconnect the electrical connector from the MAF sensor.

13 Remove the screws or bolts and remove the MAF sensor **(see illustration)**.

14 Installation is the reverse of removal.

6 Intake Air Temperature (IAT) sensor - check and replacement

Check

1 The intake air temperature sensor is a thermistor (a resistor which varies the value

7.2 Location of the ECT (arrow) - V6 engine

of its resistance in accordance with temperature changes). The change in the resistance values will directly affect the voltage signal from the sensor. As the sensor temperature DECREASES, the resistance values will INCREASE. As the sensor temperature INCREASES, the resistance values will DECREASE. A failure in the IAT sensor circuit should set a diagnostic trouble code.

Four-cylinder and 1998 and later V6 models

2 Check the IAT sensor resistance. Disconnect the electrical connector from the IAT sensor which is threaded into the air cleaner housing **(see illustration 1.1a)**.

3 Using an ohmmeter, measure the resistance between the two terminals on the sensor. It should be approximately 35.5 to 39.2 k-ohms at room temperature (68-degrees F). Start the engine (or remove the sensor and warm it with a hair dryer or heat gun) and monitor the resistance. The resistance should decrease to approximately 7 to 8 ohms at 140-degrees F. If the test results are incorrect, replace the IAT sensor. Be sure to clear the trouble code if the engine was operated with the sensor connector removed (see Section 2).

1993 through 1997 V6 models

4 Disconnect the electrical connector from the MAF sensor (see Section 5). Connect an ohmmeter between the IAT terminal and its ground terminal **(see illustration 5.3b)**. Resistance should be approximately 2 to 3 k-ohms at room temperature (68-degrees F). Start the engine (or remove the sensor and warm it with a hair dryer or heat gun) and monitor the resistance. The resistance should decrease to approximately 400 to 700 ohms at 140-degrees F. If the test results are incorrect, replace the IAT sensor. Be sure to clear the trouble code if the engine was operated with the sensor connector removed (see Section 2).

Replacement

5 Disconnect the negative battery terminal. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

Four-cylinder and 1998 and later V6 models

6 Disconnect the electrical connector from the IAT sensor.

7 Unscrew the IAT sensor from the air cleaner housing.

8 Installation is the reverse of removal.

1993 through 1997 V6 models

9 The IAT sensor is a part of the MAF sensor and is replaced as a unit with it (see Section 5).

7 Engine Coolant Temperature (ECT) sensor - check and replacement

Check

Refer to illustration 7.2

1 The engine coolant temperature (ECT) sensor is a thermistor (a resistor which varies the value of its resistance in accordance with temperature changes). The change in the resistance values will directly affect the voltage signal from the sensor. As the sensor temperature DECREASES, the resistance values will INCREASE. As the sensor temperature INCREASES, the resistance values will DECREASE.

2 Check the ECT sensor resistance. Disconnect the electrical connector from the sensor **(see the accompanying illustration** for V6 models and **illustration 1.1a** for four-cylinder models**)**.

3 Using an ohmmeter, measure the resistance between the two terminals on the sensor. It should be approximately 2200 to 2700 ohms at room temperature (68-degrees F). Start the engine (or remove the sensor and warm it in a heated pan of water) and monitor the resistance. The resistance should decrease to approximately 290 to 350 ohms at 180-degrees F. If the test results are incorrect, replace the ETC sensor. Be sure to clear the trouble code if the engine was operated with the sensor connector removed (see Section 2).

Replacement

Warning: *Wait until the engine has cooled completely before beginning this procedure.*

4 Make sure the ignition key is turned Off.

5 Before installing the new sensor, wrap the threads with Teflon sealing tape to prevent leakage and thread corrosion.

6 To remove the sensor, depress the locking tab, disconnect the electrical connector, then carefully unscrew the sensor. Coolant will leak out when the sensor is removed, so install the new sensor as quickly as possible. **Caution:** *Handle the coolant sensor with care. Damage to this sensor will affect the operation of the entire fuel injection system.*

7 Installation is the reverse of removal. Check the coolant level, adding if necessary to bring to the appropriate level (see Chapter 1).

8 Crankshaft Position (CKP) sensor - check and replacement

Check

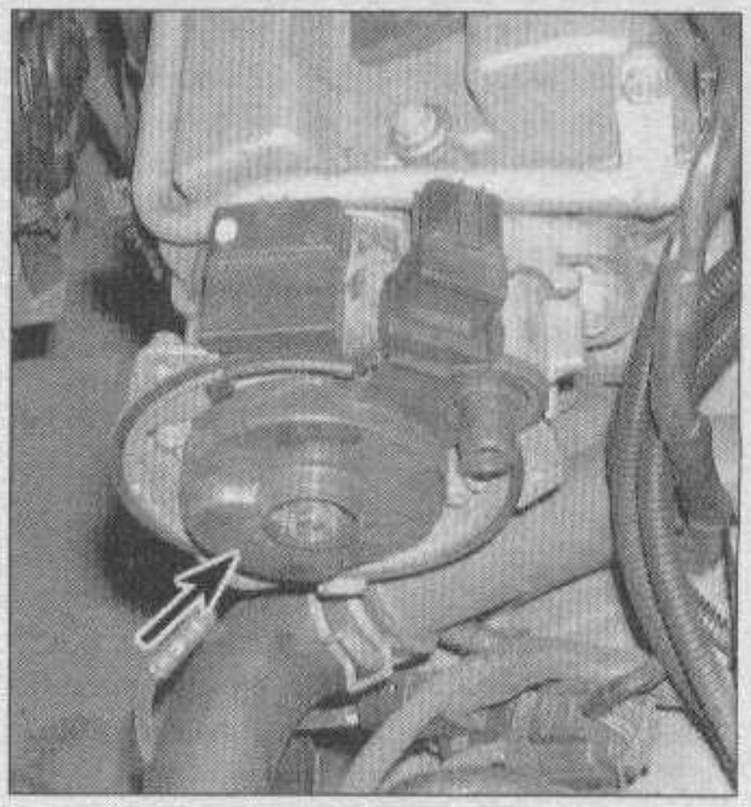
1 The crankshaft position (CKP) sensor determines the timing for the fuel injection and ignition on each cylinder. It also detects engine rpm. Early models are equipped with one CKP sensor, mounted in the distributor. Later models use a CKP sensor mounted on the front of the engine next to the crankshaft pulley in addition to the sensor in the distributor. 1998 and later models, which have a distributorless ignition system, use only the sensor mounted near the crankshaft pulley. A failure in the CKP sensor circuit should set a diagnostic trouble code. Refer to the code chart in Section 2 for additional information.

Distributor-mounted sensor (sensor no. 1)

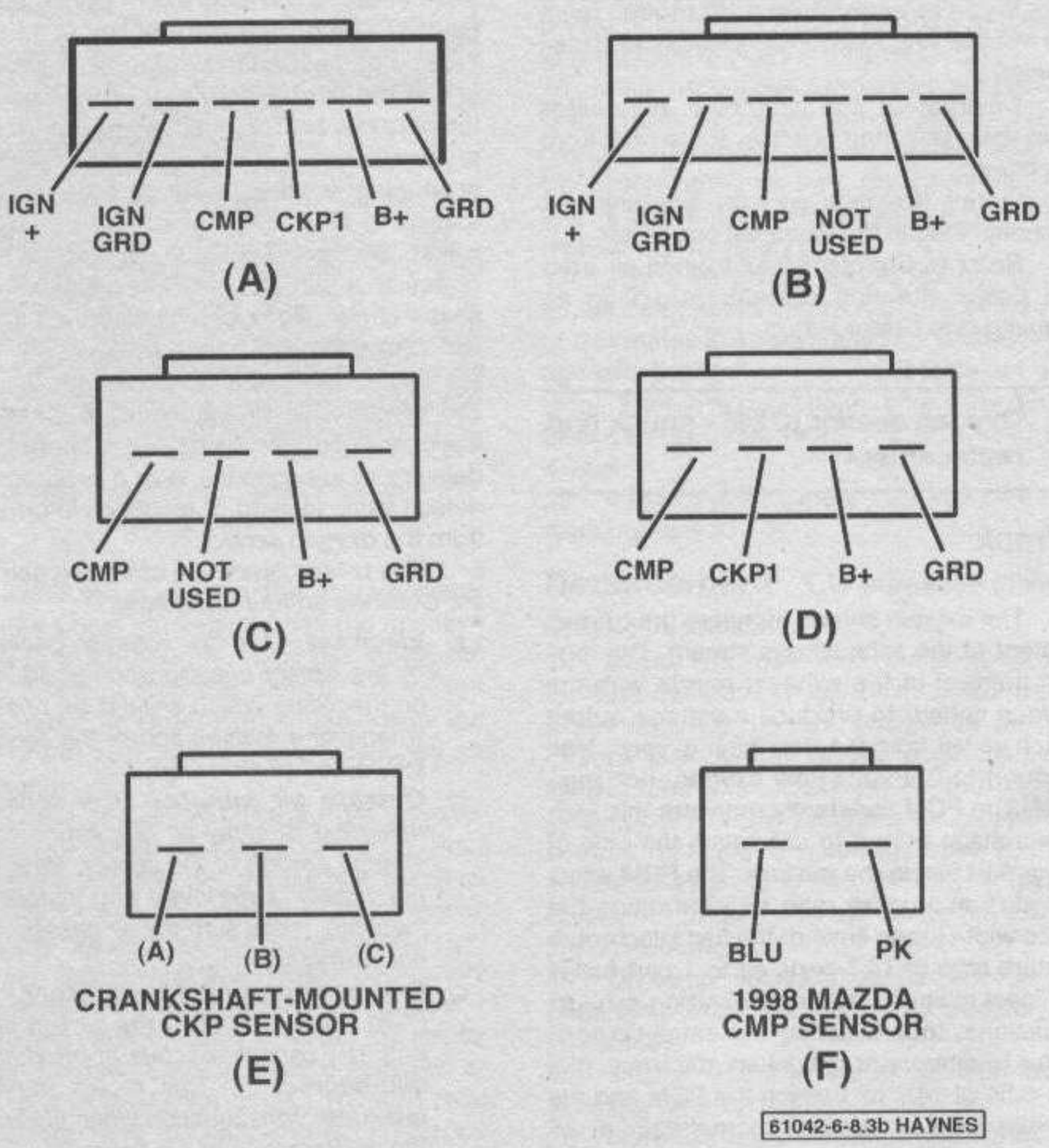
Refer to illustrations 8.3a and 8.3b

2 Remove the distributor from the engine and reconnect the larger of the two electrical connectors. **Warning:** *Don't connect the three-pin connector, as this would cause the coil to generate sparks when the test described in the next Step is performed. Also, disconnect the electrical connector(s) for the fuel injection wiring harness to prevent the fuel injectors from operating during the test.*

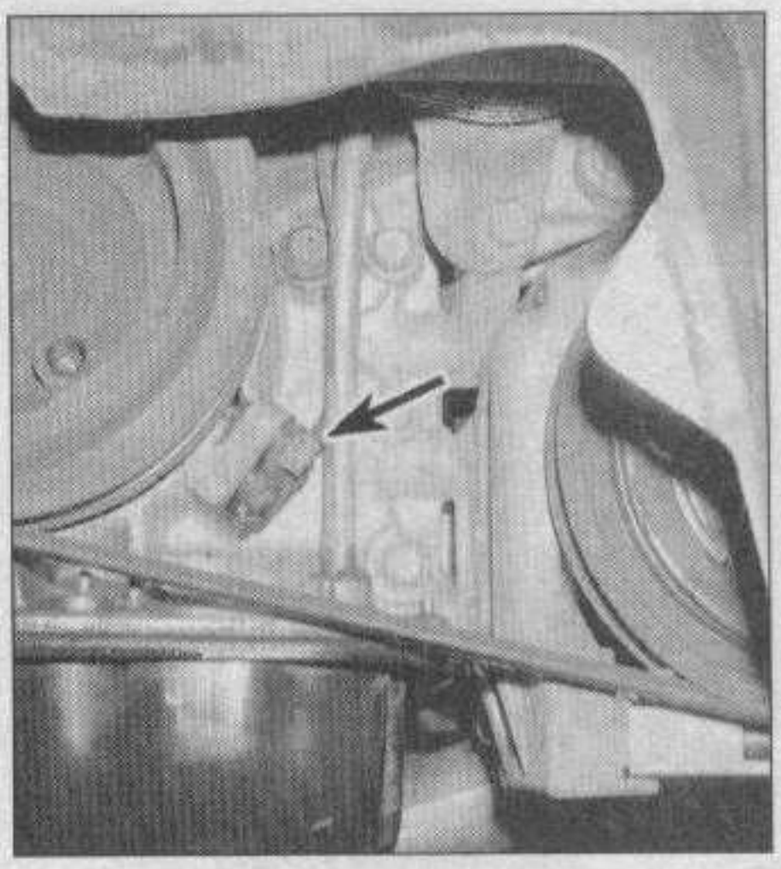
3 Backprobe the CKP1 terminal at the connector with a voltmeter **(see illustrations)**. With the key in the On position, rotate the distributor shaft by hand and note the voltmeter reading. There should be one voltage pulse for each cylinder per rotation of the shaft. In other words, each time you rotate the distributor shaft one full turn, there should be four voltage pulses on a four-cylinder



8.3a The CKP/CMP sensors on some models are located in this housing in the distributor (arrow)



8.3b CKP/CMP connector terminals - use the one that matches your vehicle to select a service procedure



8.5 Location of the no. 2 crankshaft position sensor (arrow)

engine and 6 voltage pulses on a V6 engine. There's no minimum speed of rotation.

4 If the test results are incorrect, replace the sensor. This sensor may not be available as a separate component; replacement of the distributor may be necessary (see Chapter 5). Check with your local auto parts store or dealer parts department before proceeding with disassembly.

Engine-mounted sensor (sensor no. 2)

Refer to illustration 8.5

5 Measure the gap between the sensor and its trigger wheel on the crankshaft **(see illustration)**. It should be 0.020 to 0.059-inch. The gap isn't adjustable; replace the sensor or bracket (on models with detachable brackets) if it's out of the specified range.

6 To check the CKP sensor, disconnect the electrical connector at the sensor and probe terminals A and B with an ohmmeter **(see illustration 8.3b)**. Resistance should be approximately 550 ohms (it may vary between 520 and 580 ohms). If the reading is incorrect, replace the sensor.

Replacement (sensor no. 2)

9 Disconnect the cable from the negative battery terminal. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

10 Disconnect the sensor's electrical connector and free the harness from any retainers.

11 Unbolt the sensor from the engine.

12 Installation is the reverse of the removal steps. Be sure the gap between the sensor and its trigger wheel is as specified in Step 5.

9 Camshaft Position (CMP) sensor - check and replacement

1993 through 1997 models

Check

1 The CMP sensor determines the position of the cylinder for sequential fuel injection to each cylinder. The CMP sensor is mounted inside the distributor on 1993 through 1997 models. A failure in the CMP sensor circuit should set a trouble code (see Section 2).

2 With the ignition ON but the engine not running, backprobe the B+ terminal at the larger of the two distributor electrical connectors **(see illustration 8.3b)**. There should be battery voltage between the B+ terminal and the battery negative post. If not, repair the circuits.

3 Remove the distributor from the engine and reconnect the larger of the two electrical connectors. **Warning:** *Don't connect the three-pin connector, as this would cause the coil to generate sparks when the test described in the next Step is performed. Also, disconnect the electrical connector(s) for the fuel injection wiring harness to prevent the fuel injectors from operating during the test.*

4 Backprobe the CID terminal with an AC voltmeter set on the 0 to 5-volt range. Rotate the distributor shaft by hand and watch the voltmeter. There should be one voltage pulse for each full rotation of the distributor shaft.

5 If the test results are incorrect, replace the distributor (see Chapter 5).

Replacement

6 The CMP sensor is permanently mounted in the distributor housing and not available separately. Replace the distributor.

1998 and later models

Check

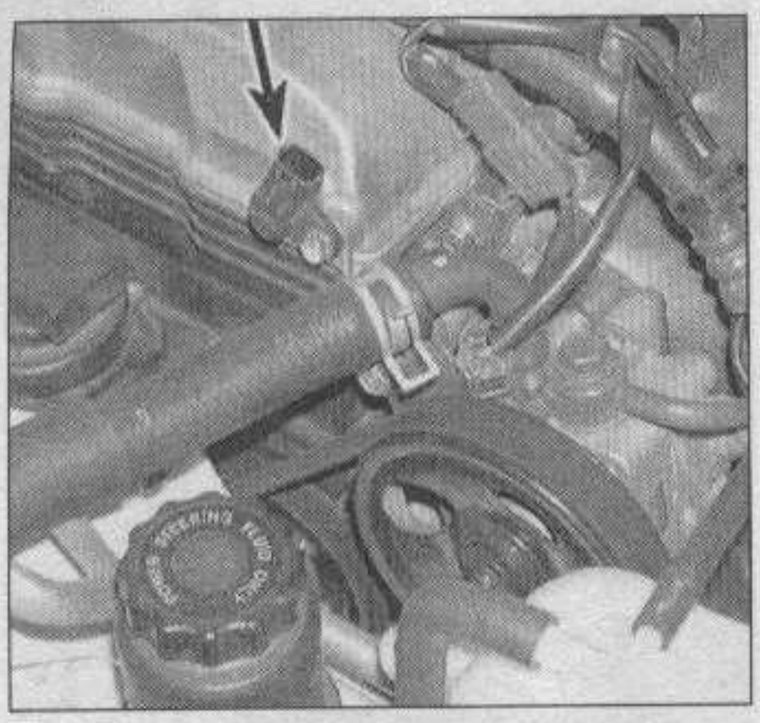
7 Locate the camshaft position sensor's electrical connector behind the camshaft pulley. Disconnect the connector and measure resistance between the sensor terminals with an ohmmeter **(see illustration 8.3b)**. It should be 950 to 1250 ohms on four-cylinder models and approximately 550 ohms on V6 models.

Replacement

Four-cylinder engine

Refer to illustration 9.8

8 Unplug the electrical connector from the sensor, remove the mounting bolt and pull



9.8 Location of the camshaft position sensor on a 1998 and later four-cylinder engine

the sensor out of the valve cover **(see illustration)**.

9 Installation is the reverse of removal.

V6 engine

10 Remove the timing belt and camshaft pulley (see Chapter 2B).

11 Disconnect the sensor's electrical connector, if not already done. Remove the mounting bolt and detach the sensor from the cylinder head.

12 Installation is the reverse of the removal steps.

10 Power Steering Pressure (PSP) switch - check and replacement

Check

1 The power steering pressure (PSP) switch is located on the power steering pump. When steering system pressure reaches a high-pressure set-point, the PSP switch closes and sends a signal to the PCM that the PCM uses to maintain engine idle speed during parking maneuvers. The On-Board Diagnostic system can detect switch problems and set trouble codes to indicate specific faults.

2 Check the operation of the PSP switch if the engine stalls during parking or if the engine idles continuously at high rpm.

3 Refer to the wiring diagrams at the end of this manual to identify the functions of connector terminals.

4 Disconnect the PSP switch connector and connect an ohmmeter to the terminals on the switch body.

5 Start the engine and let it idle.

6 Turn the steering wheel to point the front wheels straight ahead and read the ohmmeter. It should indicate no continuity (infinite resistance).

7 Turn the steering wheel to either side and watch the ohmmeter. The PSP switch should close as the wheel nears the steering stop on either side, and the meter should indicate continuity (zero ohms).

8 If the switch fails either test, replace it.

Replacement

9 If you're working on a V6 model, raise the vehicle and support it securely on jackstands.

10 Disconnect the electrical connector from the switch and unscrew the switch from the fitting.

11 Install the new switch, tightening it securely. Plug in the electrical connector.

12 Refer to Chapter 10 and bleed air from the power steering system. Add fluid as required (see Chapter 1).

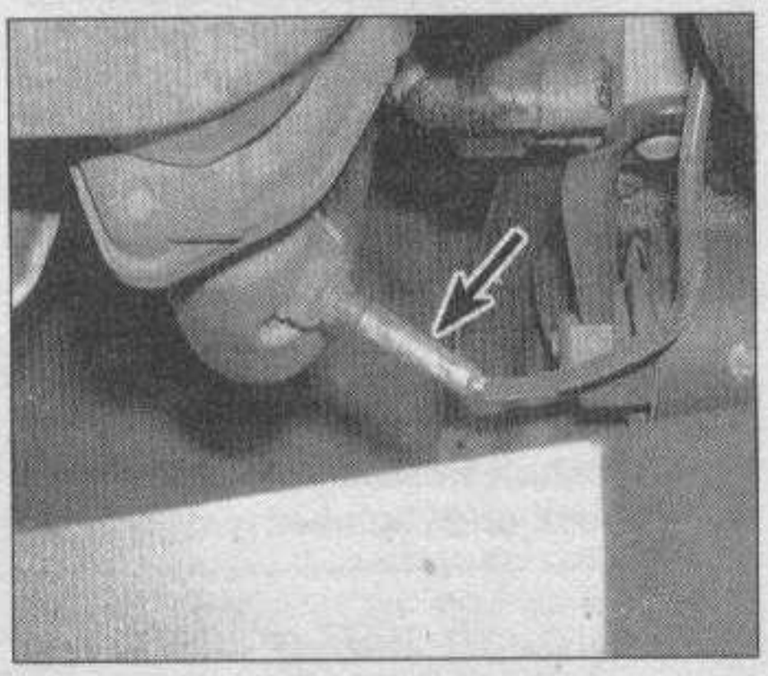
11 Oxygen sensor (O2S) - check and replacement

Check

Refer to illustration 11.7

1 The oxygen sensor monitors the oxygen content of the exhaust gas stream. The oxygen content in the exhaust reacts with the oxygen sensor to produce a voltage output which varies from 0.1-volt (high oxygen, lean mixture) to 0.9-volts (low oxygen, rich mixture). The PCM constantly monitors this variable voltage output to determine the ratio of oxygen to fuel in the mixture. The PCM alters the air/fuel mixture ratio by controlling the pulse width (open time) of the fuel injectors. A mixture ratio of 14.7 parts air to 1 part fuel is the ideal mixture ratio for minimizing exhaust emissions, thus allowing the catalytic converter to operate at maximum efficiency. It is this ratio of 14.7 to 1 which the PCM and the oxygen sensor attempt to maintain at all times. On OBD-II systems, at least two oxygen sensors are used; the primary oxygen sensor is located upstream of the catalytic converter and the secondary oxygen sensor is located after the catalytic converter (later V6 engines use four sensors). By sampling the exhaust gas before and after the catalytic converter, the PCM can also determine the efficiency of the catalytic converter.

2 The oxygen sensor produces no voltage when it is below its normal operating temperature of about 600-degrees F. During this initial period before warm-up, the PCM operates in OPEN LOOP mode.



11.7 The primary oxygen sensor (arrow) is located in the exhaust manifold or pipe before the catalytic converter - the secondary oxygen sensor is located in the exhaust pipe after the catalytic converter - follow the harness to locate the connector

3 If the engine reaches normal operating temperature and/or has been running for two or more minutes, and if the oxygen sensor is producing a steady signal voltage below 0.45-volts at 1,500 rpm or greater, the PCM will set a code. The PCM will also set other codes if it detects any problem with the heater circuit. Refer to the code chart in Section 2 for additional information.

4 When there is a problem with the oxygen sensor or its circuit, the PCM operates in the open loop mode - that is, it controls fuel delivery in accordance with a programmed default value instead of feedback information from the oxygen sensor.

5 The proper operation of the oxygen sensor depends on four conditions:

a) ***Electrical*** *- The low voltages generated by the sensor depend upon good, clean connections which should be checked whenever a malfunction of the sensor is suspected or indicated.*

b) ***Outside air supply*** *- The sensor is designed to allow air circulation to the internal portion of the sensor. Whenever the sensor is removed and installed or replaced, make sure the air passages are not restricted.*

c) ***Proper operating temperature*** *- The PCM will not react to the sensor signal until the sensor reaches approximately 600-degrees F. This factor must be taken into consideration when evaluating the performance of the sensor.*

d) ***Unleaded fuel*** *- The use of unleaded fuel is essential for proper operation of the sensor. Make sure the fuel you are using is of this type.*

6 In addition to observing the above conditions, special care must be taken whenever the sensor is serviced.

a) *The oxygen sensor has a permanently attached pigtail and electrical connector which should not be removed from the sensor. Damage or removal of the pigtail or electrical connector can adversely affect operation of the sensor.*

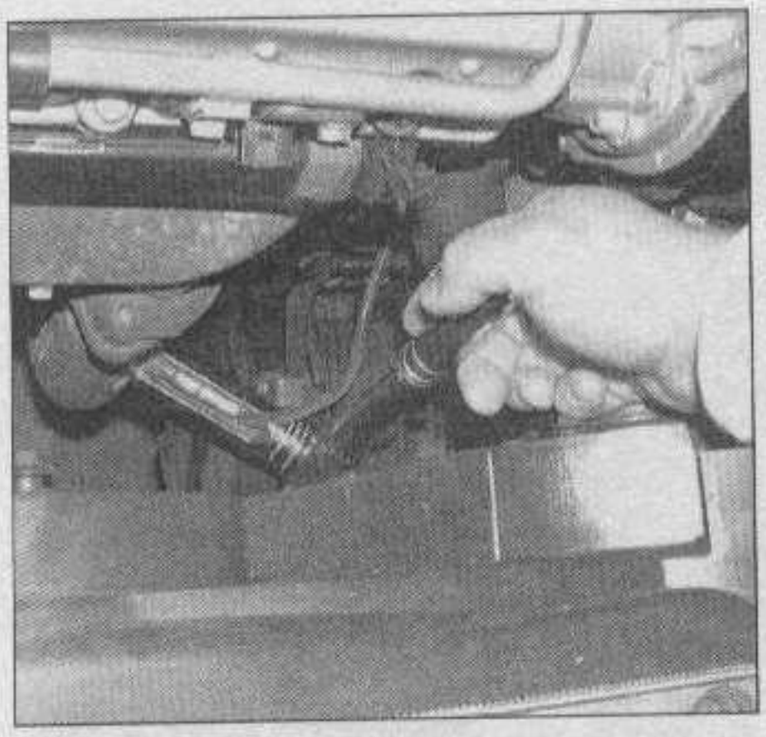
b) *Grease, dirt and other contaminants should be kept away from the electrical connector and the louvered end of the sensor.*

c) *Do not use cleaning solvents of any kind on the oxygen sensor.*

d) *Do not drop or roughly handle the sensor.*

e) *The silicone boot must be installed in the correct position to prevent the boot from being melted and to allow the sensor to operate properly.*

7 Locate the oxygen sensor electrical connector **(see illustration)** and without disconnecting it, insert a long pin into the oxygen sensor connector signal terminal and another pin into the ground terminal (refer to the wiring diagrams at the end of this man-



11.16 Use a slotted socket to remove the oxygen sensor

ual). Install the positive probe of a voltmeter onto the signal terminal pin and the negative probe to the ground terminal pin. Apply the parking brake, shift the transaxle into Park (automatic) or Neutral (manual), raise the front of the vehicle and place it securely on jackstands.

8 Check the signal voltage from the oxygen sensor during operating conditions. Start the engine and monitor the voltage signal as the engine warms up. **Warning:** *Be extremely careful of hot exhaust components when performing this procedure.* **Note:** *Secondary oxygen sensors will produce much slower fluctuating voltage values to reflect the results of the catalyzed exhaust mixture from rich or lean to less presence of CO, HC and NOx molecules. Here the CO_2 and H_2O gaseous forms do not register or react with the oxygen sensors to such a large degree.*

9 The oxygen sensor will produce a steady voltage signal at first (open loop) of approximately 0.1 to 0.2 volts with the engine cold. After a period of approximately two minutes, the engine will reach operating temperature and the oxygen sensor should start to fluctuate between 0.1 to 0.9 volts (closed loop). If the oxygen sensor fails to reach the closed loop mode or there is a very long period of time until it does switch into closed loop mode, replace the oxygen sensor.

10 Also inspect the oxygen sensor heater. Disconnect the oxygen sensor electrical connector and connect an ohmmeter between the heater terminals (refer to the wiring diagrams at the end of this manual). It should measure 10 to 40 ohms.

11 Check for proper supply voltage to the heater (refer to the wiring diagrams at the end of this manual). There should be battery voltage with the ignition key ON (engine not running). If there is no voltage, check the circuit between the main relay, the PCM and the sensor.

12 If the oxygen sensor fails any of these tests, replace it.

Replacement

Refer to illustration 11.16

13 **Note:** *Because it is installed in the exhaust manifold or pipe, which contracts when cool, the oxygen sensor may be very difficult to loosen when the engine is cold. Rather than risk damage to the sensor (assuming you are planning to reuse it in another manifold or pipe), start and run the engine for a minute or two, then shut it off. Be careful not to burn yourself during the following procedure.*

14 On some models it may be necessary to raise the vehicle and support it securely on jackstands.

15 Disconnect the electrical connector from the sensor.

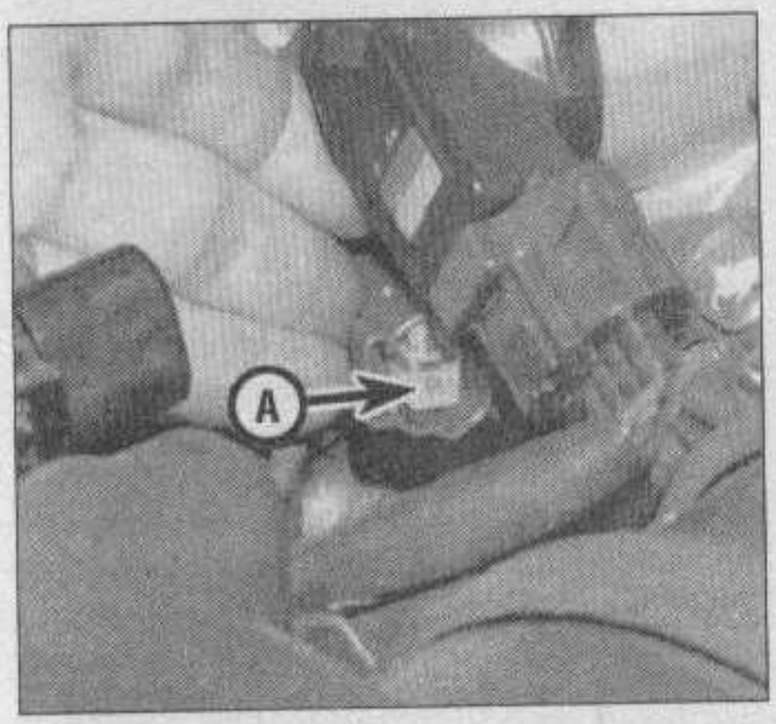
16 Carefully unscrew the sensor from the exhaust manifold (primary) or pipe (secondary) **(see illustration)**.

17 Anti-seize compound must be used on the threads of the sensor to facilitate future removal. The threads of new sensors will already be coated with this compound, but if an old sensor is removed and reinstalled, recoat the threads.

18 Install the sensor and tighten it securely.

19 Reconnect the electrical connector of the pigtail lead to the main engine wiring harness.

20 Lower the vehicle, take it on a test drive and check to see that no trouble codes set.



12.2 Unplug the electrical connector and measure the resistance of the knock sensor between terminal A and ground - on V6 engines, the connector for the sensor is located under the Throttle Position Sensor

12 Knock sensor - check and replacement

Check

Refer to illustration 12.2

1 Knock sensors detect abnormal vibration in the engine. The knock control system is designed to reduce spark knock during periods of heavy detonation. This allows the engine to use maximum spark advance to improve driveability. Knock sensors produce AC output voltage which increases with the severity of the knock. The signal is fed into the PCM and the timing is retarded to compensate for the severe detonation.

2 The knock sensor on four-cylinder engines is threaded into the rear (firewall side) of the engine block. On some models, you'll need to remove the oil filter for access (see Chapter 1). On V6 engines, it's under the intake manifold, but a pigtail harness is attached to it which makes it unnecessary to remove the manifold for testing **(see illustration)**.

3 To check a knock sensor, disconnect the electrical connector and measure the resistance between terminal A and ground **(see illustration 12.2)**. The resistance should be approximately 560 ohms at 68-degrees F. If the resistance is way out of spec, replace the knock sensor.

Replacement

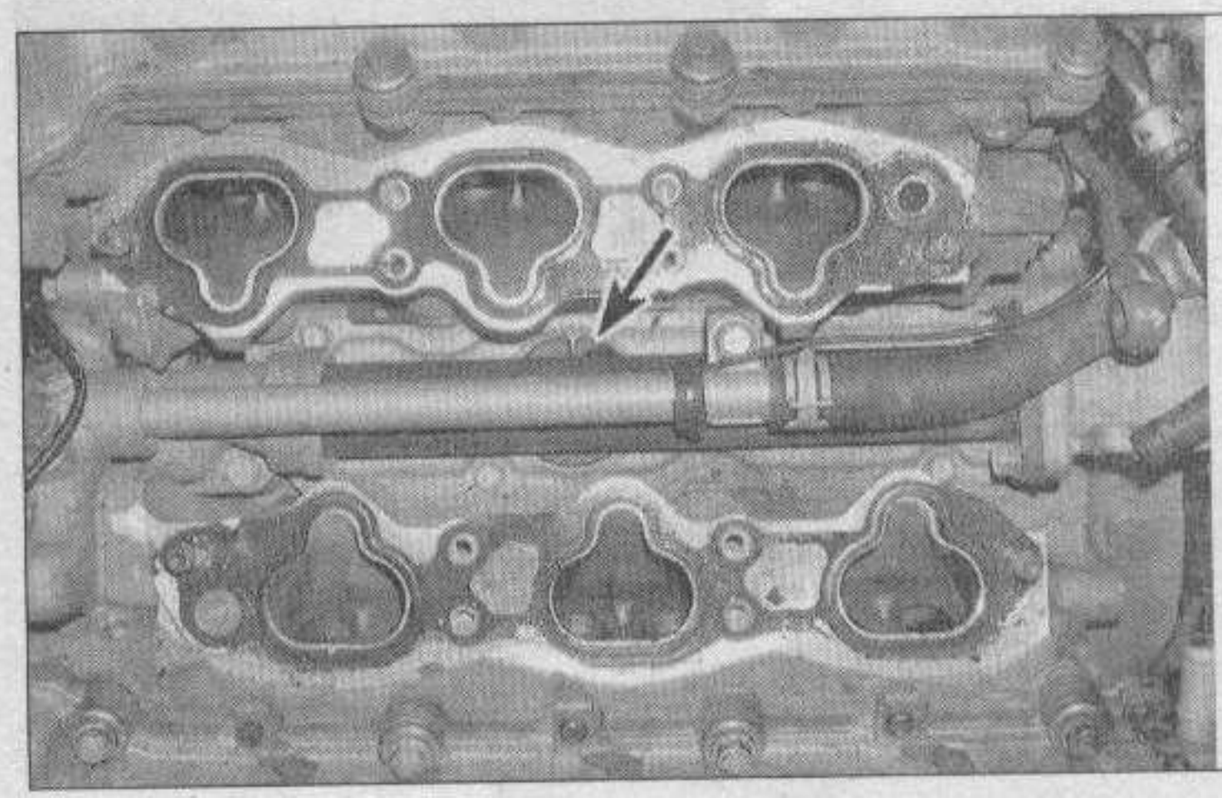
Refer to illustration 12.6

Warning: *Wait for the engine to cool completely before performing this procedure.*

4 Disconnect the cable from the negative terminal of the battery. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.* Drain the cooling system (see Chapter 1).

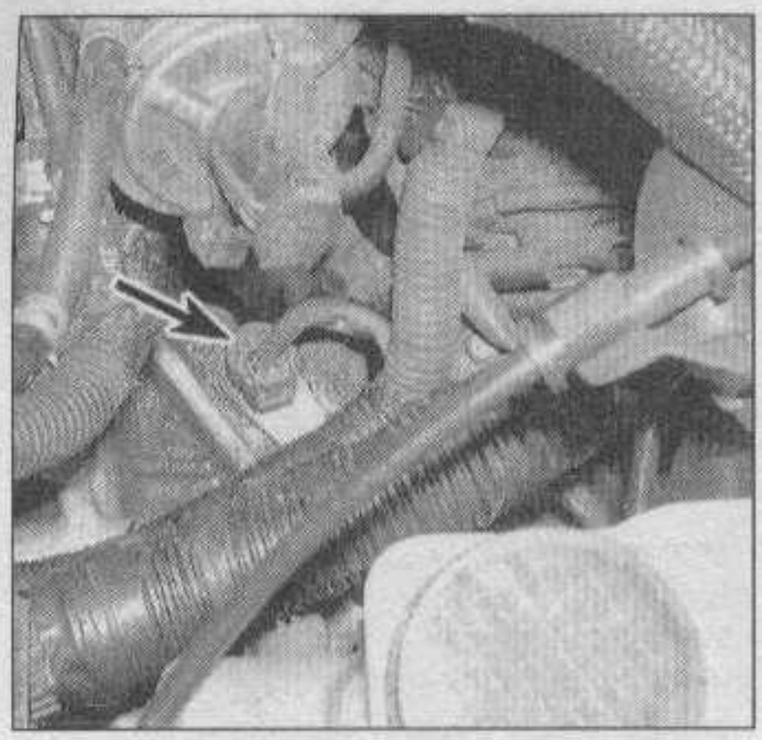
5 If you're working on a V6 engine, remove the intake manifold (see Chapter 2B) and the coolant pipe.

6 Disconnect the electrical connector and remove the knock sensor **(see illustration)**. **Note:** *New sensors are pre-coated with thread sealant, so do not apply any additional sealant or the operation of the sensor may be*

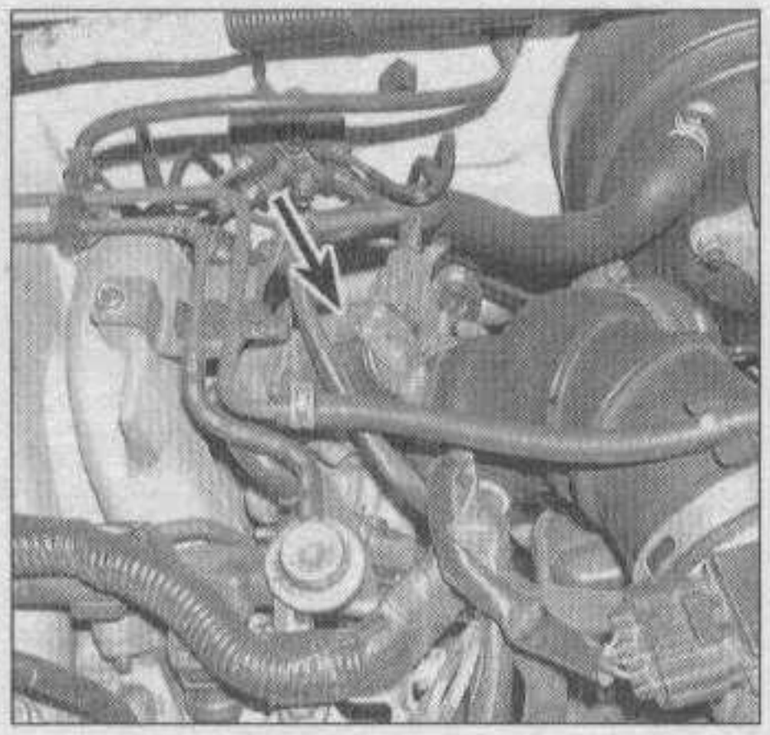


12.6 Location of the knock sensor (arrow) on a V6 engine

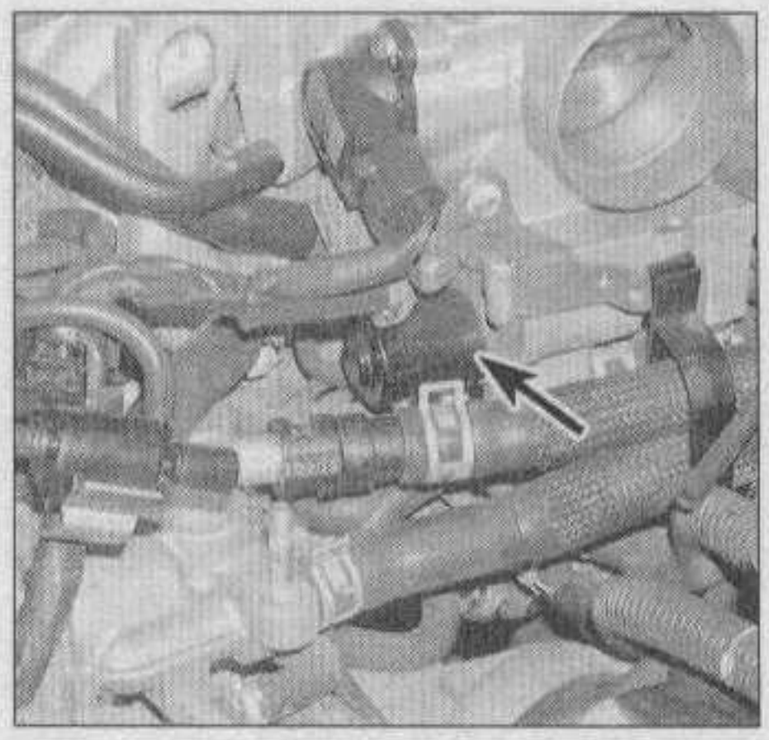
6



13.2 Location of the vehicle speed sensor (arrow) - typical



14.2a Location of the IAC valve (arrow) - four-cylinder models



14.2b Location of the IAC valve (arrow) - V6 models

affected. Tighten the sensor securely, but don't overtighten it or damage may occur.

6 Plug in the electrical connector, refill the cooling system (see Chapter 1) and check for leaks. Be sure to clear any stored trouble codes, too (see Section 2).

13 Vehicle Speed Sensor (VSS) - check and replacement

Check

Refer to illustration 13.2

1 The Vehicle Speed Sensor (VSS) is located on the transaxle. This sensor is a permanent magnetic variable reluctance sensor that produces a pulsing voltage whenever the vehicle is moving. These pulses are translated by the PCM to vehicle speed and used for speedometer operation and automatic transaxle shift control.

2 To check the vehicle speed sensor, disconnect the electrical connector at the sensor **(see illustration)**.

3 Raise the front of the vehicle and place it securely on jackstands. Block the rear wheels and place the transaxle in Neutral. Connect a voltmeter to the VSS. Securely hold or block one of the front wheels and rotate the other wheel by hand. The voltmeter should pulse between zero and 5 volts. If it doesn't, replace the sensor.

Replacement

4 To replace the VSS, disconnect the electrical connector from the VSS.

5 Remove the retaining screw and withdraw the VSS from the transaxle.

6 Replace the O-ring with a new one.

7 Installation is the reverse of removal.

14 Idle Air Control (IAC) valve - check and replacement

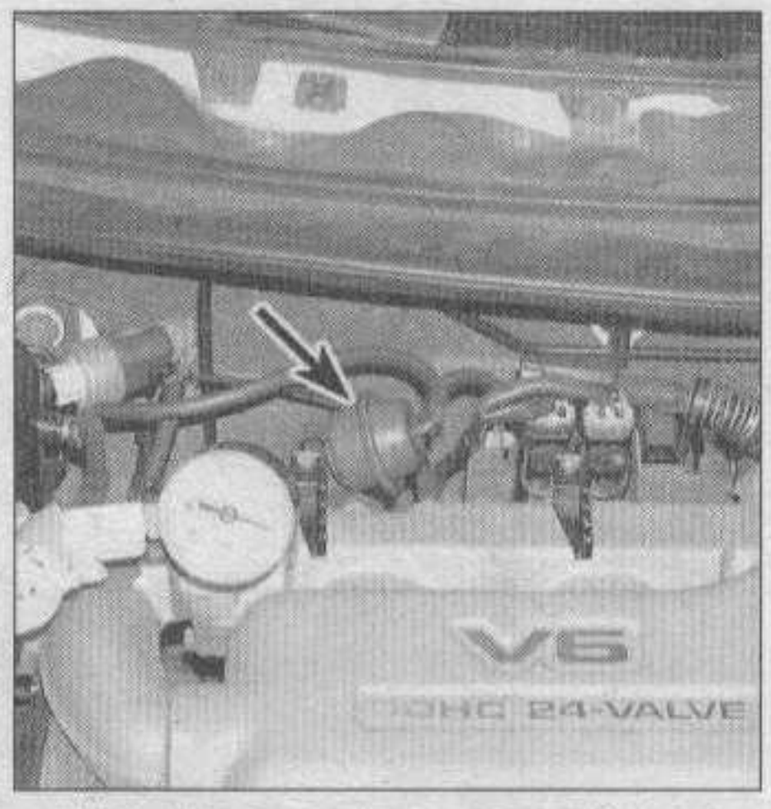
Check

Refer to illustrations 14.2a or 14.2b

Warning: *Keep hands, loose clothing, etc. away from any moving engine parts while working on a running engine or personal injury may result.*

1 The engine idle speed is controlled by the IAC valve. The IAC valve controls the amount of air that bypasses the throttle plate into the intake manifold. The IAC valve is activated by the PCM depending upon the running conditions of the engine (air conditioning system, power steering, cold and warm running etc.).

2 Apply the parking brake, block the wheels and place the transaxle in NEUTRAL (manual) or PARK (automatic). Connect a tachometer, according to the tool manufacturer's instructions, to the engine. Start the engine and hold the accelerator steady at 3,000 rpm until the coolant fan comes on. Allow the engine to idle and note the idle speed (with the cooling fan and all accessories OFF). If the idle speed is correct (see Chapter 1), the system is functioning properly. If the idle speed is less than the minimum specification, disconnect the electrical connector to the IAC valve **(see illustrations)**. The idle speed should fluctuate when the IAC valve is disconnected. If it doesn't, the IAC valve is probably defective.



15.2a Use a vacuum pump and apply vacuum to each of the shutter valve vacuum actuators - this one's at the right end of the manifold . . .

3 Using an ohmmeter, measure the resistance between the IAC valve terminals. It should be approximately 7.7 to 9.3 ohms (four-cylinder), 10.7 to 12.3 ohms (1993 through 1997 V6) or 8.7 to 10.5 ohms (1998 and later V6).

4 If the resistance readings are correct, have the PCM and electrical circuit for the IAC valve diagnosed by a dealer service department or other qualified repair shop.

Replacement

5 Disconnect the electrical connector from the IAC valve.

6 Remove the two mounting screws and remove the valve from the throttle body.

7 Installation is the reverse of removal. Be sure to install a new O-ring.

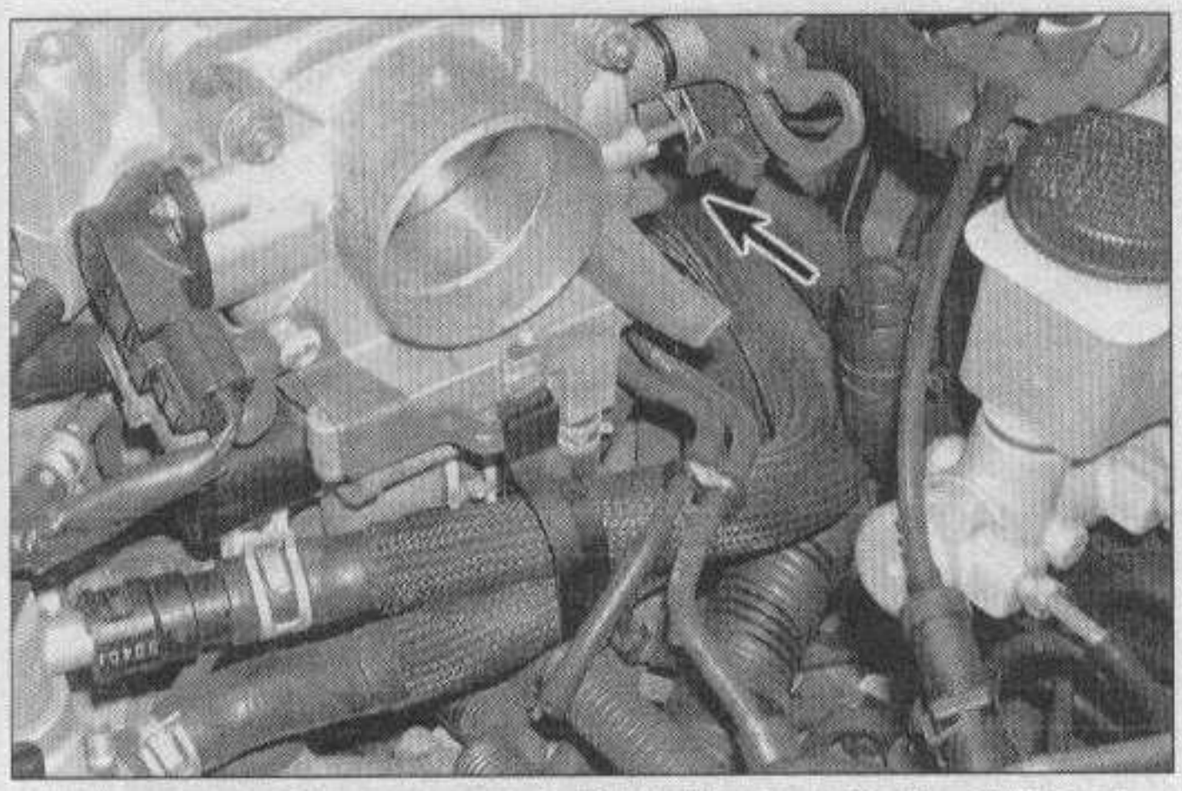
15 Variable Resonance Induction System (V6 models) - check and replacement

Refer to illustrations 15.2a and 15.2b

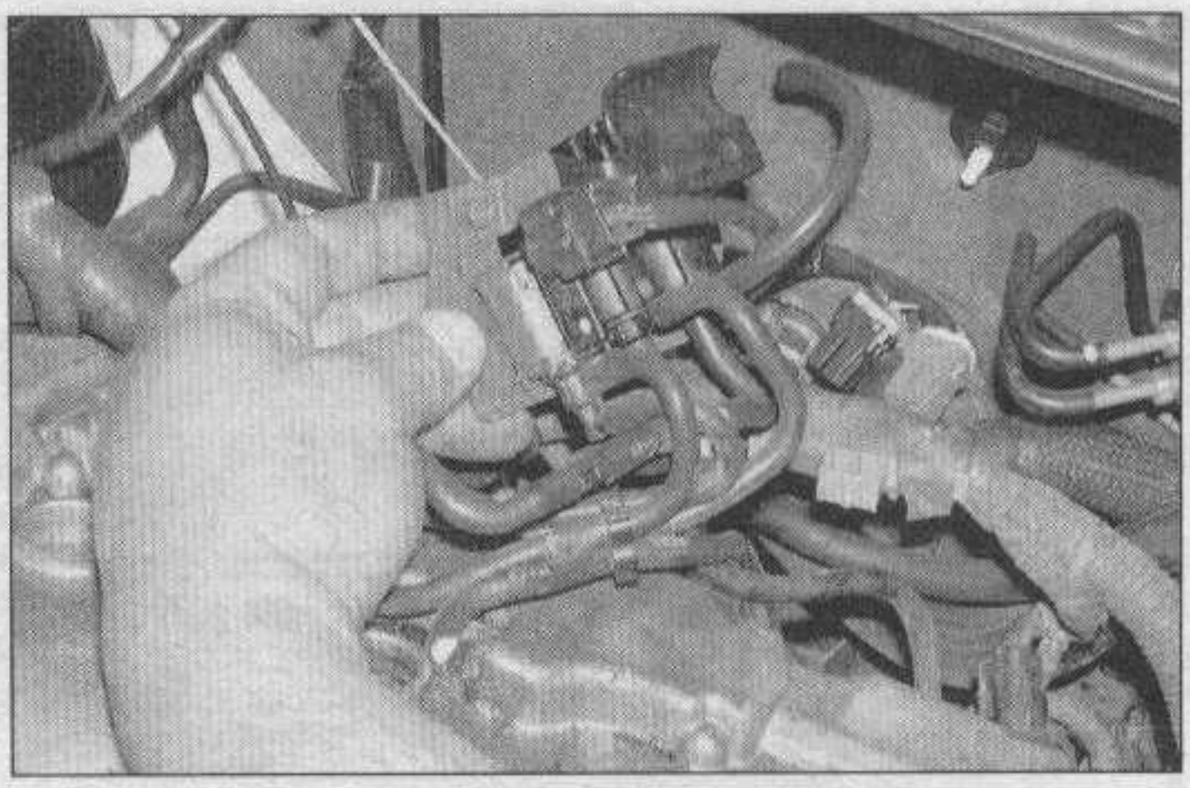
1 This system is used to improve low-speed torque by opening or closing a trio of secondary throttle valves mounted in the air intake tract. Two of the secondary throttle valves, which are linked together, are just behind the throttle body. The third is at the opposite end of the intake manifold. The two linked throttle plates and the separate throttle plate are operated by a pair of vacuum actuator. Each vacuum actuator is controlled by a solenoid in its vacuum line.

2 Locate the vacuum actuators **(see illustrations)**.

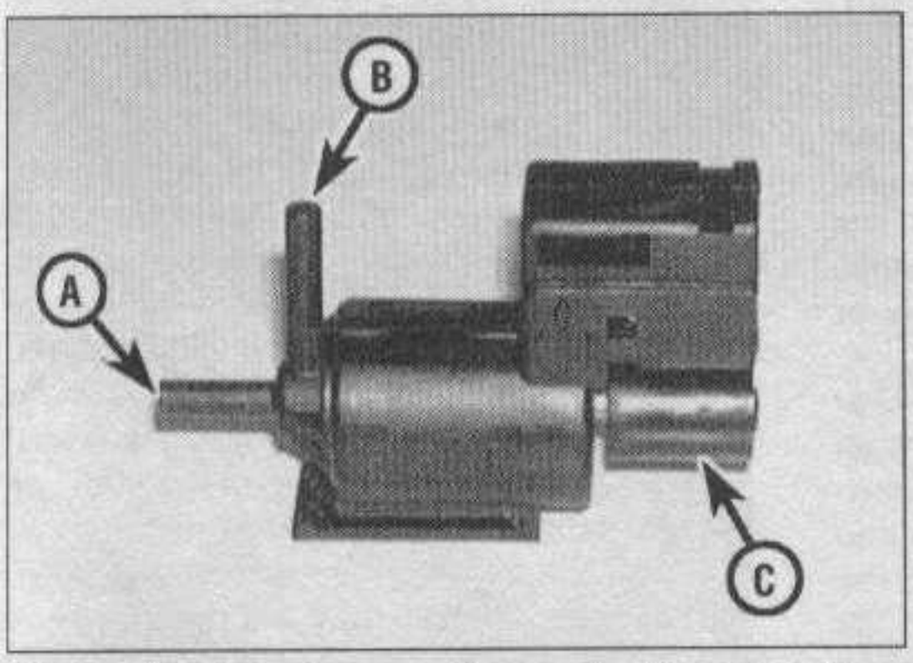
3 Warm up the engine. With the engine idling, twist and release the throttle pulley quickly to rev the engine. The vacuum actuator pull rods should move as the throttle is opened. If not, inspect the vacuum lines and replace any that are cracked or deteriorated. If the vacuum lines are good, check the system components as described below.



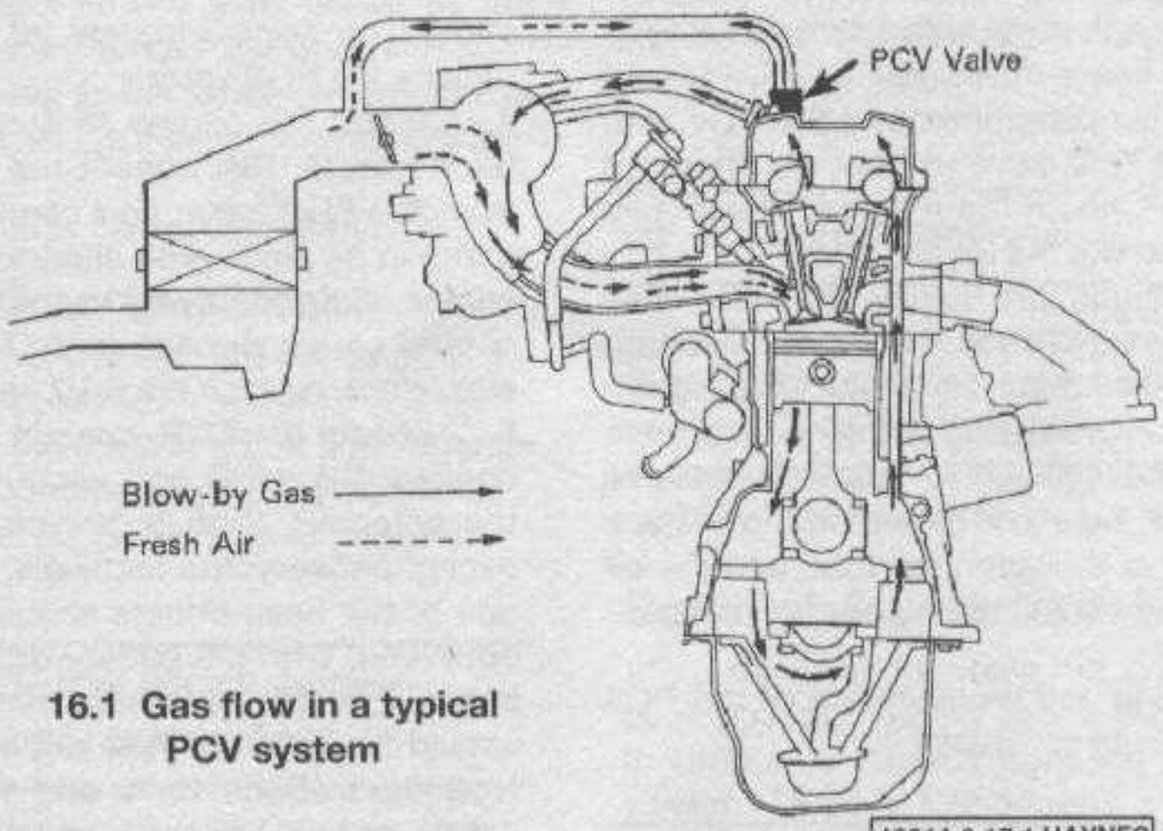
15.2b . . . and the other one is hidden behind the throttle body (not visible in this photo)



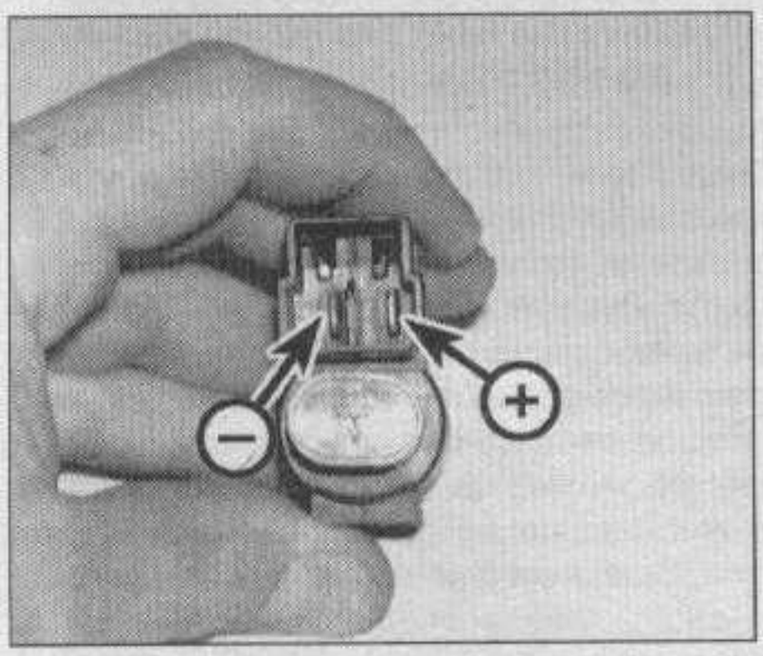
15.7a Detach the solenoids and lift them out for access



15.7b Air blown into port B should flow from the air filter (C)



16.1 Gas flow in a typical PCV system



15.8 With battery power connected to the solenoid, air blown into port B should flow from port A

Vacuum actuators

Check

4 With the engine off, disconnect the vacuum line from each vacuum actuator and connect a vacuum pump to it **(see illustration 15.2a)**. When vacuum is applied, the actuator pull rod should move. If it doesn't, replace the vacuum actuator.

Replacement

5 Disconnect the vacuum hose from the vacuum actuator (if not already done). Detach the pull rod from the shutter valve and unbolt the vacuum actuator from the engine.

6 Installation is the reverse of removal.

Solenoid valves

Check

Refer to illustrations 15.7a, 15.7b and 15.8

7 Disconnect the vacuum hose from the solenoid valve and blow air through hose B **(see illustrations)**. Check that air flows out the end of the valve.

8 Disconnect the solenoid valve electrical connector. Apply battery voltage to one terminal and ground the other **(see illustration)**.

9 Blow air through hose B again. Air should now flow out of port A.

10 If the solenoid valve doesn't pass these tests, replace it.

Replacement

11 Disconnect the vacuum hoses and electrical connector from the solenoid valve (if not already done).

12 Unclip the solenoid valve from its bracket **(see illustration 15.7a)**.

13 Installation is the reverse of the removal steps.

Vacuum chambers

Check

14 The vacuum chambers are mounted on the underside of the intake manifold. Remove the manifold (see Chapter 2B) and check the vacuum chambers for cracks or dents.

Replacement

15 Remove the intake manifold (see Chapter 2B).

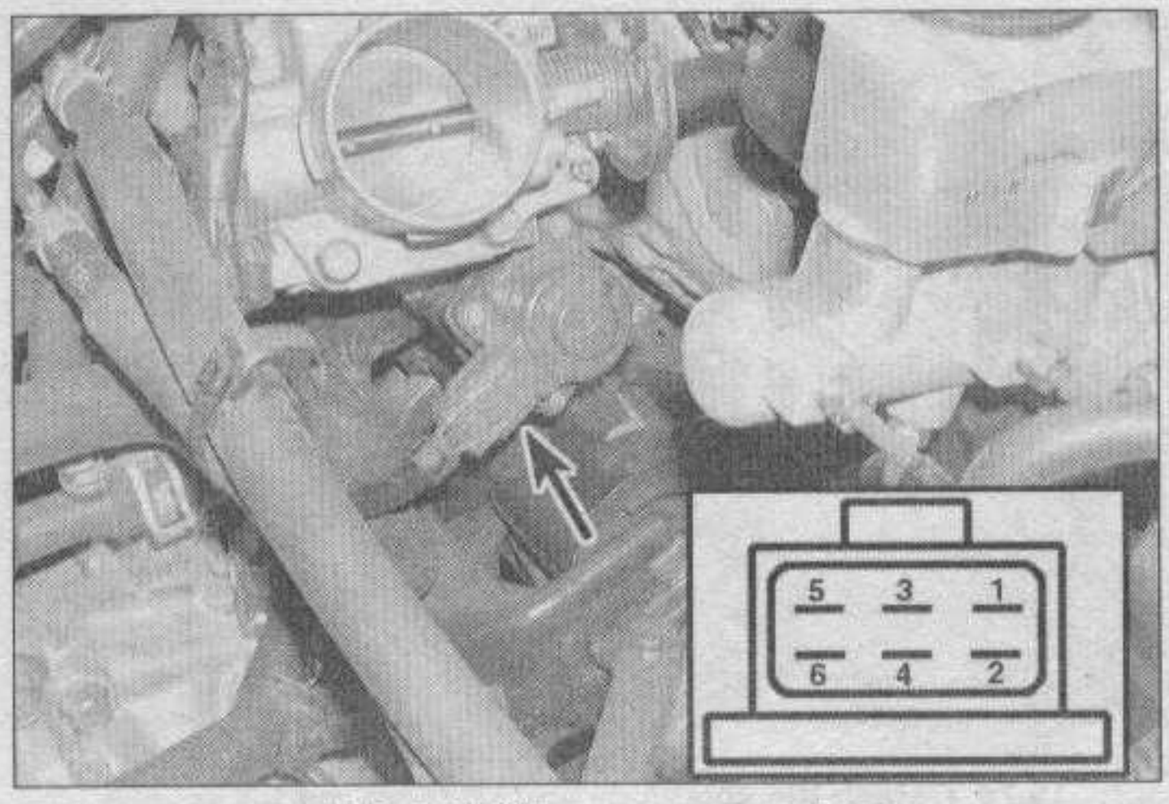
16 Disconnect the vacuum hoses from the vacuum chambers, then unbolt them from the manifold.

17 Installation is the reverse of the removal steps.

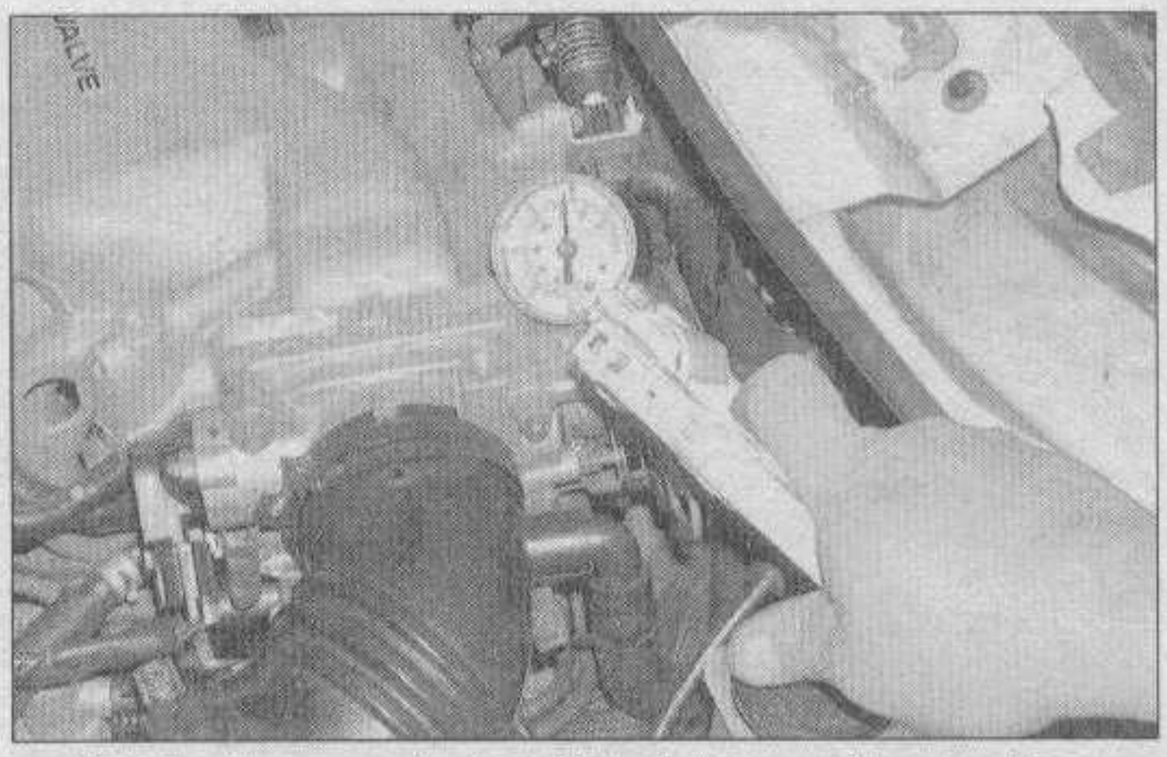
16 Positive Crankcase Ventilation (PCV) system

Refer to illustration 16.1

1 The Positive Crankcase Ventilation (PCV) system **(see illustration)** reduces hydrocarbon emissions by scavenging crankcase vapors. It does this by circulating fresh air from the air cleaner through the crankcase, where it mixes with blow-by



17.3 EGR lift sensor connector



17.4 Apply vacuum to the EGR valve; the engine should run roughly or stall

gases and is then rerouted through a PCV valve to the intake manifold.

2 The main components of the PCV system are the PCV valve, a blow-by filter and the vacuum hoses connecting these two components with the engine.

3 To maintain idle quality, the PCV valve restricts the flow when the intake manifold vacuum is high. If abnormal operating conditions (such as piston ring problems) arise, the system is designed to allow excessive amounts of blow-by gases to flow back through the crankcase vent tube into the air cleaner to be consumed by normal combustion.

4 Checking and replacement of the PCV valve is covered in Chapter 1.

17 Exhaust Gas Recirculation (EGR) system

General description

1 The EGR system reduces oxides of nitrogen by recirculating exhaust gas through the EGR valve and intake manifold into the combustion chambers.

2 The EGR system consists of the EGR valve, the EGR valve lift sensor, the Powertrain Control Module (PCM) and various sensors. The PCM memory is programmed to produce the ideal EGR valve lift for each operating condition. An EGR valve lift sensor detects the amount of EGR valve lift and sends this information to the PCM. The PCM then compares it with the ideal EGR valve lift, which is determined by data received from the other sensors. If there's any difference between the two, the PCM cuts current to the EGR valve to reduce the amount of exhaust gas recirculation.

Check

Refer to illustrations 17.3 and 17.4

3 To check the EGR valve lift sensor, disconnect the electrical connector from the EGR valve and check the resistance between terminals 1 and 3, 3 and 5, 2 and 4, and 4 and 6 on the valve **(see illustration)**. All readings should be approximately 22 ohms. If not, replace the EGR valve.

4 Warm the engine to normal operating temperature. Disconnect the vacuum hose from the EGR valve and connect a vacuum pump in its place **(see illustration)**. With the engine idling, applying vacuum to the valve should cause the engine to run roughly or stall. If not, replace the EGR valve.

5 Locate the EGR vacuum solenoid. Disconnect the wires and vacuum hoses from the solenoid. With a 12-volt battery connected between the terminals, air blown into one of the hose fittings should flow out the other one. With the battery disconnected, air blown into the port nearest the solenoid should flow out the vent end of the solenoid **(see illustrations 15.7b and 15.8)**. It should not be possible to blow air into the port farthest from the solenoid.

6 Further checking of the EGR control system requires special tools and equipment.

EGR valve replacement

Refer to illustration 17.8

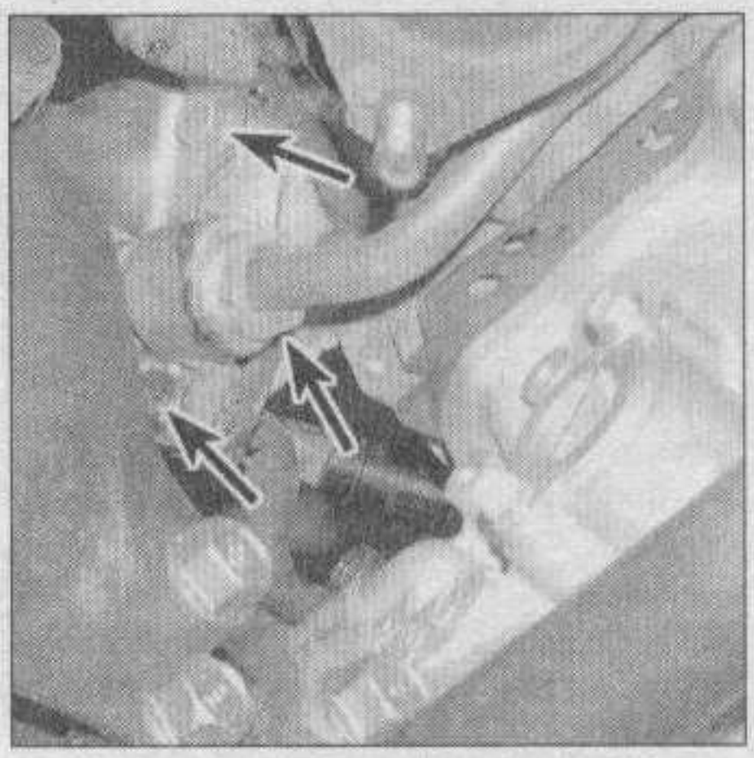
7 Disconnect the electrical connector for the EGR valve lift sensor.

8 Unscrew the EGR pipe, then remove the EGR valve mounting fasteners **(see illustration)**. Detach the EGR valve.

9 Clean the mating surfaces of the EGR valve and adapter.

10 Install the EGR valve, using a new gasket. Tighten the fasteners securely.

11 Connect the electrical connector.



17.8 Unscrew the EGR pipe fitting, remove the bolts and detach the valve (V6 EGR valve, shown from below)

18 Evaporative emissions control (EVAP) system

General description

1 The fuel evaporative emissions control (EVAP) system absorbs fuel vapors and, during engine operation, releases them into the engine intake where they mix with the incoming air-fuel mixture.

2 Every evaporative emissions control system employs a canister filled with activated charcoal to absorb fuel vapors. The means by which these vapors are controlled, however, varies considerably from one system to another. The following descriptions of a typical system for the models covered by this manual should provide you enough information to understand the system on your vehicle. **Note:** *The following descriptions are not intended as a specific description of the evaporative system on your particular vehicle. Rather, they are intended as a general description of a typical system used on fuel-injected vehicles. Although the following components are most likely all used on your particular system, there may also be other devices, not included here, which are unique to your system. Check with the VECI label and the Vacuum Hose Routing Diagram under the hood.*

3 The fuel filler cap is fitted with a two-way valve as a safety device. The valve vents fuel vapors to the atmosphere if the evaporative control system fails.

4 The fuel vapor valve is mounted on the fuel tank to recirculate the fuel vapors from the filler neck during refueling. The vapor is sent through the valve into the EVAP canister.

5 Fuel vapors travel through the two-way

valve to get to the canister. After passing through the two-way valve, fuel vapor is carried by vent hoses to the charcoal canister in the engine compartment. The activated charcoal in the canister absorbs and stores these vapors.

6 When the engine is running and warmed to a pre-set temperature, a purge cut-off solenoid valve near the canister closes, allowing a purge control diaphragm valve in the charcoal canister to be opened by intake manifold vacuum. Fuel vapors from the canister are then drawn through the purge control diaphragm valve by intake manifold vacuum.

7 A fuel tank pressure sensor is mounted on the tank to monitor pressure changes within the tank during operating and non-operating conditions.

Check

Note: *Complete checking of the evaporative emissions control system is beyond the scope of the average home mechanic. Fortunately, the evaporative control system, like all emission control systems, is protected by a Federally-mandated warranty (see your owners manual for more information). The EVAP system probably won't fail during the service life of the vehicle; however, if it does, the hoses or charcoal canister are usually to blame.*

8 Always check the hoses first. A disconnected, damaged or missing hose is the most likely cause of a malfunctioning EVAP system. Refer to the Vacuum Hose Routing Diagram (attached to the underside of the hood) to determine whether the hoses are correctly routed and attached. Repair any damaged hoses or replace any missing hoses as necessary.

9 Disconnect the vacuum line from the EVAP control canister and connect a vacuum gauge to the hose. With the engine cool (below 149-degrees F) and idling, there should be no vacuum present. If vacuum is present, there is most likely a problem with the purge control solenoid (see Step 14). If no vacuum is present, raise the engine rpm to 3,000 and allow the engine to reach normal operating temperature with the cooling fan activated. Vacuum should be present. Check the purge control solenoid if there is no vacuum present (see Step 14).

10 Disconnect the vacuum hose from the EVAP two-way valve (located near the charcoal canister) and connect a vacuum pump to the hose. Make sure the vacuum pump is linked directly to the two-way valve. With the ignition switch ON (engine not running), apply vacuum and confirm that the valve holds vacuum (pressure) steadily. Replace the two-way valve if it leaks.

11 Disconnect the electrical connector from the purge control solenoid, with the ignition key ON (engine not running), battery voltage should be present at the connector. If battery voltage is not available, check the circuit and make any necessary repairs.

12 Warm the engine up to normal operating temperature (cooling fan must come on). Check for vacuum back to the intake manifold from the purge control solenoid. If there is still no vacuum present from the purge control solenoid, disconnect the electrical connector and check for manifold vacuum now. If there is no vacuum, check to make sure the vacuum hoses are routed correctly. If there is vacuum, check for a short in the wiring harness between the connector and the PCM.

13 Check the charcoal canister for leaks. Remove the charcoal canister and plug all the vent lines with plugs. Install a vacuum pump to the canister vent shut valve, apply vacuum (pressure) and make sure there are no leaks. Replace the charcoal canister if necessary.

Replacement

Charcoal canister

14 Disconnect all the vent hoses to the charcoal canister, remove the bolts and separate the canister from the vehicle. Be sure to mark all the hoses to insure correct reassembly.

15 Installation is the reverse of removal.

Purge control solenoid valve

16 Disconnect the vacuum hoses from the purge control solenoid.

17 Remove the mounting bolt and separate the solenoid from the engine compartment.

18 Installation is the reverse of removal.

19 Brake On/Off (BOO) switch - check and replacement

Check

1 The Brake On/Off switch (also called the brake pedal position switch or brake light switch) tells the PCM when the brakes are being applied. The switch closes when brakes are applied and opens when the brakes are released. The switch is mounted on the brake pedal.

2 The brake light circuit is controlled by this switch, and burned-out bulbs or other circuit problems will cause the engine to idle roughly. Therefore, check the BOO switch operation when troubleshooting any rough-idle problems.

3 Refer to the wiring diagrams at the end of this manual to identify the functions of connector terminals.

4 Disconnect the switch connector and connect your voltmeter positive (+) lead to the connector terminal that provides battery positive (B+) voltage to the switch. Connect the negative (-) meter lead to a good ground.

6 Turn the ignition On and read the meter. It should indicate more than 10 volts or close to battery voltage.

7 Connect an ohmmeter to the switch terminals and manually open and close the switch. The meter should alternate from continuity to an open-circuit reading as the switch is opened and closed.

8 Also check continuity from the switch to the brake light bulbs. Replace any burned-out bulbs or damaged wire looms.

Replacement

Warning: *The models covered by this manual are equipped with Supplemental Restraint Systems (SRS), more commonly known as airbags. Always disable the airbag system before working in the vicinity of any airbag system components to avoid the possibility of accidental deployment of the airbag, which could cause personal injury* (see Chapter 12).

9 Remove the trim panel from below the driver's side of the instrument panel.

10 Disconnect the electrical connector from the switch.

11 Rotate the switch 1/4-turn and remove it from its bracket.

12 To install, push the switch into the bracket until it contacts the brake pedal. Reconnect the electrical connector and install the trim panel.

20 Catalytic converter

Note: *Because of a Federally mandated warranty which covers emissions-related components such as the catalytic converter, check with a dealer service department before replacing the converter at your own expense.*

General description

1 The catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust gas stream. There are two types of converters. The conventional oxidation catalyst reduces the levels of hydrocarbon (HC) and carbon monoxide (CO). The three-way catalyst lowers the levels of oxides of nitrogen (NOx) as well as hydrocarbons (HC) and carbon monoxide (CO). These models use three-way catalysts.

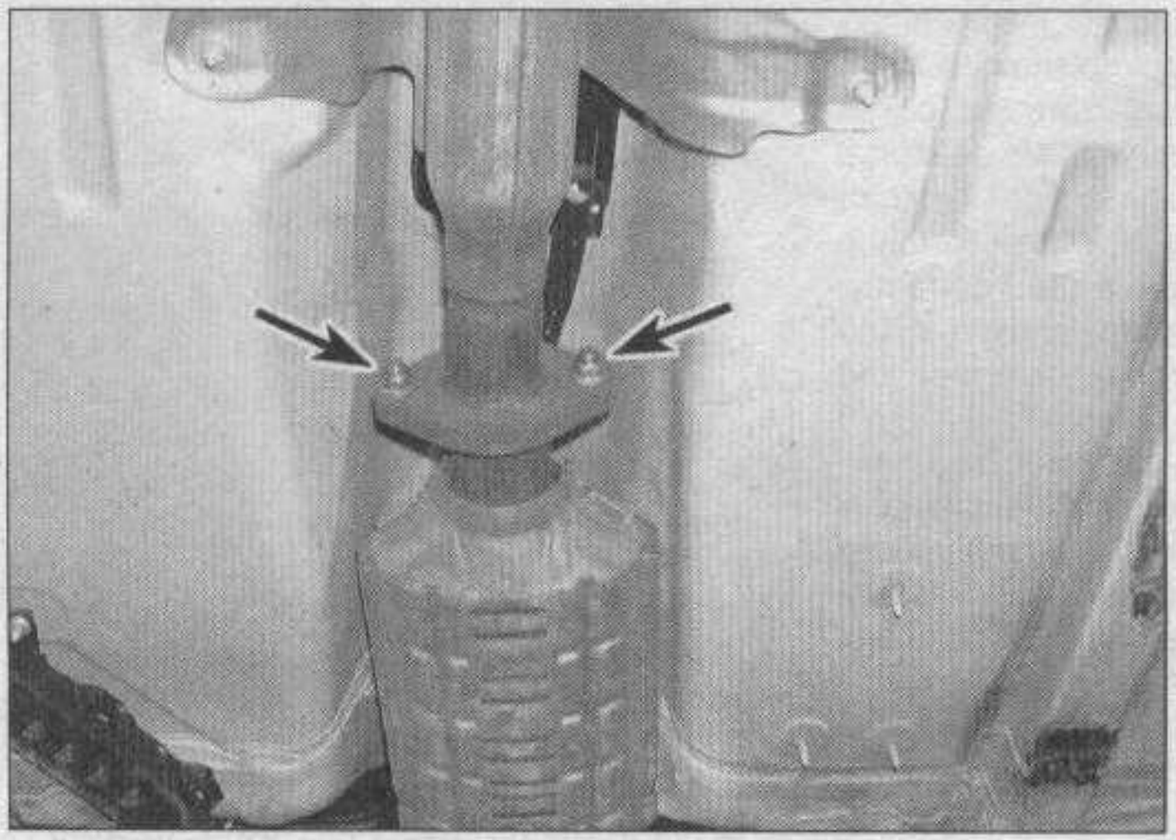
Check

2 The test equipment for a catalytic converter is expensive and highly sophisticated. If you suspect that the converter on your vehicle is malfunctioning, take it to a dealer or authorized emissions inspection facility for diagnosis and repair.

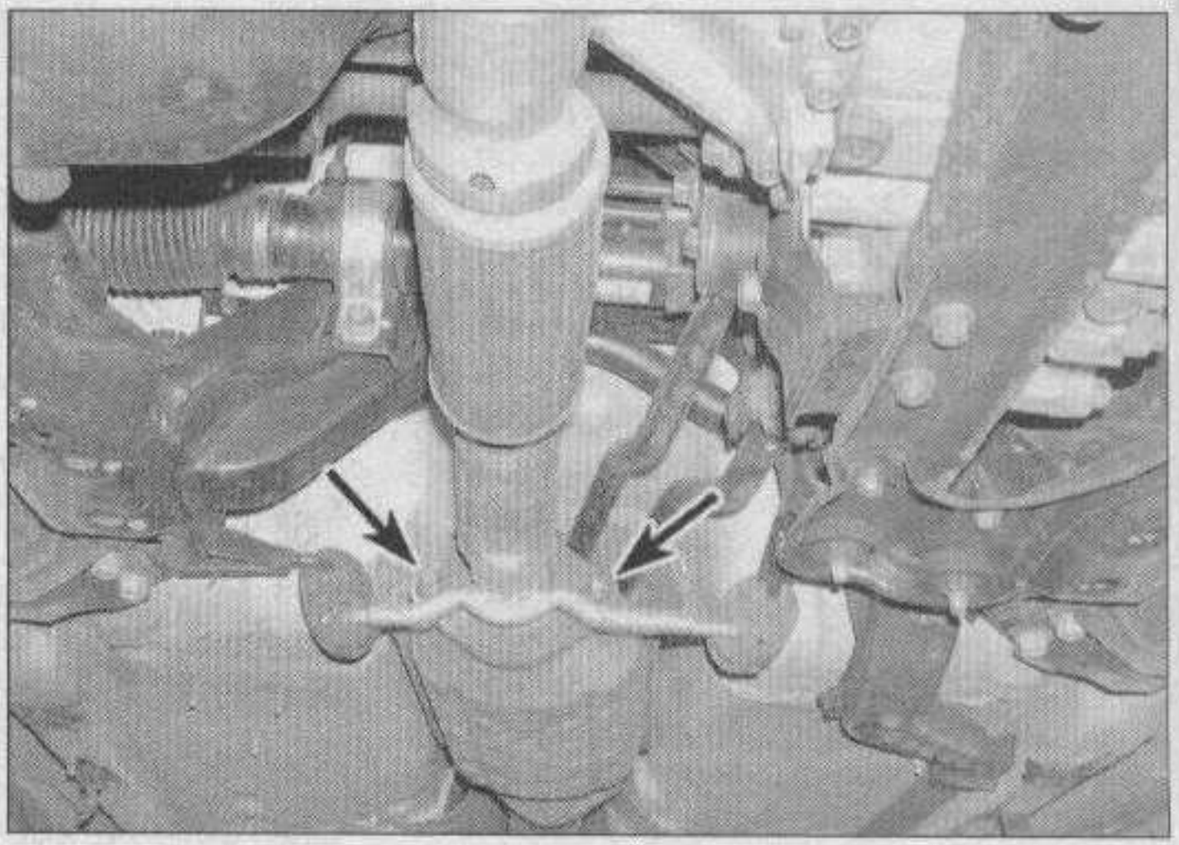
3 Whenever the vehicle is raised for servicing of underbody components, check the converter for leaks, corrosion, dents and other damage. Check the welds/flange bolts that attach the front and rear ends of the converter to the exhaust system. If damage is discovered, the converter should be replaced.

4 Although catalytic converters don't break too often, they can become plugged. The easiest way to check for a restricted converter is to use a vacuum gauge to diagnose the effect of a blocked exhaust on intake vacuum.

a) Connect a vacuum gauge to an intake manifold vacuum source (see Chapter 2C).



20.5a Spray penetrating lubricant onto the threads of the rear mounting bolts (arrows) of the catalytic converter



20.5b Forward catalytic converter flange nuts (arrows)

b) Warm the engine to operating temperature, place the transaxle in Park (automatic) or Neutral (manual) and apply the parking brake.

c) Note and record the vacuum reading at idle.

d) Quickly open the throttle to near full throttle and release it shut. Note and record the vacuum reading.

e) Perform the test three more times, recording the reading after each test.

f) If the reading after the fourth test is more than one in-Hg lower than the reading recorded at idle, the exhaust system may be restricted (the catalytic converter could be plugged or an exhaust pipe or muffler could be restricted).

Component replacement

Refer to illustrations 20.5a and 20.5b

5 Be sure to spray the exhaust nuts on the flange studs before removing them from the catalytic converter **(see illustrations)**.

6 Remove the nuts and separate the catalytic converter from the exhaust system.

7 Installation is the reverse of removal.

Chapter 7 Part A
Manual transaxle

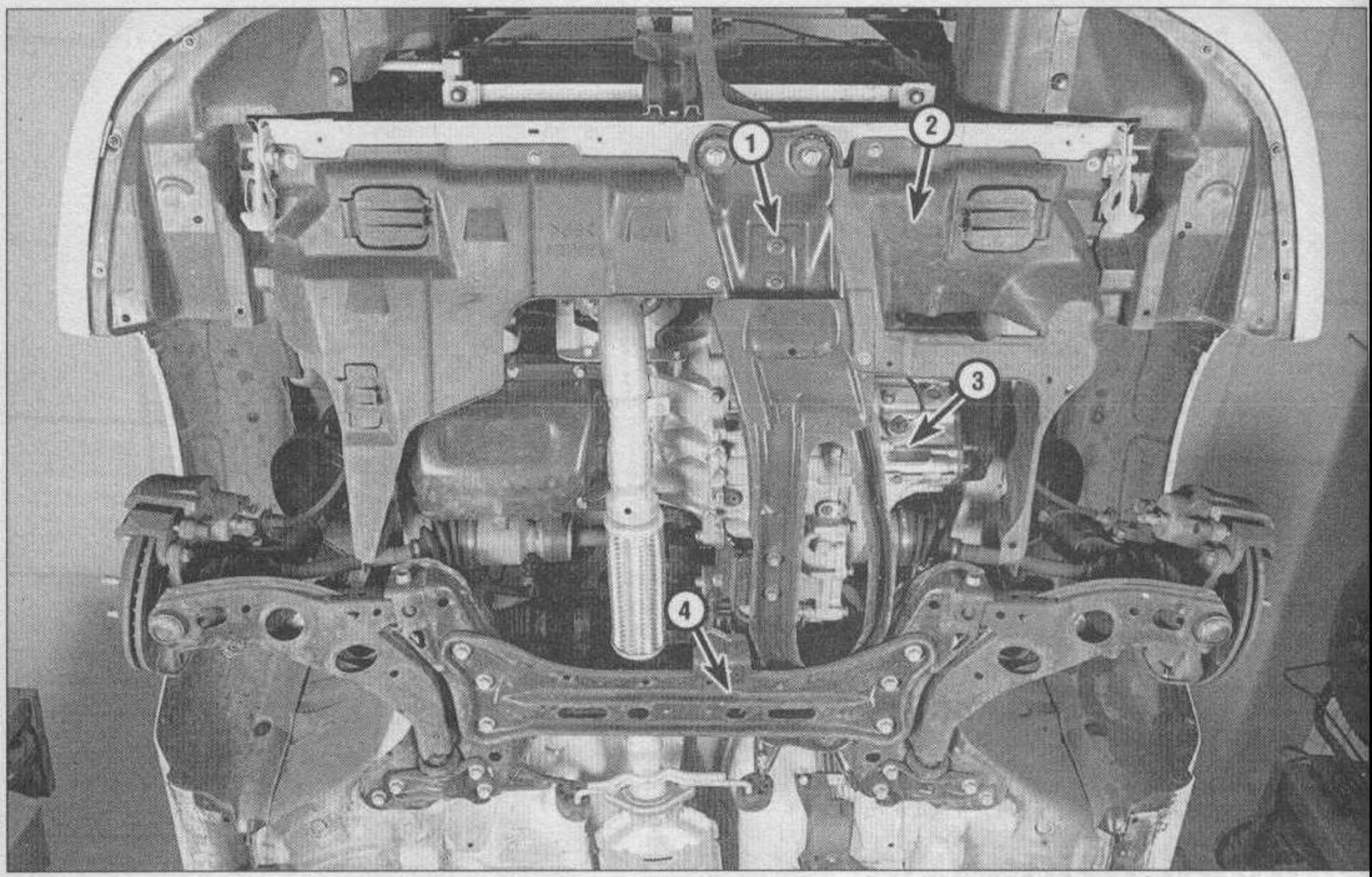
Contents

	Section
Back-up light switch - check and replacement	3
Driveaxle oil seals - replacement	See Chapter 7B
Engine mounts – check and replacement	See Chapters 2A, 2B
General information	1
Manual transaxle lubricant change	See Chapter 1
Manual transaxle lubricant level check	See Chapter 1
Manual transaxle overhaul - general information	5
Manual transaxle - removal and installation	4
Shift lever, housing and linkage - removal and installation	2

Specifications

Torque specifications

	Ft-lbs (unless otherwise indicated)
Extension bar-to-transaxle nut	28 to 38
Resonator heat shield mounting nuts	79 to 112 in-lbs
Shift lever base plate mounting nuts	87 to 130 in-lbs
Transaxle cradle bolts and nuts **(refer to illustration 8.23 in Chapter 7B)**	
A (nuts)	55 to 77
B (nuts and bolts)	50 to 68
C (nuts)	32 to 44
Transaxle crossmember	69 to 96
Transaxle-to-engine bolts	
Four-cylinder engines **(refer to illustration 4.41a)**	
Bolts A and E	66 to 86
Bolts B and D	28 to 38
Bolt C	14 to 18
V6 engines **(refer to illustration 4.41b)**	
Bolts A	50 to 73
Bolts B	28 to 38
Transaxle shift linkage bolt/nut	14 to 18



1.1 An underside view of the manual transaxle and related components

1 Transaxle cradle 2 Splash shield 3 Transaxle 4 Crossmember

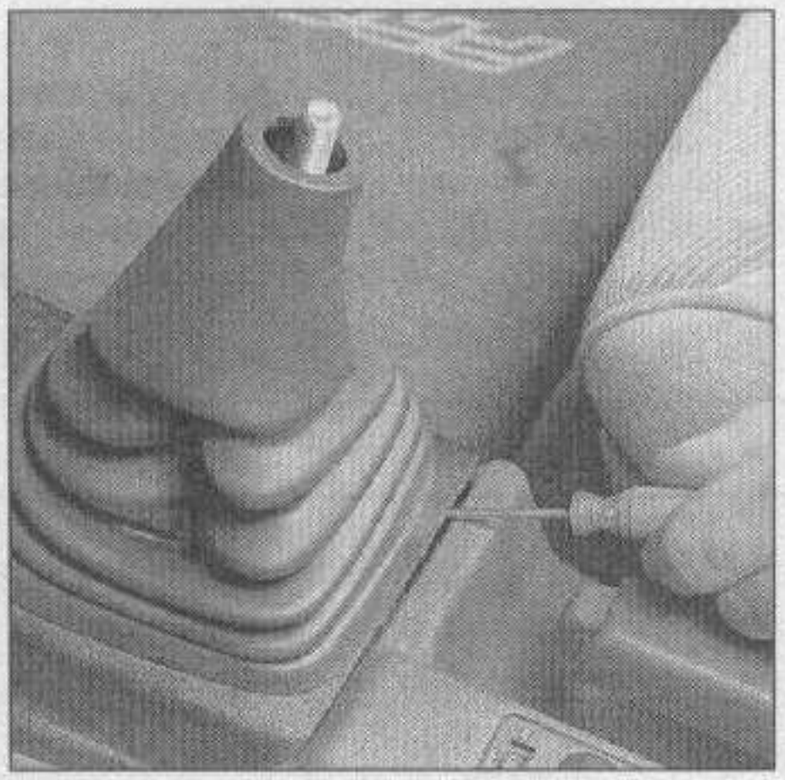
1 General information

Refer to illustration 1.1

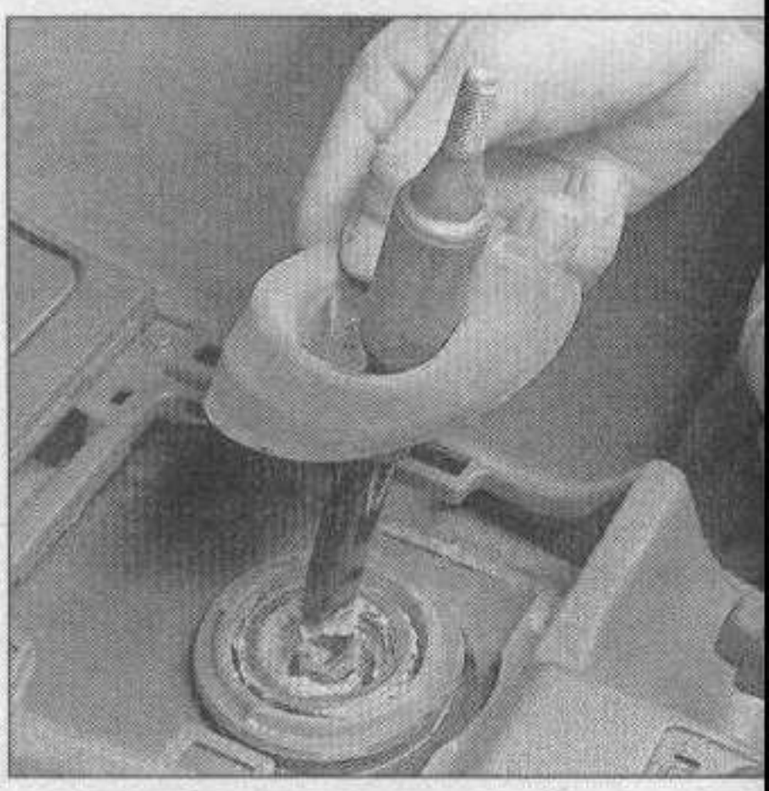
The models covered by this manual are equipped with either a five-speed manual transaxle **(see illustration)** or an automatic transaxle. Information on the manual transaxle is included in this Part of Chapter 7. Information on the automatic transaxle can be found in Chapter 7, Part B. You'll also find certain procedures common to both transaxles - such as oil seal replacement - in Chapter 7B.

The manual transaxle is a synchronized, 5-speed design, designated G25M-R. The transaxle model number is stamped onto a plate on the transaxle. Refer to *Vehicle identification numbers* at the front of this manual for the location of the plate.

Depending on the expense involved in having a transaxle overhauled, it might be a better idea to consider replacing it with either a new or rebuilt unit. Your local dealer or transaxle shop should be able to supply information concerning cost, availability and exchange policy. Regardless of how you decide to remedy a transaxle problem, you can still save a lot of money by removing and installing the unit yourself.



2.3 Pry the shift lever boot and the upper trim piece loose with a small screwdriver



2.4 Remove the boot from the lower end of the shift lever assembly

2 Shift lever, housing and linkage - removal and installation

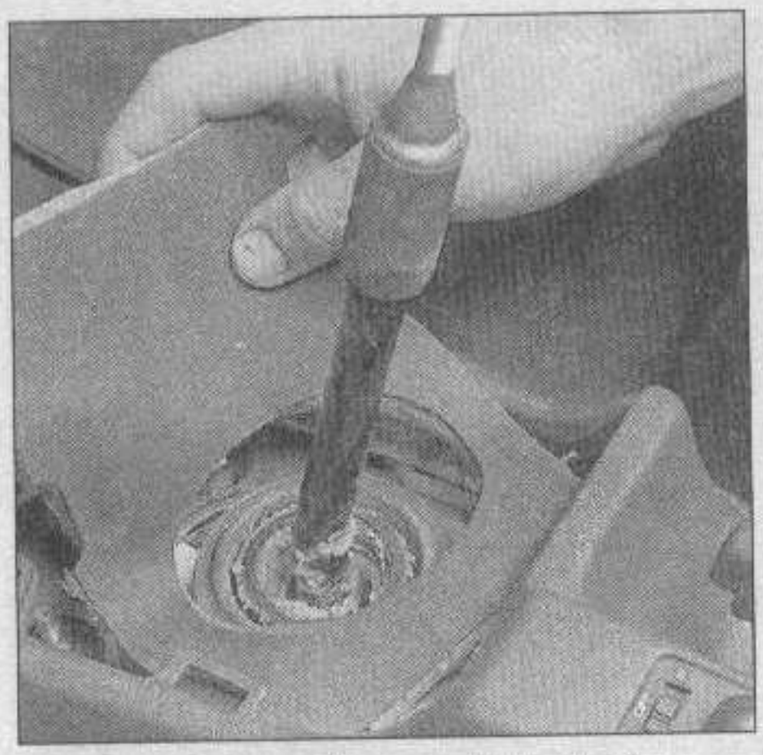
Warning: *The models covered by this manual are equipped with Supplemental Restraint systems (SRS), more commonly known as airbags. Always disable the airbag system before working in the vicinity of any airbag system component to avoid the possibility of accidental deployment of the airbag, which could cause personal injury* (see Chapter 12).

Shift lever

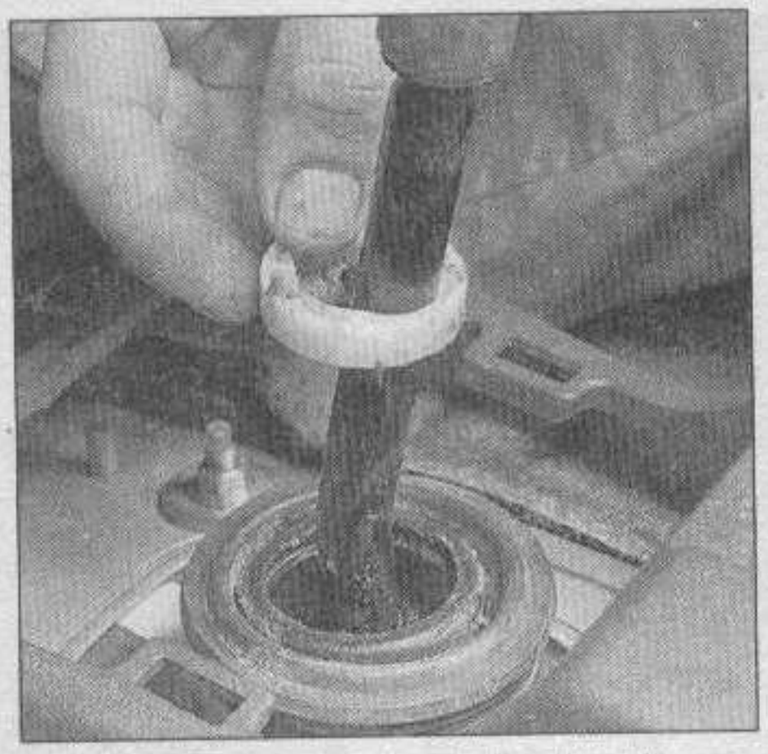
Refer to illustrations 2.3, 2.4, 2.5, 2.7, 2.11 and 2.12

1 Unscrew and remove the shift lever knob.

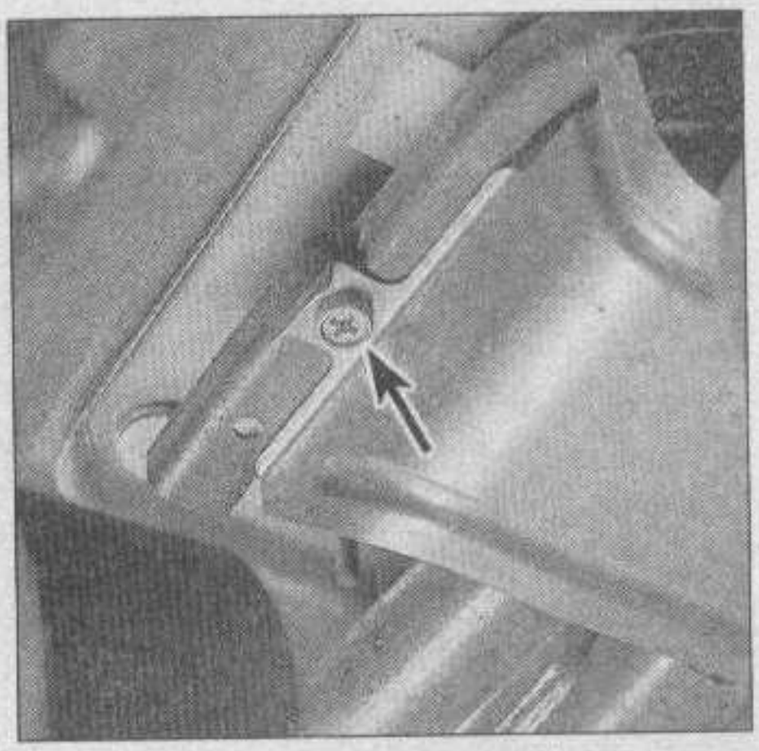
2 Remove the floor console (see Chapter 11).



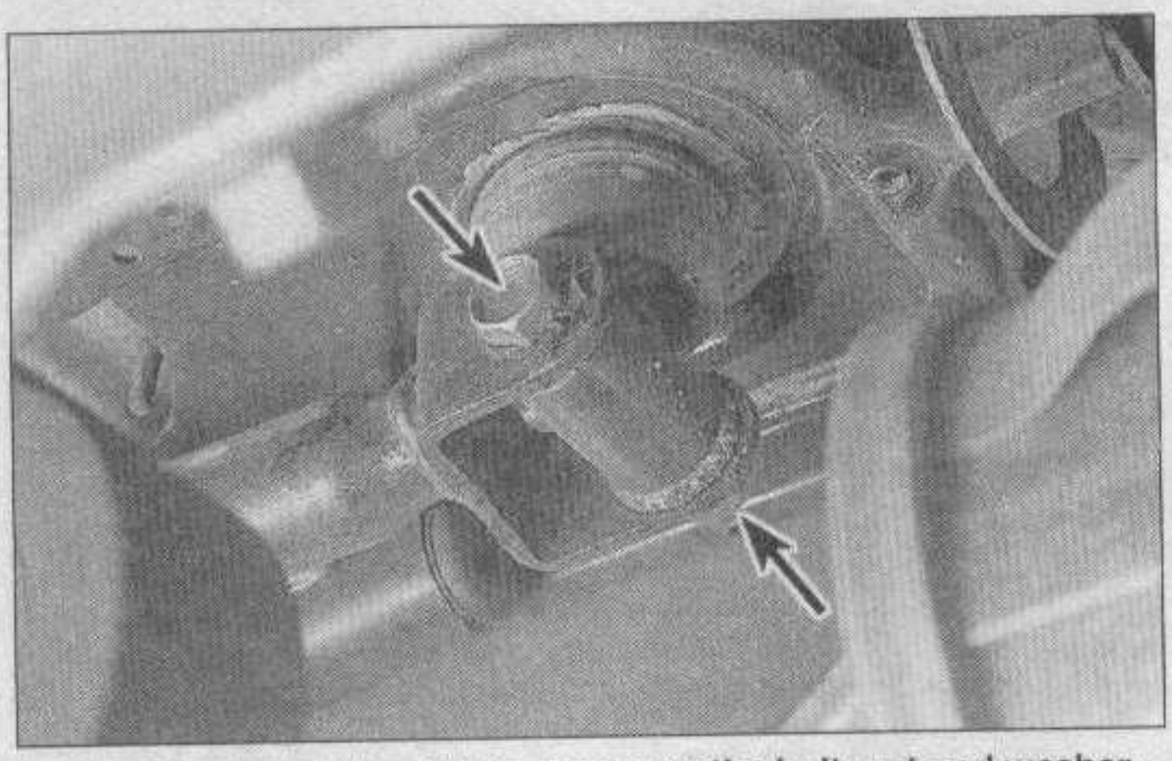
2.5 Remove the sound deadening material, if equipped



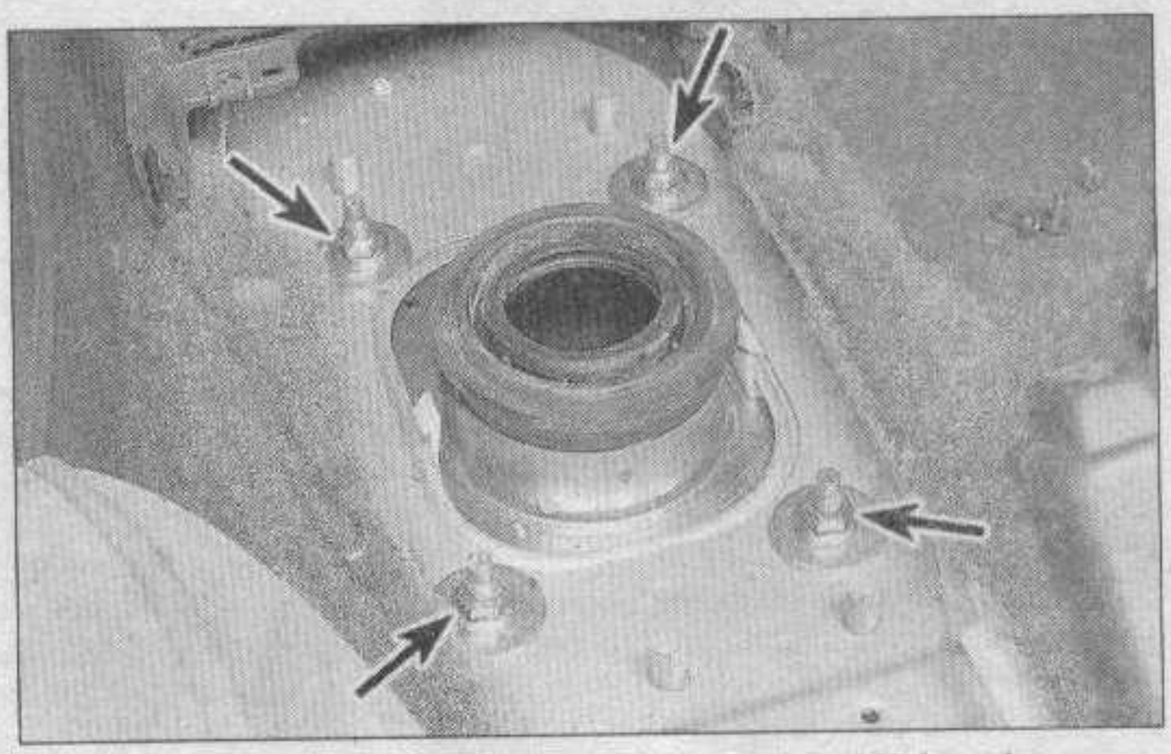
2.7 Remove the upper ball seat



2.11 Remove the screws that retain the heat shield to the underside of the console area



2.12 To remove the shift rod, remove the bolt, nut and washer (arrows) from each end



2.16 Remove the nuts (arrows) from the shift housing

3 Remove the shift lever boot **(see illustration)**.

4 Remove the boot from the lower end of the shift lever **(see illustration)**.

5 Remove the sound deadening material, if equipped **(see illustration)**.

6 Use a pair of snap-ring pliers to remove the steel snap-ring. Remove the plastic snap-ring from under the steel snap-ring, if equipped.

7 Remove the O-ring and the upper ball seat **(see illustration)**.

8 Raise the vehicle and support it securely on jackstands.

9 Working under the vehicle, disconnect the catalytic converter flange nuts (see Chapter 6). **Warning:** *Do not attempt to work in the vicinity of the exhaust system unless the engine and exhaust system have completely cooled down.*

10 Remove the exhaust system rubber hangers and lower the exhaust system.

11 Remove the resonator heat shield fasteners and detach the heat shield from the exhaust system **(see illustration)**.

12 Remove the transaxle shift linkage bolt **(see illustration)**. Use a punch and hammer to drive the gearshift lever from the housing assembly.

13 Lift the gearshift lever from the housing.

14 Installation is the reverse of removal. Tighten the resonator heat shield mounting nuts to the torque listed in this Chapter's Specifications.

Shift housing

Refer to illustration 2.16

15 Remove the shift lever from the shift lever housing (see Steps 1 through 13).

16 Remove the four shift housing mounting nuts from the base plate **(see illustration)**.

17 Disconnect the extension bar mounting through-bolt from the shift housing. Separate the shift housing from the body of the vehicle.

18 Installation is the reverse of removal. Tighten the base plate mounting nuts and the extension bar mounting bolt to the torque listed in this Chapter's Specifications.

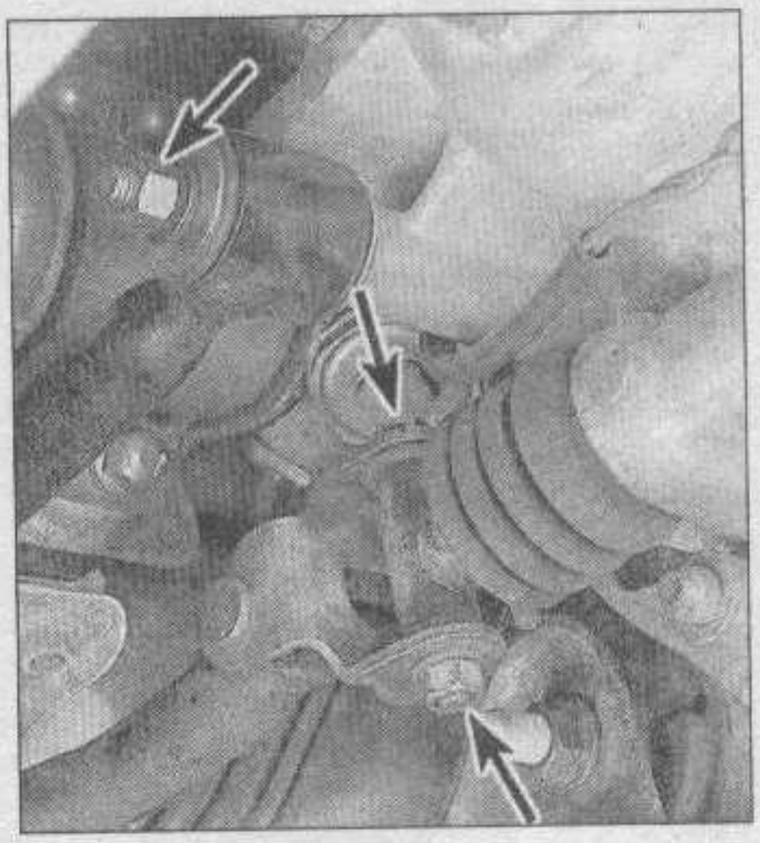
Shift linkage

Refer to illustration 2.20

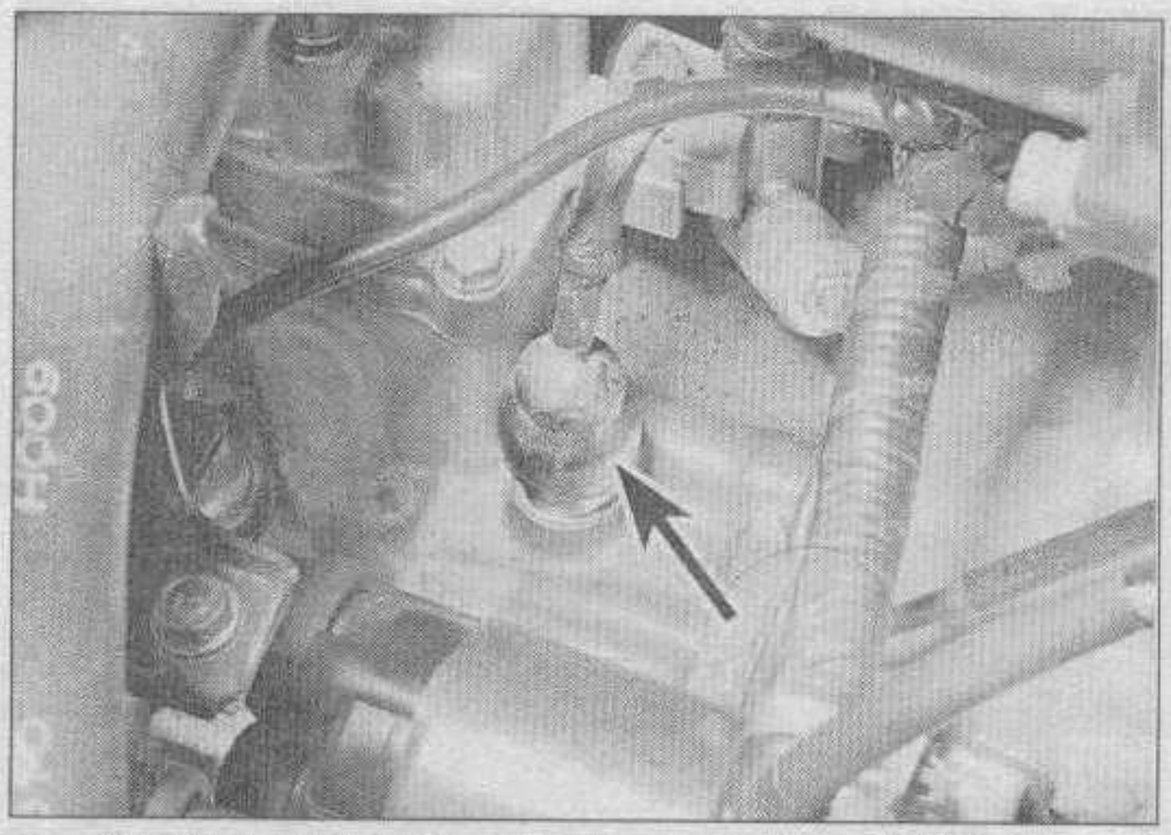
19 Remove the shift lever from the shift lever housing (see Steps 1 through 13).

20 Disconnect the extension bar and the shift linkage from the transaxle **(see illustration)**. Remove the extension bar through-bolt (see Step 17).

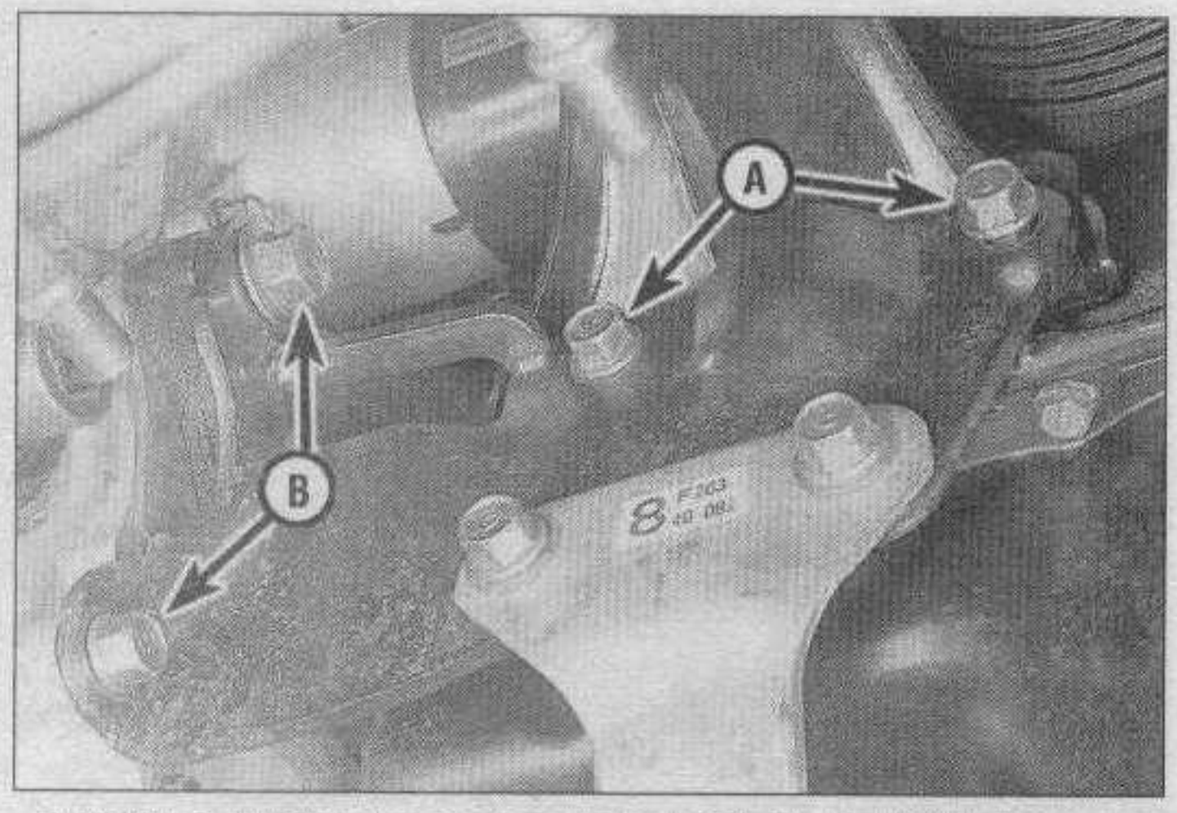
21 Installation is the reverse of removal. Tighten the transaxle shift linkage bolt and the extension bar bolt to the torque listed in this Chapter's Specifications.



2.20 Remove the bolt and nut (arrows) from the front clevis at the transaxle and the extension bar (arrows)



3.4 The back-up light switch (arrow) is threaded into the transaxle housing



4.15 On four-cylinder engines, remove the bolts (A) that secure the intake manifold brace to the engine block – the other two bolts (B) are for the starter access bracket

3 Back-up light switch - check and replacement

Check

Refer to illustration 3.4

1 Before testing the back-up light switch, check the 15A METER fuse in the under-dash fuse box. If the fuse is defective, replace it with a new one. If the fuse blows immediately, check the circuit from the back-up light switch to the ignition key. Refer to the wiring diagrams at the end of Chapter 12.

2 Place the shift lever in REVERSE and turn the ignition switch to On. The back-up lights should go on. Turn off the ignition switch.

3 If the back-up lights didn't go on, check the back-up light bulbs in the tail light assembly.

4 If the fuse and bulbs are both okay, disconnect the electrical connector from the back-up light switch **(see illustration)** and connect an ohmmeter or continuity tester across the two switch terminals.

5 With the shift lever in REVERSE, there should be continuity; there should be no continuity with the shifter in any other gear.

6 If the switch fails the above tests, replace the switch (see below).

7 If the switch is OK, check for a poor ground in the circuit; if the grounds are good, look for shorts or opens in the wires.

Replacement

8 Disconnect the back-up light switch electrical connector.

9 Unscrew and remove the back-up light switch.

10 Discard the old washer.

11 Using a new washer, install the new switch.

12 Plug in the connector.

4 Manual transaxle - removal and installation

Removal

Refer to illustrations 4.15, 4.19a, 4.19b, 4.20, 4.24 and 4.27

1 Relieve the fuel system pressure (see Chapter 4). Disconnect the negative cable and then the positive cable from the battery. Remove the battery and the battery tray (see Chapter 5). **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system. Make sure you have the correct activation code before disconnecting the battery.*

2 Remove the air intake duct and the air cleaner housing (see Chapter 4).

3 Remove the starter motor (see Chapter 5).

4 Disconnect the transaxle ground cable and all electrical connectors, then detach the wiring harness clamp from the transaxle.

5 Shift the transaxle into reverse gear.

6 Disconnect the shift linkage and extension bar from the transaxle (see Section 2). It's not necessary to disconnect the shift linkage and the extension bar from the shift lever housing. Move the linkage pieces to the side and secure them to the chassis using wire or rope.

7 Disconnect the electrical connector for the vehicle speed sensor (VSS) (see Chapter 6).

8 Unbolt the clutch release cylinder and support it out of the way with a piece of wire (see Chapter 8). **Caution:** *Be careful not to bend or kink the clutch fluid pressure line and do NOT depress the clutch pedal while the clutch release cylinder is removed.*

9 Raise the vehicle and support it securely on jackstands. Secure the engine using an engine support fixture **(see illustration 8.9 in Chapter 7B)**. If an engine support fixture is not available, connect an engine hoist and a lifting chain assembly.

10 Remove the upper transaxle-to-engine mounting bolts.

11 Remove the fuel filter (see Chapter 1).

12 Refer to Chapter 2A (four-cylinder engine) or 2B (V6 engine) and remove the engine mount from the left side of the vehicle.

13 Raise the vehicle and support it securely on jackstands. Remove the front wheels.

14 Drain the transaxle lubricant (see Chapter 1).

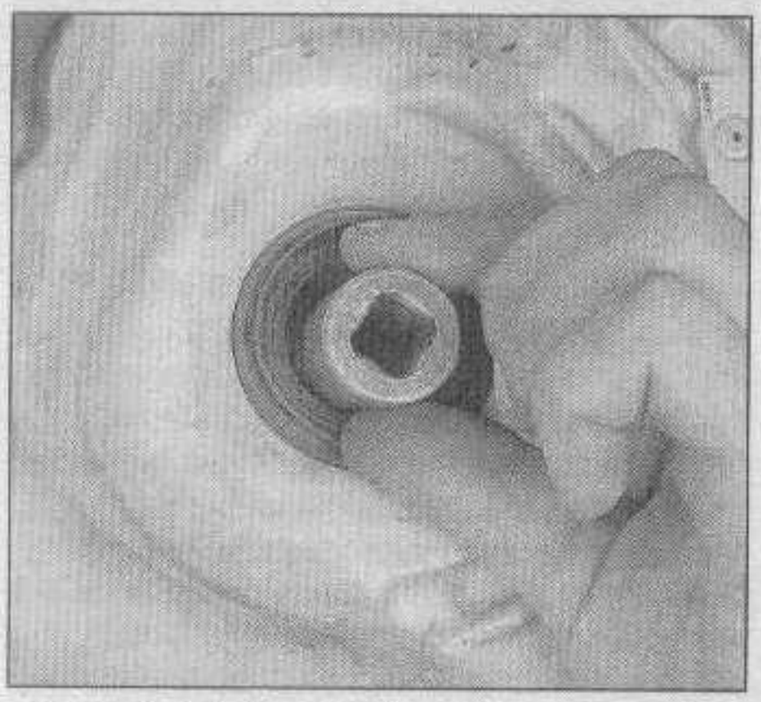
15 On four-cylinder engines, remove the intake manifold support bracket bolts **(see illustration)** and remove the support bracket from the engine.

16 Remove the exhaust system.

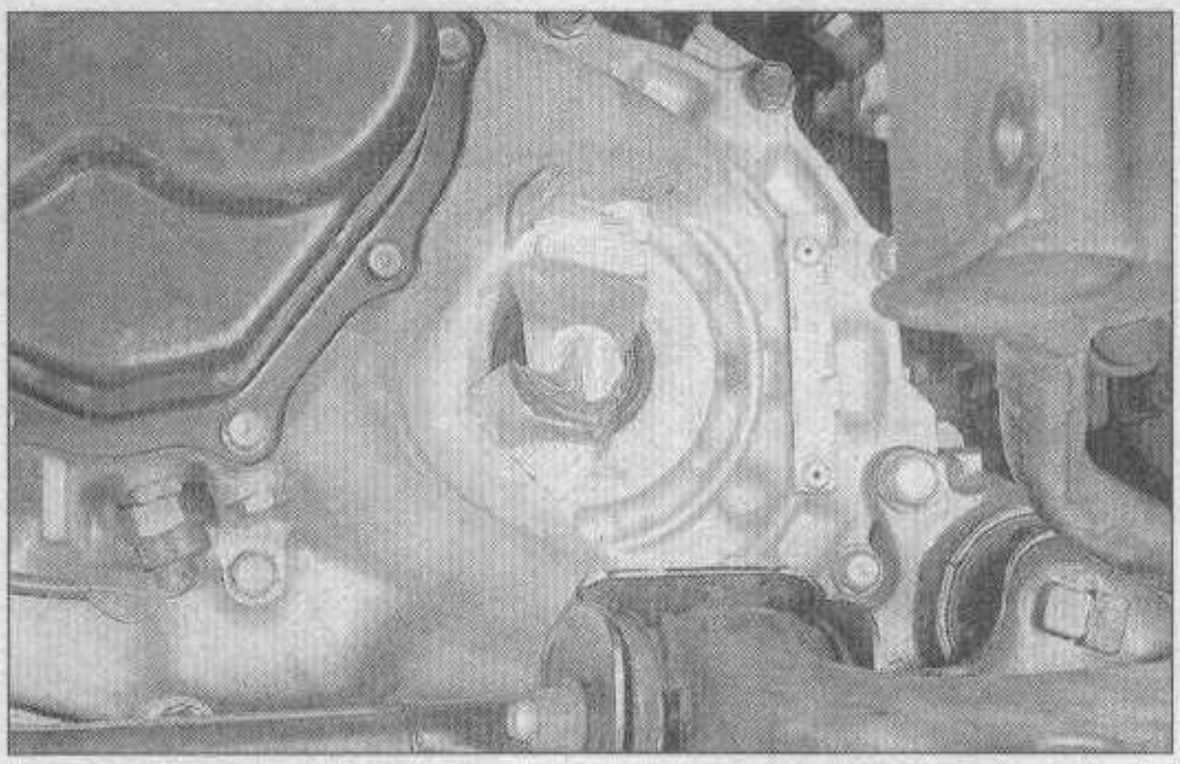
17 Disconnect the control arms from the steering knuckles (see Chapter 10).

18 Remove the driveaxles and the intermediate shaft (see Chapter 8).

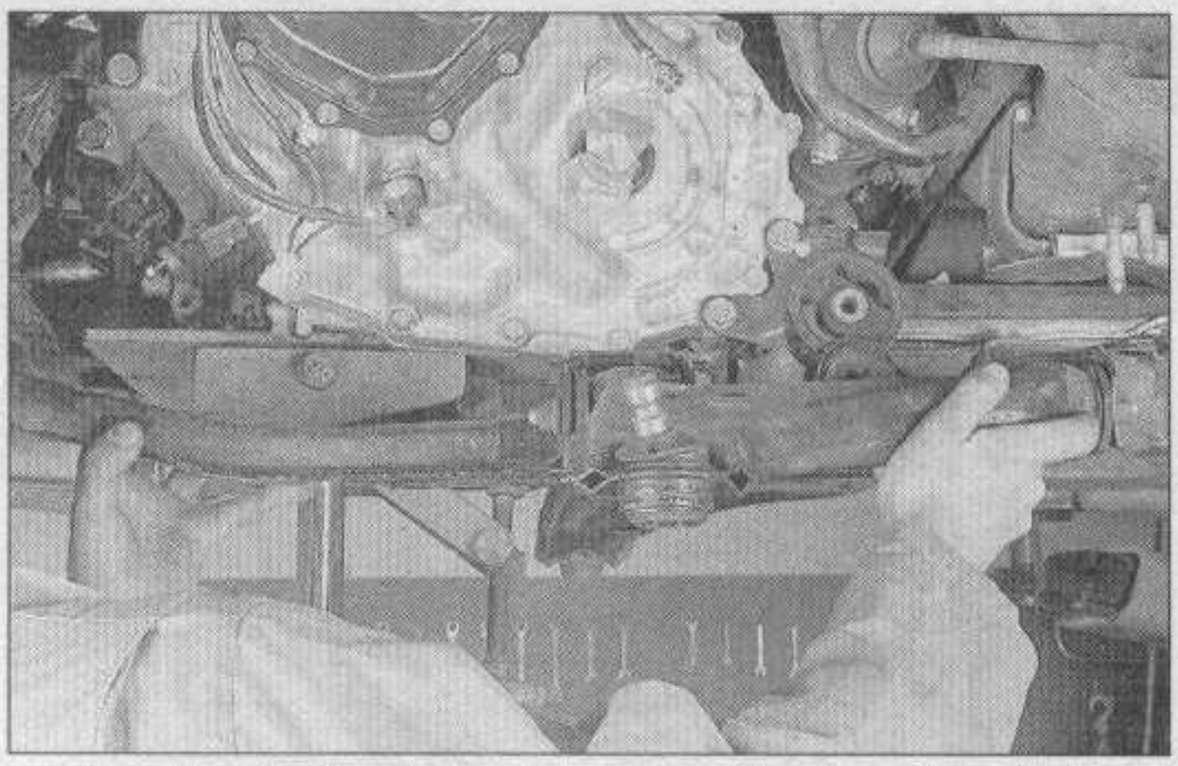
19 Insert transaxle plugs into the differential side gears to prevent the gears from dropping and becoming mispositioned. Use sockets or wood dowels and insert them into the side gears of the differential **(see illustrations)**. There are special factory tools available, however, if the sockets are properly secured, this alternate method will suffice. **Caution:** *If this isn't done and the differential*



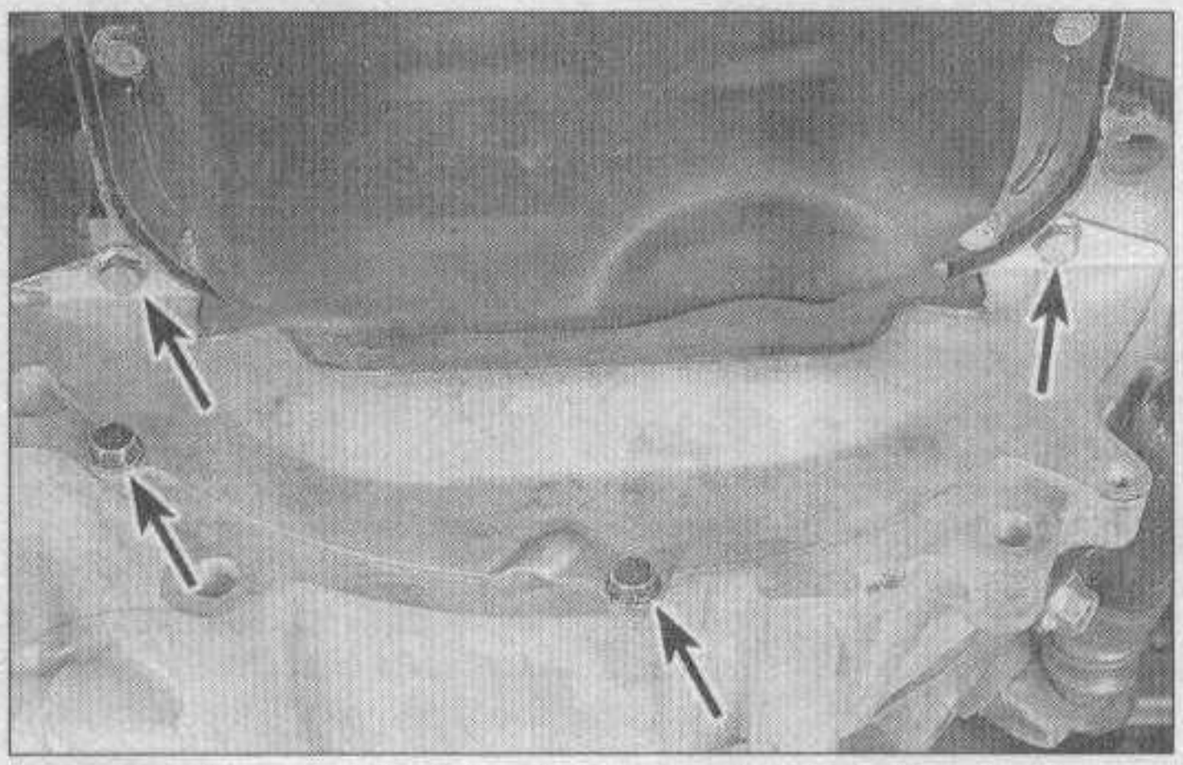
4.19a Insert transaxle plugs or sockets into each differential side gear



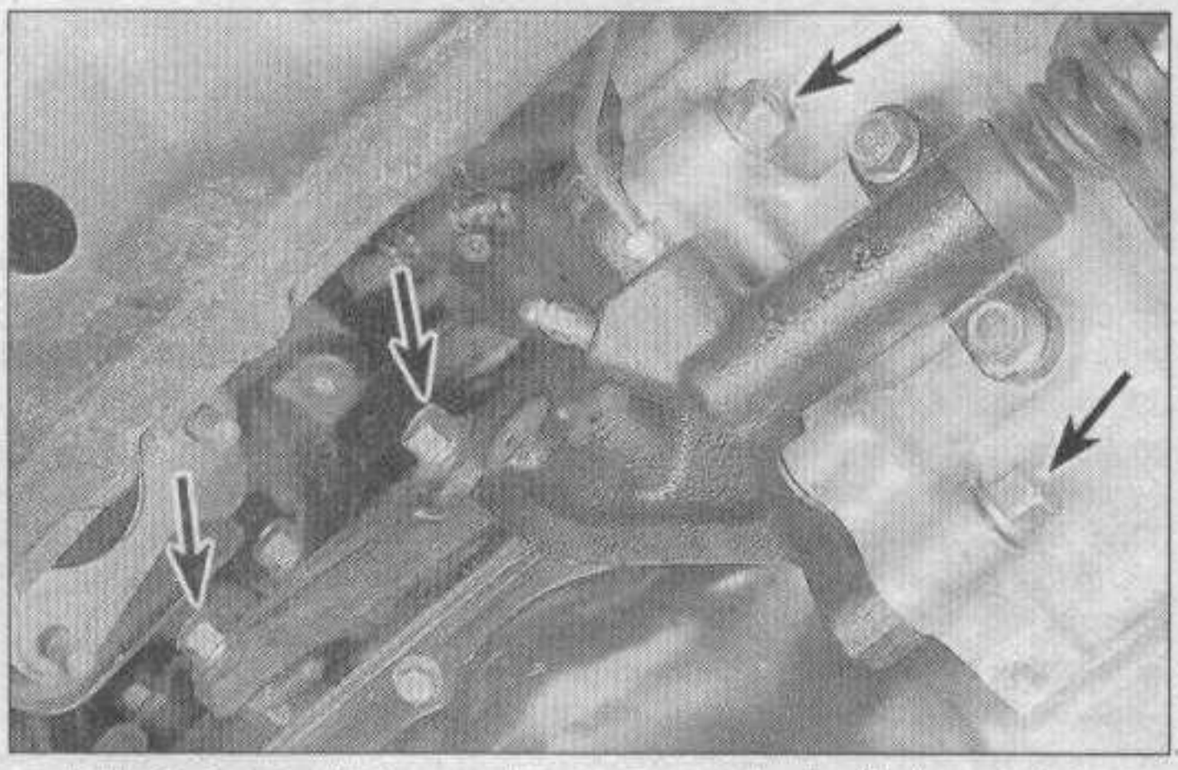
4.19b Tape the sockets into place to ensure they do not fall out while the transaxle is being handled



4.20 Remove the transaxle crossmember from the vehicle



4.24 Remove the bolts (arrows) and detach the clutch access cover



4.27 On four-cylinder engines, remove the bolts (arrows) and detach the transaxle engine support bracket

side gears become mispositioned, the transaxle will have to be disassembled.

20 Remove the splash shields. Remove the six crossmember mounting bolts and remove the crossmember from the vehicle **(see illustration)**. Refer to **illustration 1.1** for additional details of the crossmember.

21 On vehicles equipped with ABS, remove the clips from the wheel speed sensor, the mounting nuts and separate the wheel speed sensor harness from the left and right side of the vehicle.

22 Mark the relationship of the transaxle cradle to the chassis.

23 Remove the six bolts and two nuts and detach the transaxle cradle. Refer to Chapter 7B for transaxle cradle photographs.

24 Remove the clutch access cover **(see illustration)**.

25 Support the transaxle with a transaxle jack. Secure the transaxle to the jack with a safety chain. Raise the jack just enough to take the weight off the mounts. **Note:** *Special transmission adapters are available that fit onto regular floor jacks. These can be obtained at tool stores or equipment rental yards.*

26 Remove the transaxle mount and mount bracket. Refer to the engine mounts section in Chapter 2A (four-cylinder engines) or Chapter 2B (V6 engines) for additional information.

27 Remove the transaxle mounting bolts above the intermediate shaft and the transaxle mounting bolt near the clutch release cylinder **(see illustration)**. Remove the two rear engine mount bracket bolts.

28 Make a final check that all wires and hoses have been disconnected from the transaxle, then carefully pull the transaxle and jack away from the engine. Once the input shaft is clear, lower the transaxle and remove it from under the vehicle.

29 With the transaxle removed, the clutch components are now accessible and can be inspected. In most cases, new clutch components should be routinely installed when the transaxle is removed (see Chapter 8).

Installation

Refer to illustrations 4.41a and 4.41b

30 If removed, install the clutch components (see Chapter 8.)

31 With the transaxle secured to the jack by a chain, raise it into position behind the engine, then carefully slide it forward, engaging the dowel pins on the transaxle with the corresponding holes in the block and the input shaft with the clutch plate hub splines. Do not use excessive force to install the transaxle - if the input shaft does not slide into place, readjust the angle of the transaxle so it is level and/or turn the input shaft so the splines engage properly with the clutch plate hub.

32 Install the lower engine-to-transaxle mounting bolts and the rear engine mount bracket bolts. Refer to Chapter 2A (four-cylinder engines) or 2B (V6 engines) for the installation procedure and the torque specifications.

33 Install the lower left mount onto the transaxle (refer to Chapter 2A for the torque specifications).

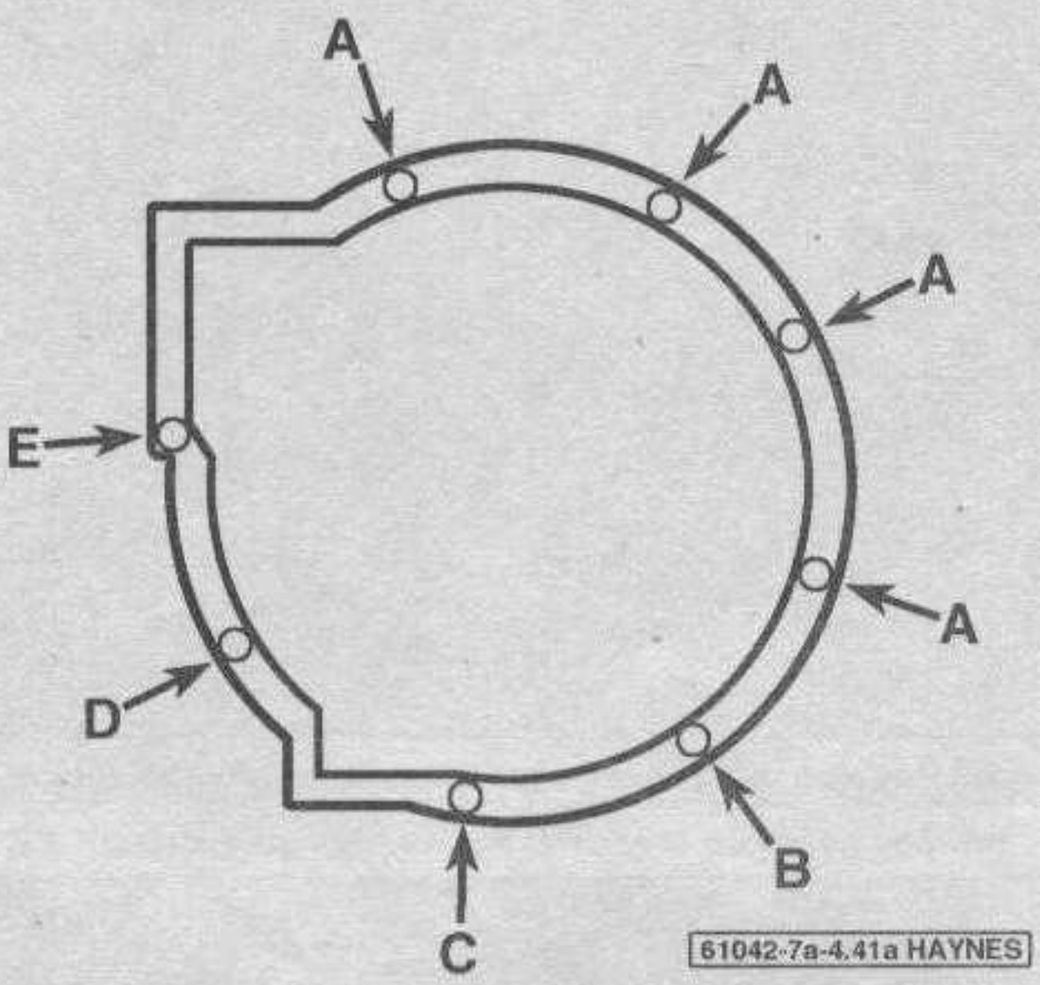
34 Install the shift linkage and the extension bar onto the transaxle.

35 Install the transaxle cradle, aligning the mark(s) made during removal and tighten the bolts to the torque listed in this Chapter's Specifications **(see illustration 8.23 in Chapter 7B)**. Clamp the power steering fluid line in the retainers.

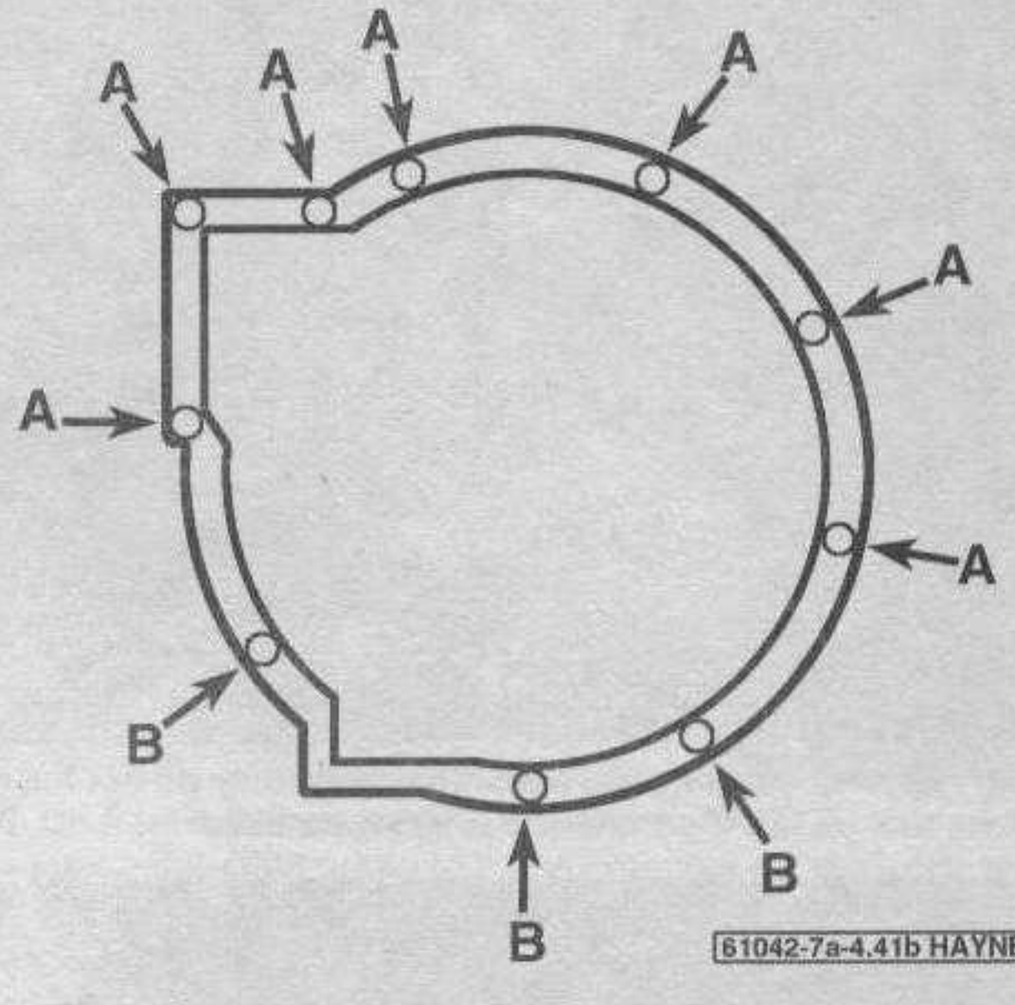
36 Remove the transaxle plugs from the differential side gears.

37 Install the intermediate shaft and driveaxles (see Chapter 8).

38 Install the transaxle crossmember and tighten the bolts to the torque listed in this Chapter's Specifications.



4.41a Transaxle-to-engine bolt designations for the four-cylinder engines



4.41b Transaxle-to-engine bolt designations for the V6 engines

39 Connect the control arm to the s steering knuckles (see Chapter 10).

40 Install the splash shield and front wheels and lower the vehicle.

41 Install the remaining transaxle mounting bolts **(see illustrations)** and tighten them to the torque listed in this Chapter's Specifications.

42 Install the front engine mount bolts (see Chapter 2A (four-cylinder engines) or 2B (V6 engines) for the installation procedure and the torque specifications.

43 The remainder of installation is the reverse of removal.

44 Refill the transaxle with the specified type and amount of lubricant (see Chapter 1).

45 Check the clutch operation and bleed the hydraulic system, if necessary (see Chapter 8).

46 Road test the vehicle for proper operation and check for leaks.

47 Loosen and retighten the engine mounts in sequence (see Chapter 2A) if vibration is evident.

48 Have the front end aligned.

5 Manual transaxle overhaul - general information

Overhauling a manual transaxle is difficult for the do-it-yourselfer. Not only must you disassemble and reassemble many small parts, but you must also measure numerous clearances and, if necessary, change them with select-fit shims, thrust washers and spacer collars.

If transaxle problems arise, you can save a lot of money by removing and installing the transaxle yourself. Then buy a rebuilt transaxle (check with local auto parts stores and transmission shops). The cost for an overhaul almost always exceeds the cost of a rebuilt unit. If rebuilt units aren't available, have the transaxle rebuilt by a shop that specializes in rebuilding these units.

Chapter 7 Part B
Automatic transaxle

Contents

	Section
Automatic transaxle fluid and filter change	See Chapter 1
Automatic transaxle - removal and installation	8
Diagnosis - general	2
Driveaxle oil seals – removal and installation	7
Engine mounts – check and replacement	See Chapter 2A and 2B
General information	1
Shift cable - removal, installation and adjustment	4
Shift interlock system - description, check and component replacement	5
Shift lever - removal and installation	3
Transaxle range sensor – check and replacement	6

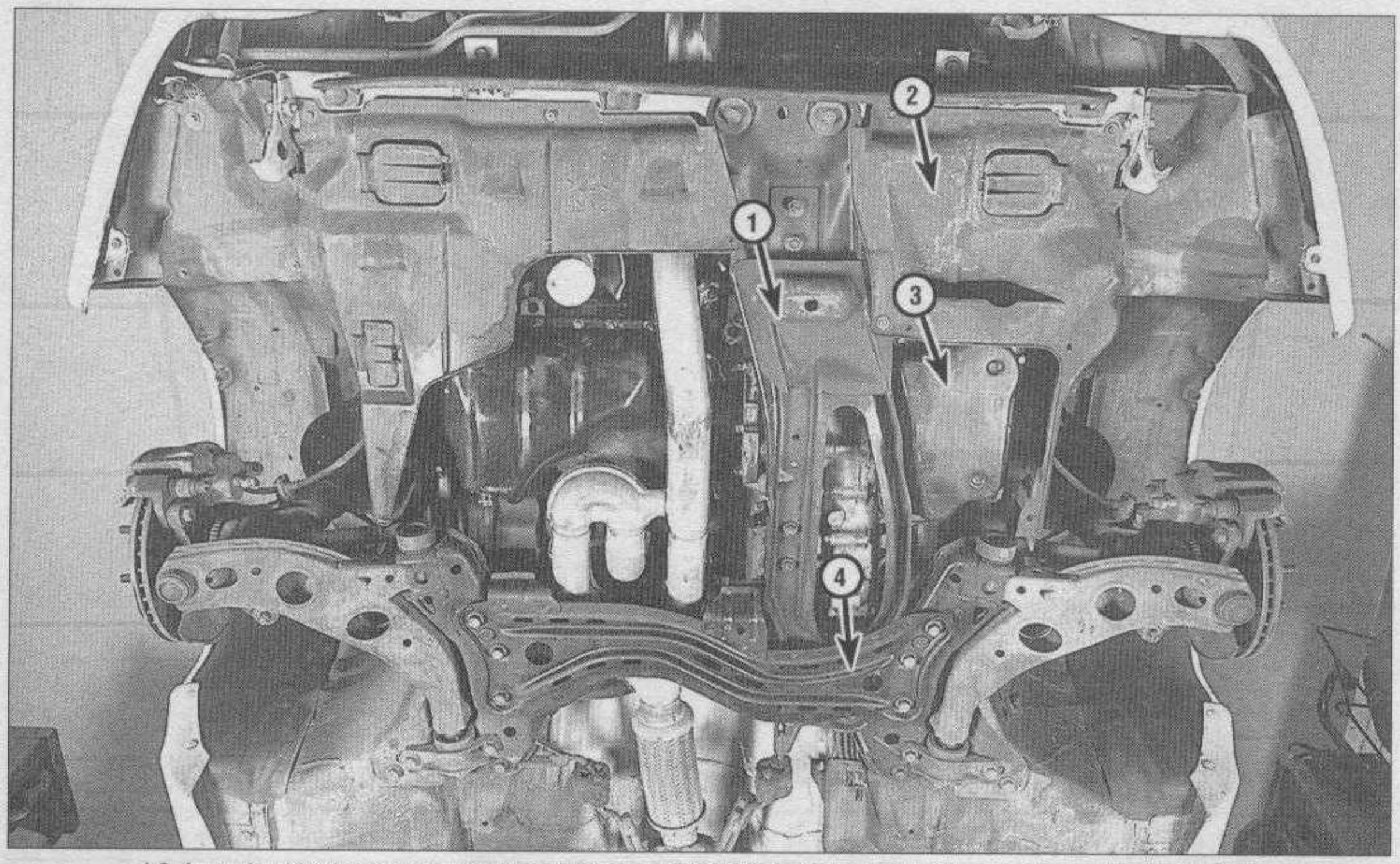
Specifications

General

Fluid type and capacity	See Chapter 1

Torque specifications

	Ft-lbs (unless otherwise indicated)
Transaxle range sensor mounting bolts	71 to 88 in-lbs
Transaxle cradle bolts and nuts **(refer to illustration 8.23)**	
A (nuts)	55 to 77
B (nuts and bolts)	50 to 68
C (nuts)	32 to 44
Transaxle crossmember	69 to 96
Transaxle-to-engine bolts	
1993 four-cylinder engine with 4EAT/GF4A-EL transaxle **(refer to illustration 8.32a)**	
Bolts A, B and F	50 to 73
Bolts C and E	28 to 38
Bolt D	14 to 18
1993 and later V6 engine with 4EAT/GF4A-EL transaxle **(refer to illustration 8.32b)**	
Bolts A and B	50 to 73
1994 and later four-cylinder engine with CD4E/LA4A-EL transaxle **(refer to illustration 8.32c)**	
Bolts A	66 to 86
Bolts B	28 to 38
Bolts C	14 to 18
Torque converter-to-driveplate bolts	32 to 45



1.2 An underside view of the automatic transaxle and related components (Ford Probe shown, Mazdas similar)

1 Transaxle cradle 2 Splash shield 3 Transaxle fluid pan 4 Crossmember

1 General information

Refer to illustration 1.2

Four-cylinder and V6 models covered by this manual are equipped with either a manual transaxle or an automatic transaxle. Information on the automatic is included in this Part of Chapter 7. Information on the manual transaxle can be found in Chapter 7, Part A. You'll also find certain procedures common to both transaxles - such as oil seal replacement - in this chapter.

The automatic transaxle is an electronically controlled, 4-speed unit **(see illustration)**. The automatic transaxles are designated 4EAT and CD4E. All 1993 models (equipped with an automatic transaxle) use the 4EAT; while on 1994 and later models, four-cylinder models use CD4E and V6 models use the 4EAT. The transaxle model number is stamped onto a plate on the transaxle. Refer to *Vehicle identification numbers* at the front of this manual for the location of the plate. **Note:** *These transaxle designations are Ford factory letters and numbers. Mazda uses their own equivalent designations; the Ford 4EAT is the Mazda GF4A-EL and the Ford CD4E is the Mazda LA4A-EL. These conversion codes are helpful when ordering parts. Be sure to consult with a dealer parts specialist or other qualified automotive parts representative when ordering replacement transaxle parts.*

The 4EAT/GF4A-EL automatic transaxle uses a single, compact planetary gear while the CD4E/LA4A-EL uses a compound planetary gearset with chain drive and an open differential. Both types of transaxles are equipped with transaxle solenoids that are controlled by the computer. These transaxle actuators (solenoids) are mounted in the valve body.

Due to the complexity of the clutches and the hydraulic control system, and because of the special tools and expertise required to perform an automatic transaxle overhaul, it should not be undertaken by the home mechanic. Therefore, the procedures in this Chapter are limited to general diagnosis, routine maintenance, adjustment and transaxle removal and installation.

If the transaxle requires major repair work, it should be left to a dealer service department or an automotive or transmission repair shop. You can, however, remove and install the transaxle yourself and save the expense, even if the repair work is done by a transmission shop (but be sure a proper diagnosis has been made before removing the transaxle).

2 Diagnosis - general

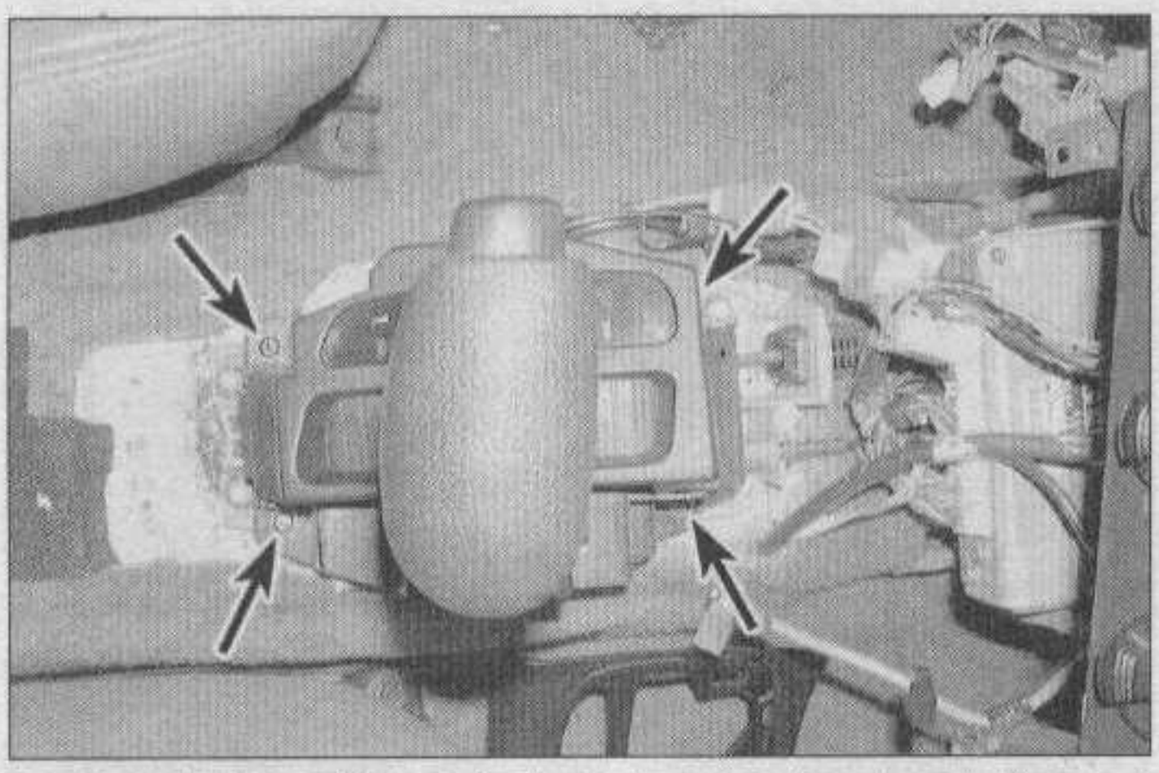
Note: *Automatic transaxle malfunctions may be caused by five general conditions: poor engine performance, improper adjustments, hydraulic malfunctions, mechanical malfunctions or malfunctions in the computer or its signal network. Diagnosis of these problems should always begin with a check of the easily repaired items: fluid level and condition* (see Chapter 1), *shift control cable adjustment and transaxle range sensor adjustment. Next, perform a road test to determine if the problem has been corrected or if more diagnosis is necessary. If the problem persists after the preliminary tests and corrections are completed, additional diagnosis should be done by a dealer service department or transmission repair shop. Refer to the Troubleshooting section at the front of this manual for information on symptoms of transaxle problems.*

Preliminary checks

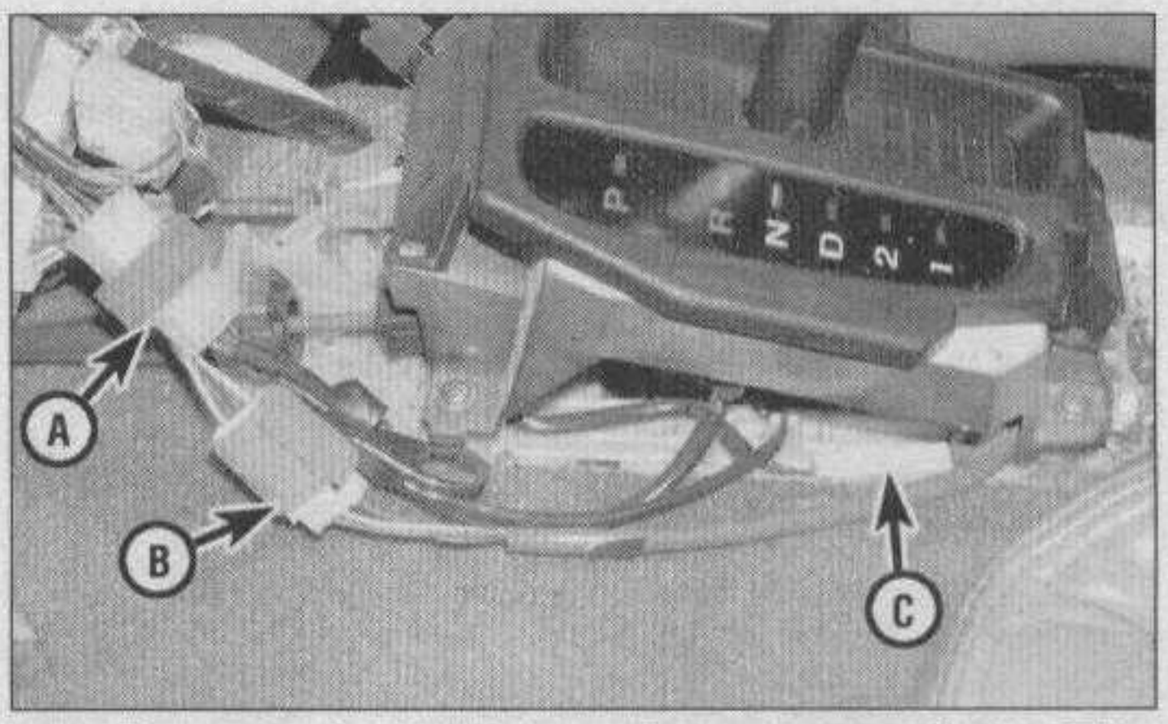
1 Drive the vehicle to warm the transaxle to normal operating temperature.

2 Check the fluid level as described in Chapter 1:

a) If the fluid level is unusually low, add



3.2 Remove the shift position indicator mounting screws (arrows) and lift the indicator from the shift lever base assembly



3.3 Disconnect the Park Range switch connector (C), the Shift Lock Actuator connector (B) and the Emergency Override Key Switch (A)

enough fluid to bring the level within the designated area of the dipstick, then check for external leaks (see below).

b) *If the fluid level is abnormally high, drain off the excess, then check the drained fluid for contamination by coolant. The presence of engine coolant in the automatic transmission fluid indicates that a failure has occurred in the internal radiator walls that separate the coolant from the transmission fluid* (see Chapter 3).

c) *If the fluid is foaming, drain it and refill the transaxle, then check for coolant in the fluid, or a high fluid level.*

3 Check the engine idle speed. **Note:** *If the engine is malfunctioning, do not proceed with the preliminary checks until it has been repaired and runs normally.*

4 Check the throttle control cable for freedom of movement (see Chapter 4).

5 Inspect the shift control linkage (see Section 4). Make sure that it's properly adjusted and that the linkage operates smoothly.

Fluid leak diagnosis

6 Most fluid leaks are easy to locate visually. Repair usually consists of replacing a seal or gasket. If a leak is difficult to find, the following procedure may help.

7 Identify the fluid. Make sure it's transmission fluid and not engine oil or brake fluid (automatic transmission fluid is a deep red color).

8 Try to pinpoint the source of the leak. Drive the vehicle several miles, then park it over a large sheet of cardboard. After a minute or two, you should be able to locate the leak by determining the source of the fluid dripping onto the cardboard.

9 Make a careful visual inspection of the suspected component and the area immediately around it. Pay particular attention to gasket mating surfaces. A mirror is often helpful for finding leaks in areas that are hard to see.

10 If the leak still cannot be found, clean the suspected area thoroughly with a degreaser or solvent, then dry the area.

11 Drive the vehicle for several miles at normal operating temperature and varying speeds. After driving the vehicle, visually inspect the suspected component again.

12 Once the leak has been located, the cause must be determined before it can be properly repaired. If a gasket is replaced but the sealing flange is bent, the new gasket will not stop the leak. The bent flange must be straightened.

13 Before attempting to repair a leak, check to make sure that the following conditions are corrected or they may cause another leak. **Note:** *Some of the following conditions cannot be fixed without highly specialized tools and expertise. Such problems must be referred to a transmission shop or a dealer service department.*

Gasket leaks

14 Check the fluid pan or right side cover periodically. Make sure the bolts are tight, no bolts are missing, the gasket is in good condition and the cover is not damaged.

15 If the leak is from the pan or right side cover area, the bolts may be too tight, the sealing surface of the transaxle housing may be damaged, the gasket may be damaged or the transaxle casting may be cracked or porous. If sealant instead of gasket material has been used to form a seal between the pan/cover and the transaxle housing, it may be the wrong sealant.

Seal leaks

16 If a transaxle seal is leaking, the fluid level or pressure may be too high, the vent may be plugged, the seal bore may be damaged, the seal itself may be damaged or improperly installed, the surface of the shaft protruding through the seal may be damaged or a loose bearing may be causing excessive shaft movement.

17 Make sure the dipstick tube seal is in good condition and the tube is properly seated. Periodically check the area around the speedometer gear or sensor for leakage. If transmission fluid is evident, check the O-ring for damage.

Case leaks

18 If the case itself appears to be leaking, the casting is porous and will have to be repaired or replaced.

19 Make sure the oil cooler hose fittings are tight and in good condition.

Fluid comes out vent pipe or fill tube

20 If this condition occurs, the transaxle is overfilled, there is coolant in the fluid, the case is porous, the dipstick is incorrect, the vent is plugged or the drain-back holes are plugged.

3 Shift lever - removal and installation

Refer to illustrations 3.2, 3.3 and 3.7

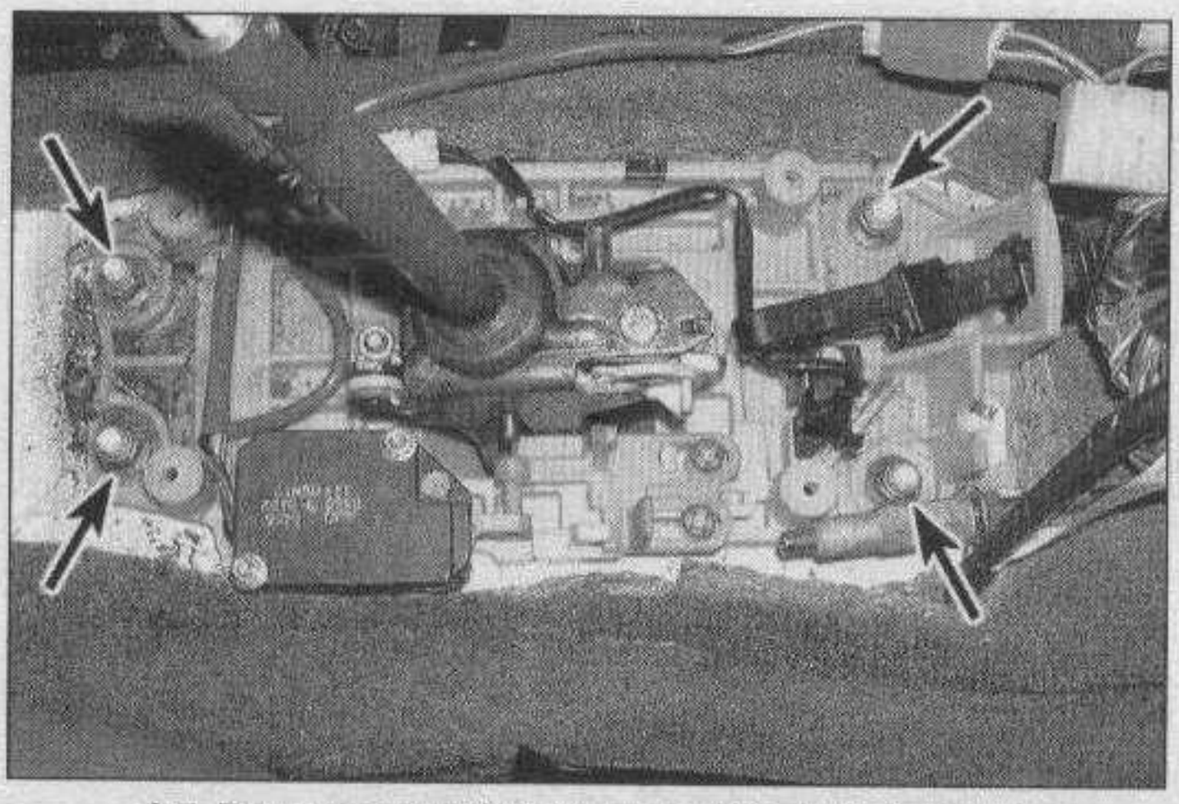
Warning: *The models covered by this manual are equipped with Supplemental Restraint systems (SRS), more commonly known as airbags. Always disable the airbag system before working in the vicinity of the impact sensors, steering column or instrument panel to avoid the possibility of accidental deployment of the airbag, which could cause personal injury* (see Chapter 12). *The yellow wiring harnesses and connectors routed through the console and instrument panel are for this system. Do not use electrical test equipment on any of the airbag system wiring or tamper with them in any way.*

1 Remove the center console (see Chapter 11).

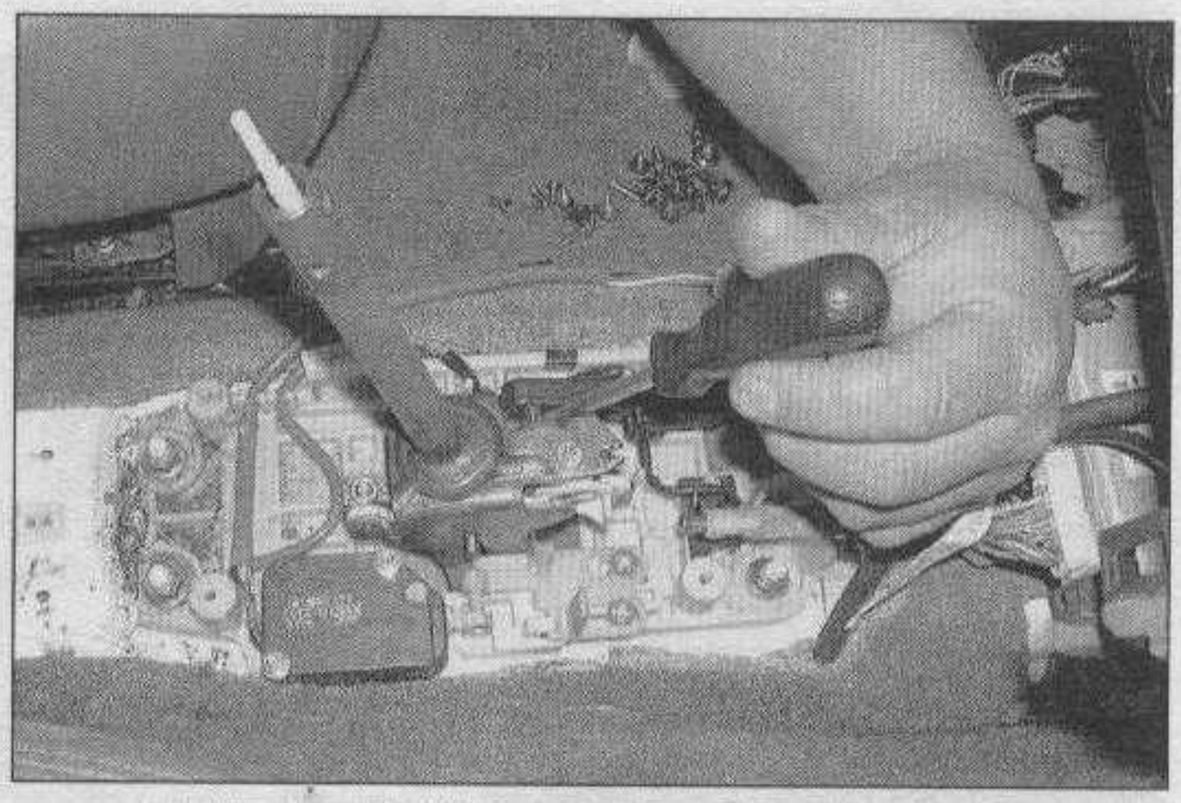
2 Remove the four shift position indicator mounting screws **(see illustration)**. Lift the shift position indicator, bend open the slit in the indicator assembly and slide it around the shift lever stalk.

3 Disconnect the Park Range switch connector, the Shift Lock Actuator connector and the Emergency Override Key Switch connector from the shift lock assembly **(see illustration)**.

4 Disconnect the OverDrive switch connector.



3.7 Remove the shift lever mounting nuts (arrows)



4.4 Use a screwdriver to pry the shift cable from the selector lever

5 Disconnect the shift lock cable from the shift lever assembly (see Section 5). Loosen the lock nut and remove the shift cable from the shift lever assembly (see Section 4). **Note:** *The shift lock cable actuates the key lock on the dash while the shift cable actuates the transaxle lever.*

6 Remove the shift lever knob screws and the knob. There are two mounting screws, one on each side of the shift lever knob.

7 Remove the shift lever assembly mounting nuts **(see illustration)**. Remove the shift lever assembly from the vehicle.

8 Installation is the reverse of removal. Be sure to tighten the nuts securely.

4 Shift cable - removal, installation and adjustment

Warning: *The models covered by this manual are equipped with Supplemental Restraint systems (SRS), more commonly known as 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, which could cause personal injury* (see Chapter 12). *The yellow wiring harnesses and connectors routed through the console and instrument panel are for this system. Do not use electrical test equipment on any of the airbag system wiring or tamper with them in any way.*

Removal

Refer to illustrations 4.4, 4.7 and 4.10

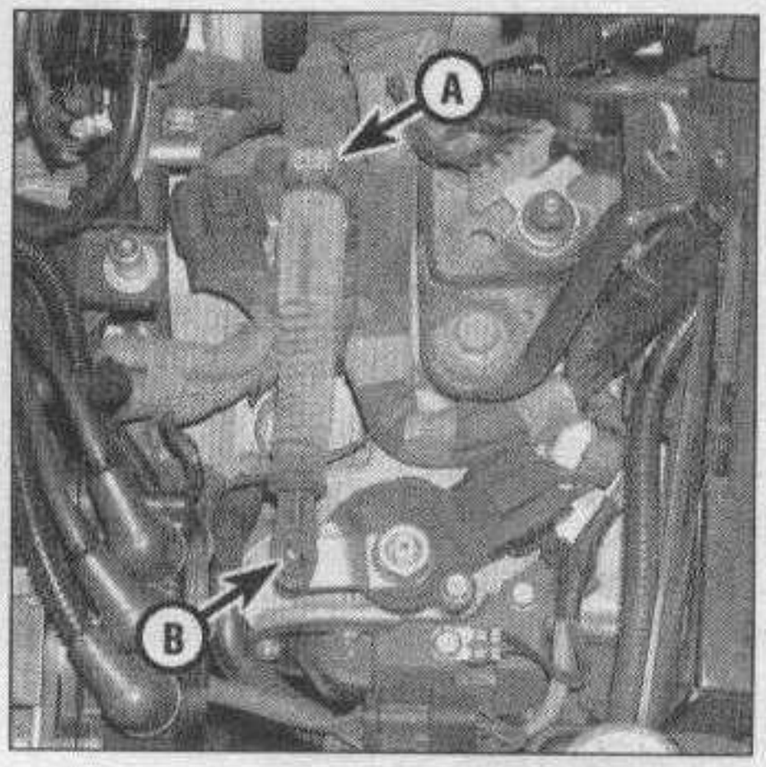
1 Remove the center console (see Chapter 11).

2 Remove the heater blower assembly (see Chapter 3).

3 Remove the four shift position indicator mounting screws **(see illustration 3.2)**. Lift the shift position indicator from the console.

4 Use a small screwdriver to separate the shift cable from the selector lever **(see illustration)**.

5 Squeeze the lock tabs on the shift cable and remove the shift cable from the selector lever base.



4.7 Lift the lock tab (A) and pry the cable end from the shift lever arm (B) on the range sensor

6 Remove the air cleaner housing (see Chapter 4).

7 Working on the transaxle, remove the lock tab cover **(see illustration)** and pry the shift cable from the range sensor arm.

8 Press the lock tabs in and slide the cable through the bracket and separate it from the transaxle.

9 Working on the bulkhead, pry the shift cable retaining clip from the bulkhead.

10 Remove the two shift cable grommet nuts securing the shift cable grommet to the bulkhead **(see illustration)**.

11 Remove the shift cable from the vehicle.

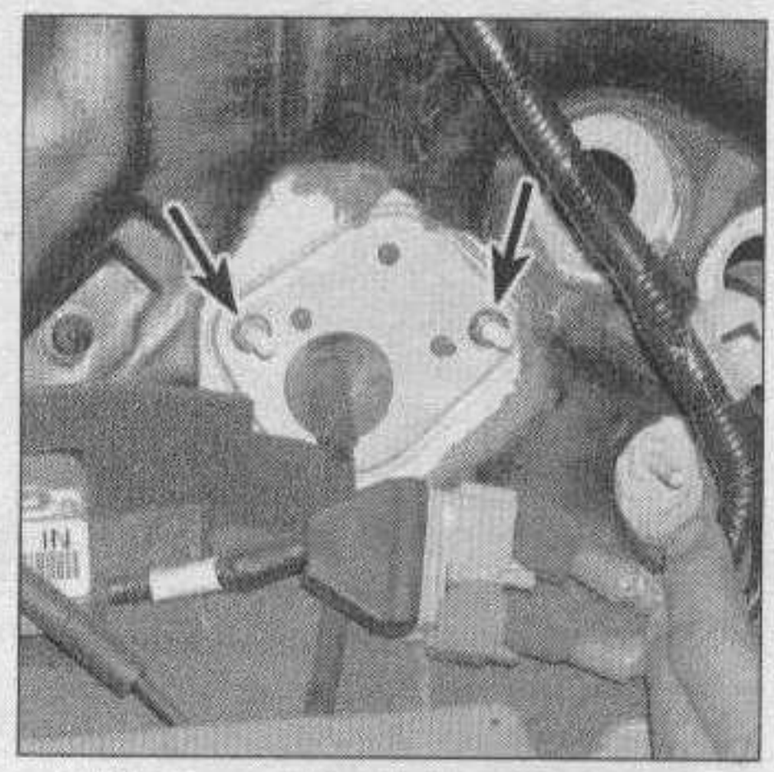
Installation

12 Insert the shift cable through the opening in the bulkhead.

13 Working in the console area of the passenger compartment, pull the cable until the lock tabs engage into the cable bracket on the shift lever assembly. Install the cable end onto the selector lever.

14 Install the lock tab cover.

15 Working in the transaxle area, install the shift cable onto the lever of the transaxle range sensor. Make sure the shift cable locks into the bracket.



4.10 Remove the shift cable grommet nuts (arrows) and separate the cable and grommet assembly from the firewall

16 Install the air cleaner housing (see Chapter 4).

17 Working on the bulkhead, position the shift cable grommet onto the two studs and tighten the nuts securely.

18 Attach the shift cable retaining clip onto the bulkhead.

19 Working in the console area of the passenger compartment, install the shift position indicator assembly and tighten the screws securely.

20 Install the heater blower unit (see Chapter 3).

21 Adjust the shift cable (see Steps 24 through 31).

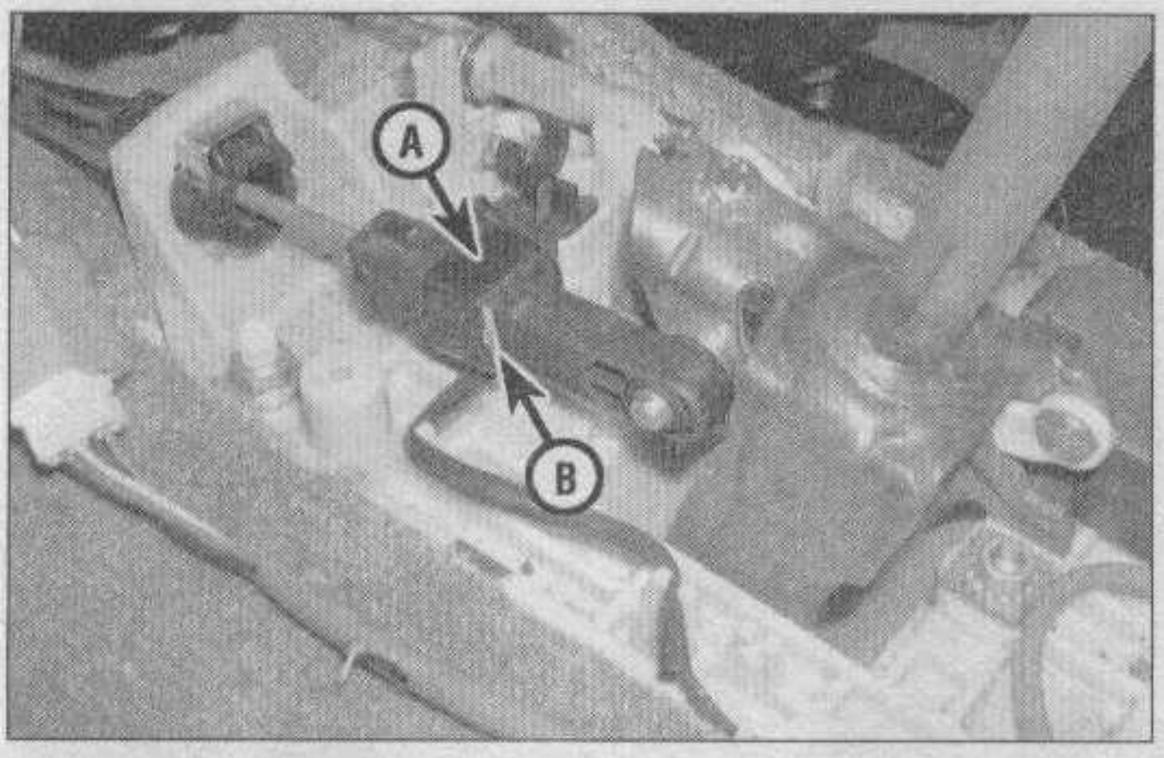
22 Install the floor console (see Chapter 11).

23 Move the shift lever to each gear to verify the correct shifting position.

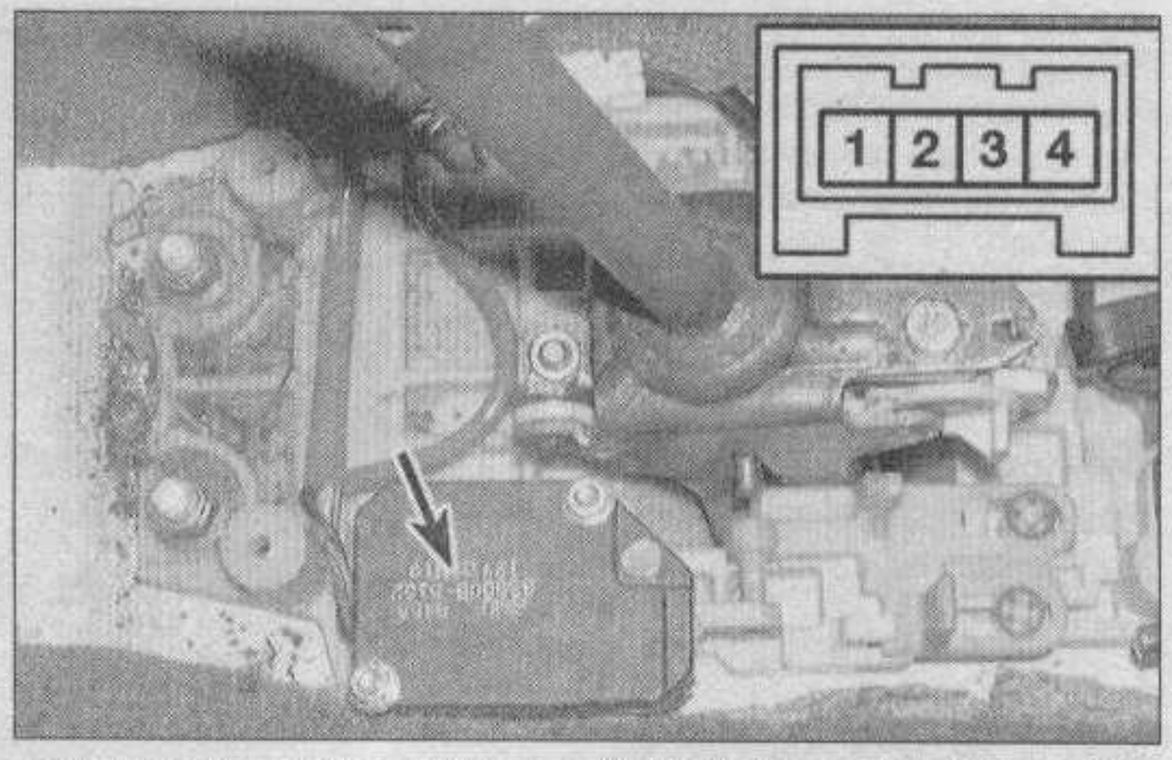
Adjustment

Refer to illustration 4.27

24 Remove the center console (see Chapter 11).



4.27 Slide the lock cover (A) back and then disconnect the locking mechanism by pulling out the set button (B)



5.10 Location of the shift lock actuator (arrow) - inset shows the connector terminals

25 Shift the selector lever into the PARK position.

26 Remove the four shift position indicator mounting screws **(see illustration 3.2)**. Lift the shift position indicator from the console.

27 Slide the lock cover back **(see illustration)**. Disconnect the set button.

28 Move the shift selector lever into the correct PARK position. Temporarily install the shift position indicator to determine the shift lever position in relation to the indicator letter P. Once it is correctly aligned, remove the shift position indicator and lock the shift lever by pressing the set button in.

29 Slide the lock cover to secure the set button in place.

30 Working in the console area of the passenger compartment, install the shift position indicator assembly and tighten the screws securely.

31 Start the engine and check the shift lever in all gears.

5 Shift Interlock system - description, check and component replacement

Warning: *The models covered by this manual are equipped with Supplemental Restraint systems (SRS), more commonly known as 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, which could cause personal injury* (see Chapter 12). *The yellow wiring harnesses and connectors routed through the console and instrument panel are for this system. Do not use electrical test equipment on any of the airbag system wiring or tamper with them in any way.*

Description

1 Vehicles equipped with an automatic transaxle have an interlock system. The shift interlock system consists of two subsystems: a shift lock system and a key interlock system.

2 The key interlock system prevents the ignition key from being removed from the ignition switch unless the shift lever is in the PARK position. If you insert the key when the shift lever is in any position other than PARK, a solenoid is activated, making it impossible for you to remove the key until the shift lever is moved to the PARK position.

3 The shift lock system prevents the shift lever from moving from the PARK position into the REVERSE or DRIVE positions unless the brake pedal is depressed. Nor can the shift lever be shifted when the brake pedal and the accelerator pedal are depressed at the same time. In the event of a system malfunction, you can release the shift lever by inserting a key into the release slot near the shift lever. This unlocking system is called the emergency override key switch.

4 The shift interlock system consists of the transaxle range sensor, the shift lock actuator, the park range switch, the Brake On/Off (BOO) switch, the shift lock cable and the emergency override key switch. If the shift lock cable is broken or out of adjustment, refer to Steps 25 through 39. The transaxle range sensor is located on the side of the transaxle. The checks and replacement procedure for the range sensor are in Section 6. The shift lock actuator is located under the center console next to the shift lever. The park range switch is located near the shift lock actuator. Follow the tests for the shift lock actuator and the range switch in this section. The brake On/Off switch is located near the brake pedal. The check and replacement procedure for the BOO switch is in Chapter 6. The emergency override key switch is actuated using a key. Problems with the key switch must be repaired by a dealer service department or other qualified automotive repair facility.

Check

5 The following checks are simple tests of the shift lock actuator and the park range switch. These two component checks assume that the other components of the Key Interlock System (the transaxle range sensor, the shift lock cable and the BOO switch) have all been tested. If all the component checks are in order, further testing of the interlock system should be left to a dealer service department.

Shift lock actuator

Refer to illustration 5.10

6 Check the condition of the 15A METER and the 20A STOP fuses. Replace the fuses if necessary. If the fuse(s) are blown, check the circuit from the shift lock actuator to the fuse panel. Repair the wiring harness if necessary. If the fuses are intact, check the shift lock actuator.

7 Remove the center console (see Chapter 11).

8 Shift the selector lever into the PARK position.

9 Remove the four shift position indicator mounting screws **(see illustration 3.2)**. Lift the shift position indicator from the console.

10 Disconnect the 4-pin electrical connector from the shift lock actuator **(see illustration)**.

11 With the ignition key ON (engine not running), check for battery voltage on terminal number 2. Battery voltage should be present. If not, check the circuit to the ignition switch for damage. Refer to the wiring schematics at the end of Chapter 12 for additional information.

12 With the ignition key OFF, check for battery voltage to terminal number 1. Battery voltage should be present at all times. If there is no voltage, check the circuit to the 20A STOP fuse.

13 If battery voltage is available on both tests, check the park range switch.

Park range switch

14 Remove the console (see Chapter 11).

15 Locate the two-pin electrical connector for the park range switch **(see illustration 3.3)**.

16 Using pins, backprobe the terminals. Install the ohmmeter probes onto the pins and check for continuity. Continuity should exist.

17 Depress the shift selector and position the lever into REVERSE and then the other selections. Continuity should not exist.
18 Make sure the shift lock releases when the lever is pushed and locks when the lever is released.
19 Replace the park range switch if the test results are incorrect.

Component replacement

Shift lock actuator

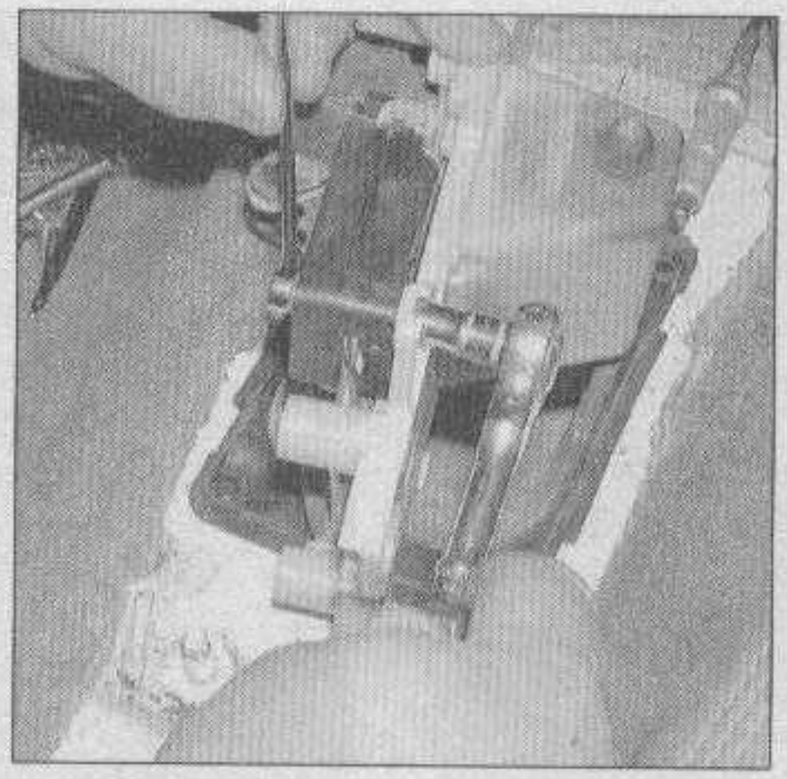
Refer to illustration 5.22

20 Remove the center console (see Chapter 11).
21 Disconnect the four-pin harness connector from the actuator.
22 Remove the mounting bolts **(see illustration)**.
23 Remove the shift lock actuator from the console area of the passenger compartment.
24 Installation is the reverse of removal.

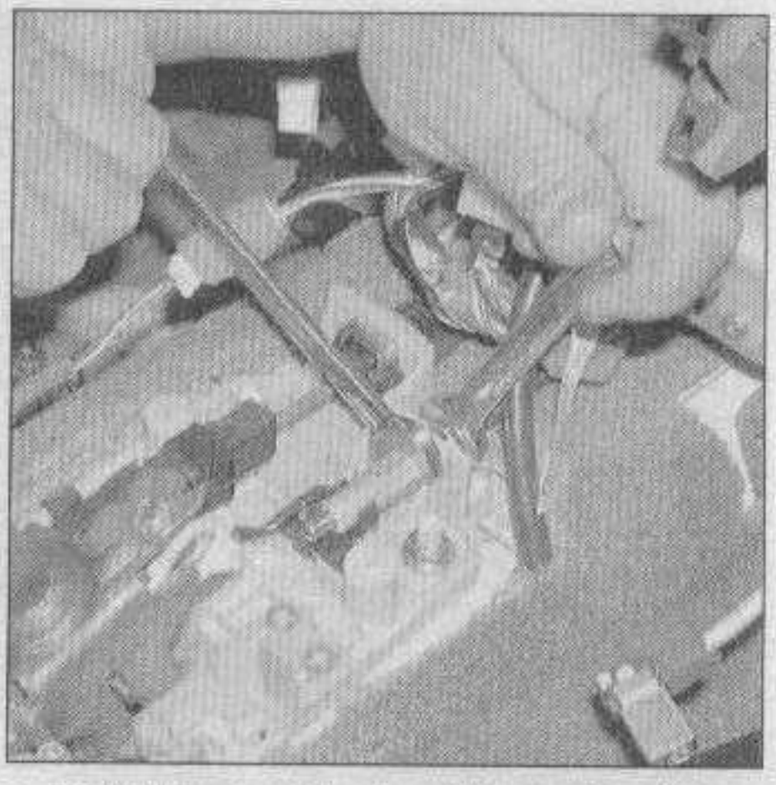
Key interlock cable

Refer to illustrations 5.27 and 5.31

25 Remove the center console (see Chapter 11).
26 Remove the four shift position indicator mounting screws **(see illustration 3.2)**. Lift the shift position indicator from the console.
27 Use back-up wrenches to loosen the lock nut on the key interlock cable **(see illustration)**.
28 Remove the key interlock cable from the bracket.
29 Remove the lower instrument panel cover from the dash area (see Chapter 11).
30 Remove the upper and lower steering column covers (see Chapter 10).
31 Remove the key interlock cable screw and bracket from the bottom of the steering column **(see illustration)**.
32 Remove the key interlock cable from the lock cylinder.
33 Remove the key interlock cable from the vehicle.
34 Working in the steering column, install



5.22 Turn the selector lever assembly to the side and remove the two shift lock actuator screws and nuts



5.27 Remove the key interlock cable locknut using a back-up wrench

the new key interlock cable. Install the key interlock cable bracket and tighten the screw securely.
35 Install the lower instrument panel cover and the upper and lower steering column covers.
36 Install the key interlock cable onto the shift lever base and tighten the locknut securely.
37 Install the shift position indicator assembly and tighten the screws securely.
38 Install the floor console (see Chapter 11).
39 Move the shift lever to each gear to verify the correct shifting position.

6 Transaxle range sensor - check, adjustment and replacement

Check

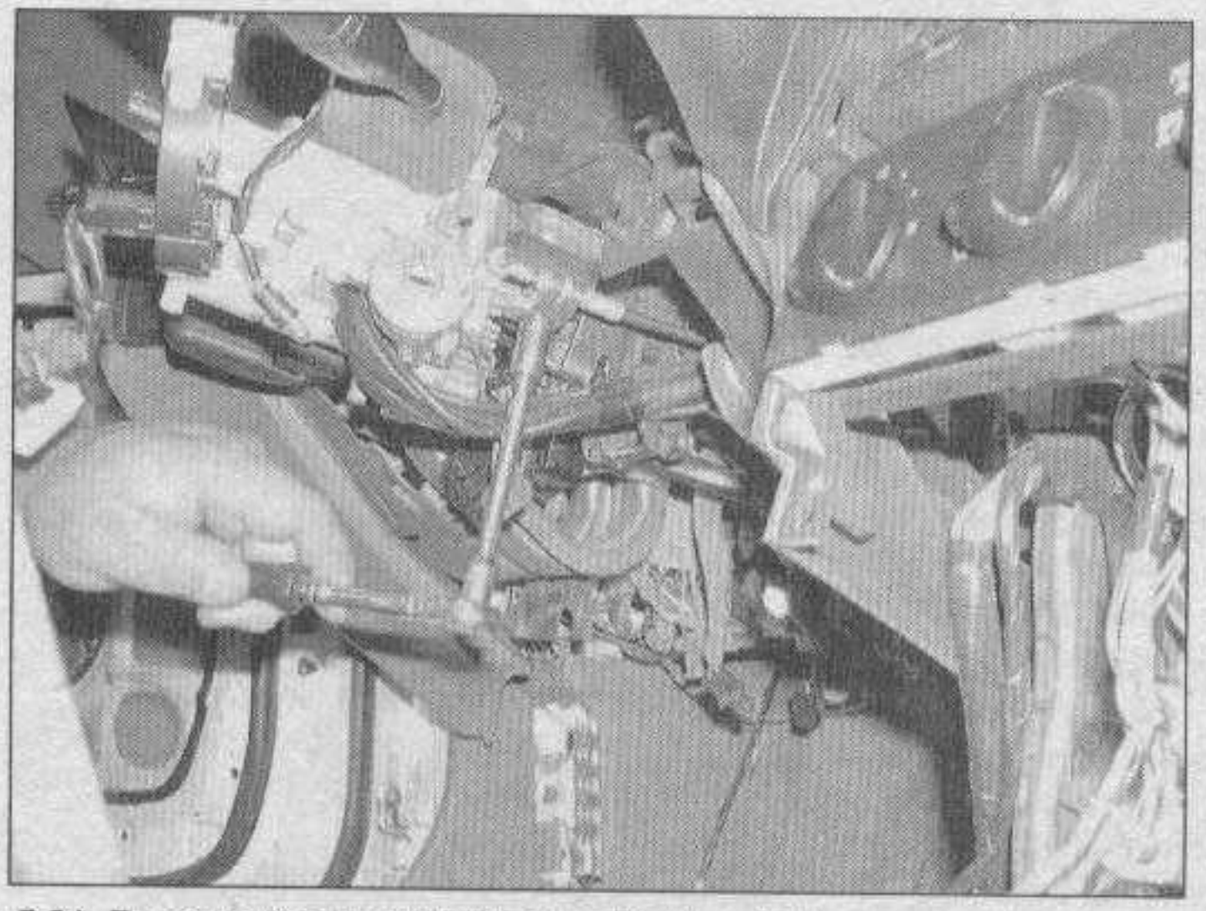
Refer to illustrations 6.2, 6.3a and 6.3b

1 Access to the switch connector for testing can be obtained from the engine compartment.
2 Disconnect the electrical connector for the transaxle range sensor **(see illustration)**. **Note:** *The 4EAT and GF4A-EL transaxles are equipped with a 9-pin connector while the CD4E and LA4A-EL transaxles have an 11-pin connector.*
3 Move the shift lever into each position and check for continuity between the indicated terminals in accordance with the accompanying tables **(see illustrations)**.
4 If the continuity isn't as designated in the table, attempt to adjust the switch. If the switch can't be adjusted to obtain the proper continuity, replace the switch.

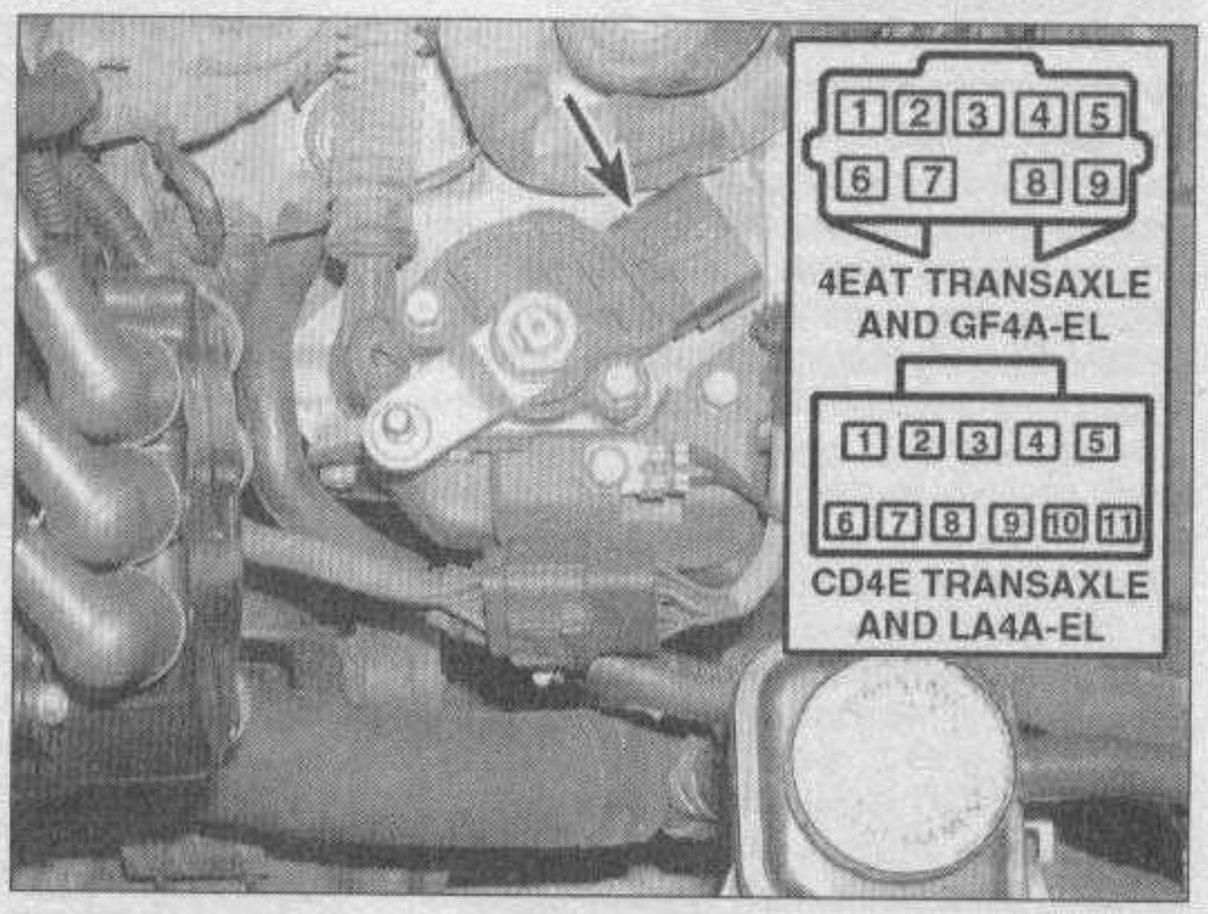
Adjustment (4EAT and GF4A-EL transaxles)

Refer to illustration 6.6

Note: *The range sensors on the CD4E and LA4A-EL transaxles require a special alignment tool to properly adjust the position.*
5 Place the shift lever in the Neutral posi-



5.31 Remove the key interlock cable bracket screw and separate the cable from the steering column



6.2 The transaxle range sensor (arrow) is accessible from the top of the engine compartment. The inset shows the connector terminal locations

SWITCH POSITION	CONTINUITY BETWEEN
Park	1 and 5; 6 and 9
Reverse	1 and 4
Neutral	1 and 8; 6 and 9
Drive	1 and 2
1	1 and 7
2	1 and 3

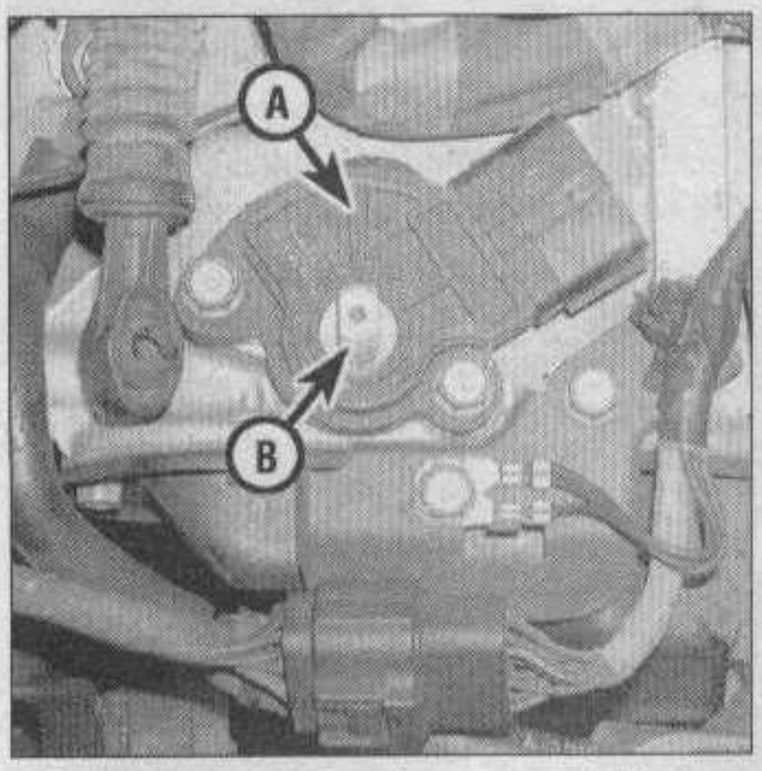
61042-7B-6.3a HAYNES

6.3a Continuity checks for the range sensor on the 4EAT and the GF4A-EL transaxles

SWITCH POSITION	CONTINUITY BETWEEN
Park	1 and 7 (3770 to 4607 ohms) 8 and 2
Reverse	1 and 7 (1304 to 1593 ohms) 5 and 3
Neutral	1 and 7 (660 to 807 ohms) 8 and 2
Drive	1 and 7 (361 to 442 ohms)
1	1 and 7 (190 to 232 ohms)
2	1 and 7 (78 to 95 ohms)

61042-7B 6.3b HAYNES

6.3b Resistance checks for the range sensor on the CD4E and LA4A-EL transaxles



6.6 Make sure the Neutral mark (A) is aligned with the Range Sensor shaft (B)

tion. Remove the shift cable from the range sensor arm (see Section 4).

6 Loosen the switch mounting bolts slightly. Rotate the switch to the Neutral position **(see illustration)**.

7 Disconnect the sensor connector and connect an ohmmeter to the terminals indicated in the transaxle continuity charts for the neutral position **(see illustration 6.2)**. Continuity should be indicated on the meter.

8 Tighten the mounting bolts securely. Install the connector and shift cable.

9 Follow the continuity chart and make sure that continuity exists on the remaining designated terminals.

Replacement

10 Raise the vehicle and support it securely on jackstands.

11 Disconnect the sensor connector.

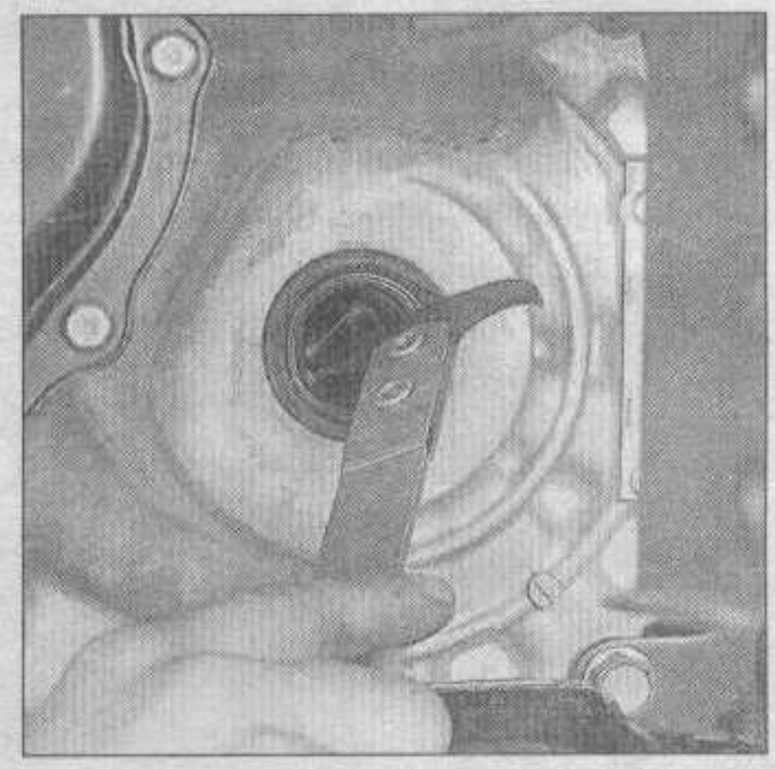
12 Position the shift lever in the Neutral position.

13 Remove the transaxle range sensor mounting bolts.

14 Install the new switch onto the control shaft. Make sure the switch remains in the Neutral position when you tighten the bolts.

15 Adjust the range sensor (see Steps 5 through 9).

16 Make sure the engine starts only when the shift lever is in the Neutral or Park position.



7.4 Pry the seal out of the transaxle bore with a special seal removal tool (shown) or with a prybar or large screwdriver – make sure you don't damage the seal bore

7 Driveaxle oil seals - replacement

Refer to illustrations 7.4 and 7.6

1 Oil leaks frequently occur due to wear of the driveaxle oil seals. Replacement of these seals is relatively easy, since the repair can usually be performed without removing the transaxle from the vehicle.

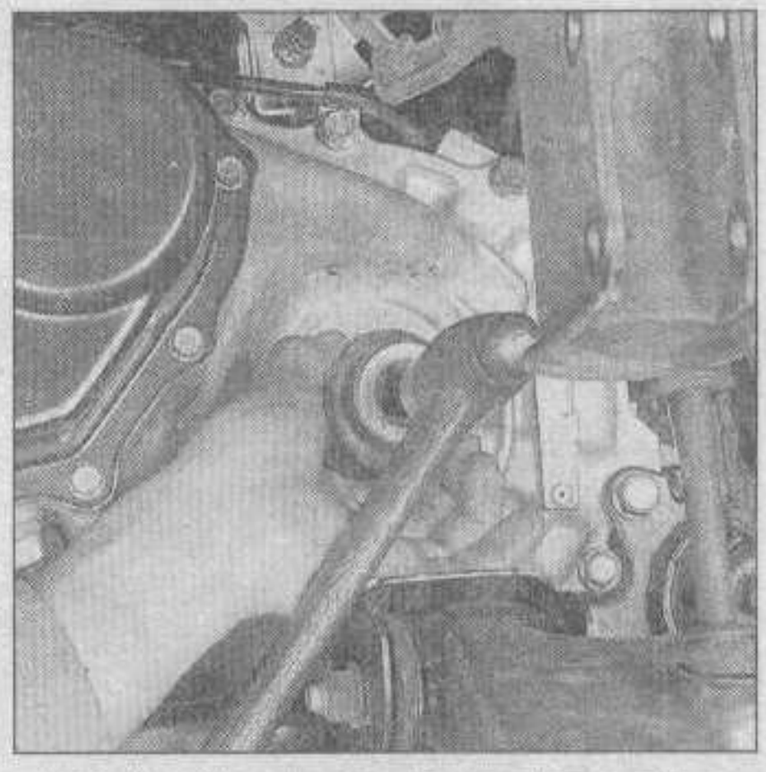
2 The driveaxle oil seals are located at the sides of the transaxle, where the driveaxles are attached. If leakage at the seal is suspected, raise the vehicle and support it securely on jackstands. If the seal is leaking, lubricant will be found on the sides of the transaxle, below the seals.

3 Refer to Chapter 8 and remove the driveaxles.

4 Using a screwdriver or prybar, carefully pry the oil seal out of the transaxle bore **(see illustration)**.

5 If the oil seal cannot be removed with a screwdriver or prybar, a special oil seal removal tool (available at auto parts stores) will be required.

6 Using a large section of pipe or a large deep socket (slightly smaller than the outside diameter of the seal) as a drift, install the new oil seal **(see illustration)**. Drive it into the bore squarely and make sure it's completely



7.6 Tap the new seal into place with a large socket or piece of pipe and a hammer – the outside diameter of the pipe or socket should be slightly smaller than the seal

seated. Coat the seal lip with transaxle lubricant.

7 Install the driveaxle(s). Be careful not to damage the lip of the new seal.

8 Automatic transaxle - removal and installation

Removal

Refer to illustrations 8.9, 8.10, 8.20 and 8.23

1 Disconnect the negative cable and then the positive cable from the battery. Remove the battery and the battery tray (see Chapter 5). **Caution:** *The stereo in your vehicle is equipped with an anti-theft system. Make sure you have the correct activation code before disconnecting the battery.*

2 Remove the air intake duct and the air cleaner housing (see Chapter 4).

3 Disconnect the starter motor cables and remove the starter motor (see Chapter 5).

4 Disconnect the transaxle ground cable and the transaxle range sensor (see Section 6), then detach the wiring harness clamp from the transaxle.

5 Disconnect the transaxle harness connector from the side of the transaxle. 4EAT

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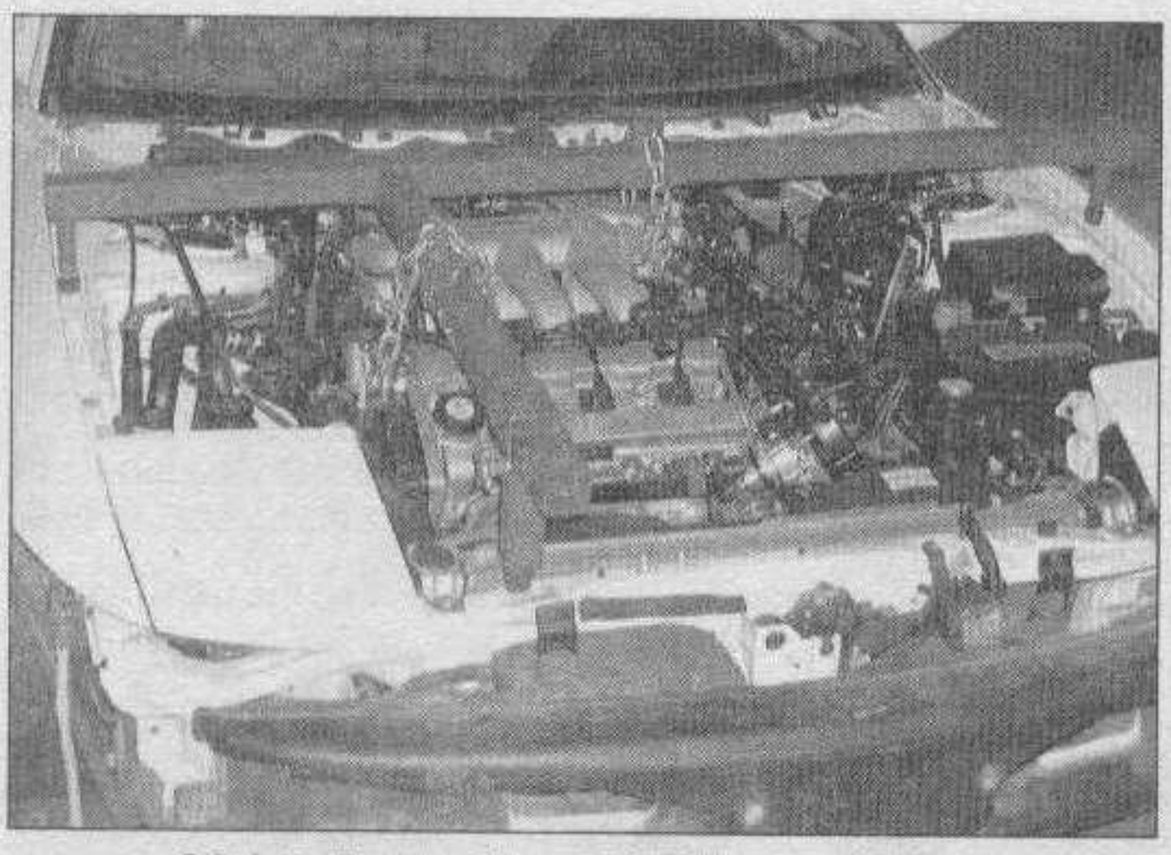
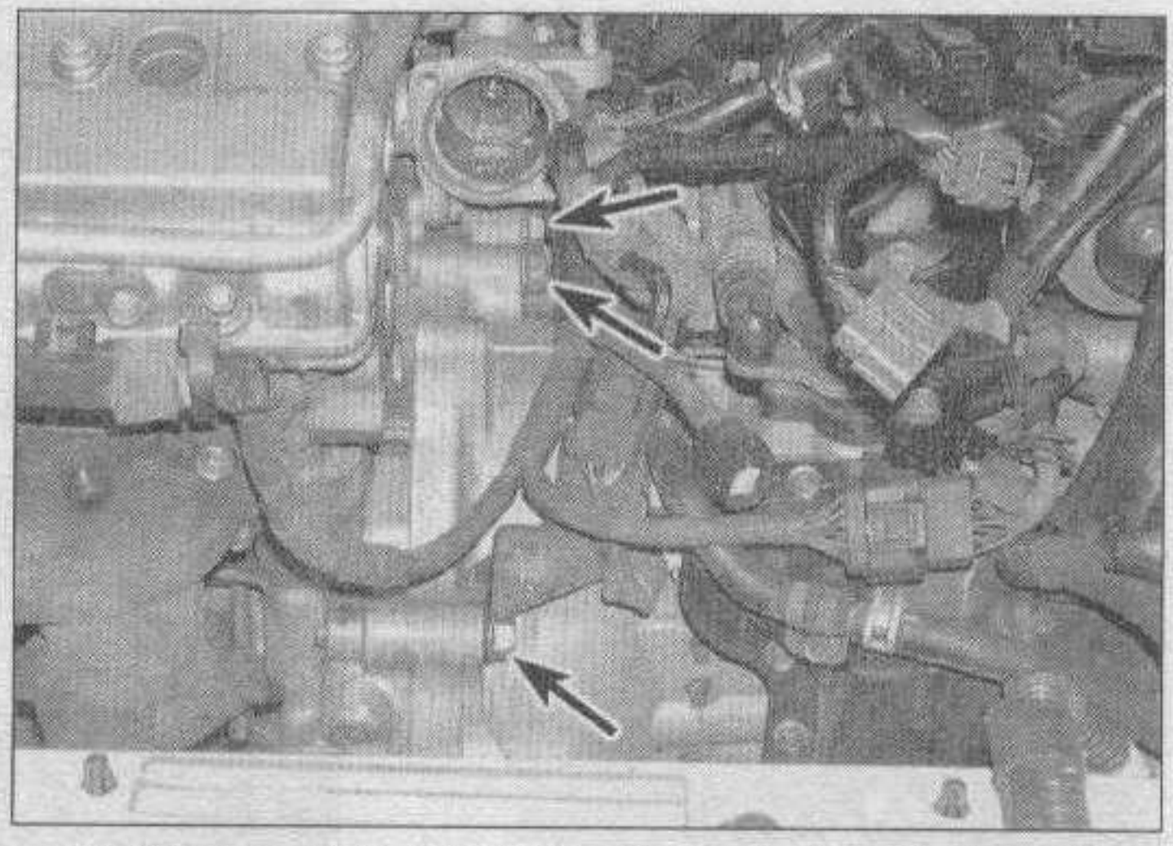
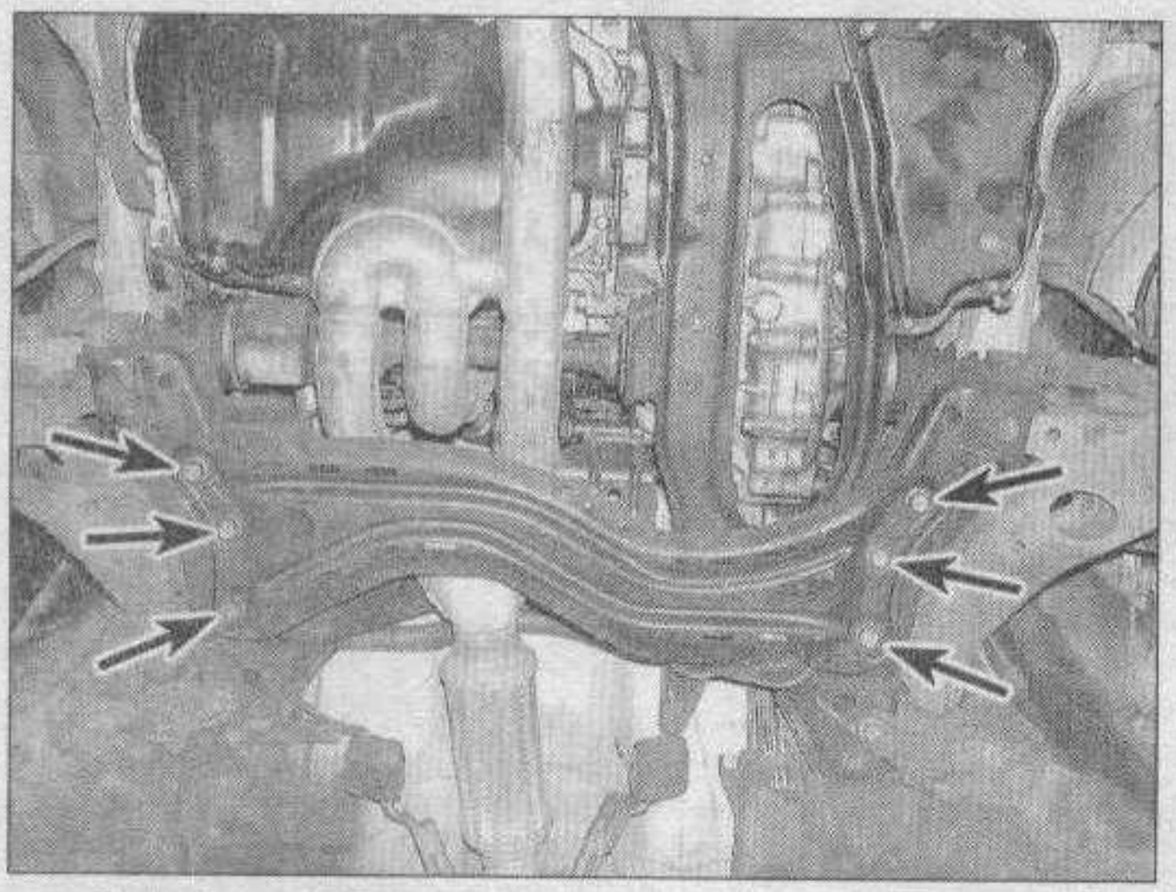


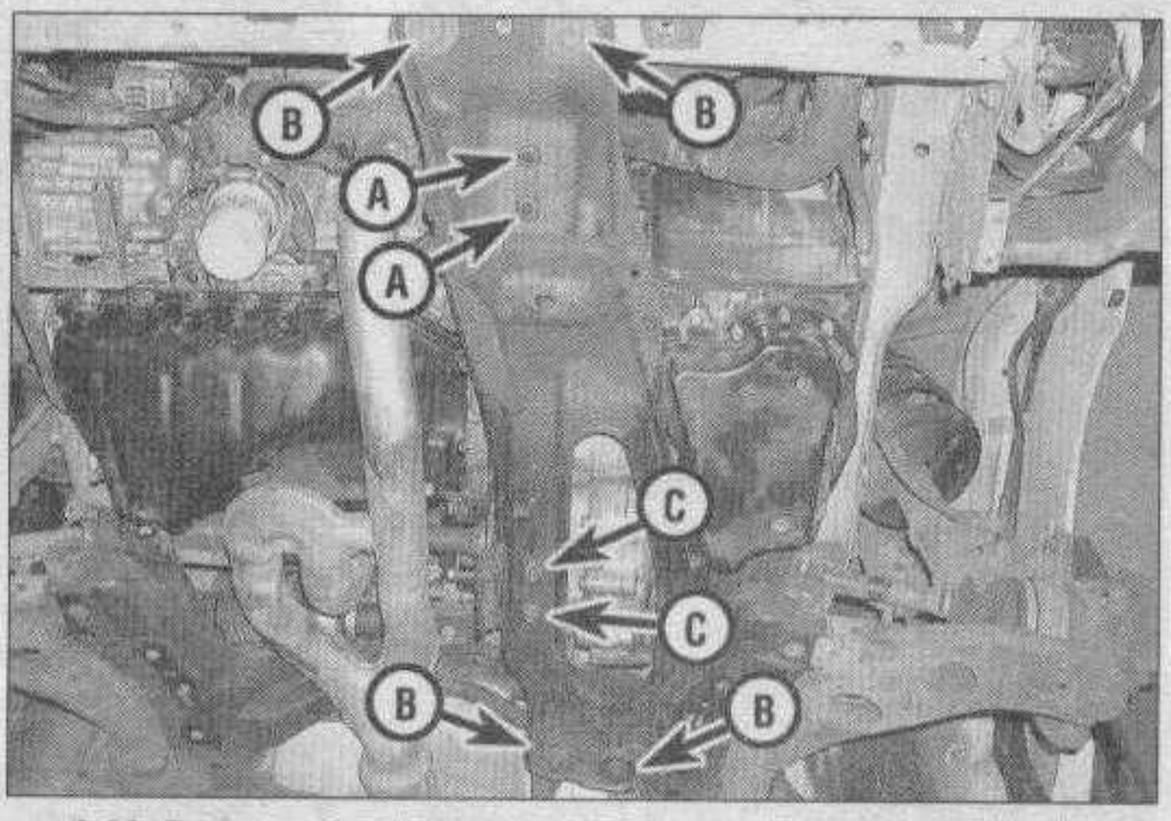
8.9 Install an engine support brace across the engine compartment



8.10 Remove the upper transaxle-to-engine bolts (arrows) (V6 engine shown)



8.20 Remove the crossmember mounting bolts (arrows)



8.23 Remove the transaxle cradle mounting nuts and bolts

A Engine-to-cradle bolts
B Cradle-to-body bolts
C Transaxle-to-cradle bolts

and GF4A-EL transaxles are equipped with a rectangular connector while the CD4E and LA4A-EL transaxles use an oval shaped connector.

6 Disconnect the shift cable from the transaxle (see Section 2).

7 Disconnect the electrical connector for the vehicle speed sensor (VSS).

8 Disconnect the transaxle fluid cooler lines from the transaxle.

9 Raise the vehicle and support it securely on jackstands. Secure the engine using an engine support brace that is installed above the engine compartment **(see illustration)**. If an engine support brace is not available, install an engine lift and a lifting chain assembly. This will keep the engine stable during the entire transaxle removal procedure.

10 Remove the upper transaxle-to-engine mounting bolts **(see illustration)**.

11 Disconnect the fuel filter bracket and position the fuel filter assembly to the side (see Chapter 1, if necessary).

12 Refer to Chapter 2A (four cylinder) or 2B (V6) and remove the engine mount from the left side of the vehicle.

13 Remove the front wheels.

14 Drain the transaxle lubricant (see Chapter 1).

15 On four-cylinder engines, remove the intake manifold support bracket bolts and bracket.

16 Disconnect the lower control arms from the steering knuckles.

17 Disconnect the bearing support and detach the intermediate shaft from the transaxle (see Chapter 8). **Note:** *On V6 engines, remove the three catalytic converter nuts directly at the exhaust manifold. Lower the exhaust system.*

18 Pry the right driveaxle and the intermediate shaft from the transaxle as a complete unit. Disconnect the left driveaxle from transaxle (see Chapter 8). Tie a plastic bag over the left inner CV joint to keep it clean.

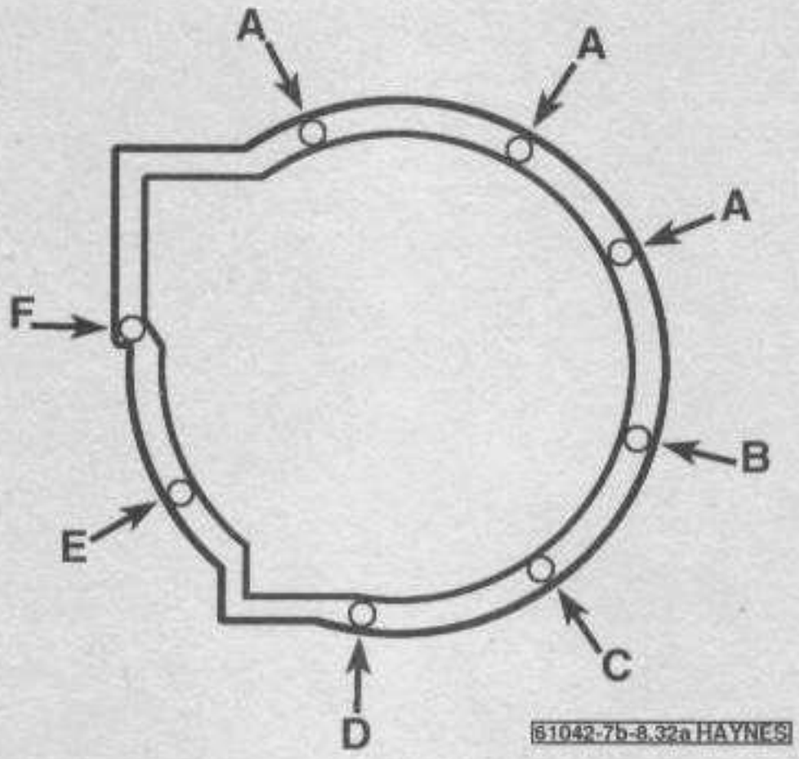
19 Insert large deep sockets into the of the holes where the driveaxles were removed - this will keep the differential side gears from falling (see Chapter 7A, **illustrations 4.19a and 4.19b**). There are special factory tools available; however, if the sockets are properly secured, this alternate method will suffice. **Caution:** *If this isn't done and the differential side gears become mispositioned, the transaxle will have to be disassembled.*

20 Remove the splash shields. Remove the six crossmember mounting bolts and remove the crossmember from the vehicle **(see illustration)**.

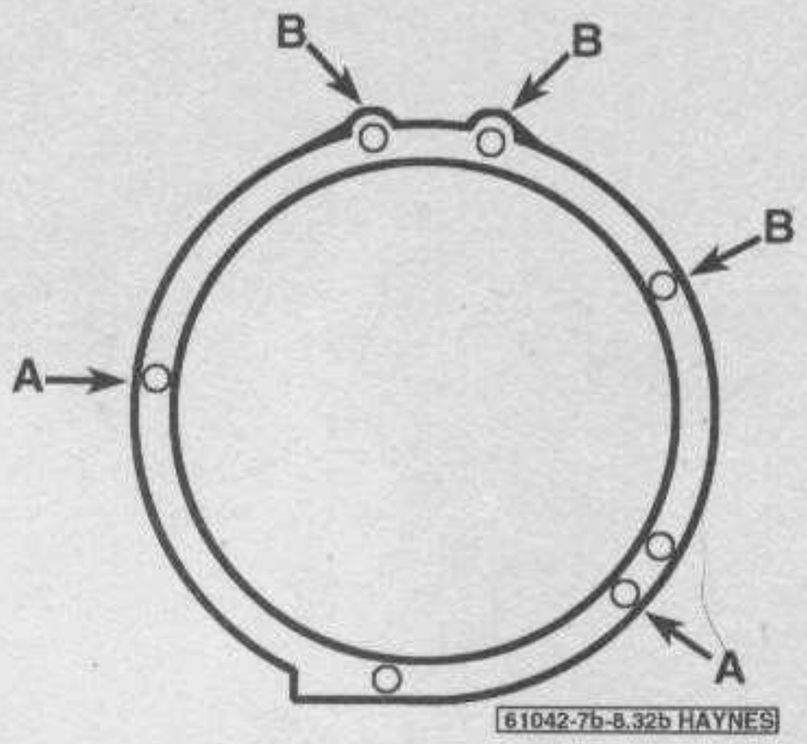
21 On V6 engines, disconnect the left and right side oxygen sensor heater connectors (see Chapter 6).

22 On vehicles equipped with ABS, remove the clips from the wheel speed sensors, remove the sensor mounting nuts and separate the wheel speed sensor harness from the left and right side of the vehicle.

23 Remove the six bolts and two nuts from the transaxle cradle and remove the cradle **(see illustration)**. Support the cradle as the last fasteners are removed so the cradle won't fall. Also, be sure to paint alignment



8.32a Transaxle mounting bolt locations for the 1993 four-cylinder engine with the 4EAT/GF4A-EL transaxle



8.32b Transaxle mounting bolt locations for the 1993 and later V6 engine with the 4EAT/GF4A-EL transaxle

marks on the transaxle cradle and chassis joints to insure correct alignment on reassembly.

24 Remove the torque converter nuts through the starter access hole in the transaxle on CD4E/LA4A-EL transaxles. On 4EAT/GF4A-EL transaxles, remove the access cover from the lower section of the transaxle and remove the torque converter nuts. Rotate the engine for access to all the nuts (there are usually four).

25 Support the transaxle with an approved transaxle jack and safety chains. Floor jacks are often not stable enough to support and lower the transaxle from the vehicle.

26 Remove the transaxle mount and mount bracket. Refer to the Engine Mounts Section in Chapter 2A (four cylinder engine) or Chapter 2B (V6 engines) for additional information.

27 Remove the remaining transaxle mounting bolts.

28 Make a final check that all wires and hoses have been disconnected from the transaxle, then carefully pull the transaxle and jack away from the engine. Lower the transaxle and remove it from under the vehicle.

29 With the transaxle removed, inspect the torque converter, torque converter seal and other transaxle seals (side cover seal, VSS seal, etc.) for damage and wear. Replace the torque converter seal and torque converter if necessary.

Installation

Refer to illustrations 8.32a, 8.32b and 8.32c

30 If removed, install the torque converter into the transaxle.

31 With the transaxle secured to the jack by a chain, raise it into position behind the engine, then carefully slide it forward, engaging the dowel pins on the transaxle with the corresponding holes in the block and the bolt holes in the driveplate with the flywheel. Do not use excessive force to install the transaxle - if the torque converter does not slide into place, readjust the angle of the transaxle so it is level.

32 Install the engine-to-transaxle mounting bolts **(see illustrations)**.

a) *On 1993 four-cylinder engines, with the 4EAT/GF4A-EL transaxle, tighten bolts B, C, D, E and then F in the correct order to the torque listed in this Chapter's Specifications.*

b) *On 1993 and later V6 engines with the 4EAT/GF4A-EL transaxle, tighten bolts A to the torque listed in this Chapter's Specifications.*

c) *On 1994 and later four-cylinder engines with the CD4E/LA4A-EL transaxle, tighten bolts B and C to the torque listed in this Chapter's Specifications.*

33 Tighten the rear engine mount bracket bolts. Refer to Chapter 2A (four cylinder engines) or 2B (V6 engines) for the installation procedure and the torque specifications for the engine mounts.

34 Install the lower, left engine mount onto the transaxle (see Chapter 2A (four cylinder engines) or 2B (V6 engines) for the installation procedure and the torque specifications.

35 Install the shift cable onto the transaxle (see Section 3).

36 Install the transaxle cradle, aligning the mark(s) made during removal and tighten the bolts to the torque listed in this Chapter's Specifications **(see illustration 8.23)**.

37 Install the crossmember **(see illustration 8.20)** and torque the bolts to the Specifications listed in this Chapter.

38 Install the remaining engine-to-transaxle mounting bolts **(see illustrations 8.32a, 8.32b and 8.32c)**.

a) *On 1993 four-cylinder engines, tighten bolts A to the torque listed in this Chapter's Specifications.*

b) *On 1993 and later V6 engines with the 4EAT/GF4A-EL transaxle, tighten bolts B to the torque listed in this Chapter's Specifications.*

c) *On 1994 and later four-cylinder engines with the CD4E/LA4A-EL transaxle, tighten bolts A to the torque listed in this Chapter's Specifications.*

39 Remove the transaxle plugs from the differential side covers.

40 Install the intermediate shaft and driveaxles. Be sure to use new retaining clips on the driveaxles (see Chapter 8)

41 Connect the steering knuckle to the lower control arm (see Chapter 10).

42 Install the splash shield and front wheels and lower the vehicle.

43 Install the front engine mount bracket bolts (see Chapter 2A for four-cylinder engines or 2B for V6 engines) for the installation procedure and the torque specifications.

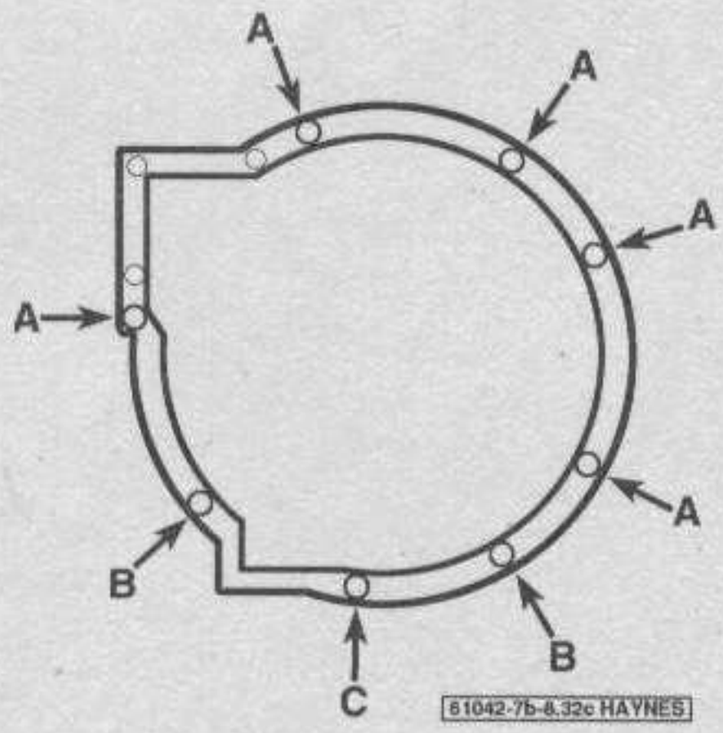
44 The remainder of installation is the reverse of removal.

45 Refill the transaxle with the specified type and amount of lubricant (see Chapter 1).

46 Road test the vehicle for proper operation and check for leaks.

47 Loosen and retighten the engine mounts in sequence (see Chapter 2A) if vibration is evident.

48 Have the front end aligned.



8.32c Transaxle mounting bolt locations for the 1994 and later four-cylinder engine with the CD4E/LA4A-EL transaxle

7B

Chapter 8
Clutch and driveaxles

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Clutch release cylinder - removal and installation	4
Driveaxle boot replacement	13
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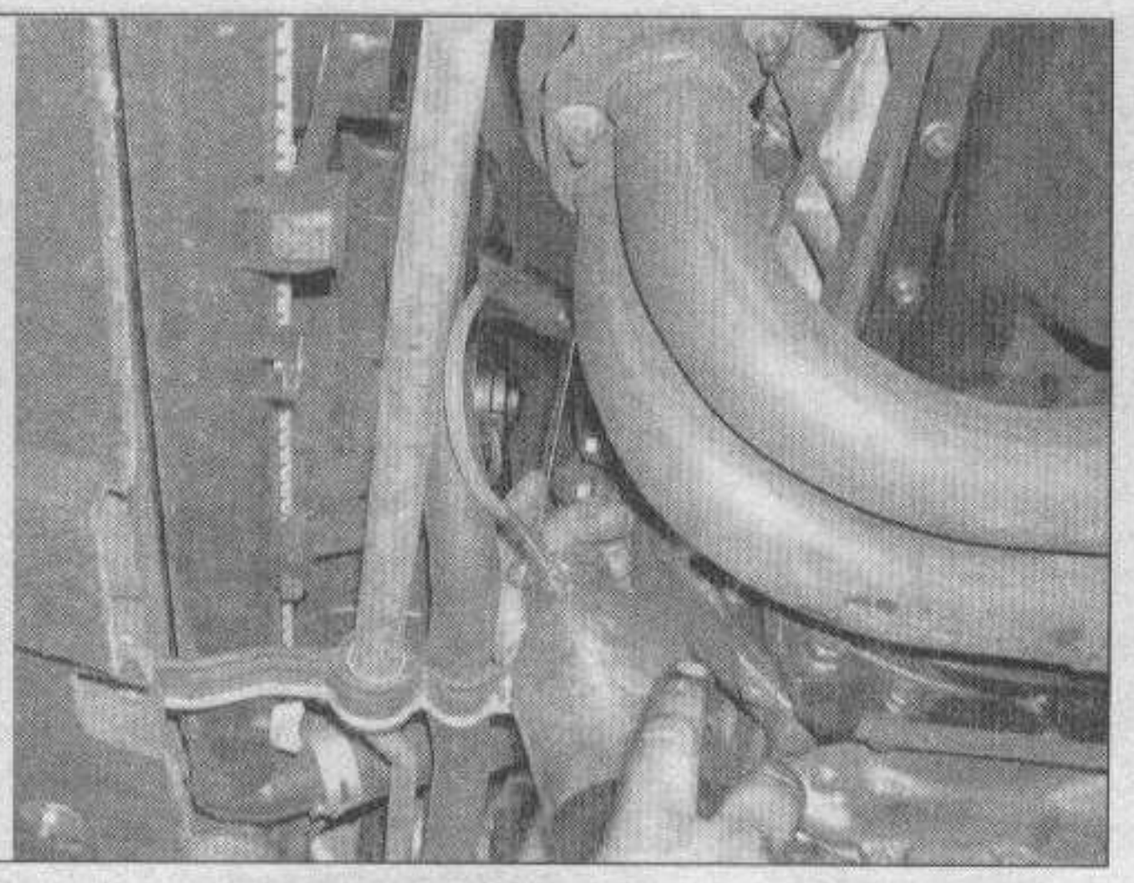
Specifications

General

Clutch pedal freeplay	3/64 to 1/8 inch
Clutch pedal standard height	
1993 through 1997 models	7-21/64 to 8-5/16 inches
1998 and later models	7-41/64 to 7-61/64 inches

Driveaxles

Driveaxle length	
Four-cylinder engine	
Manual transaxle	
1993 through 1997 models	
Left axle	25-9/16 to 25-61/64 inches
Right axle	23-5/8 to 24-1/64 inches
1998 and later models	
Left axle	25-23/64 to 25-47/64 inches
Right axle	23-7/16 to 23-13/16 inches
Automatic transaxle	
1993 through 1997 models	
Left	25-13/32 to 25-15/16 inches
Right	23-9/16 to 23-31/32 inches
1998 and later models	
Left axle	26-63/64 to 27-3/8 inches
Right axle	23-23/64 to 23-3/4 inches



5.5 When bleeding the clutch hydraulic system, a hose is connected to the bleeder valve at the release cylinder and then submerged in brake fluid. When the pedal is depressed and the valve is opened, air will be seen as bubbles in the hose and container

3 Clutch master cylinder - removal and installation

Removal

1 Disconnect the cable from the negative battery terminal. **Caution:** *If the radio in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Working under the dashboard, remove the cotter pin from the clutch master cylinder pushrod clevis. Pull out the clevis pin to disconnect the pushrod from the pedal.

3 While you're under the dash, unscrew the clutch master cylinder retaining nut.

4 Working in the engine compartment, remove the charcoal canister (see Chapter 6).

5 Clamp a pair of locking pliers onto the clutch fluid feed hose, a couple of inches downstream of the brake fluid reservoir (the clutch master cylinder is supplied with fluid from the brake fluid reservoir). The pliers should be just tight enough to prevent fluid flow when the hose is disconnected. Disconnect the reservoir hose from the clutch master cylinder.

6 Using a flare-nut wrench, disconnect the hydraulic line fitting at the cylinder. Have rags handy, as some fluid will be lost as the line is removed. Cap or plug the ends of the line to prevent fluid leakage and the entry of contaminants.

7 Remove the remaining mounting nut and detach the cylinder from the firewall. **Caution:** *Don't allow brake fluid to come into contact with the paint, as it will damage the finish.*

Installation

8 Place the master cylinder in position on the firewall and install the mounting nut finger tight.

9 Connect the hydraulic line fitting to the clutch master cylinder and tighten it finger tight (since the cylinder is still a bit loose, it'll be easier to start the threads into the cylinder).

10 Tighten the mounting nut to the torque listed in this Chapter's Specifications, then tighten the hydraulic line fitting securely.

11 Install the charcoal canister (see Chapter 6).

12 Attach the fluid feed hose from the reservoir to the clutch master cylinder and tighten the hose clamp. Remove the locking pliers.

13 Working under the dash, install the remaining mounting nut and tighten it to the torque listed in this Chapter's Specifications. Connect the pushrod to the clutch pedal, using a new cotter pin to secure the clevis pin.

14 Fill the reservoir with brake fluid conforming to DOT 3 specifications and bleed the clutch system as outlined in Section 5.

4 Clutch release cylinder - removal and installation

Removal

1 Disconnect the negative cable from the battery. **Caution:** *The stereo in your vehicle is equipped with an anti-theft system. Make sure you have the correct activation code before disconnecting the battery.*

2 Raise the vehicle and support it securely on jackstands.

3 Disconnect the hydraulic line at the release cylinder using a flare-nut wrench. Have a small can and rags handy, as some fluid will be spilled as the line is removed. Plug the line to prevent excessive fluid loss and contamination.

4 Remove the two release cylinder mounting bolts.

5 Remove the release cylinder.

Installation

6 Lubricate the pocket in the release fork with multi-purpose grease. Install the release cylinder on the clutch housing and install the bolts, but leave them a little loose until after the hydraulic line fitting threads have been started. Make sure the pushrod is seated in the release fork pocket.

7 Connect the hydraulic line fitting to the release cylinder, using your fingers only at this time (since the cylinder is still a bit loose, it'll be easier to start the threads into the cylinder).

8 Tighten the mounting bolts to the torque listed in this Chapter's Specifications.

9 Tighten the hydraulic fitting securely, using a flare-nut wrench.

10 Check the fluid level in the brake fluid reservoir, adding brake fluid conforming to DOT 3 specifications until the level is correct.

11 Bleed the system as described in Section 5, then recheck the brake fluid level.

12 Lower the vehicle and connect the negative battery cable.

5 Clutch hydraulic system - bleeding

Refer to illustration 5.5

1 Bleed the hydraulic system whenever any part of the system has been removed or the fluid level has fallen so low that air has been drawn into the master cylinder. The bleeding procedure is very similar to bleeding a brake system.

2 Fill the brake master cylinder reservoir with new brake fluid conforming to DOT 3 specifications. **Caution:** *Do not re-use any of the fluid coming from the system during the bleeding operation or use fluid which has been inside an open container for an extended period of time.*

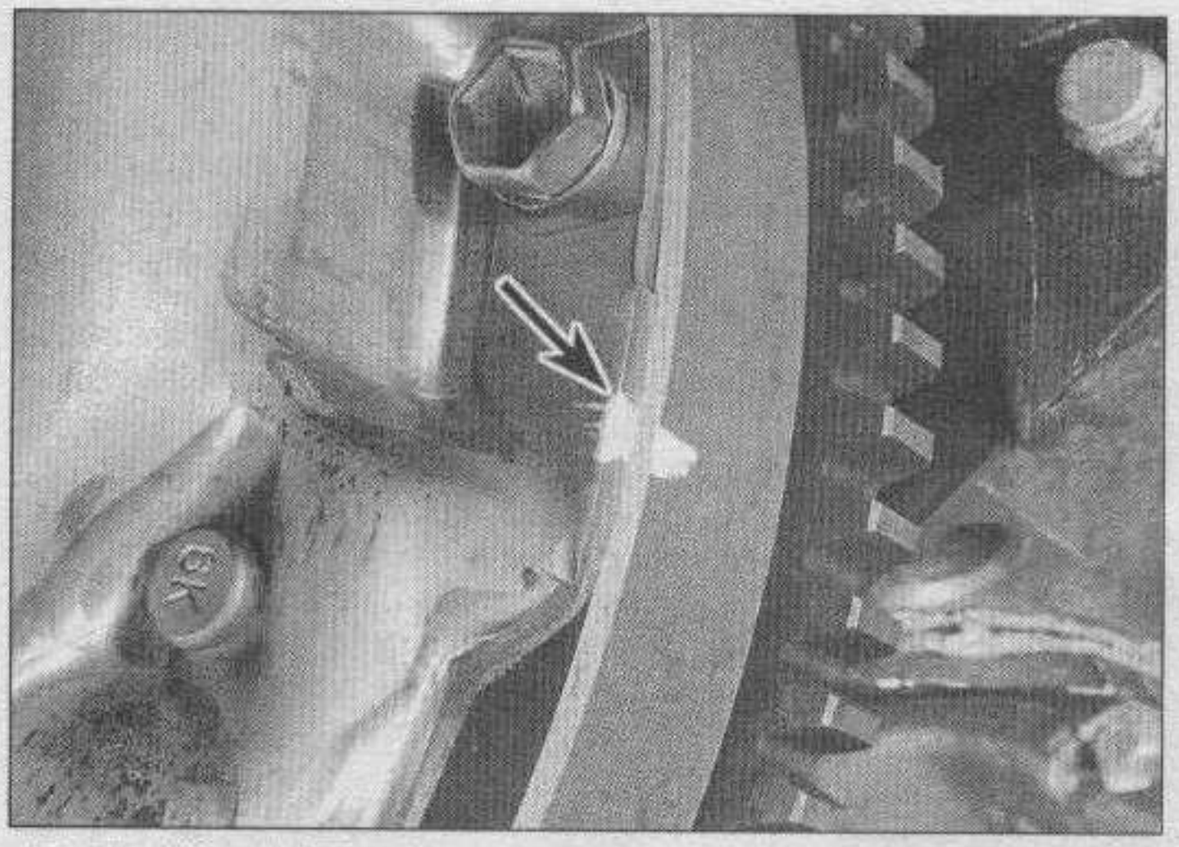
3 Raise the vehicle and support it securely on jackstands to gain access to the release cylinder, which is located on the front of the transaxle.

4 Remove the dust cap which fits over the bleeder valve and push a length of plastic hose over the valve. Place the other end of the hose into a clear container with about two inches of brake fluid. The hose end must be in the fluid at the bottom of the container.

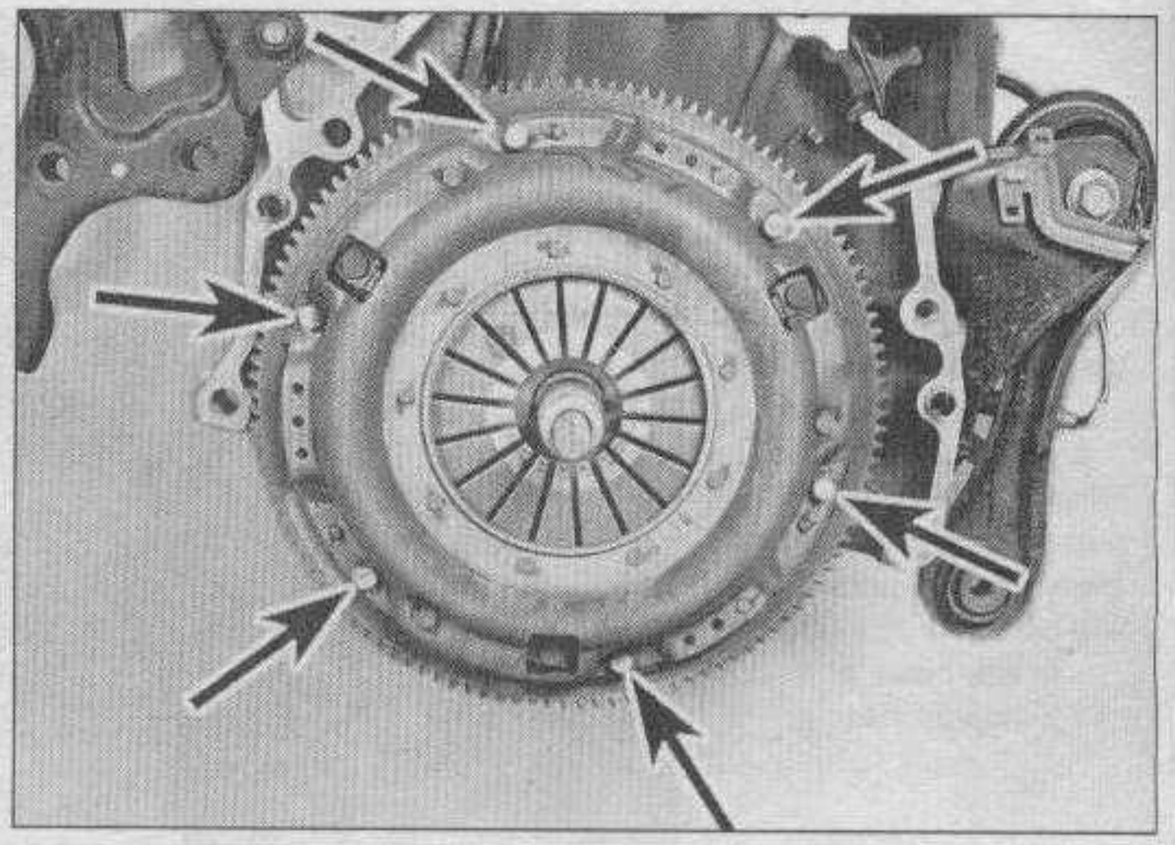
5 Have an assistant depress the clutch pedal and hold it. Open the bleeder valve on the release cylinder, allowing fluid to flow through the hose **(see illustration)**. Close the bleeder valve when the flow of fluid (and bubbles) ceases. Once closed, have your assistant release the pedal.

6 Continue this process until all air is evacuated from the system, indicated by a solid stream of fluid being ejected from the bleeder valve each time with no air bubbles in the hose or container. Keep a close watch on the fluid level inside the clutch master cylinder reservoir - if the level drops too far, air will get into the system and you'll have to start all over again.

7 Install the dust cap and lower the vehicle. Check the brake fluid level again, and add some, if necessary, to bring it to the appropriate level. Check carefully for proper operation before placing the vehicle into normal service.



6.5 Mark the relationship of the pressure plate to the flywheel (if you're planning to re-use the old pressure plate)



6.6 Remove the pressure plate bolts (arrows) gradually and evenly in a criss-cross pattern

6 Clutch components - removal, inspection and installation

Warning: *Dust produced by clutch wear and deposited on clutch components may contain asbestos, which is hazardous to your health. DO NOT blow it out with compressed air and DO NOT inhale it. DO NOT use gasoline or petroleum-based solvents to remove the dust. Brake system cleaner should be used to flush the dust into a drain pan. After the clutch components are wiped clean with a rag, dispose of the contaminated rags and cleaner in a covered, marked container.*

Removal

Refer to illustrations 6.5 and 6.6

1 Access to the clutch components is normally accomplished by removing the transaxle, leaving the engine in the vehicle. If the engine is being removed for major overhaul, check the clutch for wear and replace worn components as necessary. However, the relatively low cost of the clutch components compared to the time and trouble spent gaining access to them warrants their replacement anytime the engine or transaxle is removed, unless they are new or in near-perfect condition. The following procedures are based on the assumption the engine will stay in place.

2 Remove the transaxle from the vehicle (see Chapter 7, Part A). Support the engine while the transaxle is out. Preferably, an engine support fixture or a hoist should be used to support it from above. However, if a jack is used underneath the engine, make sure a piece of wood is positioned between the jack and oil pan to spread the load. **Caution:** *The pick-up for the oil pump is very close to the bottom of the oil pan. If the pan is bent or distorted in any way, engine oil starvation could occur.*

3 The clutch fork and release bearing can remain attached to the transaxle housing for the time being.

4 To support the clutch disc during removal, install a clutch alignment tool through the clutch disc hub.

5 Carefully inspect the flywheel and pressure plate for indexing marks. The marks are usually an X, an O or a white letter. If they cannot be found, scribe or paint marks yourself so the pressure plate and the flywheel will be in the same alignment during installation **(see illustration)**.

6 Turning each bolt a little at a time, loosen the pressure plate-to-flywheel bolts **(see illustration)**. Work in a criss-cross pattern until all spring pressure is relieved. Then hold the pressure plate securely and completely remove the bolts, followed by the pressure plate and clutch disc.

Inspection

Refer to illustrations 6.9, 6.11a, 6.11b and 6.13

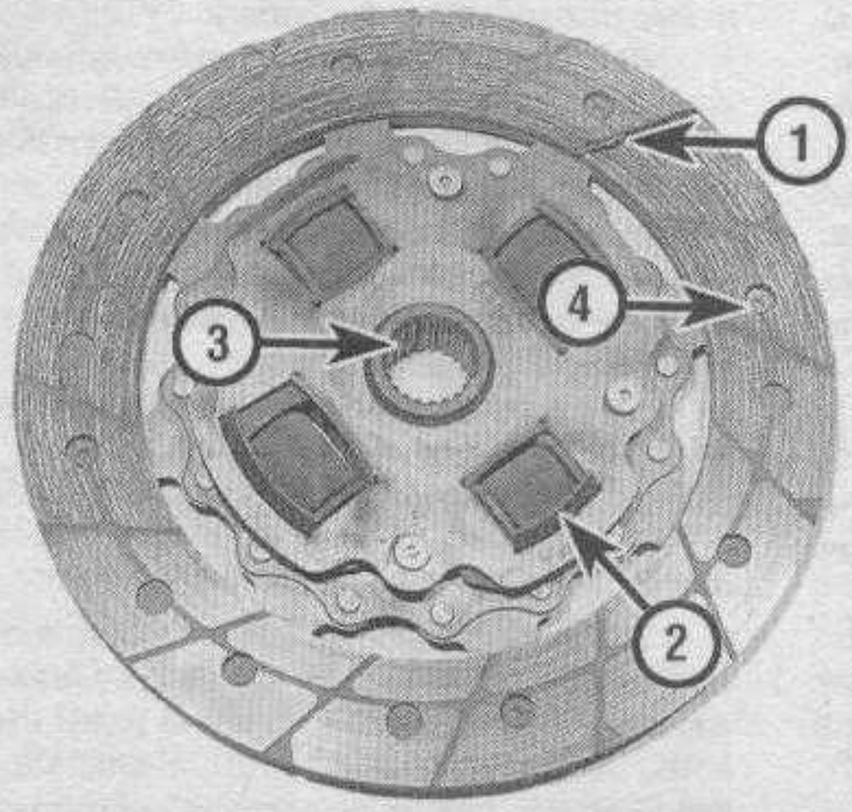
7 Ordinarily, when a problem occurs in the clutch, it can be attributed to wear of the clutch driven plate assembly (clutch disc). However, all components should be inspected at this time.

8 Inspect the flywheel for cracks, heat checking, grooves and other obvious defects. If the imperfections are slight, a machine shop can machine the surface flat and smooth, which is highly recommended regardless of the surface appearance. Refer to Chapter 2 for the flywheel removal and installation procedure.

9 Inspect the lining on the clutch disc. There should be at least 1/16-inch of lining above the rivet heads. Check for loose rivets, distortion, cracks, broken springs and other obvious damage **(see illustration)**. As mentioned above, ordinarily the clutch disc is routinely replaced, so if in doubt about the condition, replace it with a new one.

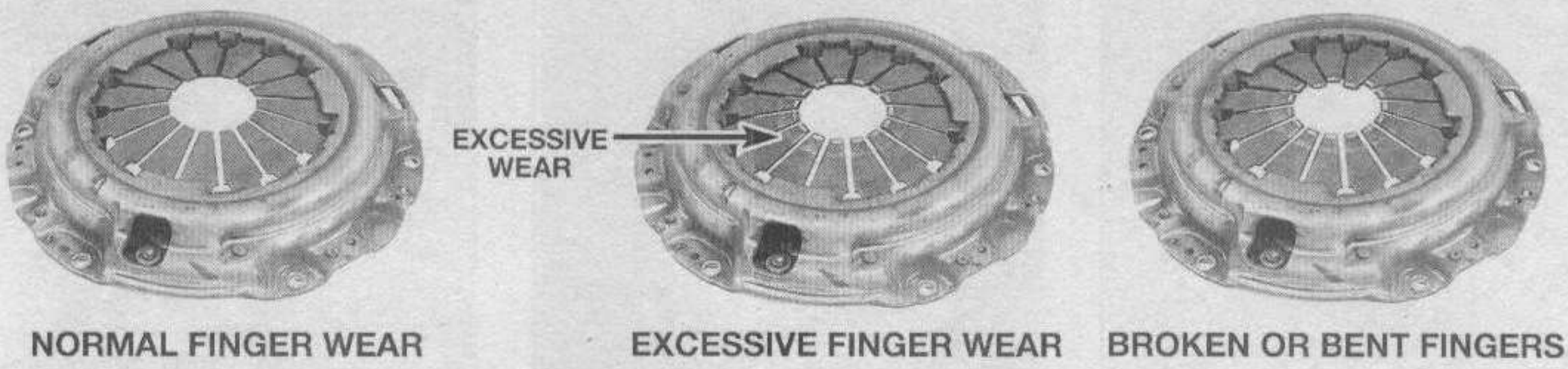
10 The release bearing should also be replaced along with the clutch disc (see Section 7).

11 Check the machined surfaces and the diaphragm spring fingers of the pressure plate **(see illustrations)**. If the surface is grooved or otherwise damaged, replace the pressure plate. Also check for obvious damage, distortion, cracking, etc. Light glazing can be removed with emery cloth or sandpaper. If a new pressure plate is required, new and re-manufactured units are available.

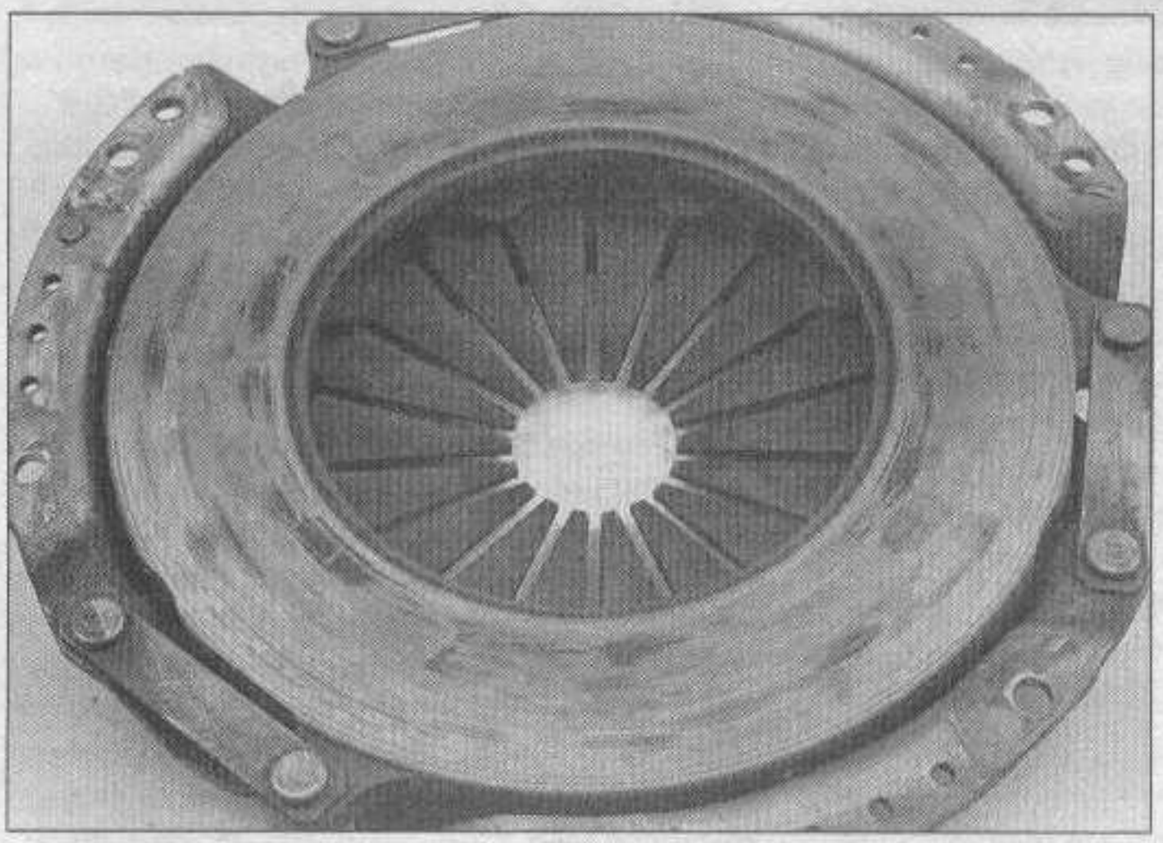


6.9 The clutch disc

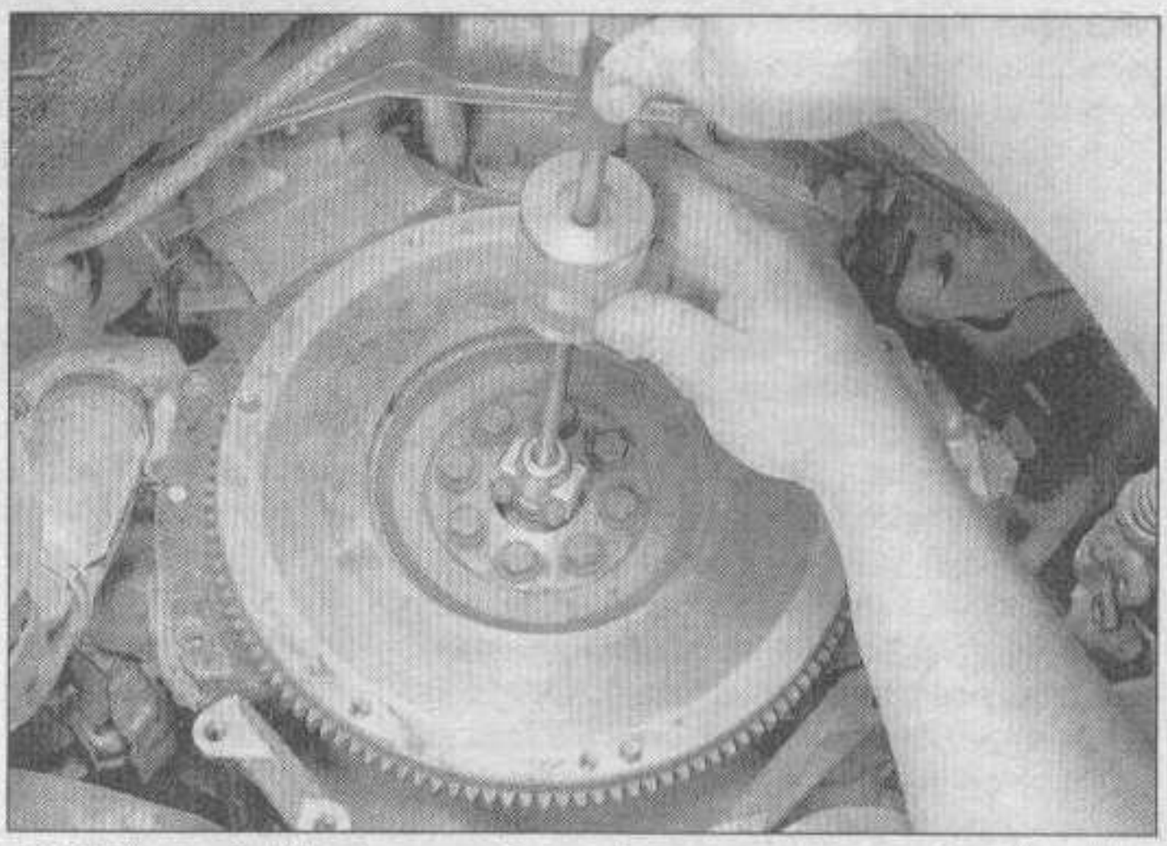
1 ***Lining*** *- this will wear down in use*
2 ***Springs or dampers*** *- check for cracking and deformation*
3 ***Splined hub*** *- the splines must not be worn and should slide smoothly on the transaxle input shaft splines*
4 ***Rivets*** *- these secure the lining and will damage the flywheel or pressure plate if allowed to contact the surfaces*



6.11a Replace the pressure plate if excessive wear or damage are noted



6.11b Inspect the pressure plate surface for excessive score marks, cracks and signs of overheating



6.13 A small slide hammer is handy for removing a pilot bearing

12 Check the pilot bearing in the end of the crankshaft for excessive wear, scoring, dryness, roughness and any other obvious damage. If any of these conditions are noted, replace the bearing.

13 Removal can be accomplished with a slide hammer and puller attachment **(see illustration)**, which are available at most auto parts stores or tool rental yards.

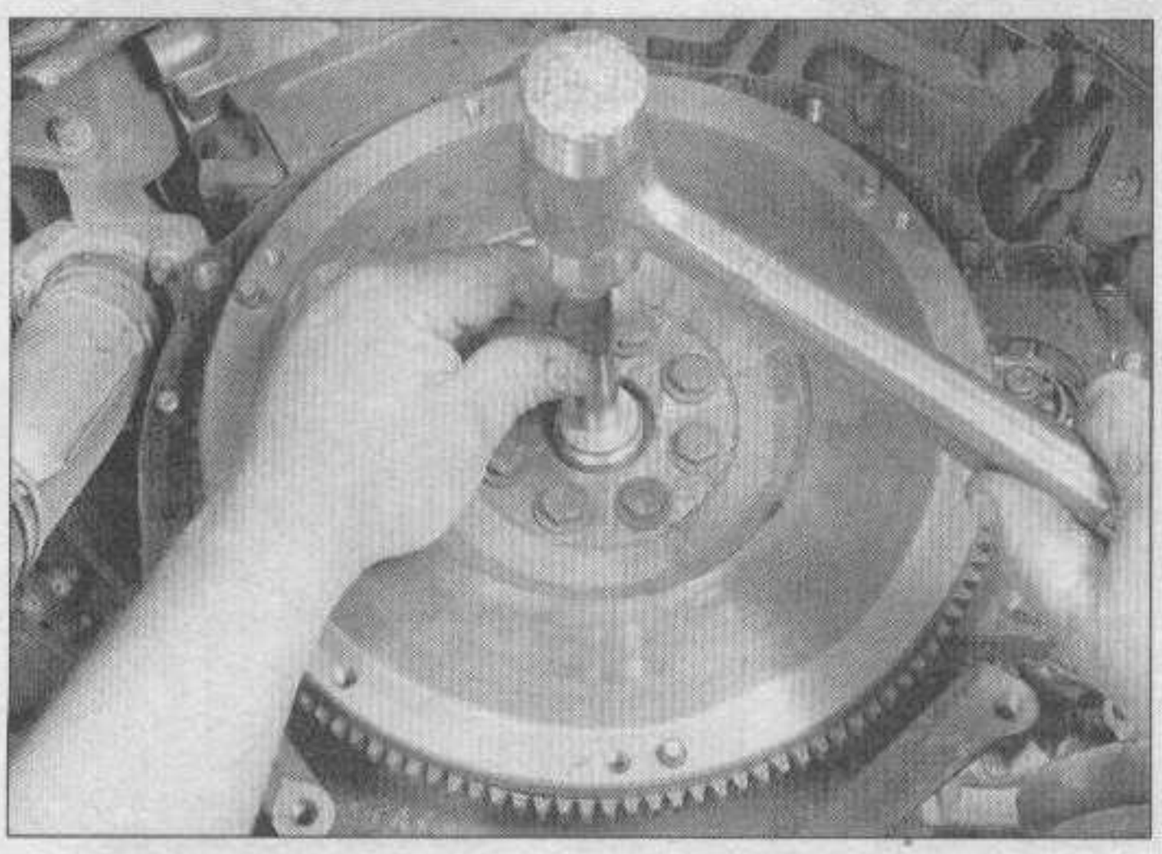
Installation

Refer to illustrations 6.14 and 6.16

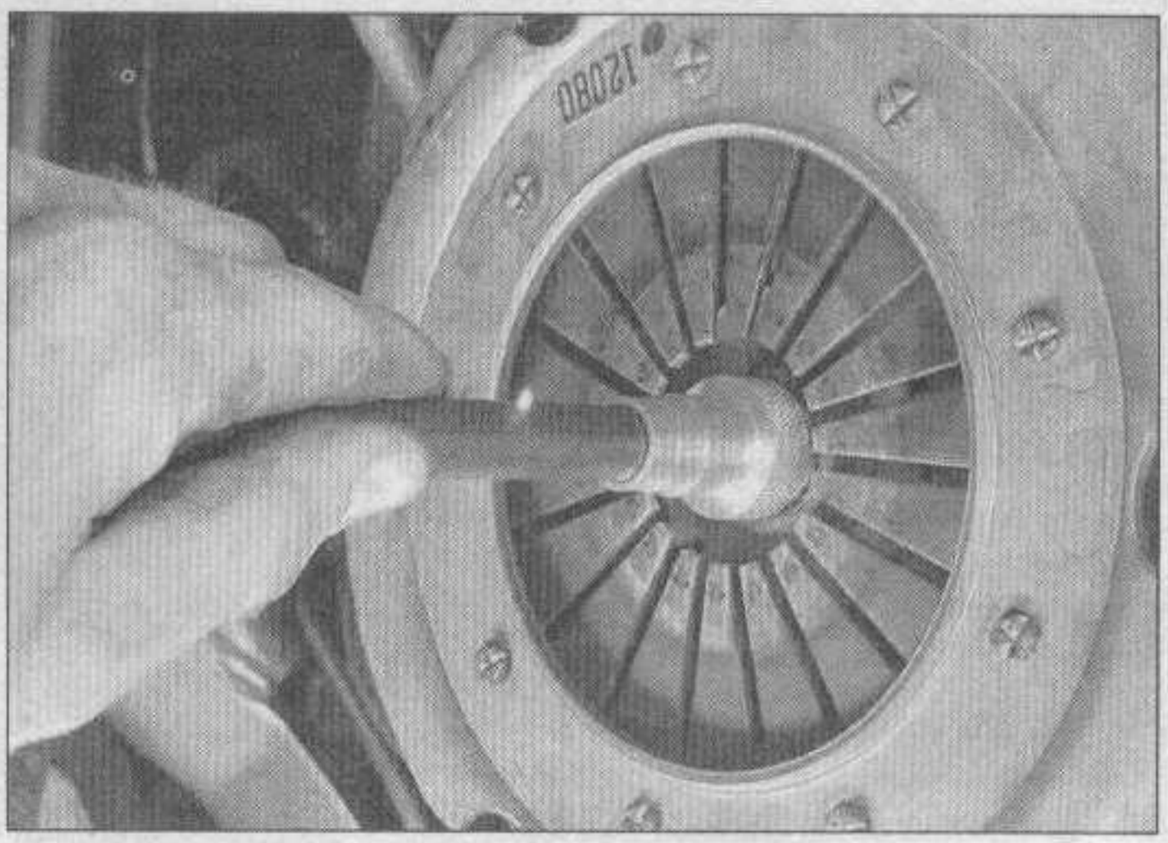
14 To install a new pilot bearing, lightly lubricate the outside surface with grease, then drive it into the recess with a bearing driver or a socket **(see illustration)**.

15 Before installation, clean the flywheel and pressure plate machined surfaces with brake cleaner, lacquer thinner or acetone. It's important that no oil or grease is on these surfaces or the lining of the clutch disc. Handle the parts only with clean hands.

16 Position the clutch disc and pressure plate against the flywheel with the clutch held in place with an alignment tool **(see illustration)**. Make sure the disc is installed properly (most replacement clutch discs will be marked "flywheel side" or something similar -

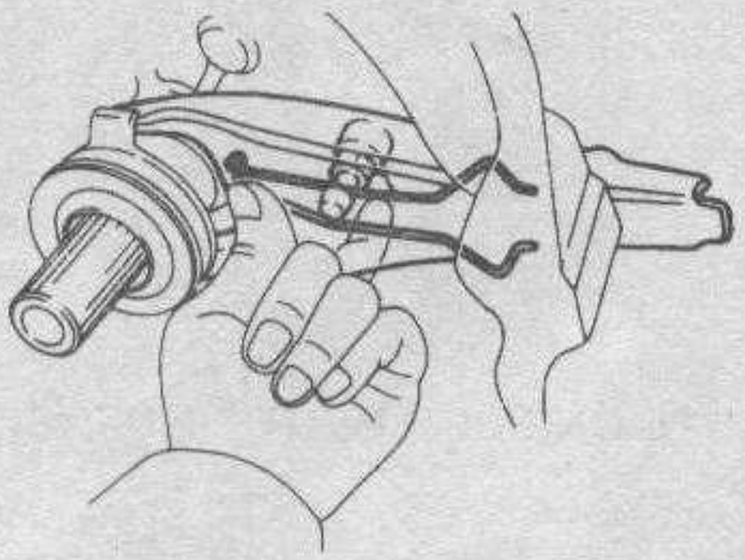


6.14 Tap the bearing into place with a bearing driver or a socket that is slightly smaller than the outside diameter of the bearing

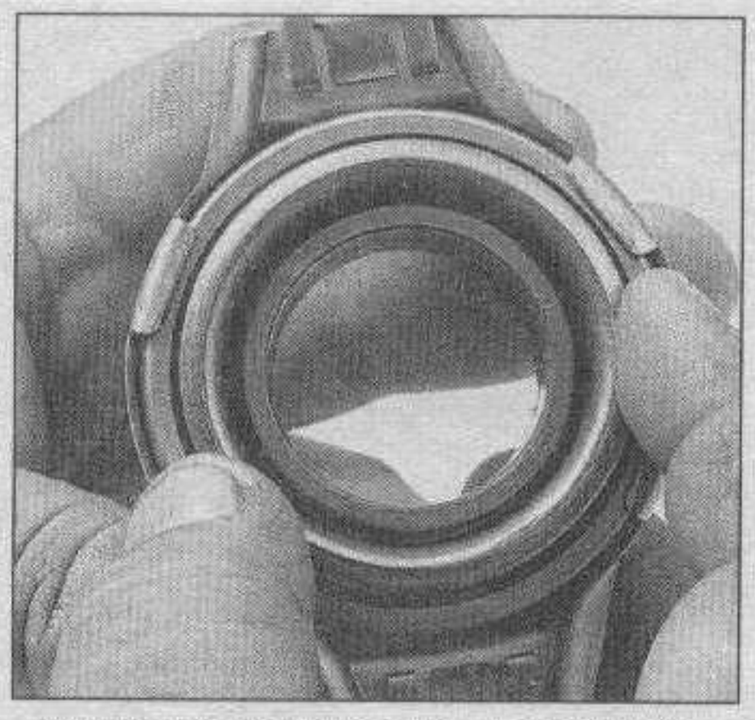


6.16 Center the clutch disc in the pressure plate with a clutch alignment tool

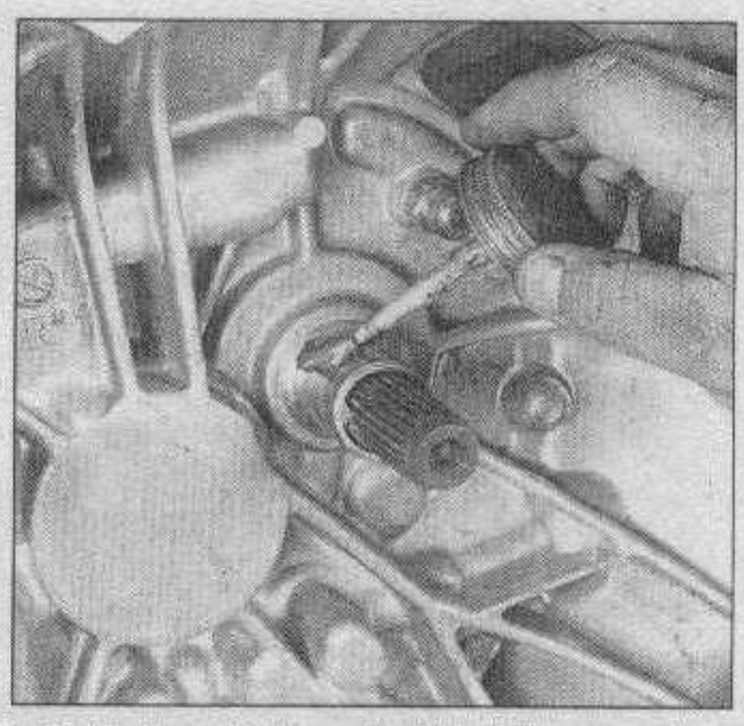
8



7.3 Reach behind the release lever and disengage the lever from the ball stud by pulling on the retention spring, then remove the lever and bearing



7.4 To check the bearing, hold it by the outer race and rotate the inner race while applying pressure; if the bearing doesn't turn smoothly or if it is noisy, replace the bearing



7.6 Apply a light coat of high-temperature grease to the bearing surface of the retainer (before installing the transaxle, apply the same grease to the input shaft splines and the ball stud to help the shaft slide through the clutch hub)

if not marked, install the clutch disc with the damper springs toward the transaxle).

17 Tighten the pressure plate-to-flywheel bolts only finger tight, working around the pressure plate.

18 Center the clutch disc by ensuring the alignment tool extends through the splined hub and into the pilot bearing in the crankshaft. Wiggle the tool up, down or side-to-side as needed to center the disc. Tighten the pressure plate-to-flywheel bolts a little at a time, working in a criss-cross pattern to prevent distorting the cover. After all of the bolts are snug, tighten them to the torque listed in this Chapter's Specifications. Remove the alignment tool.

19 Using high-temperature grease, lubricate the inner groove of the release bearing (see Section 7). Also place grease on the release lever contact areas and the transaxle input shaft bearing retainer.

20 Install the clutch release bearing (see Section 7).

21 Install the transaxle and all components removed previously.

7 Clutch release bearing and fork - removal, inspection and installation

Warning: *Dust produced by clutch wear and deposited on clutch components may contain asbestos, which is hazardous to your health. DO NOT blow it out with compressed air and DO NOT inhale it. DO NOT use gasoline or petroleum-based solvents to remove the dust. Brake system cleaner should be used to flush the dust into a drain pan. After the clutch components are wiped clean with a rag, dispose of the contaminated rags and cleaner in a covered, marked container.*

Removal

Refer to illustration 7.3

1 Unbolt the clutch release cylinder (see Section 4), but don't disconnect the fluid line between the master cylinder and the release cylinder. Suspend the release cylinder out of the way with a piece of wire. **Caution:** *Don't depress the clutch pedal with the release cylinder unbolted.*

2 Remove the transaxle (see Chapter 7, Part A).

3 Pull the clutch release fork off the ball stud and slide the release bearing off the input shaft along with the release fork **(see illustration)**.

Inspection

Refer to illustration 7.4

4 Hold the bearing by the outer race and rotate the inner race while applying pressure **(see illustration)**. If the bearing doesn't turn smoothly or if it's noisy, replace it with a new one. Wipe the bearing with a clean rag and inspect it for damage, wear and cracks. It's common practice to replace the bearing with a new one whenever a clutch job is performed, to decrease the possibility of a bearing failure in the future. Don't immerse the bearing in solvent - it's sealed for life and to do so would ruin it.

5 Check the release lever for cracks and bends.

Installation

Refer to illustrations 7.6, 7.7a and 7.7b

6 Fill the inner groove of the release bearing with high temperature grease. Also apply a light coat of the same grease to the transaxle input shaft splines, ball stud and the front bearing retainer **(see illustration)**.

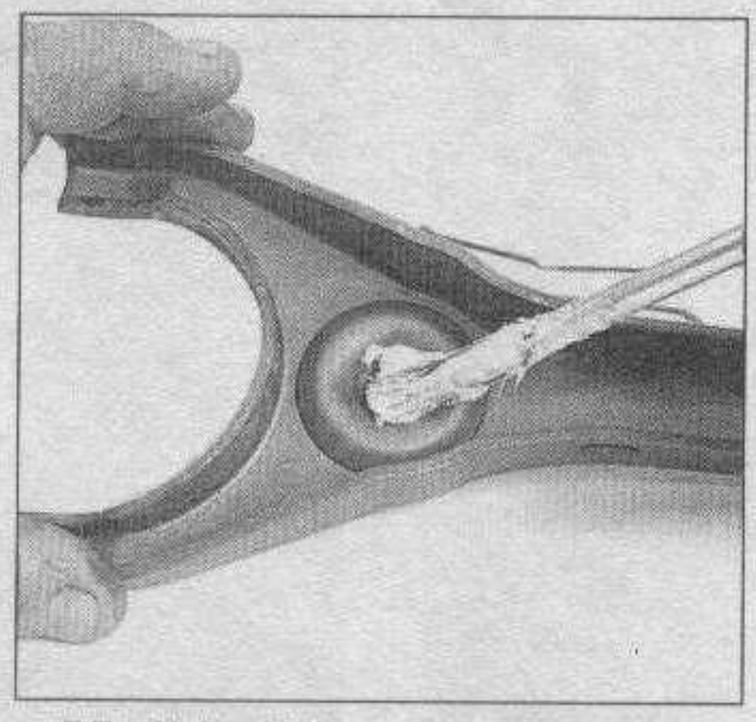
7 Lubricate the release fork ball socket, fork ends and release cylinder pushrod socket with high temperature grease **(see illustrations)**.

8 Attach the release bearing to the release fork.

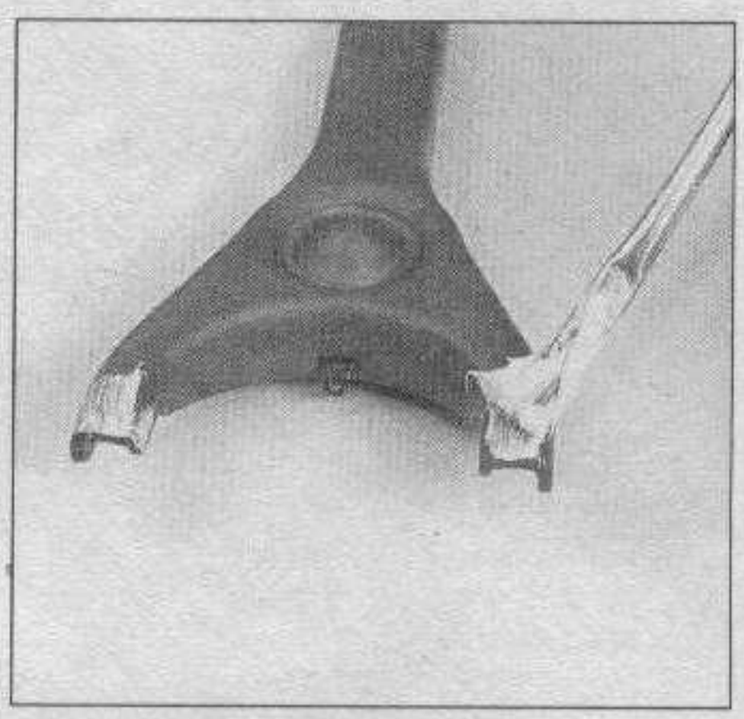
9 Slide the release bearing onto the transaxle input shaft front bearing retainer while passing the end of the release fork through the opening in the clutch housing. Push the clutch release fork onto the ball stud until it's firmly seated.

10 Apply a light coat of high temperature grease to the face of the release bearing where it contacts the pressure plate diaphragm fingers.

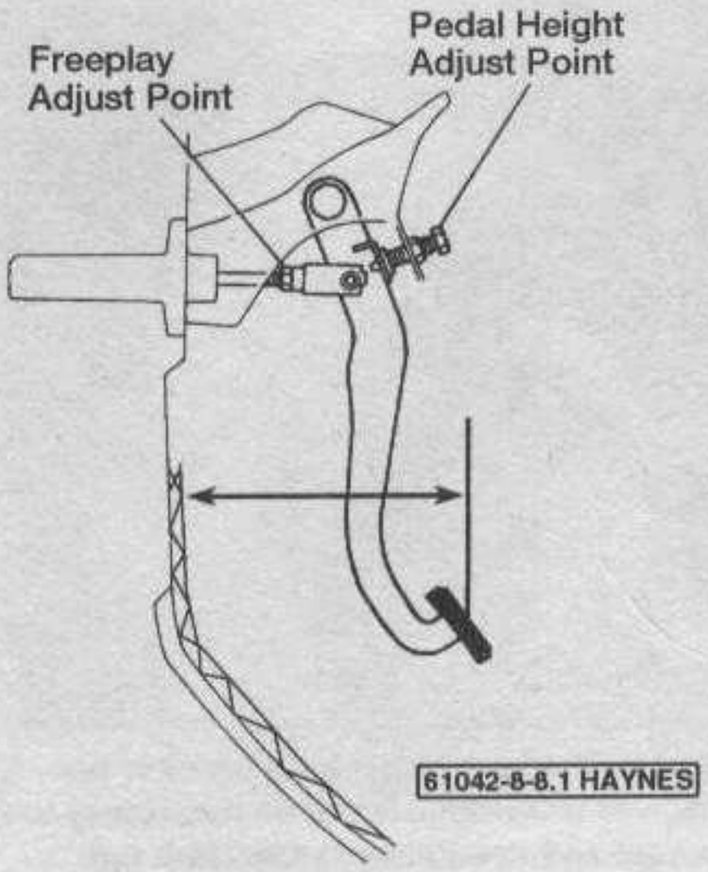
11 The remainder of installation is the reverse of the removal procedure.



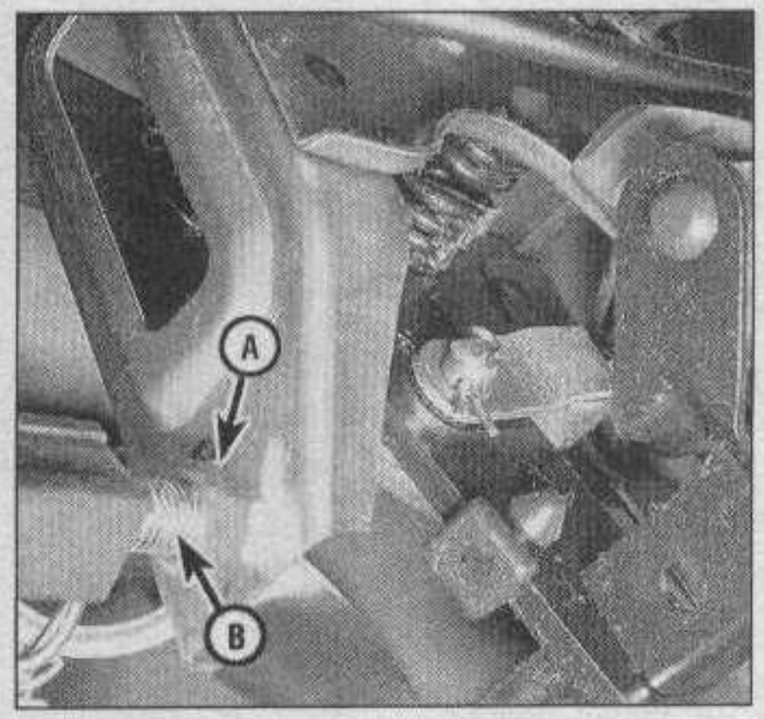
7.7a Using high temperature grease, lubricate the ball stud socket in the back of the release lever . . .



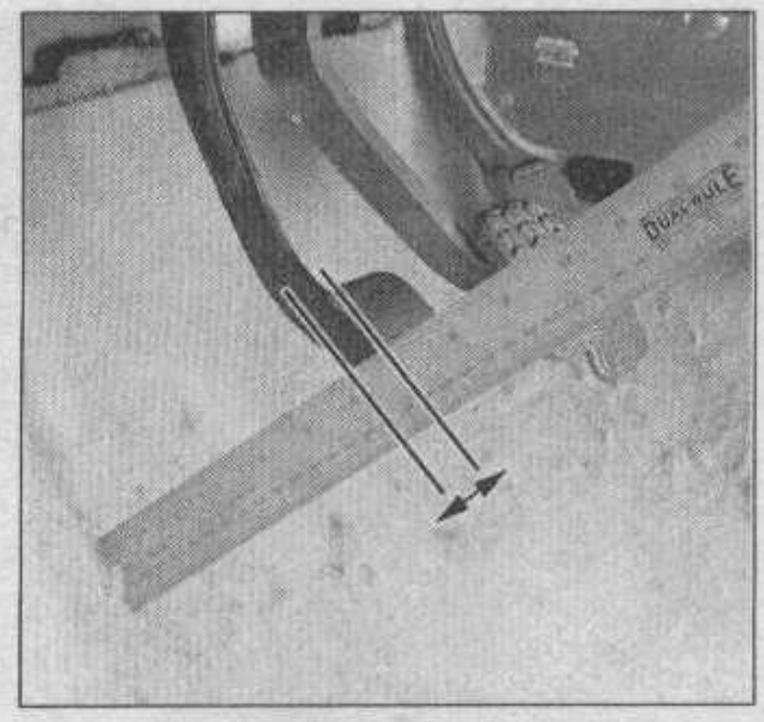
7.7b . . . the lever ends and the depression for the release cylinder pushrod



8.1 Clutch pedal height is the distance between the pedal pad and the floor



8.2 Loosen the locknut (A) then turn the adjusting bolt (B) to achieve the specified pedal height



8.4 Clutch pedal freeplay is the distance from the natural resting point of the pedal to the point at which resistance is felt

8 Clutch pedal adjustment

Pedal height

Refer to illustrations 8.1 and 8.2

1 The height of the clutch pedal is the distance the pedal sits off the floor **(see illustration)**. If the pedal height is not within the specified range, it must be adjusted. Measure the pedal height from the center of the clutch pedal pad to the floor (with the carpet in place).

2 To adjust the clutch pedal, loosen the locknut on the adjusting bolt and back the bolt out to increase the pedal height or turn the bolt in to decrease pedal height **(see illustration)**. Check the pedal height (see Step 1), then tighten the locknut.

3 Adjust the starter/clutch interlock switch as described in Section 9.

Pedal freeplay

Refer to illustration 8.4

4 The freeplay is the pedal slack, or the distance the pedal can be depressed before it begins to have any effect on the clutch system **(see illustration)**. If the pedal freeplay is not within the specified range, it must be adjusted.

5 To adjust the pedal freeplay, loosen the locknut on the clutch pushrod **(see illustration 8.1)**. Turn the pushrod to adjust the pedal freeplay to the specified range and retighten the locknut.

6 Check and, if necessary, adjust the starter/clutch interlock switch (see Section 9).

9 Starter/clutch interlock switch - check, replacement and adjustment

Check

Refer to illustration 9.5

1 The starter/clutch interlock switch is located near the upper end of the clutch pedal. There are two types of harness connectors; a three-terminal connector and a five-terminal connector. When the ignition switch key is turned to the Start position and the clutch pedal is depressed, the starter circuit is closed by the starter/clutch interlock switch and the starter motor is activated.

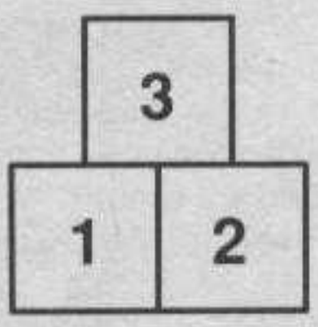
2 If the engine won't crank when the clutch pedal is depressed, adjust the switch (see Step 9) and try again. If it still won't turn over, check the switch (see Step 4) and, if necessary, replace it (see Step 7). If the engine starts when the clutch pedal isn't depressed, adjust the switch and try again.

3 If the engine won't start when the clutch pedal is depressed, either there's no voltage from the ignition switch to the switch, or there's no continuity between the two terminals on the switch.

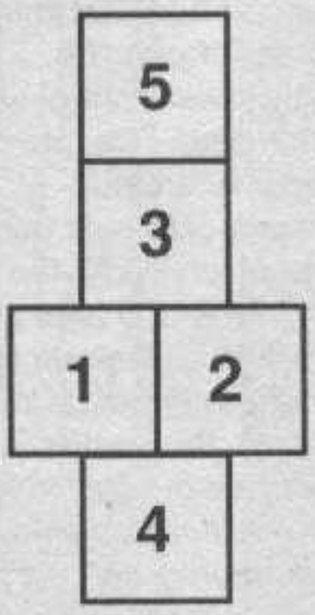
4 Check the voltage to the switch using a voltmeter or test light. Refer to the wiring diagrams at the end of Chapter 12. Voltage should be available with the ignition key ON (engine not running). If there isn't, look for an open or short circuit condition somewhere between the ignition switch and the switch.

5 Check the switch for continuity. With the clutch pedal depressed, continuity should exist between terminals 1 and 2. With the clutch pedal released, continuity should not exist **(see illustration)**. Try adjusting it (see Step 9).

9.5 Disconnect the electrical connector from the starter/clutch interlock switch and see if continuity exists between terminals 1 and 2 with the clutch pedal depressed



3 TERMINAL CONNECTOR



5 TERMINAL CONNECTOR

61042-8-9.5 HAYNES

Replacement

6 Disconnect the electrical connector.

7 There are two types of starter/clutch interlock switches.

a) On front-mounted switches, rotate the switch 90-degrees and separate the switch from its mounting bracket.

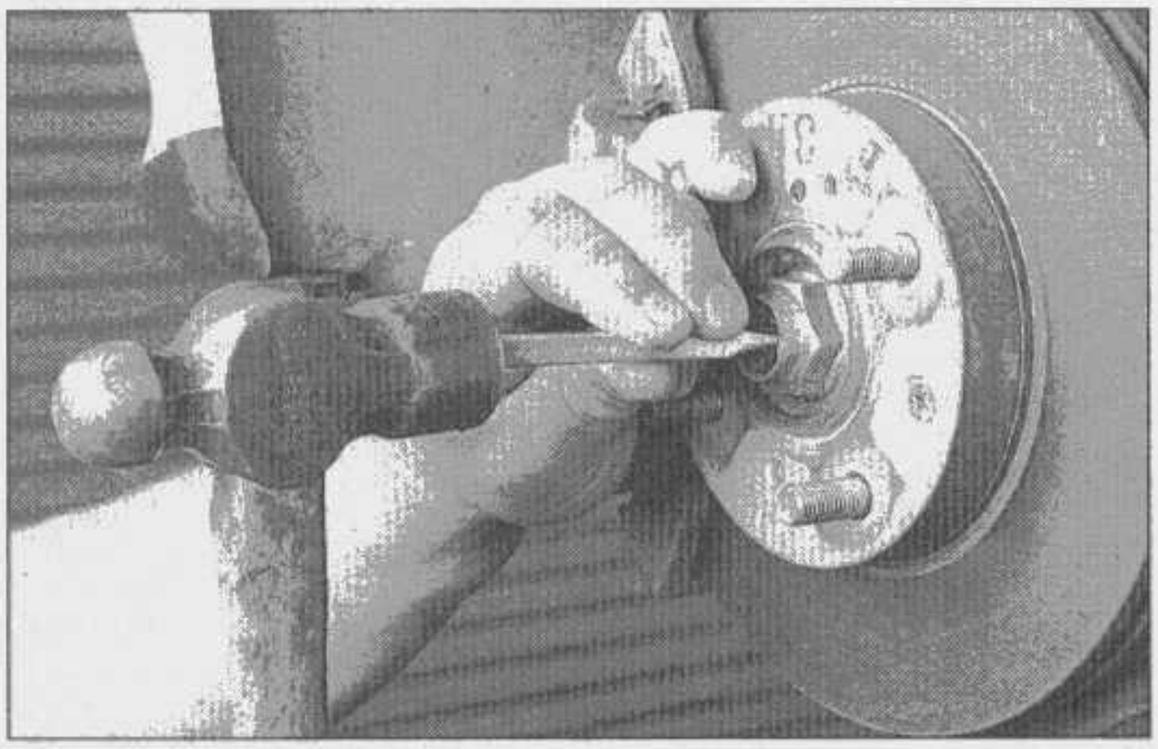
b) On side-mounted switches, remove the two mounting screws and separate the switch from the mounting bracket.

8 Installation is the reverse of removal.

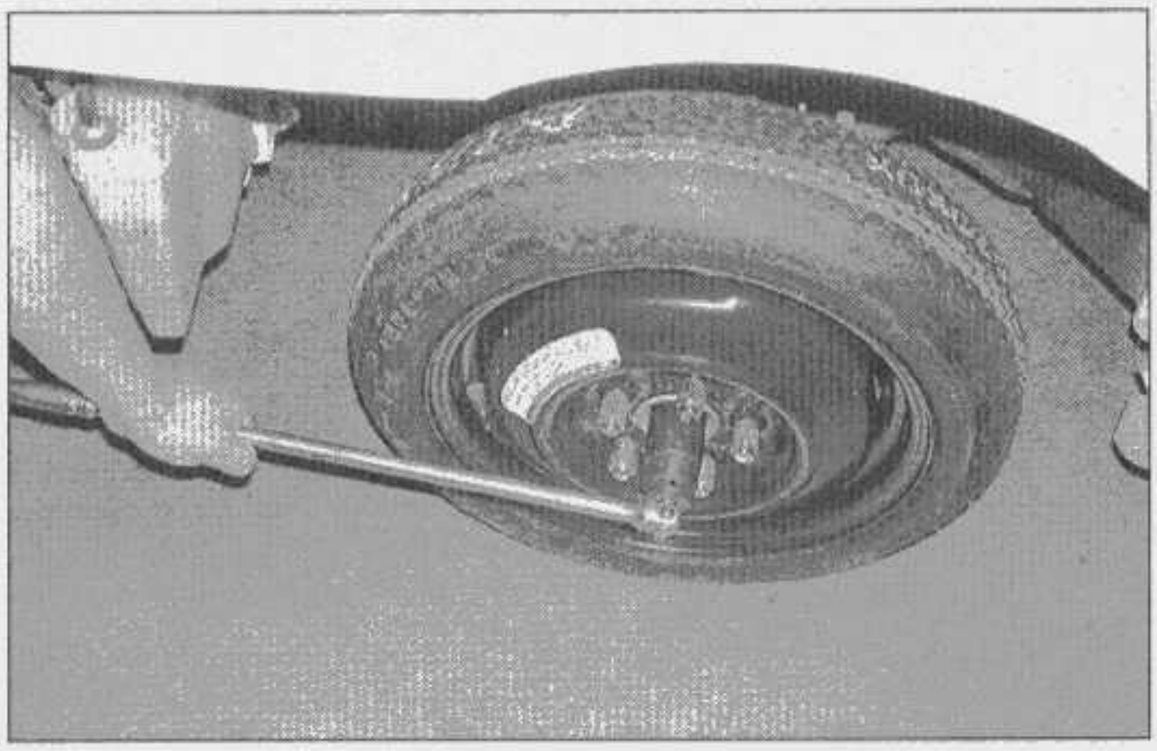
Adjustment

Note: *Front-mounted switches cannot be adjusted. Check the clutch pedal height (see Section 8).*

9 Loosen the two mounting nuts and slide the switch in or out, as necessary, to provide continuity through the switch when the clutch pedal is depressed. Once continuity is achieved, tighten the mounting nuts.



11.1 Use a center punch to unstake the driveaxle/hub nut (wheel removed for clarity)



11.2 Loosen the driveaxle/hub nut with a long breaker bar - depending on the design of the wheel, it will be necessary to install the spare wheel and tire to access the hub nut

10 Driveaxles - general information and inspection

1 Power is transmitted from the transaxle to the wheels through a pair of driveaxles. The inner end of the left driveaxle is splined into the differential side gear; the right driveaxle is splined to the intermediate shaft. The outer ends of the driveaxles are splined to the axle hubs and secured by a large locknut.

2 The inner ends of the driveaxles are equipped with sliding constant velocity joints, which are capable of both angular and axial motion. On automatic transaxle models a "tripot" inner joint is used. On manual transaxle models a "ball-and-cage" type inner joint is used. The inner joints can be disassembled and cleaned in the event of a boot failure (see Section 13), but if any parts are damaged, the joints must be replaced as a unit.

3 The outer CV joints are the "ball-and-cage" type, which have ball bearings running between an inner and outer race; these joints allow angular but not axial movement. The outer joints should be cleaned, inspected and repacked when replacing the boot, but they cannot be disassembled. If an outer joint is damaged, it must be replaced along with the axleshaft (the outer joint and axleshaft are sold as a single component).

4 The boots should be inspected periodically for damage and leaking lubricant. Torn CV joint boots must be replaced immediately or the joints can be damaged. Boot replacement involves removal of the driveaxle (see Section 11). **Note:** *Some auto parts stores carry "split" type replacement boots, which can be installed without removing the driveaxle from the vehicle. This is a convenient alternative, but it should only be considered a temporary fix. At any rate, the driveaxle still must be removed and the CV joint disassembled and cleaned to ensure the joint is free from contaminants such as moisture and dirt which will accelerate CV joint wear.* The most common symptom of worn or damaged CV joints, besides lubricant leaks, is a clicking noise in turns, a clunk when accelerating after coasting, and vibration at highway speeds. To check for wear in the CV joints and driveaxle shafts, grasp each axle (one at a time) and rotate it in both directions while holding the CV joint housings, feeling for play indicating worn splines or sloppy CV joints. Also check the driveaxle shafts for cracks, dents and distortion.

11 Driveaxles - removal and installation

Removal

Refer to illustrations 11.1, 11.2, 11.6 and 11.8

1 Remove the wheel cover or hub cap. Unstake the driveaxle/hub nut with a punch or chisel **(see illustration)**.

2 Break the hub nut loose with a socket and large breaker bar **(see illustration)**. **Note:** *If the socket will not fit through the opening in the center of the wheel, remove the wheel and install the spare tire/wheel.*

3 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands. Remove the wheel. Drain the transaxle lubricant (see Chapter 1).

4 Detach the stabilizer bar link(s) from the control arm(s) (see Chapter 10).

5 Separate the lower control arm from the steering knuckle (see Chapter 10). Now remove the driveaxle/hub nut.

6 Swing the knuckle/hub assembly out (away from the vehicle) until the end of the driveaxle is free of the hub **(see illustration)**. **Note:** *If the driveaxle splines stick in the hub, tap on the end of the driveaxle with a plastic hammer.* Support the outer end of the driveaxle with a piece of wire to avoid unnecessary strain on the inner CV joint.

7 If you're removing the right driveaxle, carefully pry the inner CV joint off the intermediate shaft using a large screwdriver or prybar positioned between the CV joint housing and the intermediate shaft bearing support.

8 If you're removing the left driveaxle, pry the inner CV joint out of the transaxle using a large screwdriver or prybar positioned between the transaxle and the CV joint housing **(see illustration)**. Be careful not to damage the differential seal.

9 Support the CV joints and carefully remove the driveaxle from the vehicle.

Installation

Refer to illustrations 11.10a and 11.10b

10 Pry the old spring clip from the inner end of the driveaxle (left side) or outer end of the intermediate shaft (right side) and install a new one **(see illustrations)**. Lubricate the differential or intermediate shaft seal with multi-purpose grease and raise the driveaxle into position while supporting the CV joints. **Note:** *Position the spring clip with the opening facing up; this will ease insertion of the driveaxle and prevent damage to the clip.*

11 Push the splined end of the inner CV joint into the differential side gear (left side) or onto the intermediate shaft (right side) and make sure the spring clip locks in its groove.

12 Apply a light coat of multi-purpose grease to the outer CV joint splines, pull out on the steering knuckle assembly and install the stub axle into the hub.

13 Insert the balljoint stud into the steering knuckle and tighten the pinch bolt to the torque listed in the Chapter 10 Specifications.

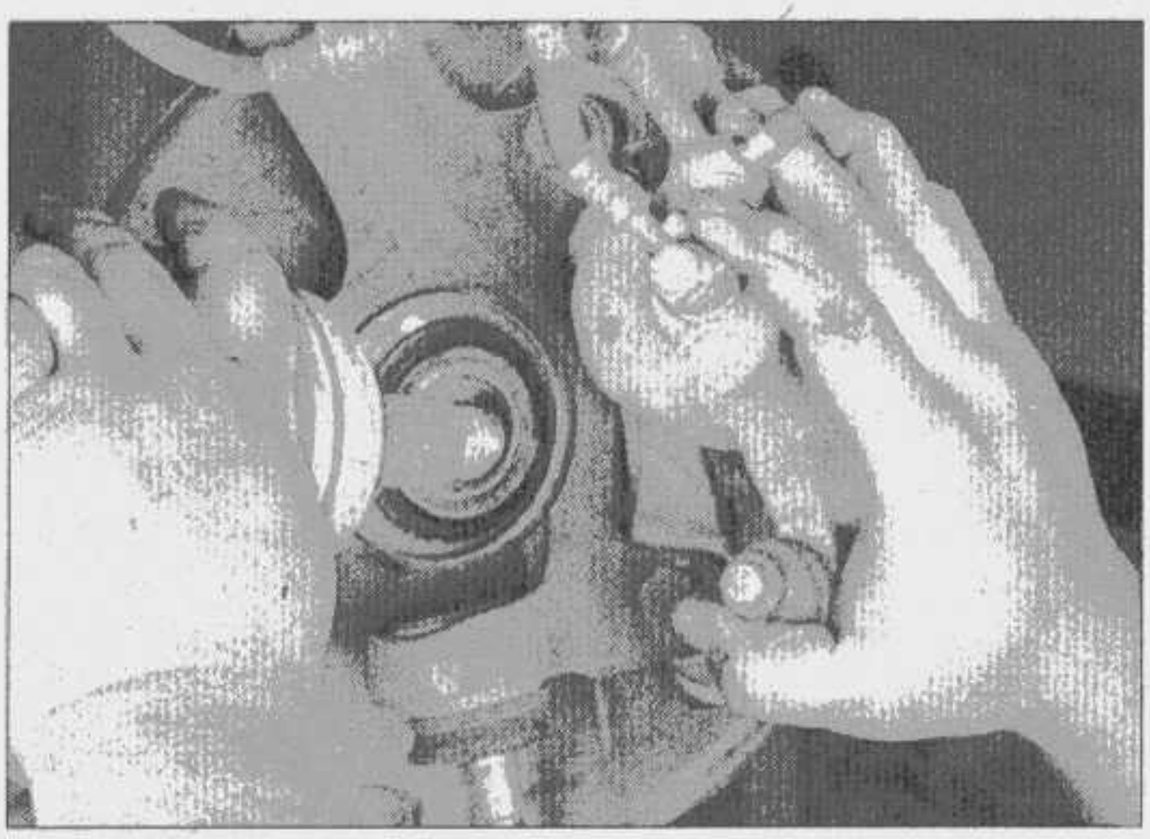
14 Install a ***new*** driveaxle/hub nut. Tighten the hub nut securely, but don't try to tighten it to the actual torque specification until you've lowered the vehicle to the ground.

15 Grasp the inner CV joint housing (not the driveaxle) and pull out to make sure the driveaxle has seated securely in the transaxle or on the intermediate shaft.

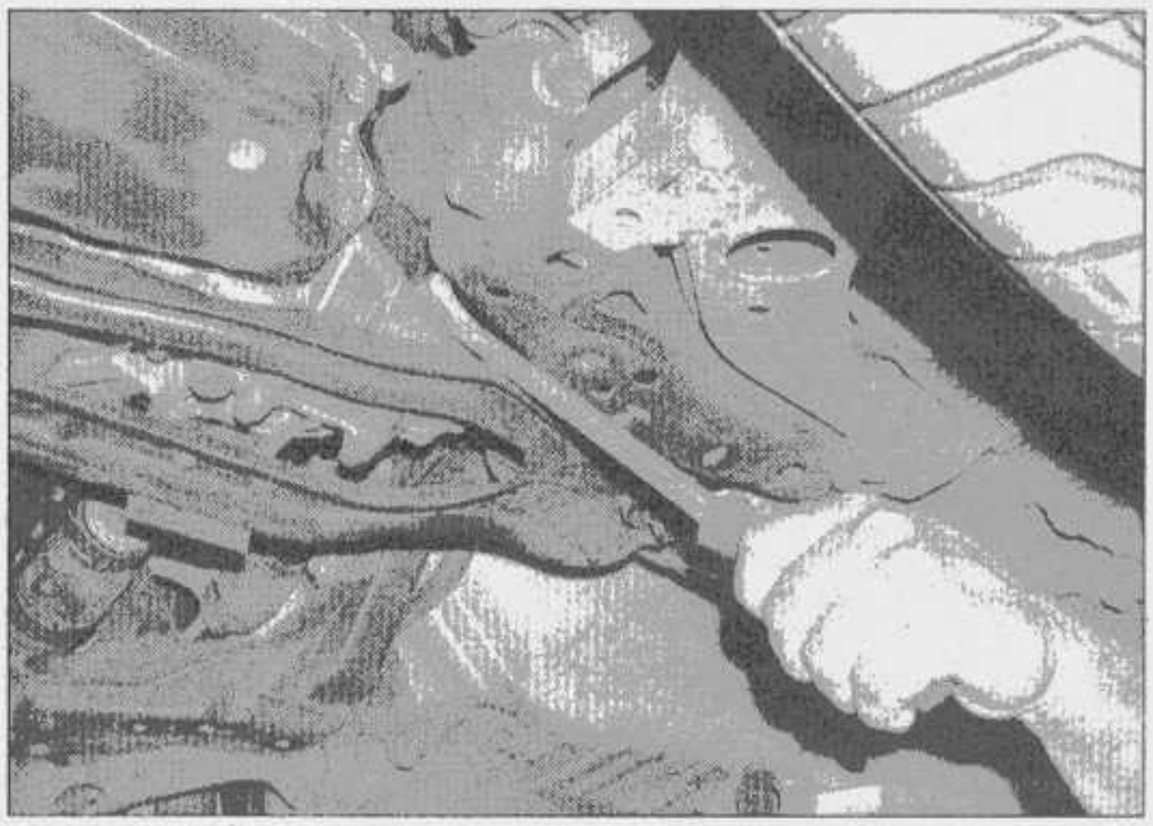
16 Connect the stabilizer bar link(s) (see Chapter 10).

17 Install the wheel and lug nuts, then lower the vehicle. Tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

18 Tighten the driveaxle/hub nut to the



11.6 Swing the hub/knuckle out (away from the vehicle) and pull the driveaxle from the hub



11.8 Use a large screwdriver or a prybar to pop the inner CV joint of the left driveaxle from the left side of the transaxle

torque listed in this Chapter's Specifications. Using a hammer and punch, stake the nut to the groove in the driveaxle. Install the hub cap or wheel cover.

19 Refill the transaxle with the recommended type and amount of lubricant (see Chapter 1).

12 Intermediate shaft - removal and installation

Removal

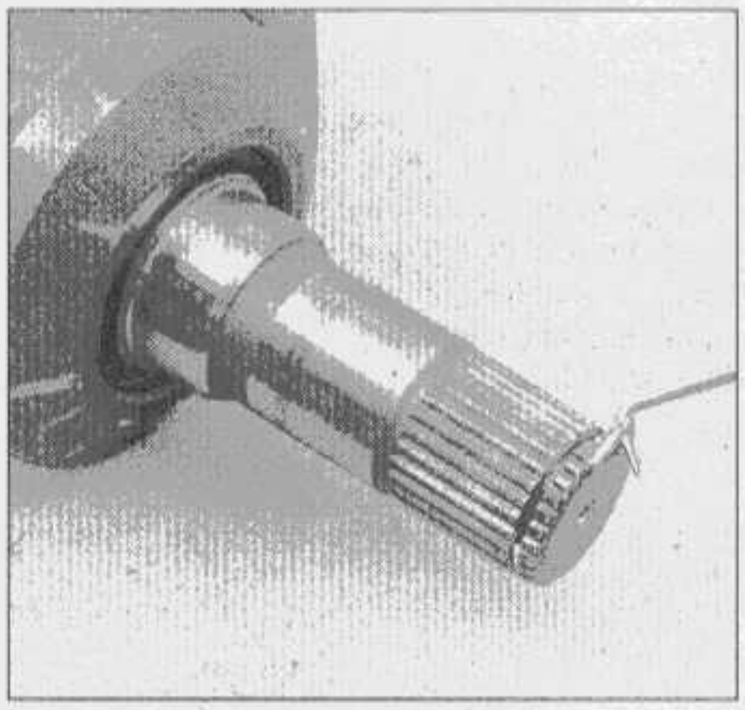
Refer to illustrations 12.5a and 12.5b

1 Loosen the right (passenger's side) front wheel lug nuts, raise the front of the vehicle and support it securely on jackstands. Remove the wheel.

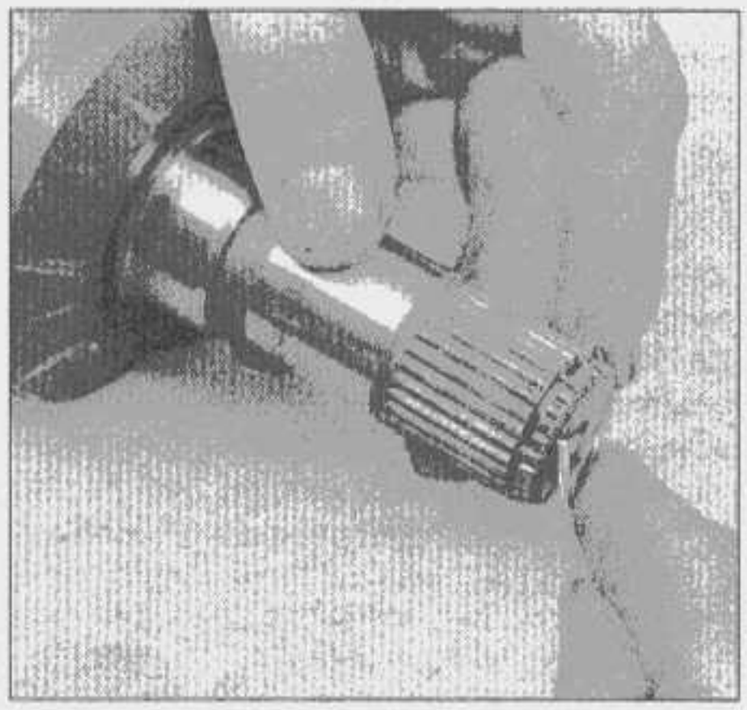
2 Drain the transaxle lubricant (see Chapter 1).

3 Separate the right control arm balljoint from the steering knuckle (see Chapter 10).

4 Pry the inner CV joint housing from the intermediate shaft. Position the driveaxle out of the way and hang it with a piece of wire. Do not allow it to hang unsupported, as the outer CV joint may be damaged.



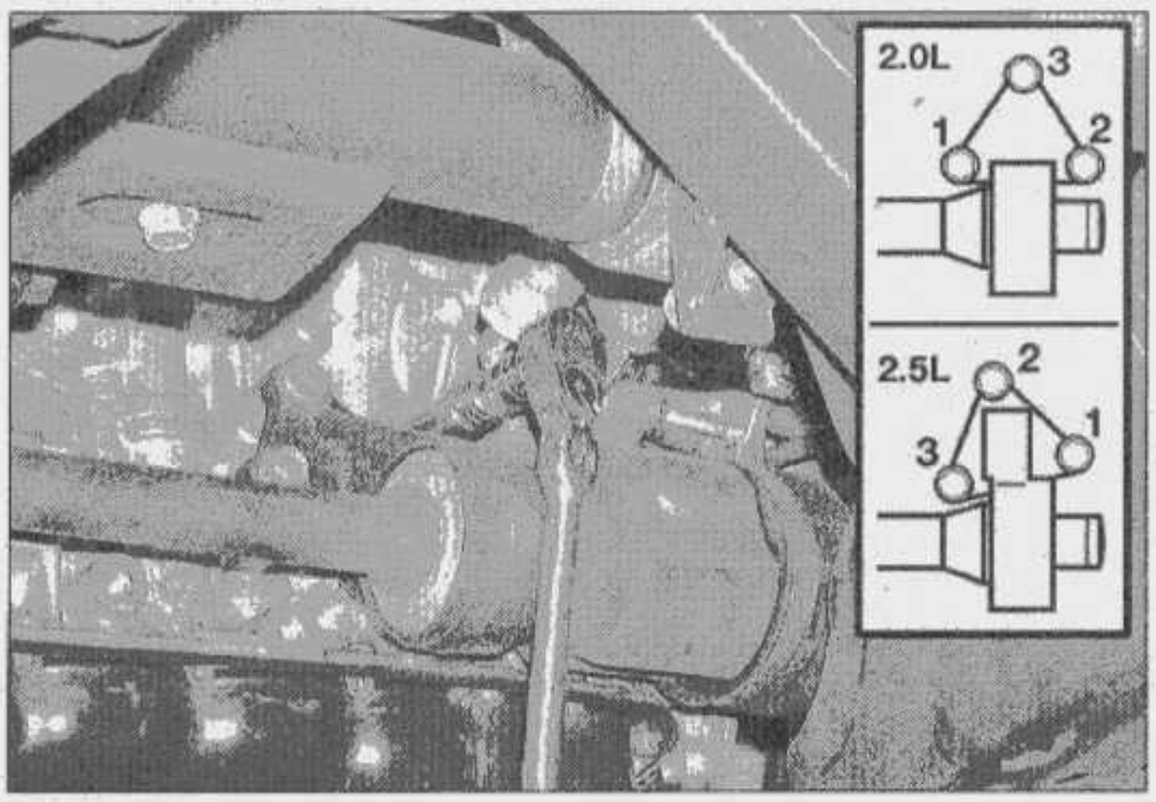
11.10a Pry the old spring clip from the inner end of the driveaxle with a small screwdriver or awl



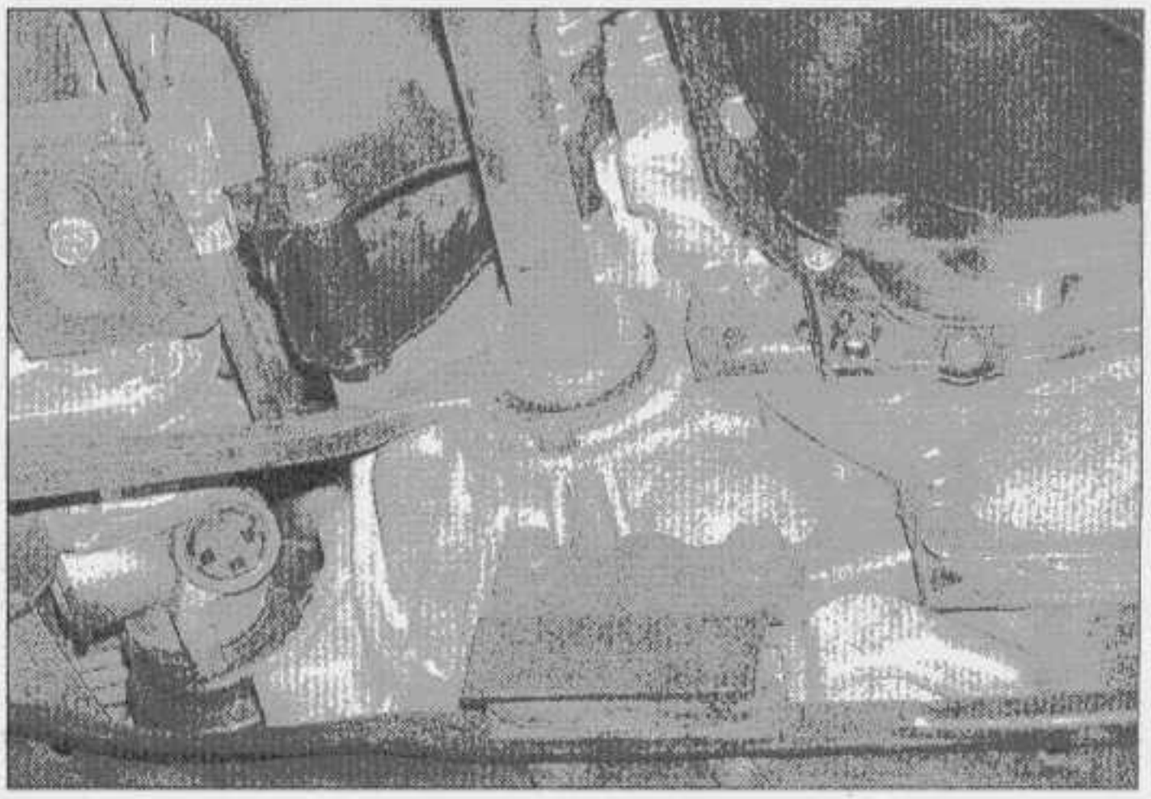
11.10b To install the new spring clip, start one end in the groove and work the clip over the shaft end, into the groove

5 Remove the three bearing support-to-engine block bolts **(see illustration)** and slide the intermediate shaft out of the transaxle, prying carefully if necessary **(see illustration)**. Be careful not to damage the differential seal when pulling the shaft out.

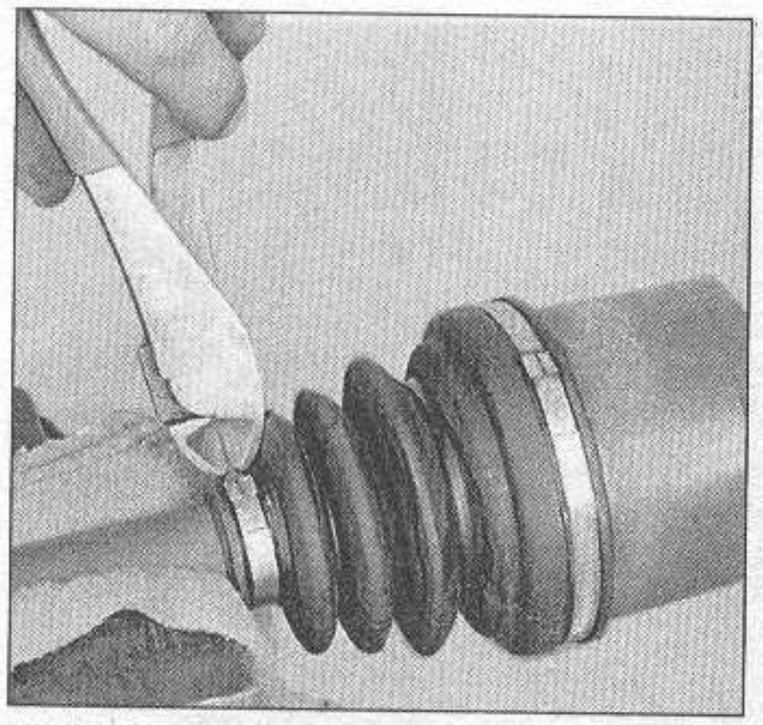
6 **Caution:** *If the left driveaxle has also*



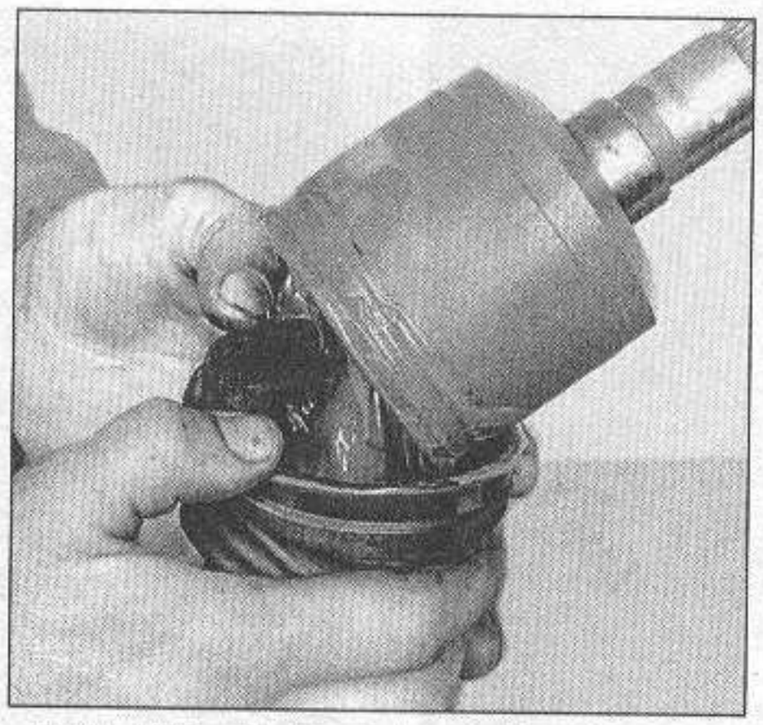
12.5a Remove the bolts for the intermediate shaft bearing support; the insets show the proper order for tightening the bolts to the specified torque



12.5b When removing the intermediate shaft, insert the prybar between the intermediate shaft flange and the transaxle to pry it loose



13.3a Cut off the boot clamps and discard them - don't try to reuse old clamps



13.3b Slide the boot down the driveaxle, out of the way

been removed, insert transaxle plugs into the differential side gears to prevent the gears from becoming mispositioned **(see illustrations 4.19a and 4.19b in Chapter 7A)**. There are special factory tools available, however, if the sockets are properly secured, this alternate method will suffice.

7 Check the support bearing for smooth operation by turning the shaft while holding the bearing. If you feel any roughness, take the intermediate shaft to an automotive machine shop or other qualified repair facility to have a new bearing installed.

Installation

8 Remove the transaxle plug (if one was installed).

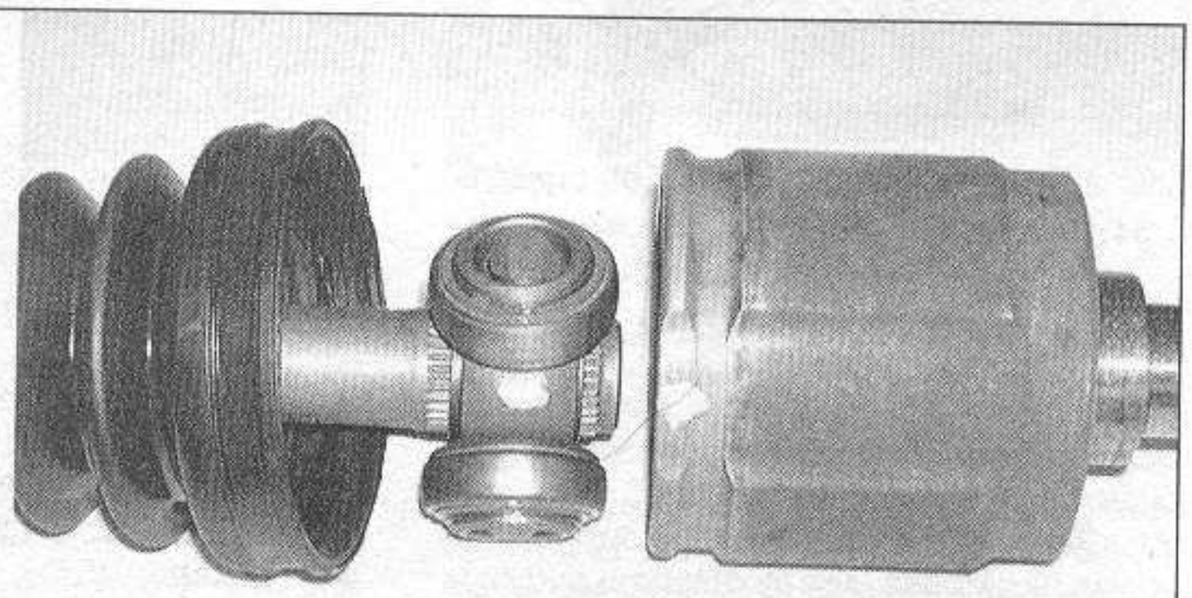
9 Lubricate the lips of the differential seal with multi-purpose grease. Carefully guide the intermediate shaft into the differential side gear then install the mounting bolts through the bearing support. Tighten the bolts to the torque listed in this Chapter's Specifications, working in the recommended sequence **(see illustration 12.5a)**.

10 Install a new spring clip on the end of the intermediate shaft **(see illustrations 11.10a and 11.10b)** and seat the inner CV joint onto the intermediate shaft splines.

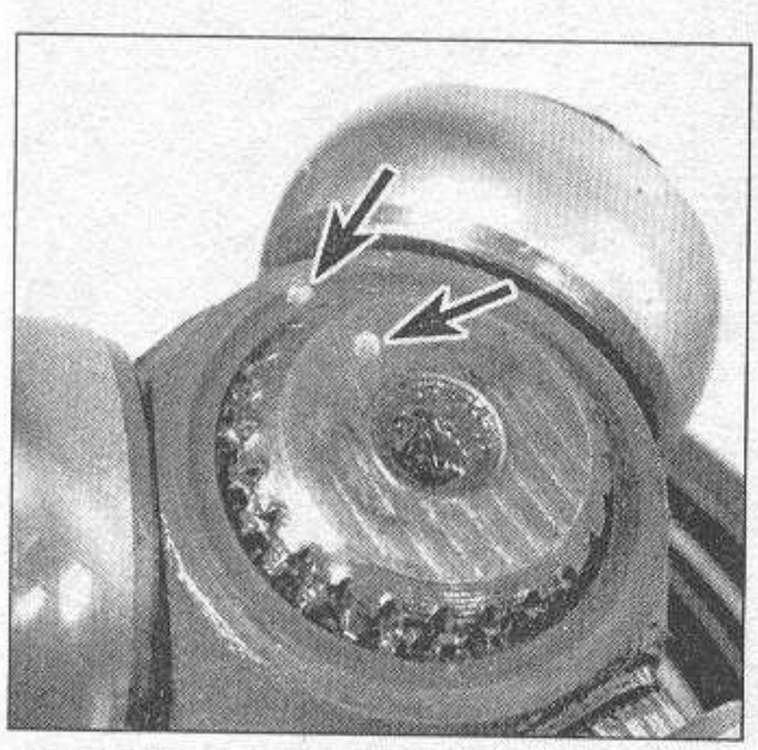
11 Connect the lower control arm balljoint to the steering knuckle and tighten the pinch bolt to the torque listed in Chapter 10 Specifications.

12 Install the wheel and lug nuts, lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

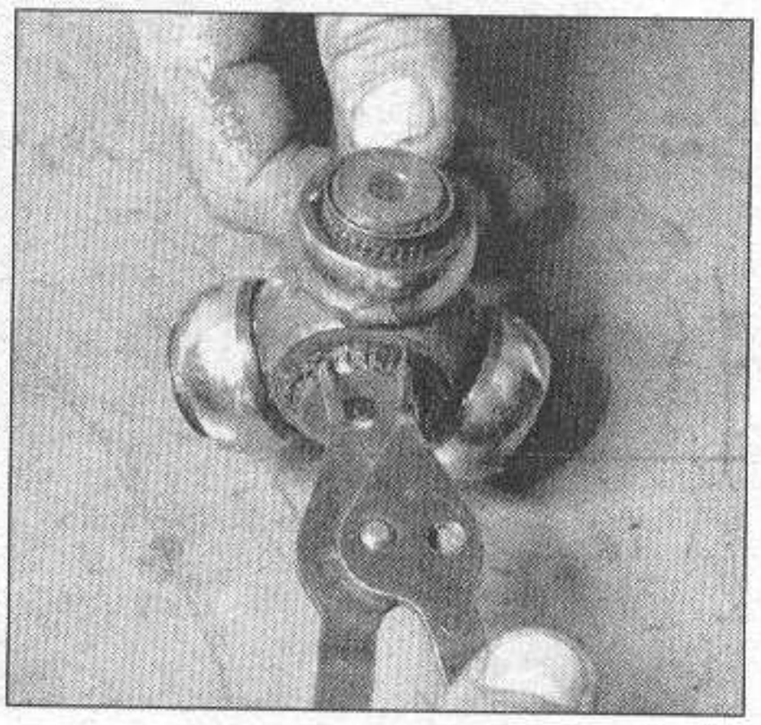
13 Refill the transaxle with the proper type and amount of lubricant (see Chapter 1).



13.4 Mark the relationship of the tri-pot assembly to the outer race



13.5 Use a center punch to place marks (arrows) on the tri-pot and the driveaxle to ensure that they are properly reassembled



13.6 Remove the snap-ring from the groove in the end of the axleshaft

13 Driveaxle boot - replacement

Note 1: *If the CV joints are worn, indicating the need for an overhaul (usually due to torn boots), explore all options before beginning the job. Complete rebuilt driveaxles are available on an exchange basis, which eliminates much time and work.*

Note 2: *Some auto parts stores carry "split" type replacement boots, which can be installed without removing the driveaxle from the vehicle. This is a convenient alternative; however, the driveaxle should be removed and the CV joint disassembled and cleaned to ensure the joint is free from contaminants such as moisture and dirt which will accelerate CV joint wear.*

Note 3: *Models equipped with ABS are equipped with ABS sensor rings on the outer CV joints. Be sure to inspect the sensor rings for chipped or missing teeth. Replace the sensor ring if necessary.*

1 Remove the driveaxle from the vehicle (see Section 11).

2 Mount the driveaxle in a vise. The jaws of the vise should be lined with wood or rags to prevent damage to the driveaxle.

Inner CV joint and boot

Tri-pot type

Disassembly

Refer to illustrations 13.3a, 13.3b, 13.4, 13.5, 13.6 and 13.7

3 Remove the boot clamps **(see illustration)**.

4 Pull the boot back from the inner CV joint, remove the retainer ring and slide the joint housing off. Be sure to mark the relationship of the tri-pot to the outer race **(see illustration)**.

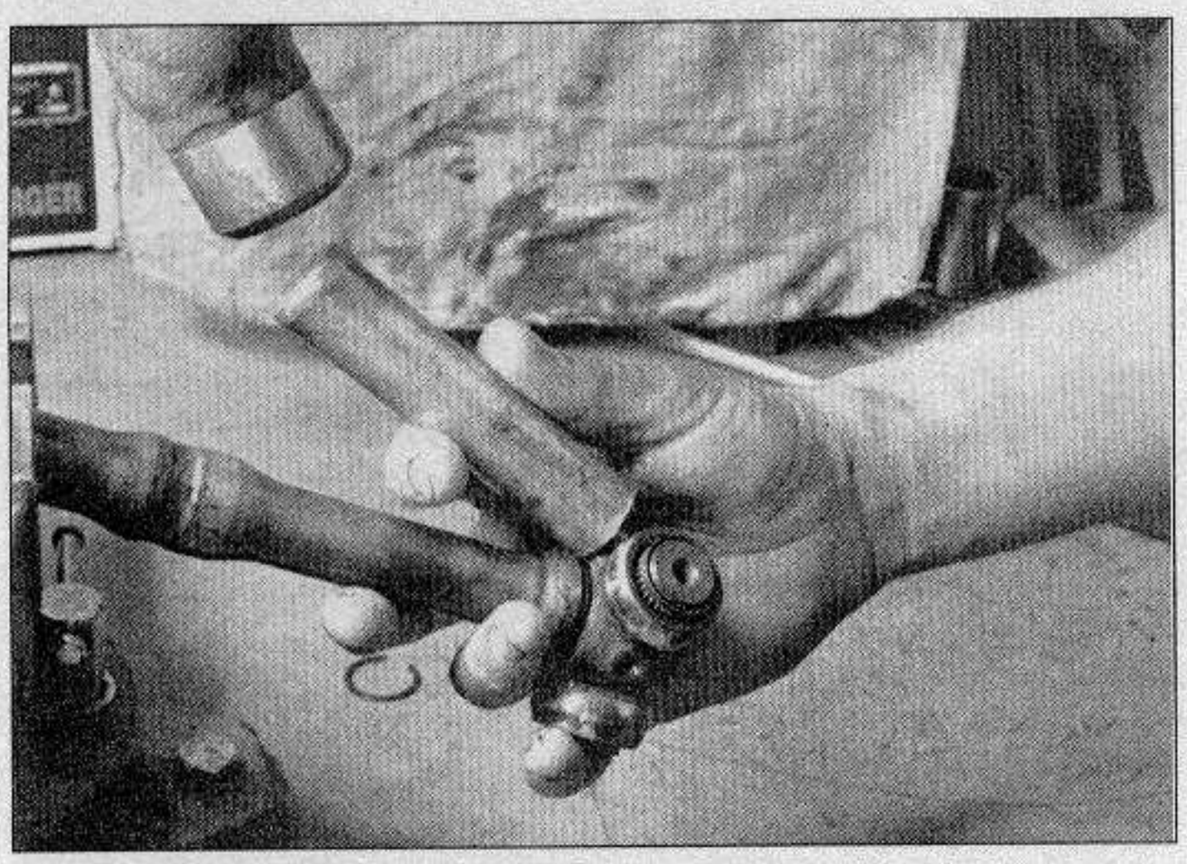
5 Use a center punch to mark the tri-pot and axleshaft to ensure that they are reassembled properly **(see illustration)**.

6 Remove the snap-ring from the end of the axleshaft with a pair of snap-ring pliers **(see illustration)**.

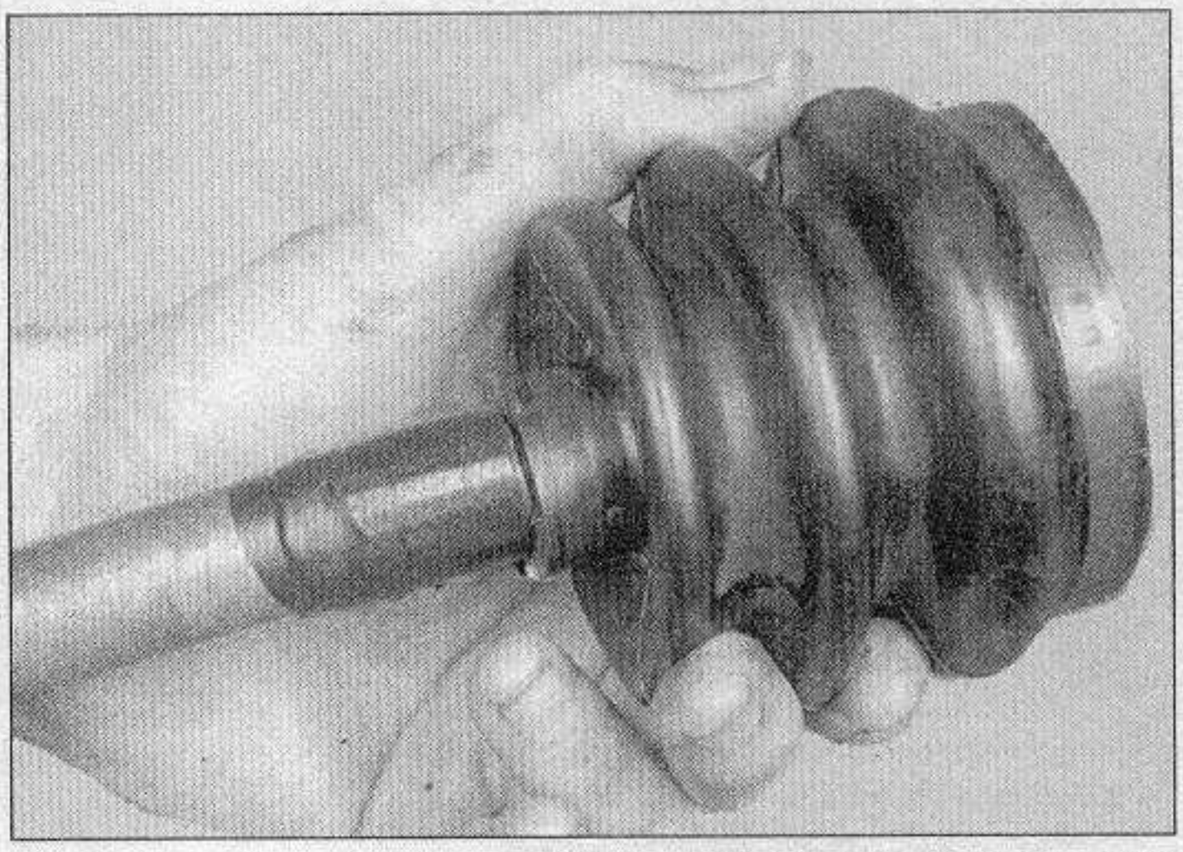
7 Use a hammer and a brass punch to drive the tri-pot joint from the driveaxle **(see illustration)**.

Inspection

8 Clean the old grease from the outer race and the tri-pot bearing assembly. Carefully disassemble each section of the tri-pot assembly, one at a time so as not to mix up the parts, and clean the needle bearings with solvent.

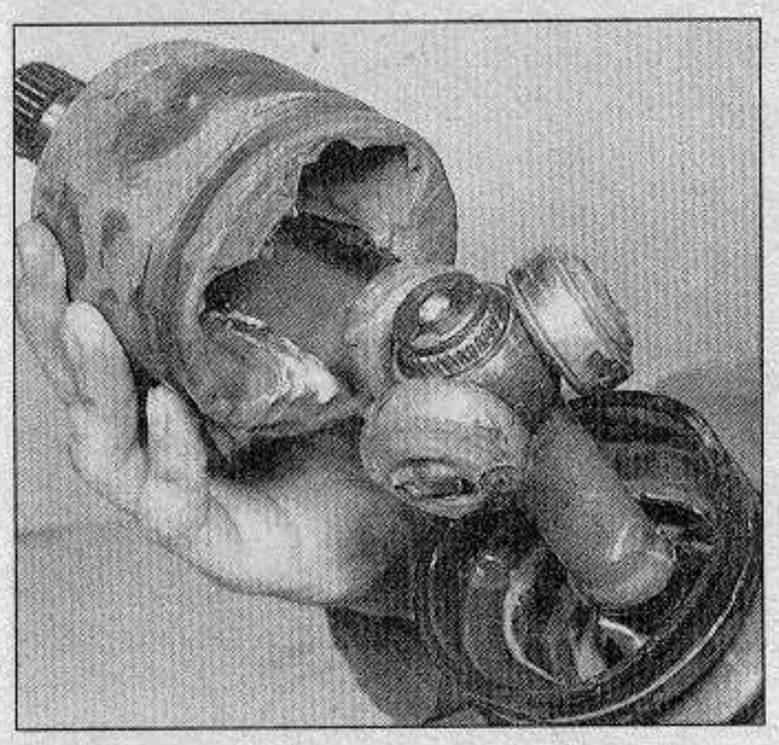


13.7 Drive the tri-pot joint from the axleshaft with a brass punch and hammer – make sure you don't damage the bearing surfaces or the splines on the shaft



13.10 Wrap the splined area of the axleshaft with tape to prevent damage to the boot(s) when installing it

9 Inspect the rollers, tri-pot, bearings and outer race for scoring, pitting or other signs of abnormal wear, which will warrant the replacement of the inner CV joint.



13.11 Pack the outer race with grease and slide it over the tri-pot assembly – make sure the match marks on the CV joint housing and tri-pot line up

Reassembly

Refer to illustrations 13.10, 13.11, 13.13, 13.14, 13.15a, 13.15b, 13.15c, 13.15d and 13.15e

10 Slide the clamps and boot onto the axleshaft. It's a good idea to wrap the axleshaft splines with tape to prevent damaging the boot **(see illustration)**.

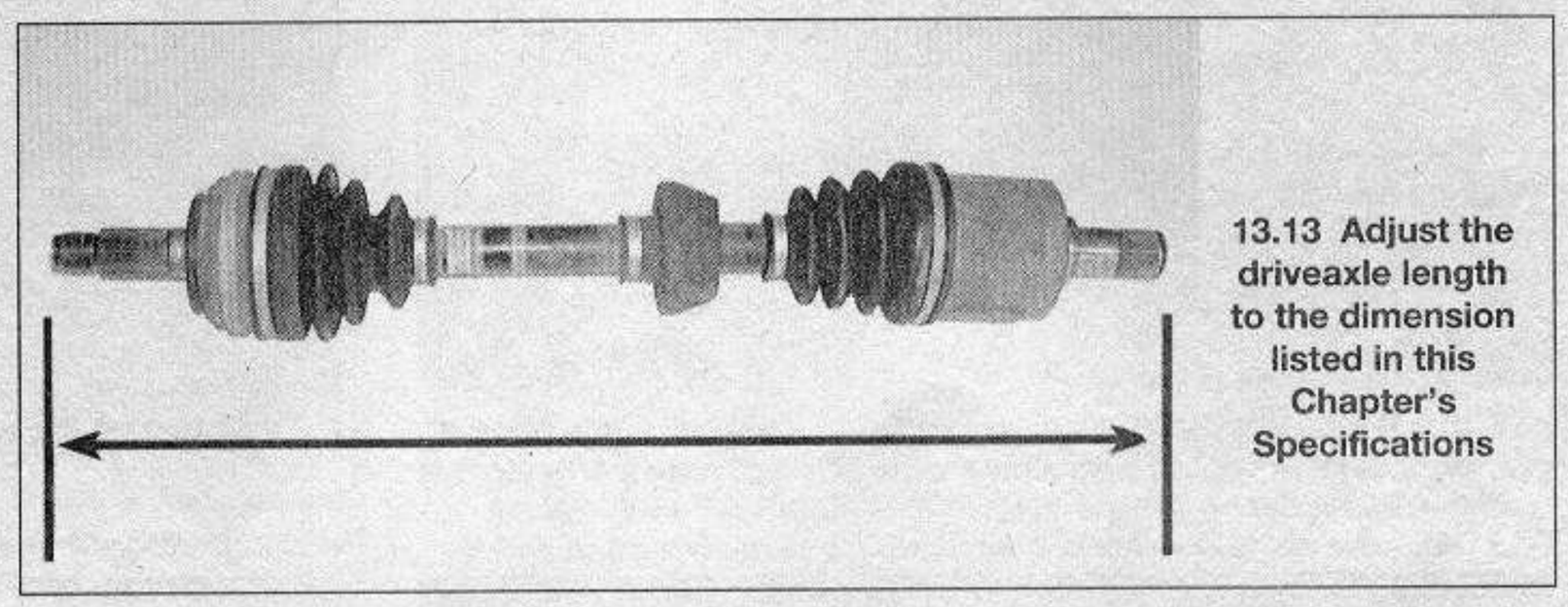
11 Place the tri-pot on the shaft (making sure the marks are aligned) and install the snap-ring. Apply grease to the tri-pot assembly, the inside of the joint housing and the inside of the boot **(see illustration)**.

12 Slide the boot into place, making sure both ends seat in their grooves.

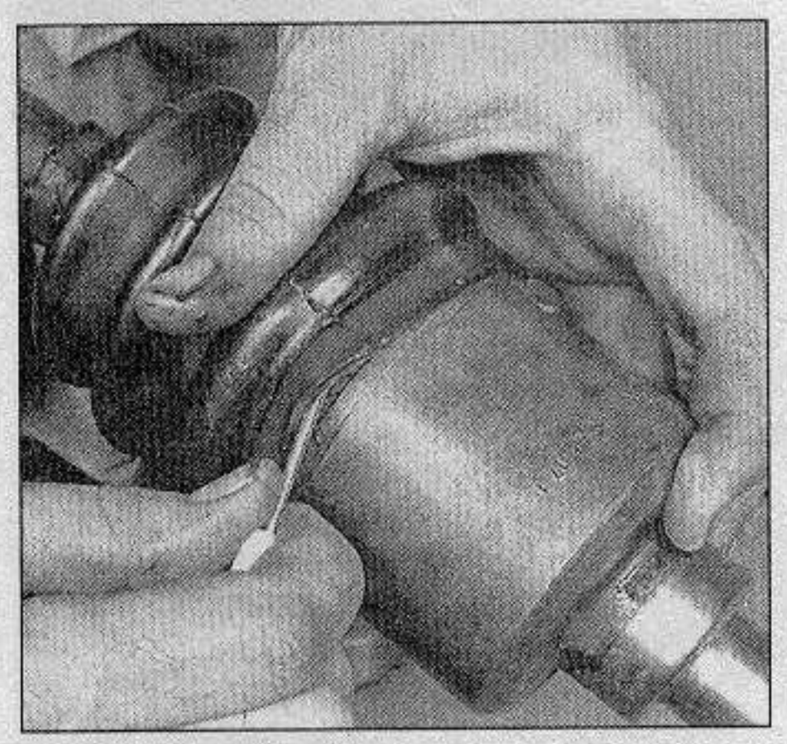
13 Adjust the length of the joint to the length listed in this Chapter's Specifications **(see illustration)**.

14 Equalize the pressure within the boot **(see illustration)**.

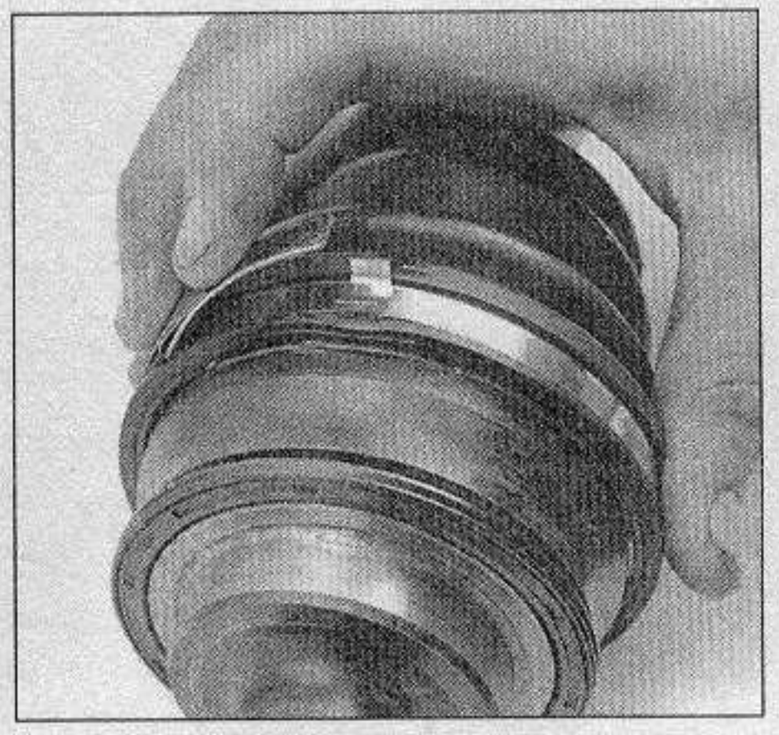
15 Tighten and the boot clamps **(see illustrations)**. Proceed to Step 35.



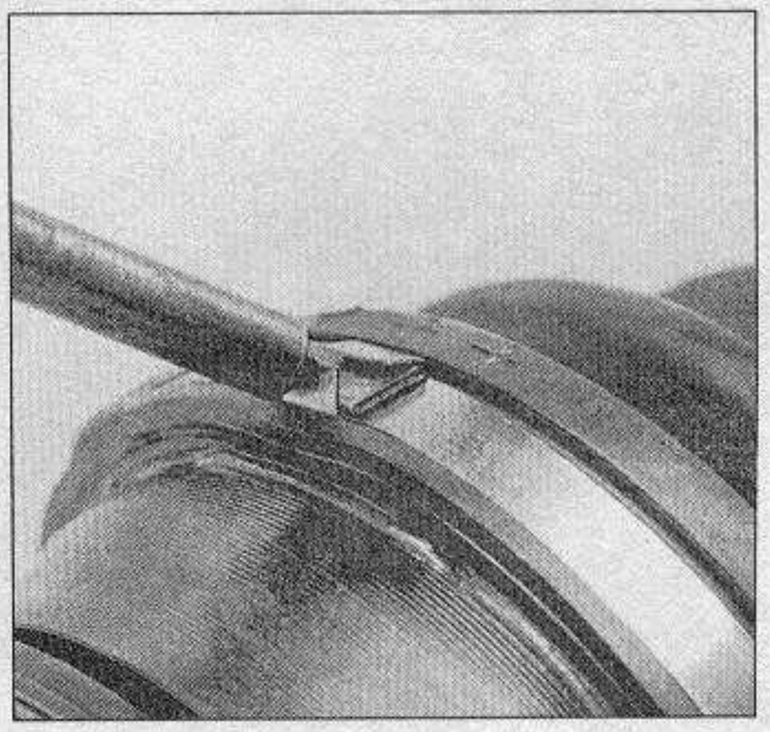
13.13 Adjust the driveaxle length to the dimension listed in this Chapter's Specifications



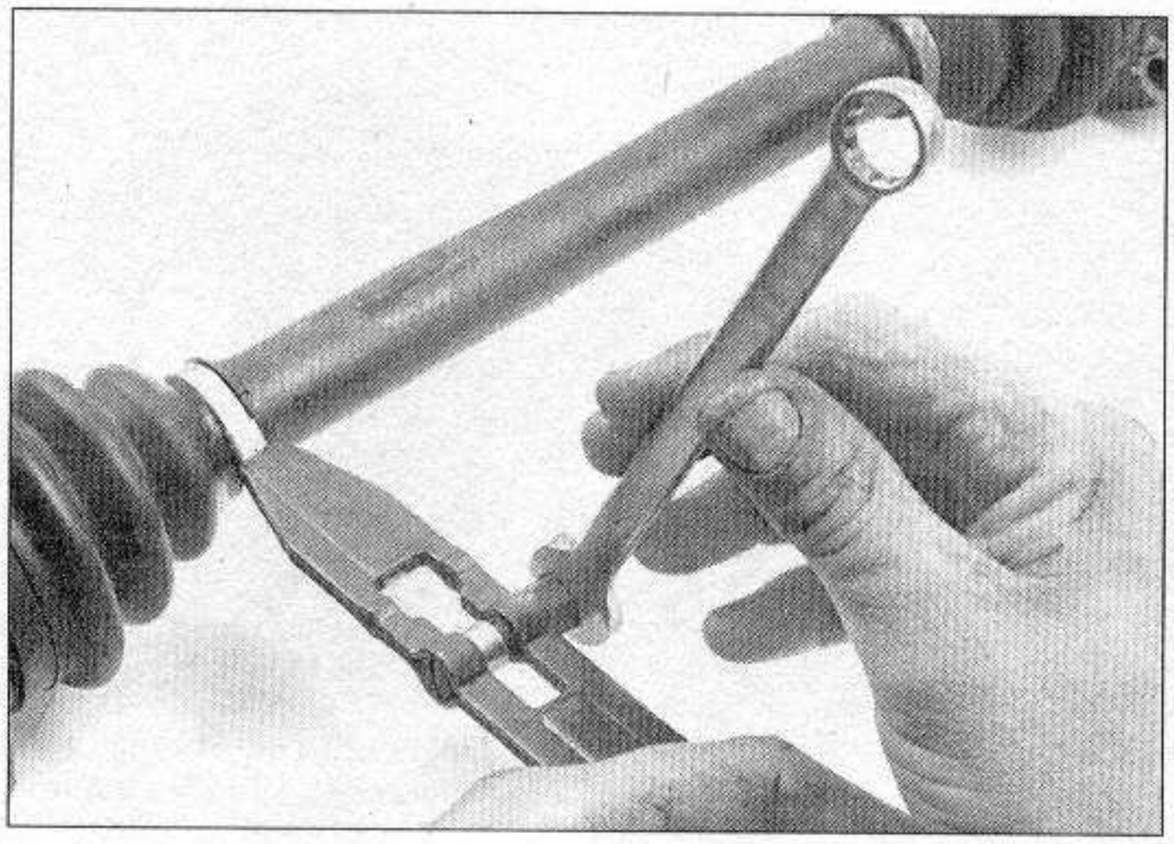
13.14 Equalize the pressure inside the boot by inserting a small, dull screwdriver between the boot and the outer race



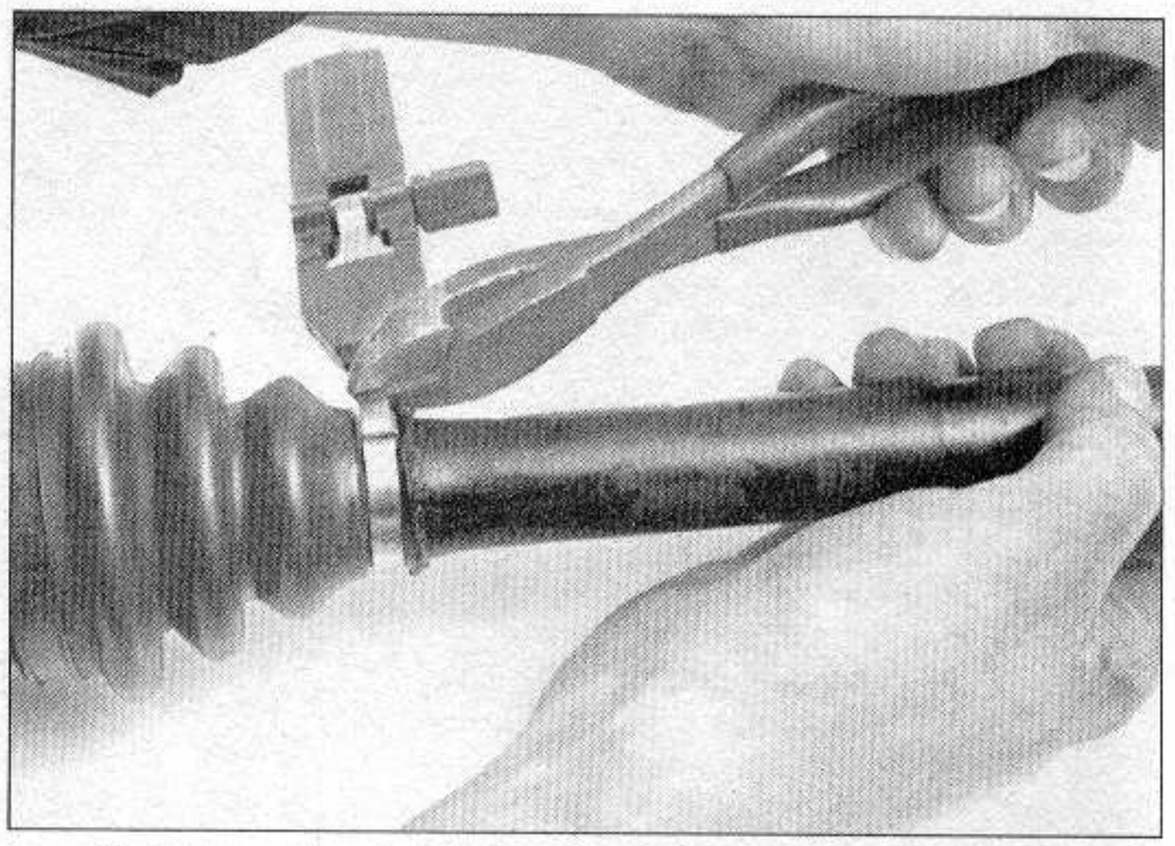
13.15a To install new fold-over type clamps, bend the tang down . . .



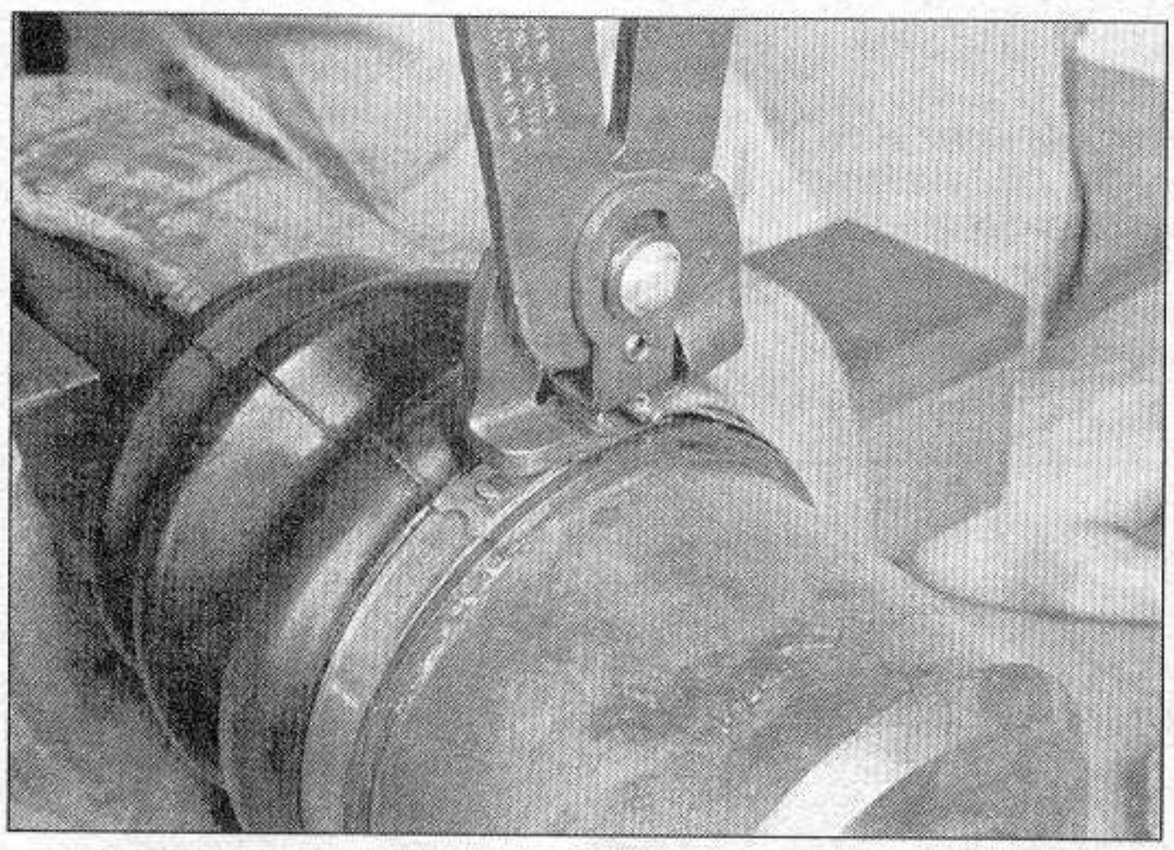
13.15b . . . and flatten the tabs to hold it in place



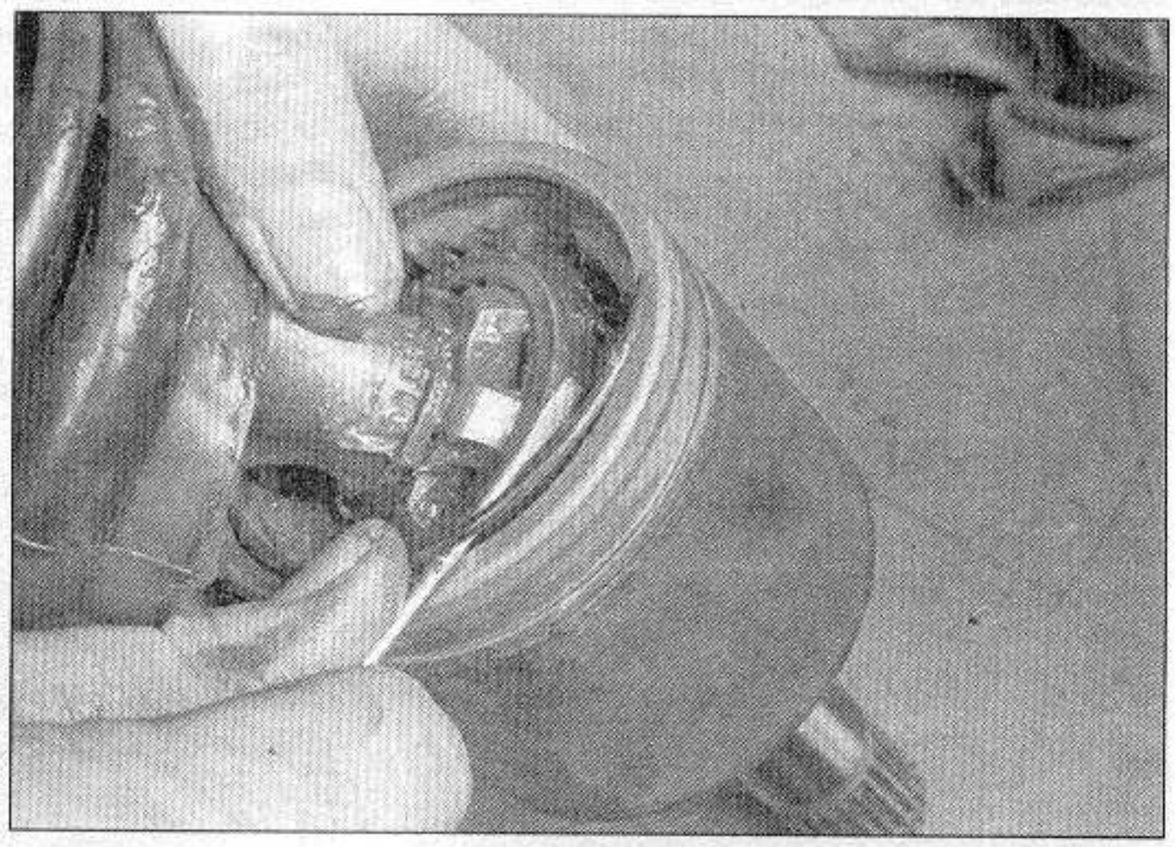
13.15c To install band-type clamps you'll need a special tool; install the band with its end pointing in the direction of axle rotation and tighten it securely, then pivot the tool up 90-degrees and tap the center of the clip with a center punch . . .



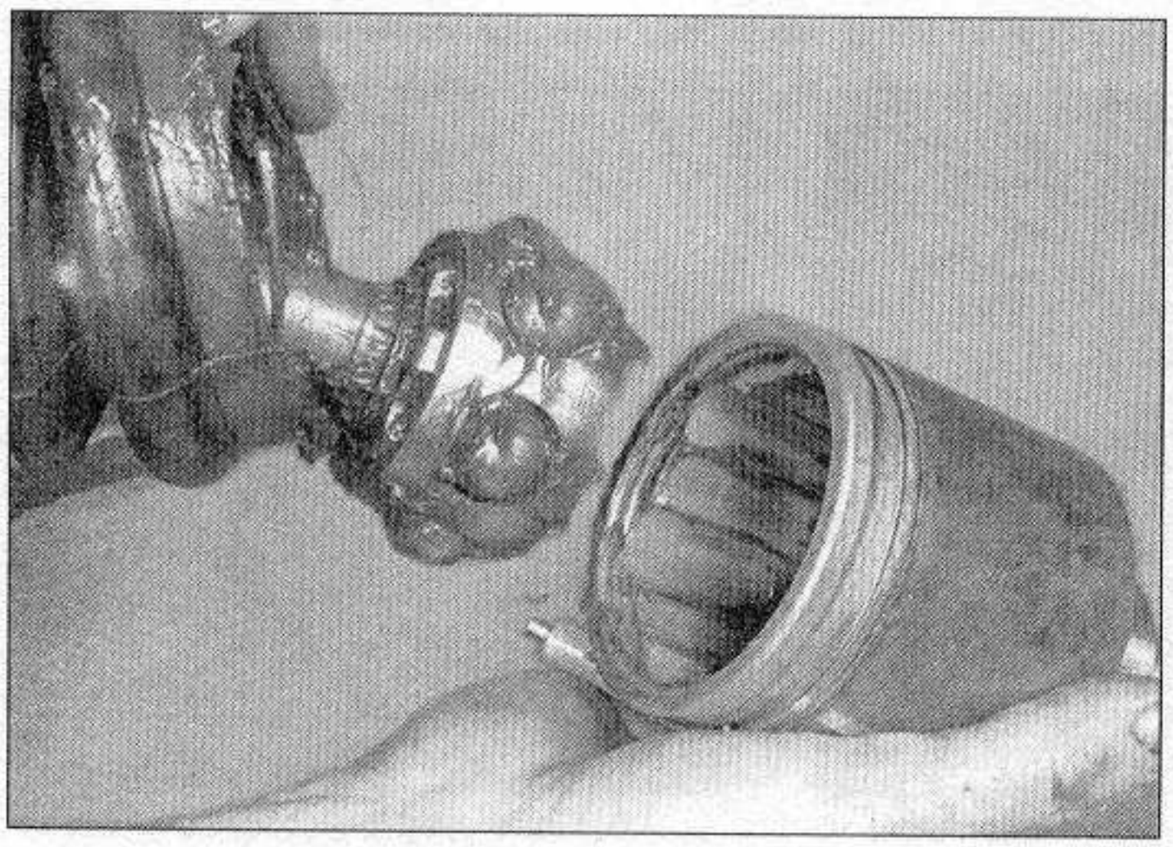
13.15d . . . then bend the end of the clamp back over the clip and cut off the excess



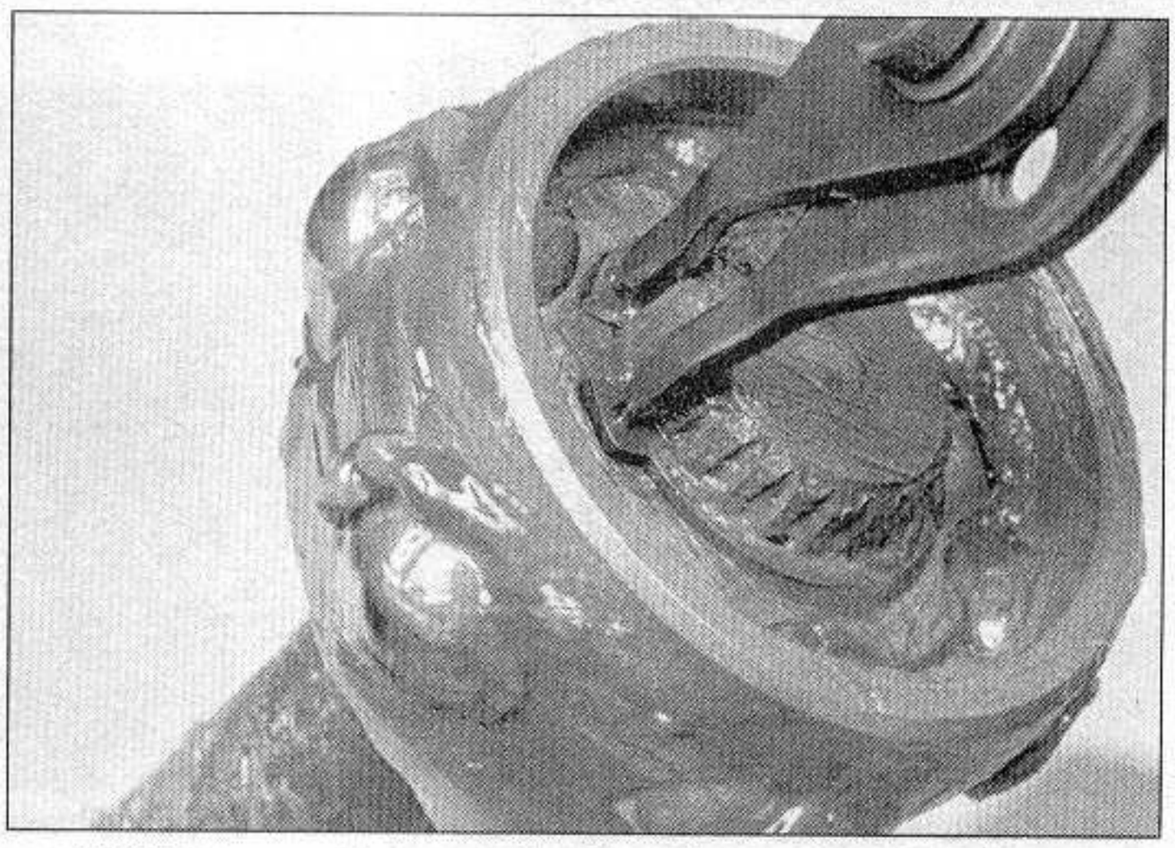
13.15e If you're installing crimp-type boot clamps, you'll need a pair of special crimping pliers (available at most auto parts stores)



13.18 Pry the wire retainer ring from the CV joint housing with a small screwdriver



13.19 With the retainer removed, the CV joint housing can be pulled off the ball-and-cage bearing assembly



13.20 Remove the snap-ring from the end of the axleshaft

Ball-and-cage type

Disassembly

Refer to illustrations 13.18, 13.19, 13.20 and 13.22

16 Remove both boot clamps **(see illustration 13.3a)** and discard them.

17 Slide the boot away from the outer race (CV joint housing).

18 Pry the wire ring bearing retainer from the CV joint housing **(see illustration)**.

19 Pull the CV joint housing off the inner bearing assembly **(see illustration)**.

20 Remove the snap-ring from the groove in the axleshaft with a pair of snap-ring pliers **(see illustration)**.

21 Slide the inner race off the axleshaft.

22 Make index marks on the inner race and cage to insure correct alignment for reassembly **(see illustration)**.

23 Using a screwdriver, pry the ball bearings from the cage. Be careful not to scratch the inner race, the ball bearings or the cage. Remove the cage.

Inspection

Refer to illustrations 13.24a and 13.24b

24 Clean the components with solvent to remove all traces of grease. Inspect the cage and races for pitting, score marks, cracks and other signs of wear and damage **(see illustrations)**. Shiny, polished spots are normal and will not adversely affect CV joint performance.

Reassembly

Refer to illustration 13.26 and 13.28

25 Wrap the axleshaft splines with tape to avoid damaging the boot. Slide the small boot clamp and boot onto the axleshaft, then remove the tape. Slide the large boot clamp over the boot.

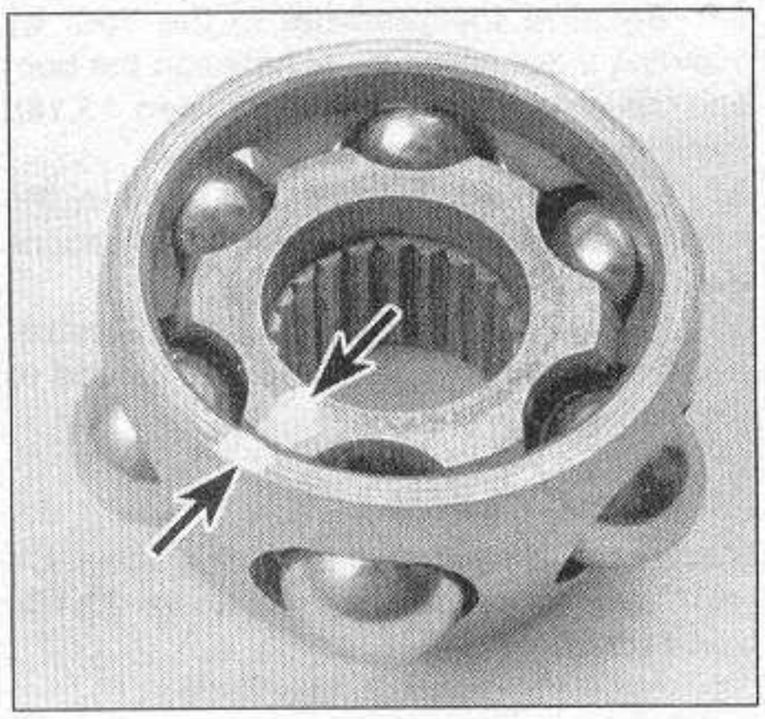
26 Assemble the cage, inner race and ball bearings. Move the cage up over the inner race. Press the ball bearings into the cage windows with your thumbs **(see illustration)**.

27 Fill the ball-and-cage assembly with CV joint grease (normally included with the new boot kit).

28 Install the cage, race and ball bearing assembly onto the axleshaft with the smaller diameter side of the cage facing in and the larger side facing out **(see illustration)**.

29 Install the snap-ring in the groove. Make sure it's completely seated by pushing on the inner race.

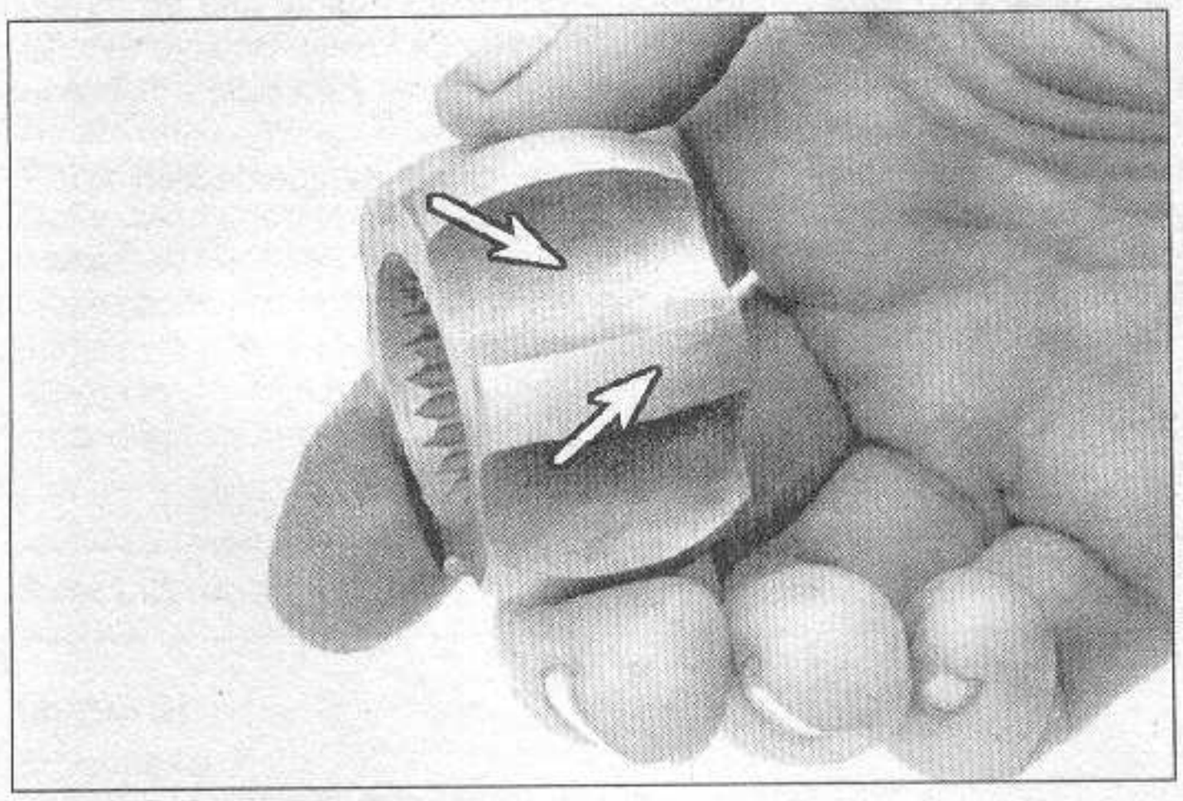
30 Pack the CV joint inner housing with grease, by hand, until grease is worked completely into the housing.



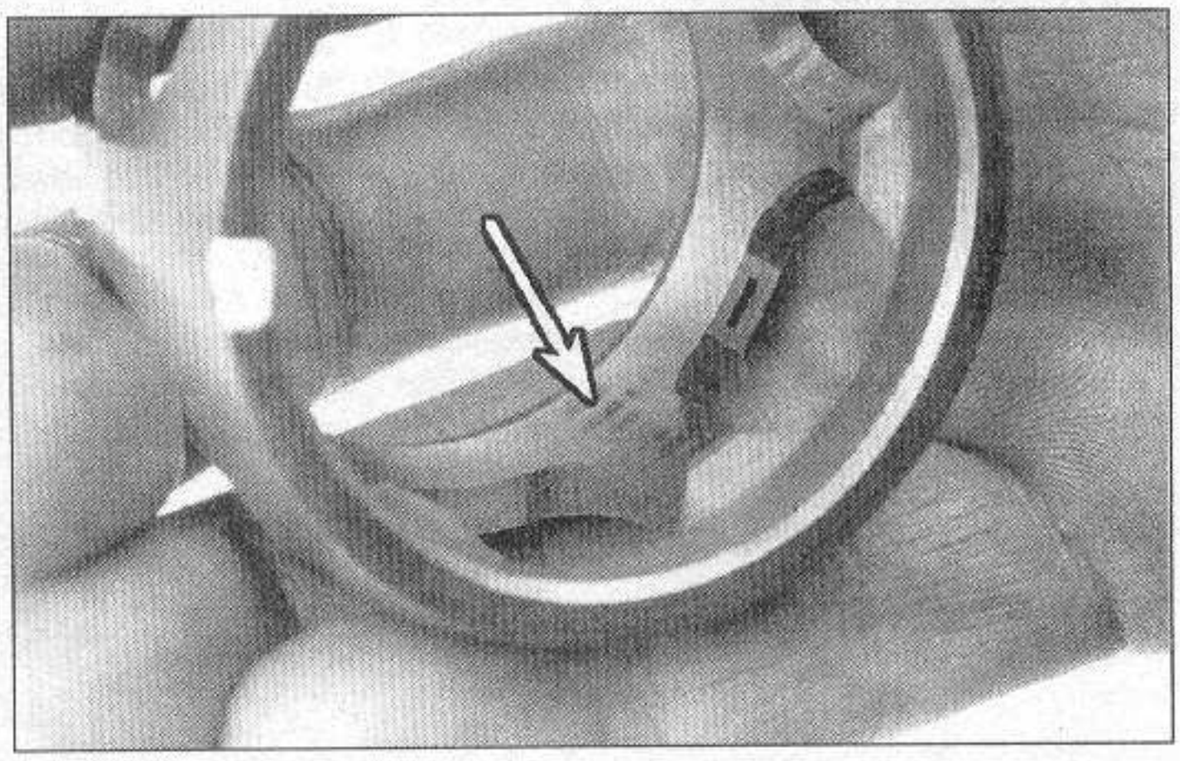
13.22 Make index marks on the inner race and cage so they will both be facing the same direction when reassembled

31 Install the wire ring bearing retainer.

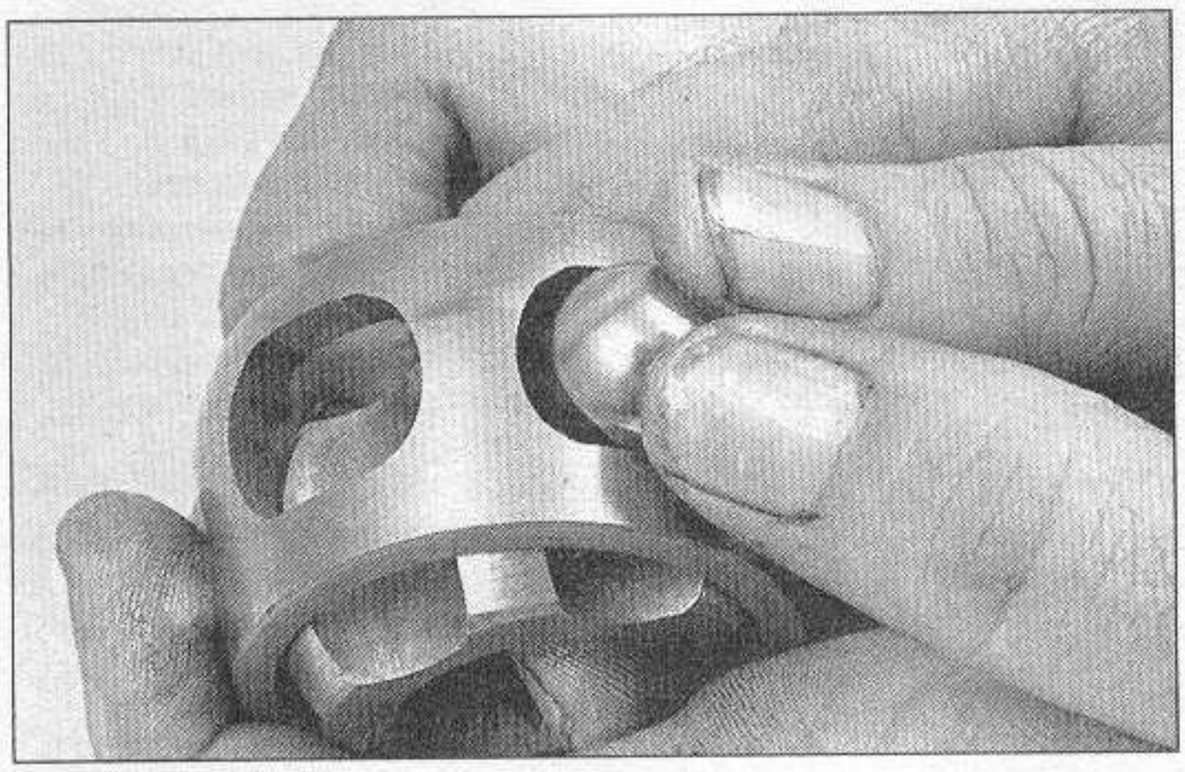
32 Wipe any excess grease from the axle boot groove on the CV joint housing. Seat the small diameter of the boot in the recessed area on the axleshaft. Push the other end of the boot onto the CV joint housing.



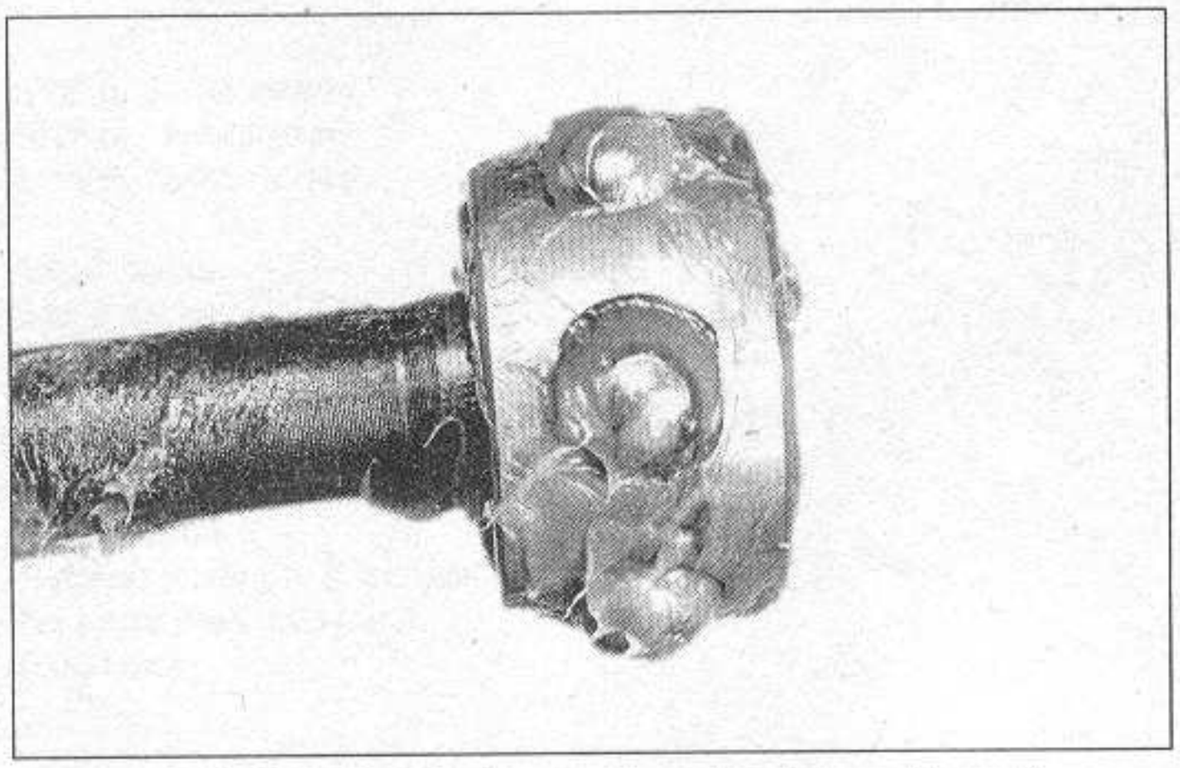
13.24a Inspect the inner race lands and grooves for pitting, score marks, cracks and other signs of wear and damage



13.24b Inspect the cage for cracks, pitting and score marks (shiny, polished spots are normal and will not adversely affect CV joint performance)



13.26 Press the balls into the cage through the windows



13.28 Note that the larger diameter side, or "bulge", is facing OUT

8

33 Equalize the pressure in the boot by inserting a dull screwdriver between the boot and the outer race **(see illustration 13.13)**. Don't damage the boot with the tool.

34 Adjust the length of the joint to the length listed in this Chapter's Specifications **(see illustration 13.14)**.

35 Tighten the boot clamps **(see illustrations 13.15a through 13.15e)**. Proceed to the next Step.

All inner CV joints

35 Install a new circlip on the inner CV joint stub axle **(see illustrations 11.10a and 11.10b)**.

36 Install the driveaxle (see Section 11).

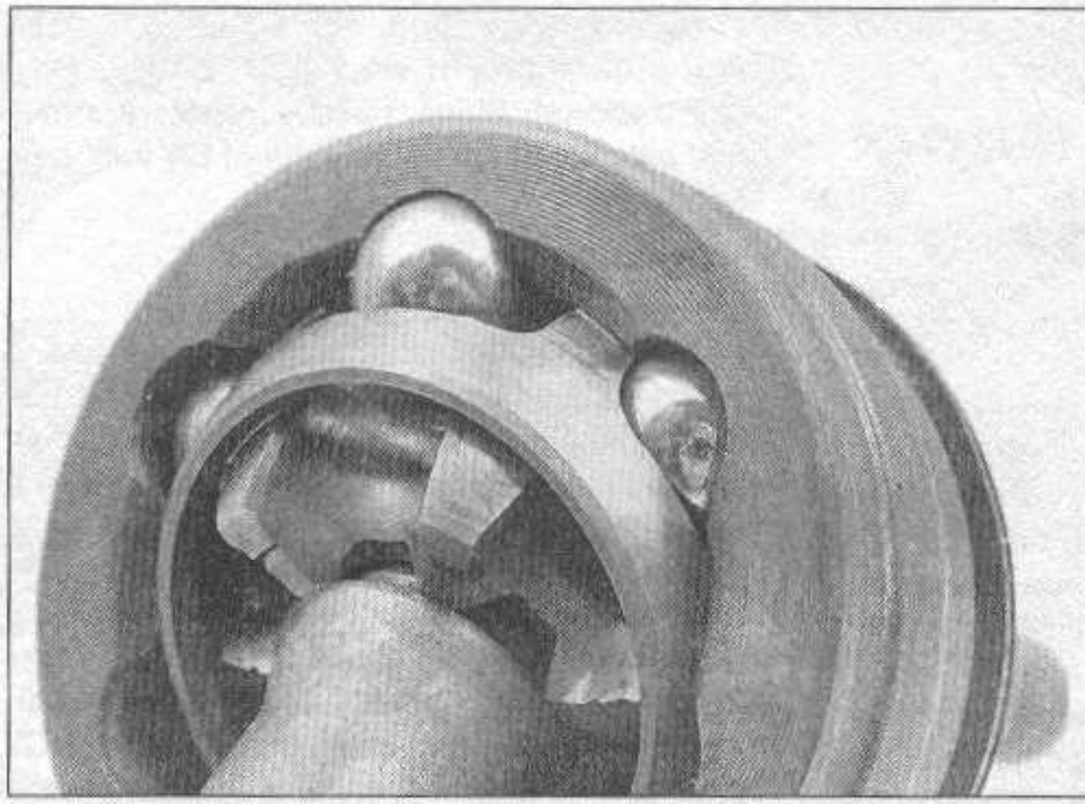
Outer CV joint

Refer to illustration 13.39

37 Remove the boot clamps **(see illustrations 13.3a and 13.3b)** and slide the boot back far enough to inspect the joint.

38 Thoroughly wash the outer CV joint in clean solvent and blow dry it with compressed air, if available. The outer joint can't be disassembled, so it's difficult to wash away all the old grease and to rid the bearing of solvent once it's clean. But it's imperative that the job be done thoroughly, so take your time and do it right.

39 Bend the outer CV joint housing at an angle to the driveaxle to expose the bearings, inner race and cage. Inspect the bearing surfaces for signs of wear. If the joint is worn, replace it, along with the axleshaft **(see illustration)**.



13.39 After the old grease has been rinsed away and the solvent has been blown out with compressed air, rotate the outer joint assembly through its full range of motion and inspect the bearing surfaces for wear and damage - if any of the ball bearings, the race or the cage look damaged, replace the driveaxle and outer joint assembly

40 If the boot is damaged but the joint is OK, remove the inner CV joint and boot (see Steps 3 through 9 for tri-pot joints and Steps 16 through 24 for ball-and-cage joints). If the shaft is equipped with a dynamic damper, mark or measure its position on the shaft, then remove the clamp and slide it off.

41 Slide the new outer boot onto the driveaxle. It's a good idea to wrap vinyl tape around the shaft splines to prevent damage to the boot **(see illustration 13.10)**. When the boot is in position, add the specified amount of grease (included in the boot replacement kit) to the outer joint and the boot (pack the joint with as much grease as it will hold and put the rest into the boot). Slide the boot on the rest of the way, equalize the pressure inside the boot and install the new clamps **(see illustrations 13.15a through 13.15e)**. Slide the dynamic damper (if equipped) and a new clamp onto the shaft, aligning it with the mark made in Step 40. Tighten the clamp.

42 Slide on the small clamp and inner boot and install the inner CV joint (see Steps 10 through 15 for tri-pot joints and 25 through 35 for ball-and-cage joints). Be sure to adjust the length of the inner joint before tightening the clamps.

43 Install the driveaxle (see Section 11).

Chapter 9 Brakes

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Specifications

General

Brake pedal	
Height (with carpet in place)	
1993 through 1997 models	7-35/64 to 7-3/4 inches
1998 and later models	7-19/32 inches
Freeplay	
1993 through 1997 models	
Manual transaxle	5/32 to 21/64 inches
Automatic transaxle	5/16 to 15/32 inches
1998 and later models	5/16 to 15/32 inches
Parking brake lever travel	
1993 through 1997 models	5 to 7 clicks
1998 and later models	6 to 8 clicks
Power brake booster pushrod-to-master cylinder piston clearance (with a vacuum of 20 in-Hg applied to booster)	0.004 to 0.012 inch

Disc brakes

Brake pad minimum thickness	See Chapter 1
Disc minimum thickness	Refer to minimum thickness cast into disc
Thickness variation (parallelism)	No more than 0.001 inch
Runout limit	0.004 inch

Drum brakes

Brake lining minimum thickness	See Chapter 1
Drum diameter (maximum)	Refer to maximum diameter cast into drum

Torque specifications

Ft-lbs (unless otherwise indicated)

General

Brake hose-to-caliper banjo bolt (front or rear)	16 to 22
Master cylinder mounting nuts	96 to 144 in-lbs
Equalizer bracket mounting nuts	14 to 19
Brake booster mounting nuts	14 to 19
Wheel sensor mounting bolts	12 to 17

Front disc brake

Caliper mounting bolts	33 to 36
Caliper mounting bracket bolts	58 to 74
Disc-to-hub screws	87 to 120 in-lbs

Rear disc brake

Caliper mounting bolts	25 to 29
Caliper mounting bracket bolts	33 to 49

1 General information

General

All vehicles covered by this manual are equipped with hydraulically operated, power-assisted brake systems. All front brake systems are disc type. Some models use drum type brakes at the rear, others are equipped with rear disc brakes.

All brakes are self-adjusting. The front and rear disc brakes automatically compensate for pad wear, while the rear drum brakes incorporate an adjustment mechanism which is activated as the brakes are applied, either through the pedal or the parking brake lever.

The hydraulic system is a split design, meaning there are two separate circuits that control the brakes. If one circuit fails, the other circuit will remain functional and a warning indicator will light up on the dashboard when a substantial amount of brake fluid is lost, showing that a failure has occurred.

Master cylinder

The master cylinder is bolted to the power brake booster, which is mounted on the driver's side of the firewall. To locate the master cylinder, look for the large fluid reservoir on top. The fluid reservoir is plastic, secured to the master cylinder by grommets and a screw. The brake master cylinder reservoir supplies fluid to the clutch master cylinder and brake master cylinder.

The master cylinder is designed for the "split system" mentioned earlier and has separate piston assemblies for each circuit.

Proportioning valve

The proportioning valve assembly is located on the firewall, near the master cylinder. It regulates the hydraulic pressure to the rear brakes during heavy braking to eliminate rear wheel lock-up. Under normal braking conditions, it allows full pressure to the rear brake system until a predetermined pedal pressure is reached. Above that point, the pressure to the rear brakes is limited.

The proportioning valve is not serviceable. If a problem develops with the valve, it must be replaced as an assembly.

Power brake booster

The power brake booster, which uses engine manifold vacuum and atmospheric pressure to provide assistance to the hydraulically operated brakes, is mounted on the firewall in the engine compartment.

Parking brake

A parking brake lever inside the vehicle operates a rod attached to a pair of rear cables, each of which is connected to its respective rear brake. When the parking brake lever is pulled up on drum brake models, each rear cable pulls on a lever attached to the brake shoe assembly, causing the shoes to expand against the drum. When the lever is pulled on models with rear disc brakes, the rear cables pull on levers that are attached to screw-type actuators in the caliper housings, which apply force to the caliper pistons, clamping the brake pads against the brake disc.

Precautions

There are some general cautions and warnings involving the brake system on these vehicles:

a) *Use only brake fluid conforming to DOT 3 specifications.*

b) *The brake pads and linings may contain asbestos fibers, which are hazardous to your health if inhaled. Whenever you work on brake system components, clean all parts with brake system cleaner. Do not allow the fine dust to become airborne, and wear a filter/mask over your nose and mouth when cleaning or servicing brakes, regardless of the material the pads are made of.*

c) *Safety should be paramount whenever any servicing of the brake components is performed. Do not use parts or fasteners which are not in perfect condition, and be sure that all clearances and torque specifications are adhered to. If you are at all unsure about a certain procedure, seek professional advice. Upon completion of any brake system work, test the brakes carefully in a controlled area before putting the vehicle into normal service.*

d) *If a problem is suspected in the brake system, don't drive the vehicle until it's fixed.*

2 Anti-lock Brake System (ABS) - general information and trouble codes

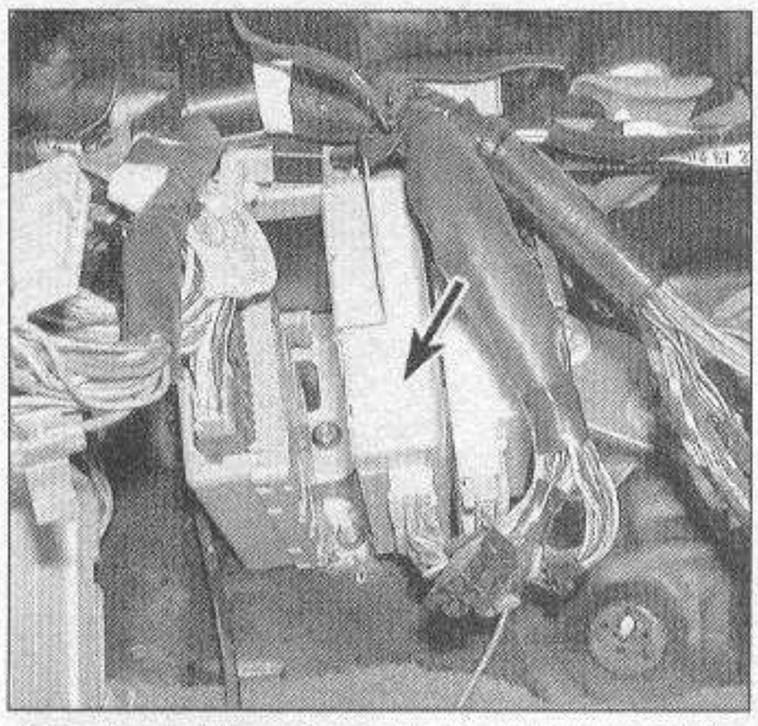
General information

Refer to illustrations 2.2a, 2.2b, 2.3a and 2.3b

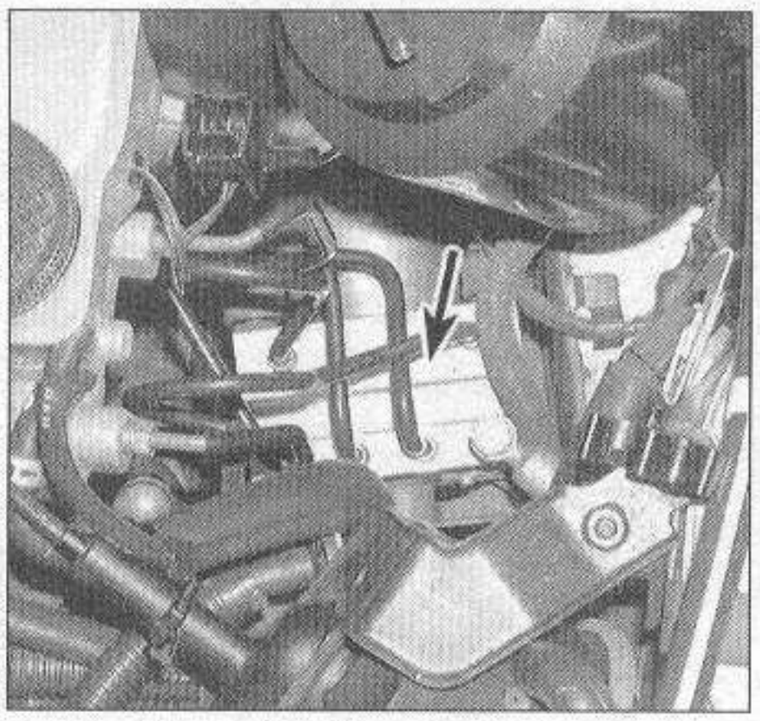
1 In a conventional braking system, if you press the brake pedal too hard, the wheels can "lock up" (stop turning) and the vehicle can go into a skid. If the wheels lock up, you can lose control of the vehicle. The Anti-lock Brake System (ABS) prevents the wheels from locking up by modulating (pulsing on and off) the pressure of the brake fluid at each caliper.

2 The Anti-lock Brake System has two basic subsystems: One is an electrical system and the other is hydraulic. The electrical half has four "gear pulsers," four wheel sensors, a computer **(see illustration)** and an electrical circuit connecting all the components. The hydraulic part of the system consists of a hydraulic actuation assembly **(see illustration)**, the disc brake calipers and the hydraulic fluid lines between the hydraulic actuation assembly and the calipers.

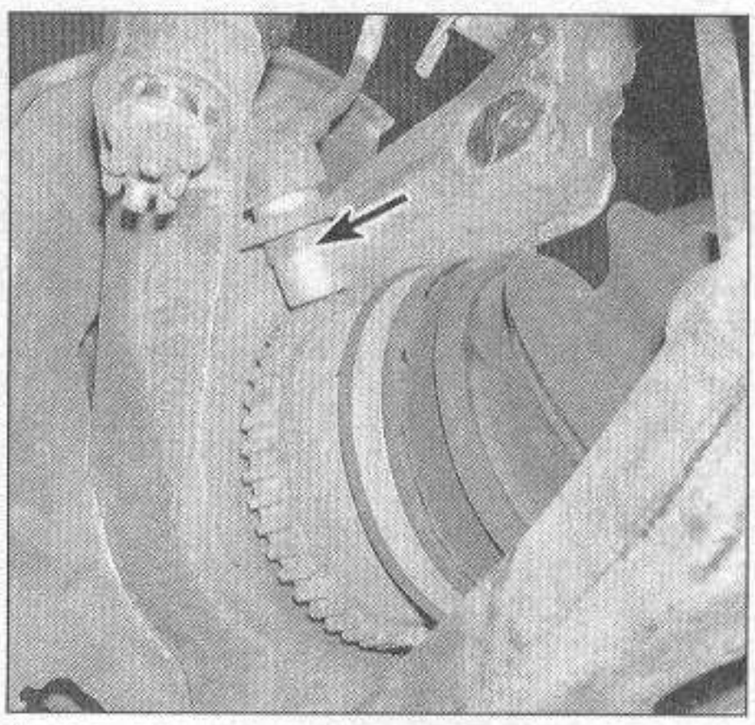
3 In principle, the system is pretty simple: Each wheel has a wheel sensor monitoring a



2.2a Location of the ABS control module (arrow) under the left side of the instrument panel



2.2b The hydraulic actuator (arrow) is located below the master cylinder



2.3a Location of the front ABS wheel speed sensor (arrow)

gear pulser (a ring with evenly spaced raised ridges cast into its circumference). The wheel sensor "counts" the ridges of the gear pulser as they pass by, converts this information into an electrical output and transmits it back to the computer **(see illustrations)**. The computer constantly "samples" the voltage inputs from all four wheel sensors and compares them to each other. As long as the gear pulsers at all four wheels are rotating at the same speed, the Anti-lock Brake System is inactive. But when a wheel locks up, the voltage signal from that wheel sensor deviates from the signals coming from the other wheels. So the computer "knows" the wheel is locking up. It sends an electrical signal to the hydraulic actuator assembly, which releases the brake fluid pressure to the brake caliper at that wheel. As soon as the wheel unlocks and resumes turning at the same rate of speed as the other wheels, its wheel sensor voltage output once again matches the output of the other wheels and the computer deactivates the signal to the hydraulic actuator assembly.

4 In reality, the Anti-lock Brake System is far more complex than it sounds, so we don't recommend that you attempt to diagnose or service it. If the Anti-lock Brake System on your vehicle develops problems, take it to a dealer service department or other qualified shop.

ABS trouble codes

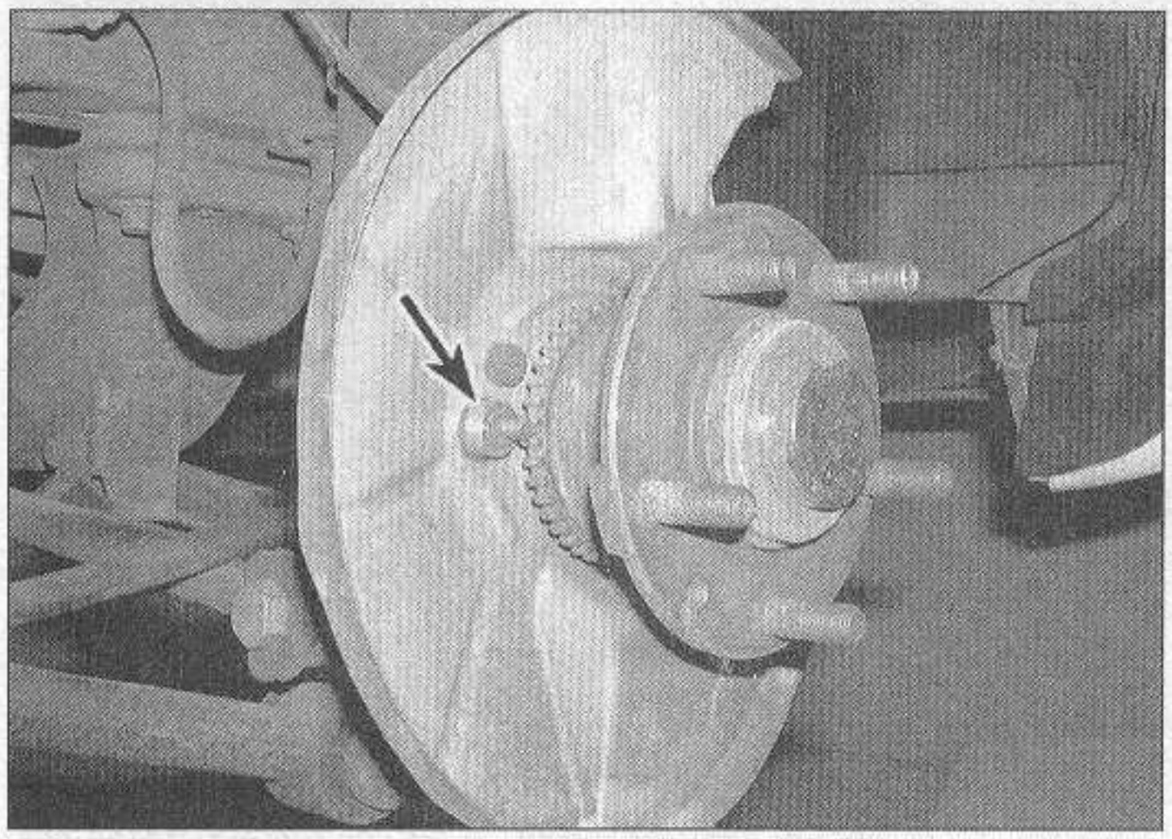
Refer to illustration 2.6

5 Normally, the ABS indicator light should come on when the engine is started, then go off immediately. Under certain conditions, however, the indicator light may remain on. If this occurs, the ABS computer has stored a diagnostic trouble code because it has detected a problem in the ABS system. There are two different methods used for accessing ABS trouble codes. Models from 1993 to 1997 can be accessed through the Data Link Connector (DLC) in the engine compartment. 1998 and later models require a special scan tool connected to the 16-pin data link connector in the passenger compartment. If the special scan tool is not available, have the diagnostic codes extracted from the Powertrain Control Module (PCM) by a dealer service department or other qualified repair facility.

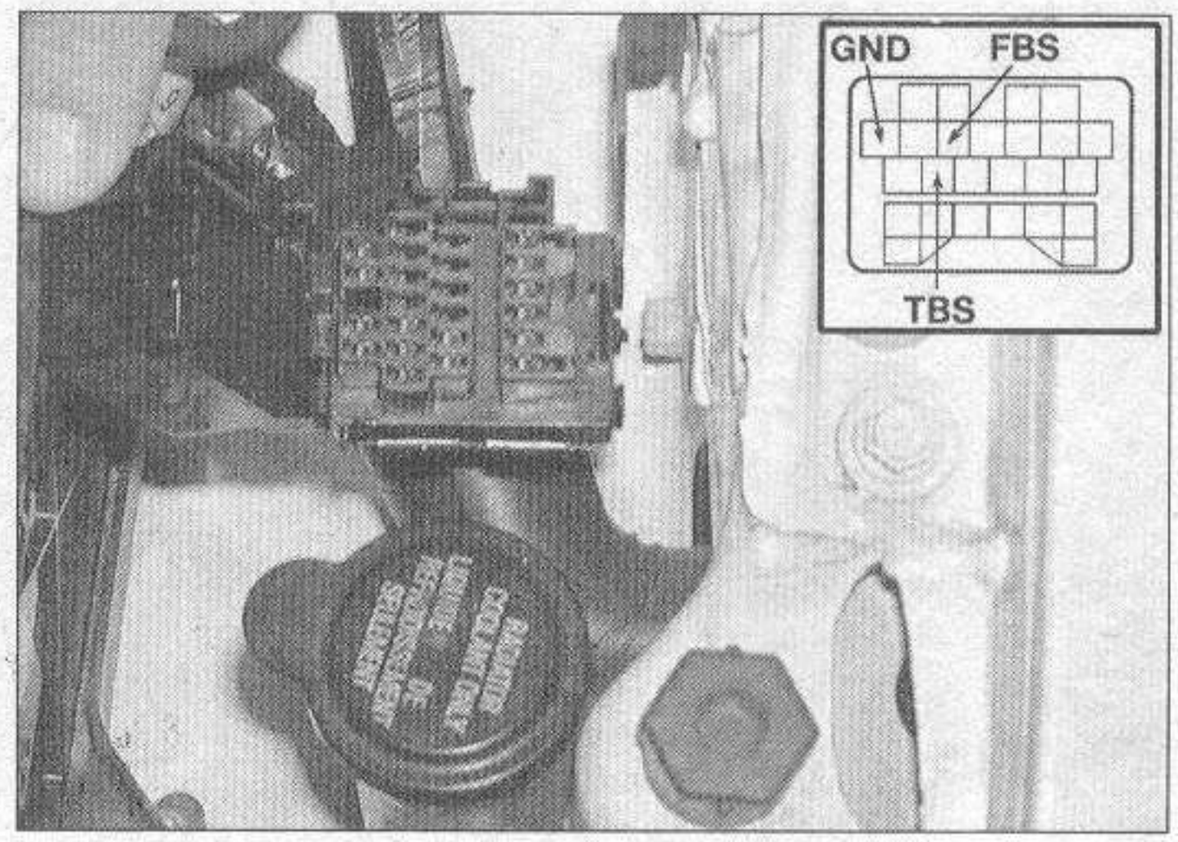
6 On 1993 through 1997 models, to access the ABS self diagnosis system, connect a jumper wire between terminals FBS and GND. Also, connect a voltmeter from the TBS terminal to chassis ground (-) **(see illustration)**. With the ignition key ON (engine not running), watch the sweeps of the voltmeter needle. The voltmeter must be an analog type to see the movement of the needle as it sweeps across the face of the meter. Make sure the battery voltage is greater than 11 volts, the transaxle is in Neutral, the accessories are OFF, the throttle valve is closed and the engine is at normal operating temperature. Turn the ignition to the ON position but do not start the engine.

7 The diagnostic code is the number of sweeps on the voltmeter needle. If no codes are stored, the ABS light will come on briefly and then go out. If any malfunction has been detected, the light will blink the first digit of the code at a long interval. For example, a code 22 (solenoid valve), will first blink two long flashes and then pause and blink two short flashes.

8 The following code chart lists the ABS codes for the most common Anti-lock Brake System problems. Most ABS repairs must be performed by a dealer service department or other qualified automotive repair facility.



2.3b Location of the rear ABS wheel speed sensor (arrow)



2.6 Location of the Data Link Connector (DLC) on a 1993 Ford Probe

ABS Trouble Codes

Code	Probable cause
11	Right front wheel sensor (open/short to body ground or short to power)
12	Left front wheel sensor (open/short to body ground or short to power)
13	Right rear wheel sensor (open/short to body ground or short to power)
14	Left rear wheel sensor (open/short to body ground or short to power)
15	Speed sensor (no current detected from ABS module to speed sensor)
22	Right front solenoid
24	Left front solenoid
26	Right rear solenoid
28	Left rear solenoid
29	Right front or left rear brake line, or hydraulic actuator assembly malfunction
30	Left front or right rear brake line, or hydraulic actuator assembly malfunction
51	Fail-safe relay
53	Motor relay malfunction
61	ABS control module
63	Battery/alternator malfunction

9 The ABS diagnostic codes on 1998 and later models are accessed using a special scan tool. Refer to Chapter 6 for additional information on scan tools and accessing diagnostic trouble codes. Most ABS system repairs must be performed by a dealer service department or other qualified automotive repair facility.

10 The diagnostic codes must be cleared from the computer memory after the repairs have been performed. The diagnostic codes can only be erased using the special scan tool. If the scan tool is not available, have the code clearing procedure performed by a dealership service department or other qualified repair facility. Refer to Chapter 6 for additional information on scan tools and accessing diagnostic trouble codes.

3 Disc brake pads - replacement

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

Note: *This procedure applies to front and rear disc brakes.*

1 Remove the cap from the brake fluid reservoir.

2 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands.

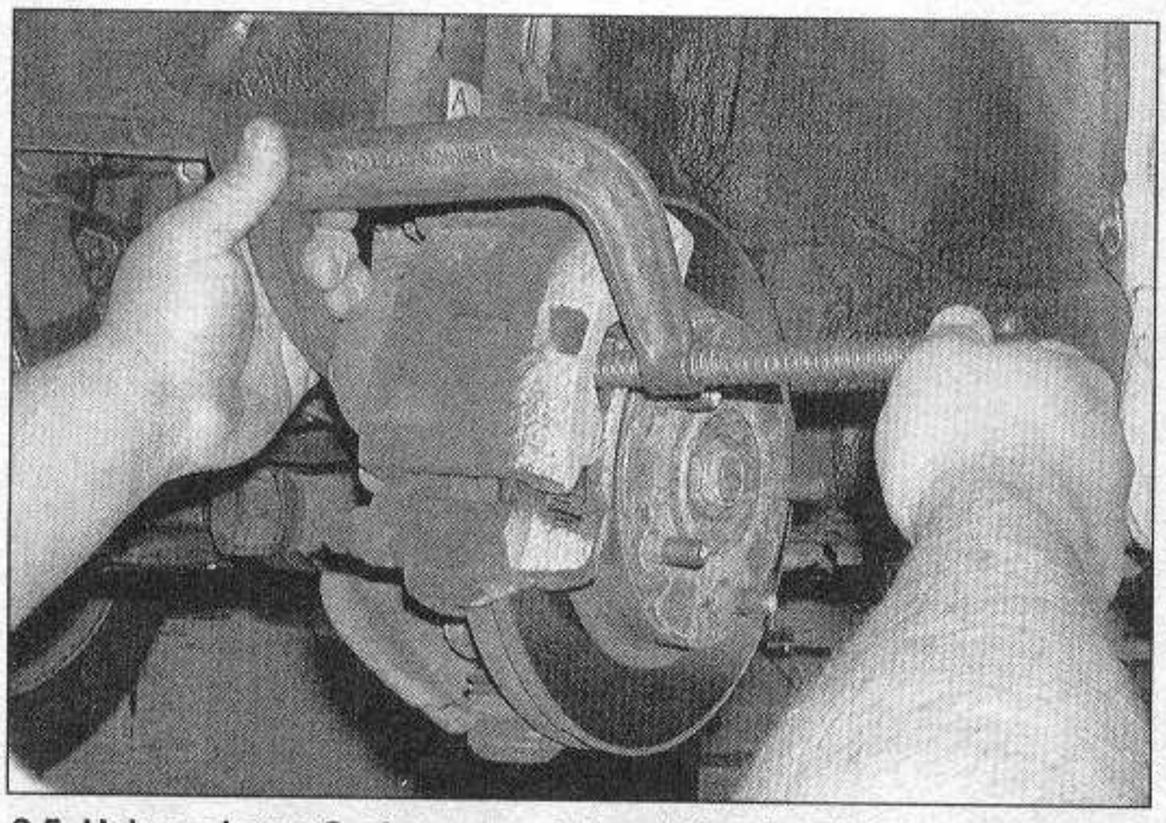
3 Remove the wheels. Work on one brake assembly at a time, using the assembled brake for reference if necessary.

4 Inspect the brake disc carefully as outlined in Section 5. If machining is necessary, follow the information in that Section to remove the disc, at which time the calipers and pads can be removed as well.

Front pads

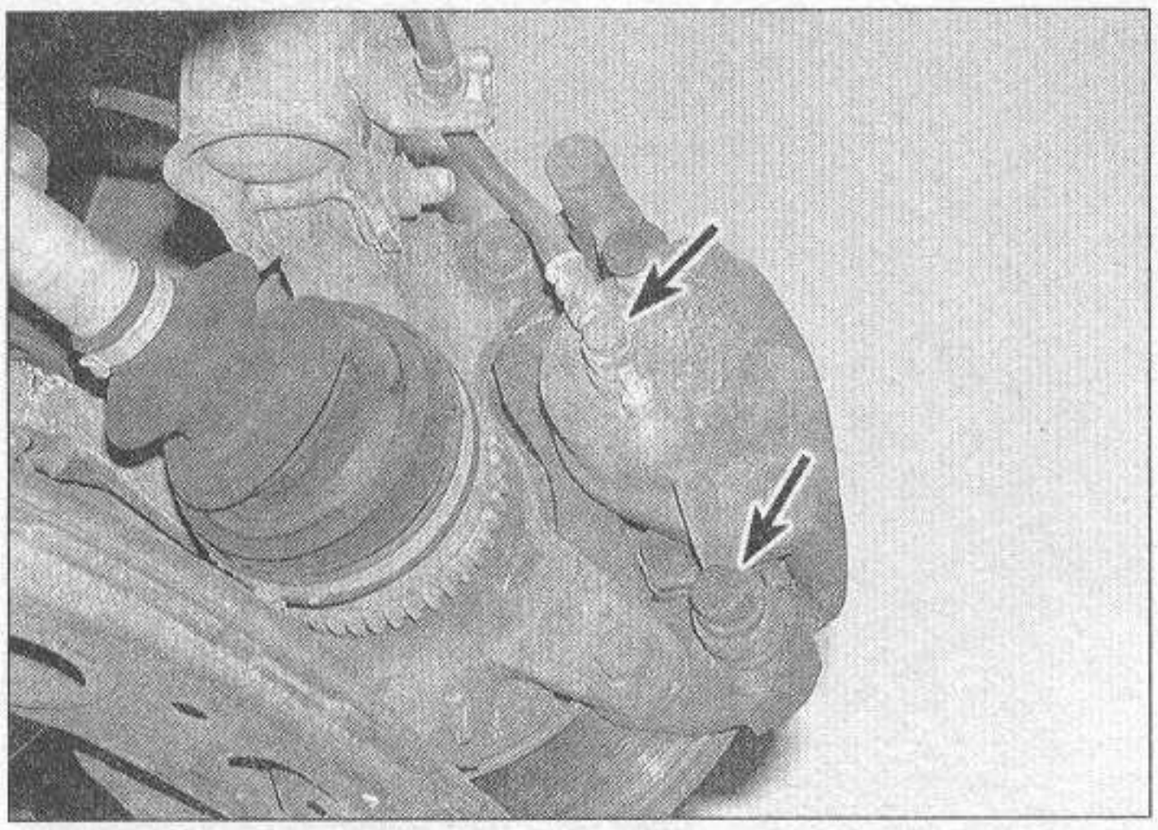
Refer to illustrations 3.5 and 3.6a through 3.6p

5 Push the piston back into the bore to provide room for the new brake pads. A C-clamp can be used to accomplish this **(see illustration)**. As the piston is depressed to

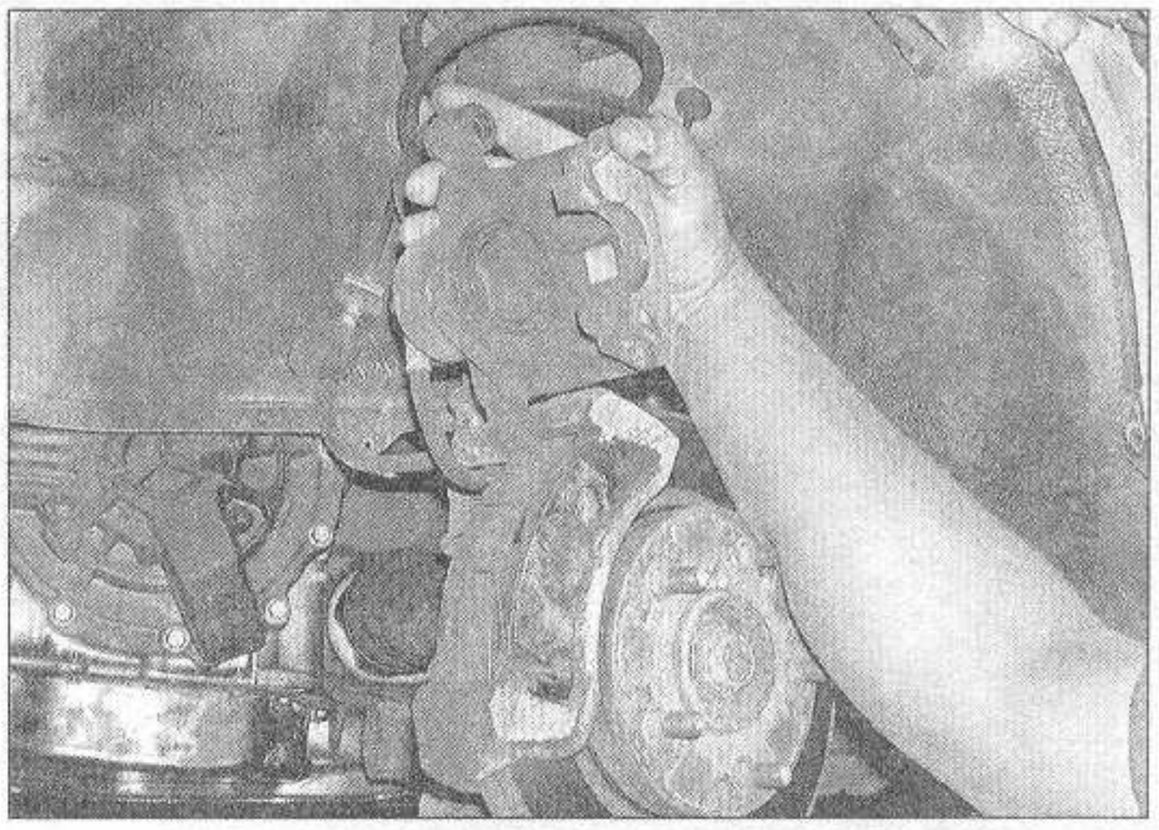


3.5 Using a large C-clamp, push the piston back into the caliper - note that one end of the clamp is on the back side of the caliper and the other end (screw end) is pressing on the outer brake pad

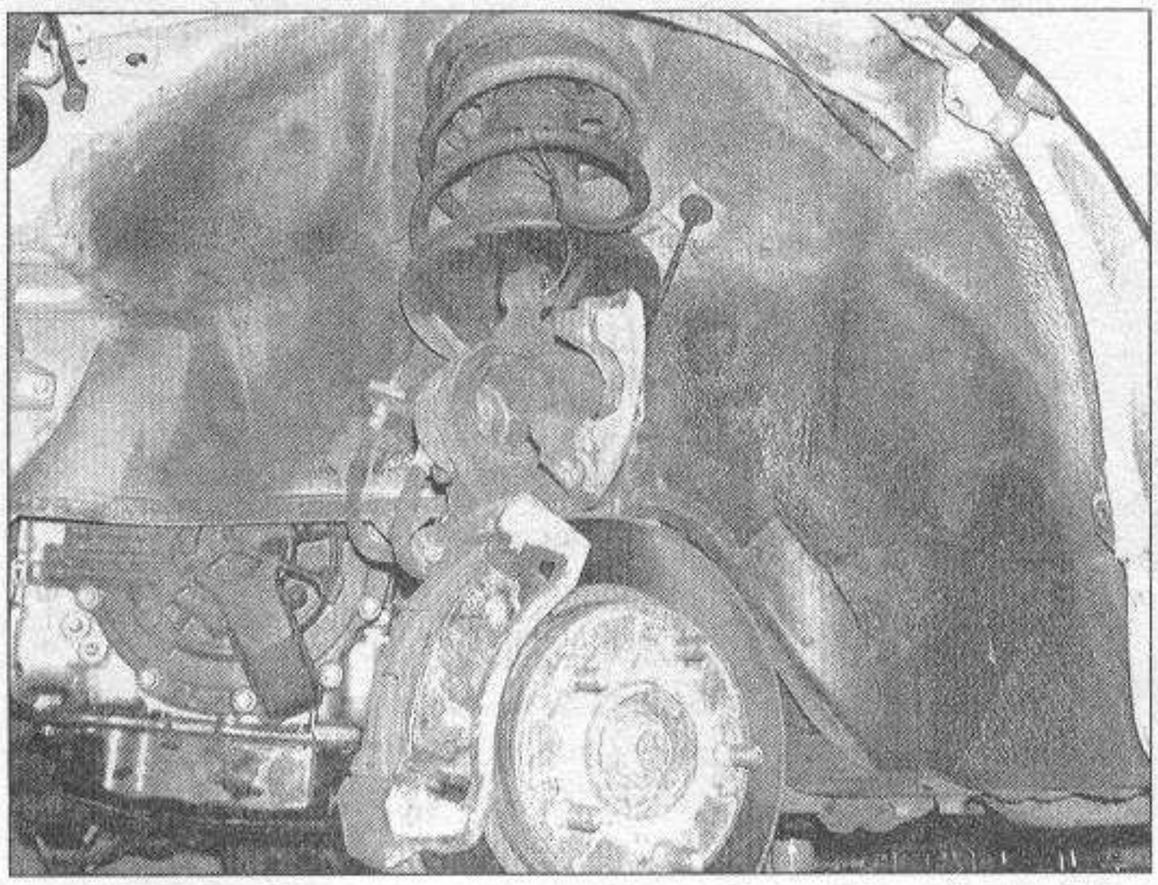
3.6a Before removing anything, spray the disc, caliper and brake pads with brake system cleaner to remove the dust produced by brake pad wear - DO NOT blow the dust off with compressed air!



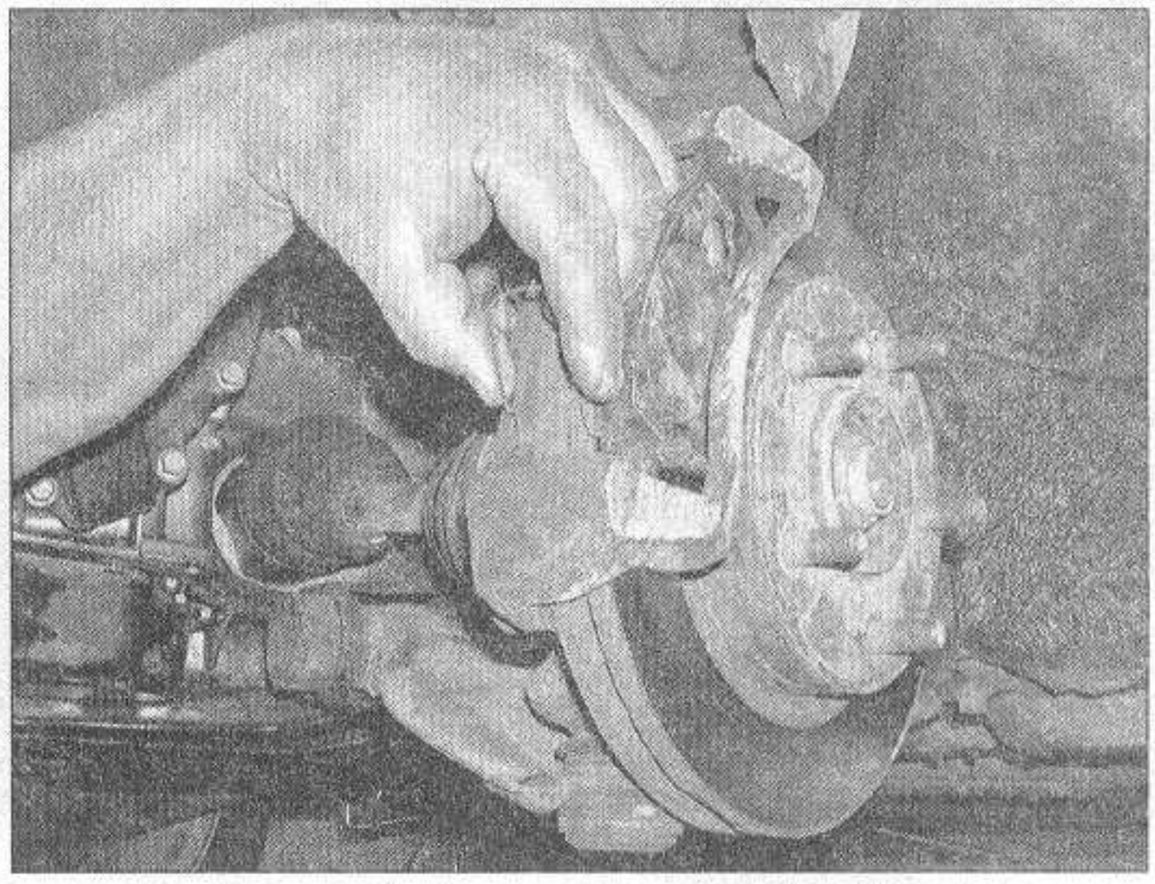
3.6b Remove the caliper mounting bolt (lower arrow; upper arrow points to banjo fitting for the brake hose, which should not be disconnected unless you are removing the caliper from the vehicle for replacement)



3.6c Swing the caliper up . . .



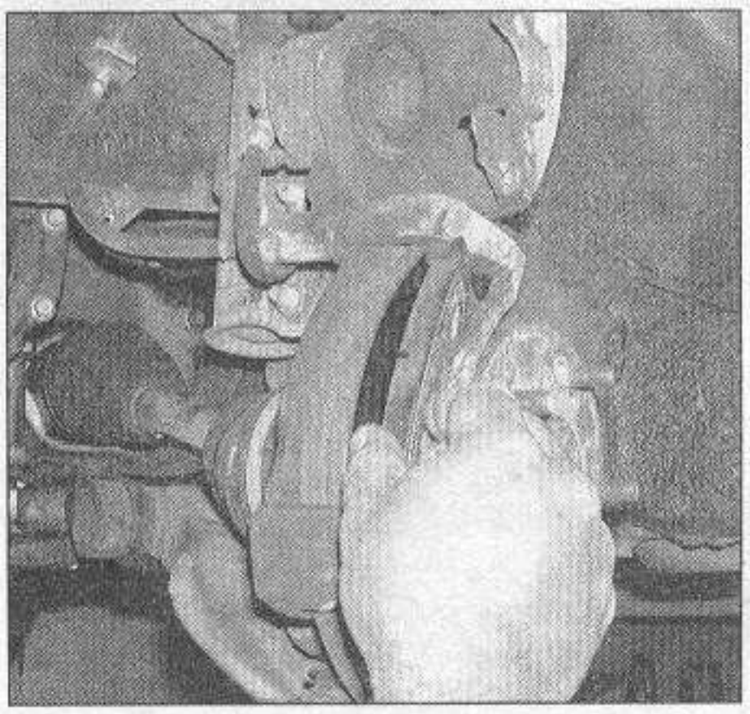
3.6d . . . and secure the caliper in this position with a piece of wire



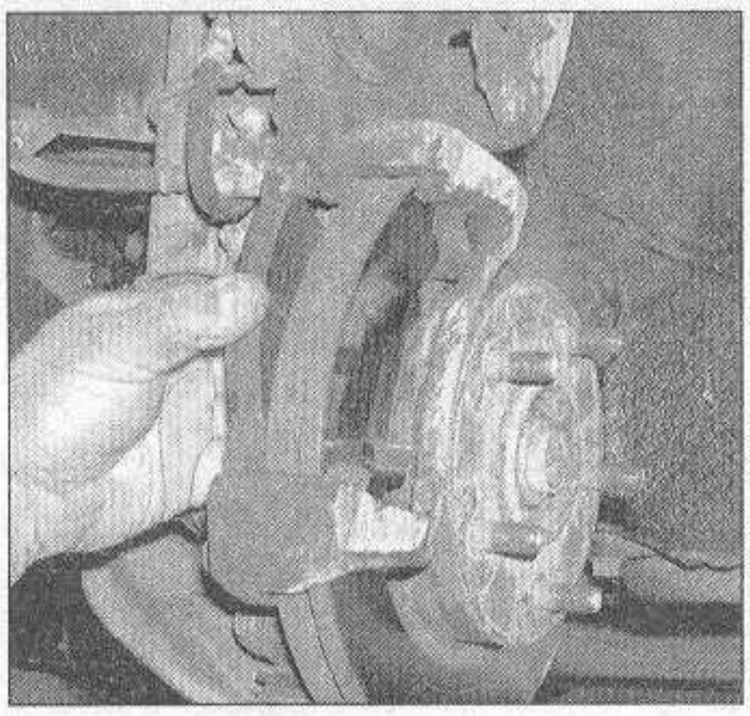
3.6e Remove the lower and upper anti-rattle springs

the bottom of the caliper bore, the fluid in the master cylinder will rise. Make sure it doesn't overflow. If necessary, drain off some of the fluid.

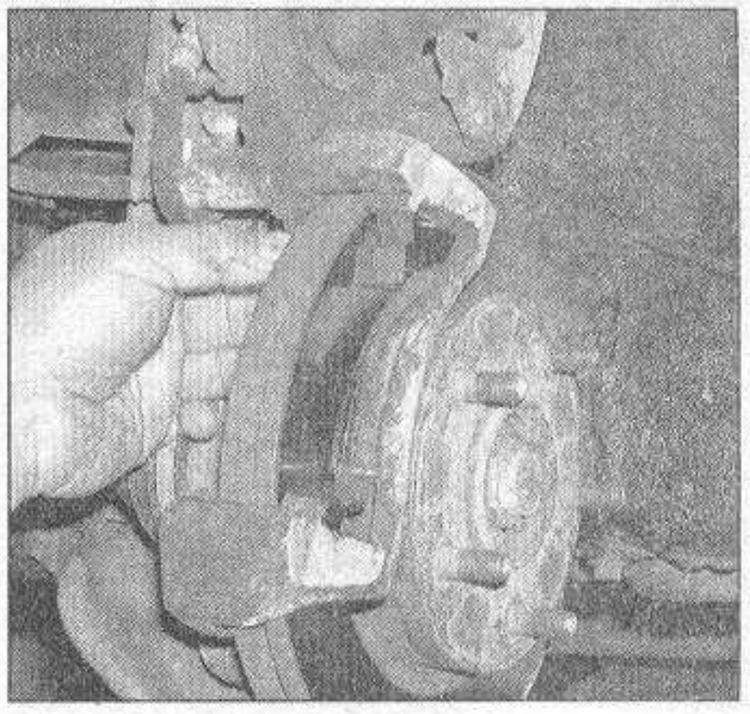
6 Follow the accompanying photos, beginning with **illustration 3.6a**, for the actual pad replacement procedure. Be sure to stay in order and read the caption under each illustration. When you have completed the Steps described in the accompanying photos, proceed to Step 15.



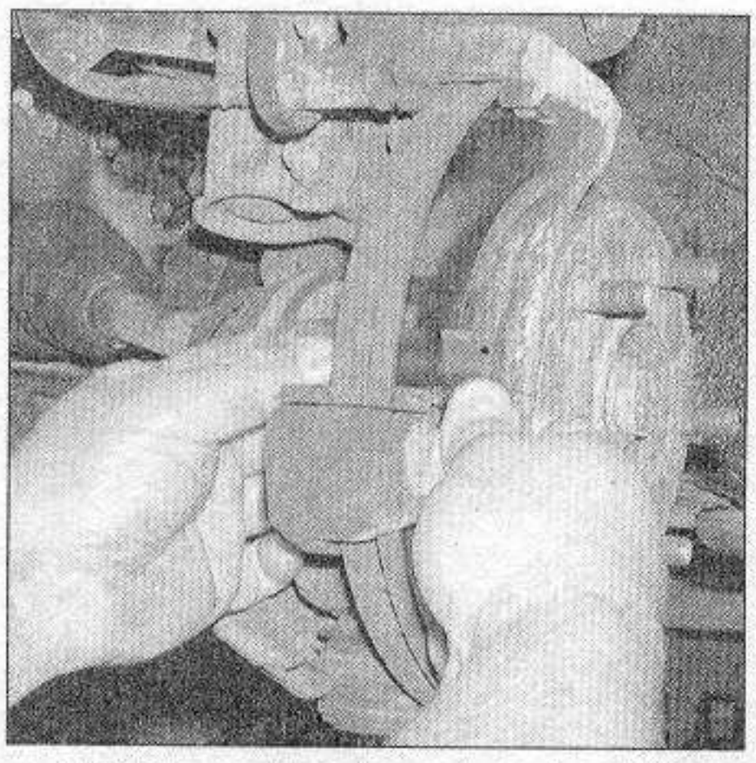
3.6f Remove the outer brake pad and shim



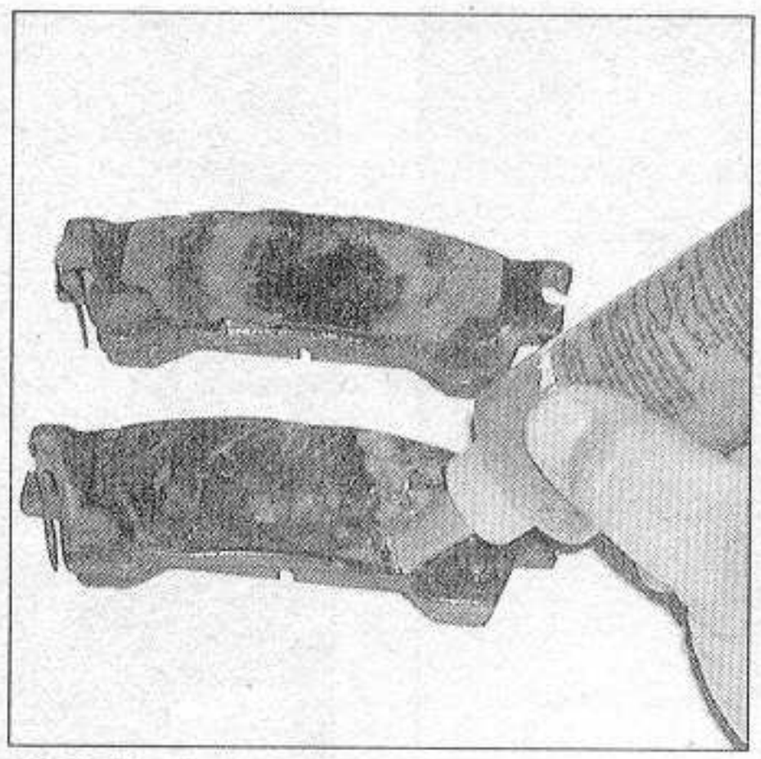
3.6g Remove the inner brake pad and shim(s)



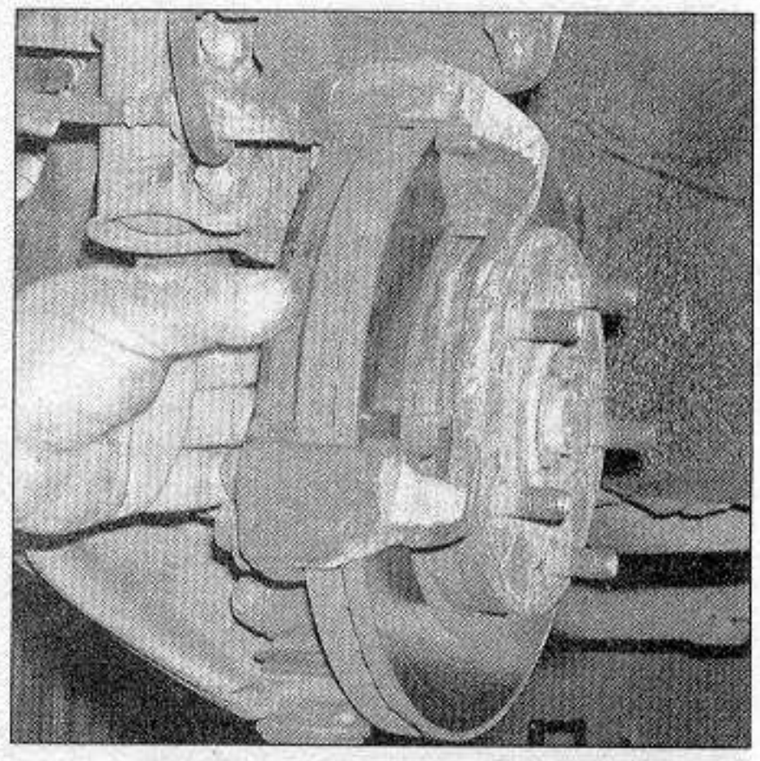
3.6h Remove and inspect the upper and lower pad retainer clips



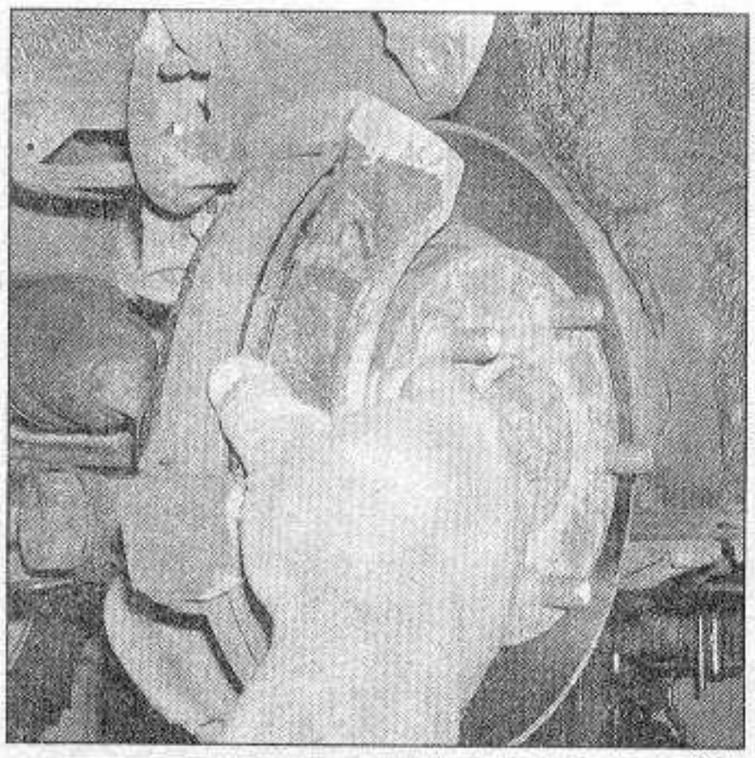
3.6i The pad retainer clips should fit snugly in the caliper mounting bracket; if they don't, replace them. Apply a thin film of high-temperature grease to the retainer



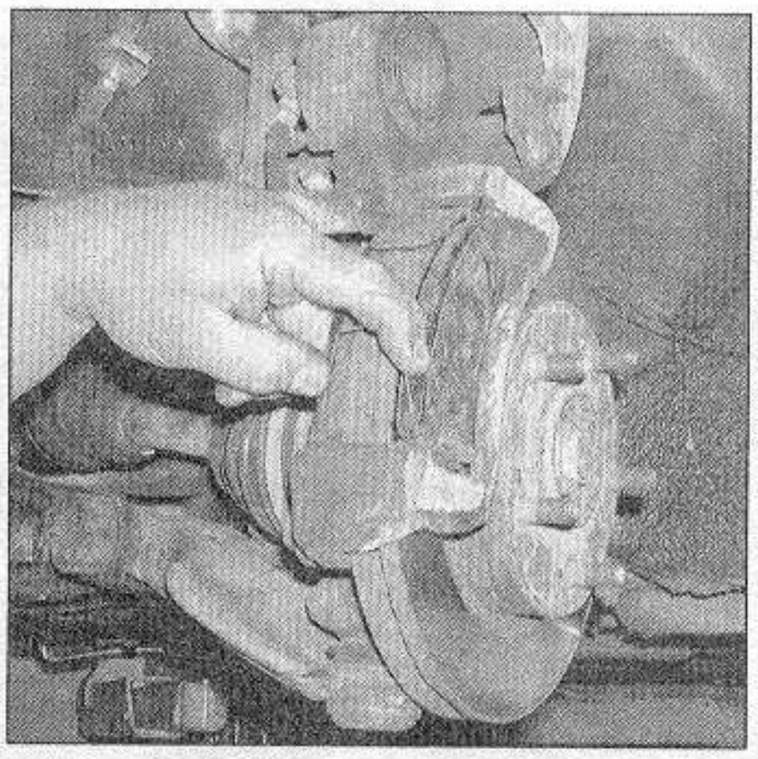
3.6j Apply anti-squeal compound to the back of the pads



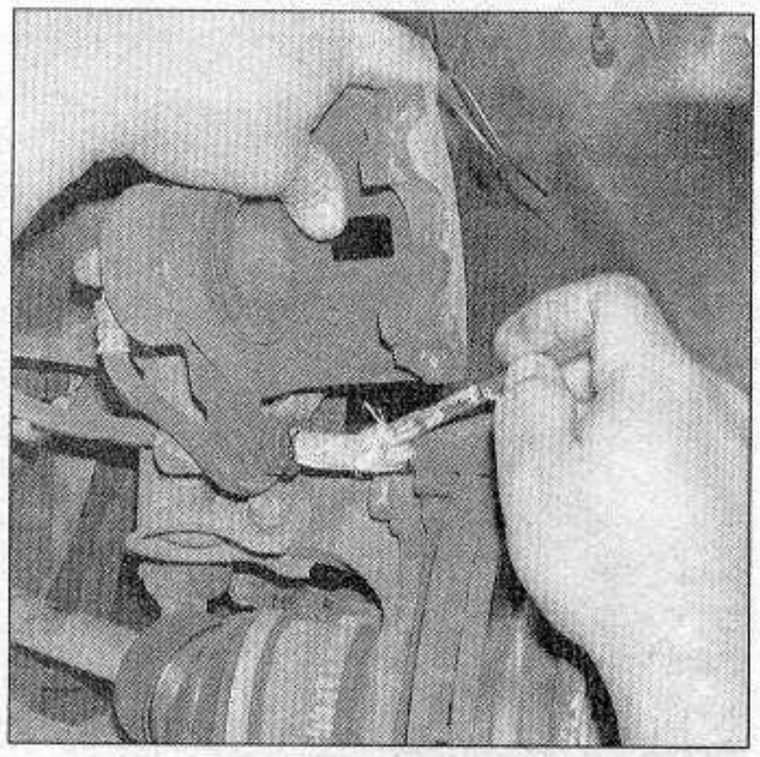
3.6k Install the new inner pad and shim(s); make sure the "ears" on the upper and lower ends of the pad are fully engaged with their respective grooves and the pad retainer clips



3.6l Install the new outer pad and shim (if the new pad has no shim, take the old shim off the old pad and install it on the new outer pad)



3.6m Install the upper and lower anti-rattle springs



3.6n Clean off the caliper pin and coat it with high-temperature grease

Rear pads

Refer to illustrations 3.7a through 3.7k and 3.8

7 Wash the brake assembly with brake system cleaner, then follow the accompanying photos, beginning with **illustration 3.7a**, for the actual pad replacement procedure. Be sure to stay in order and read the caption under each illustration. When you have completed the Steps described in the accompanying photos, proceed to Step 8.

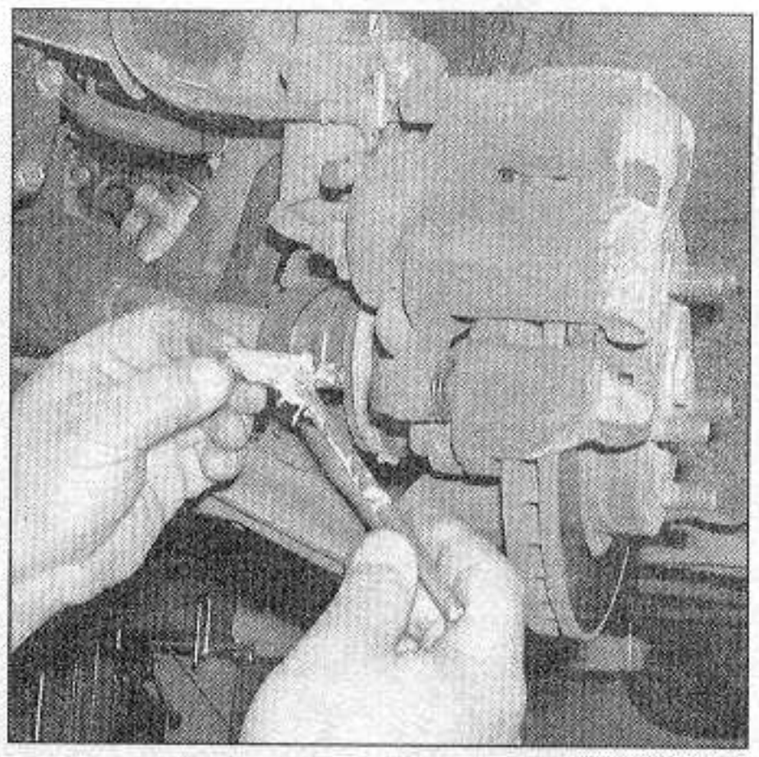
8 Apply a thin coat of disc brake anti-squeal compound, in accordance with the manufacturer's recommendations, on the backing plates of the new pads **(see illustration)**.

9 Install the shims onto their pads.

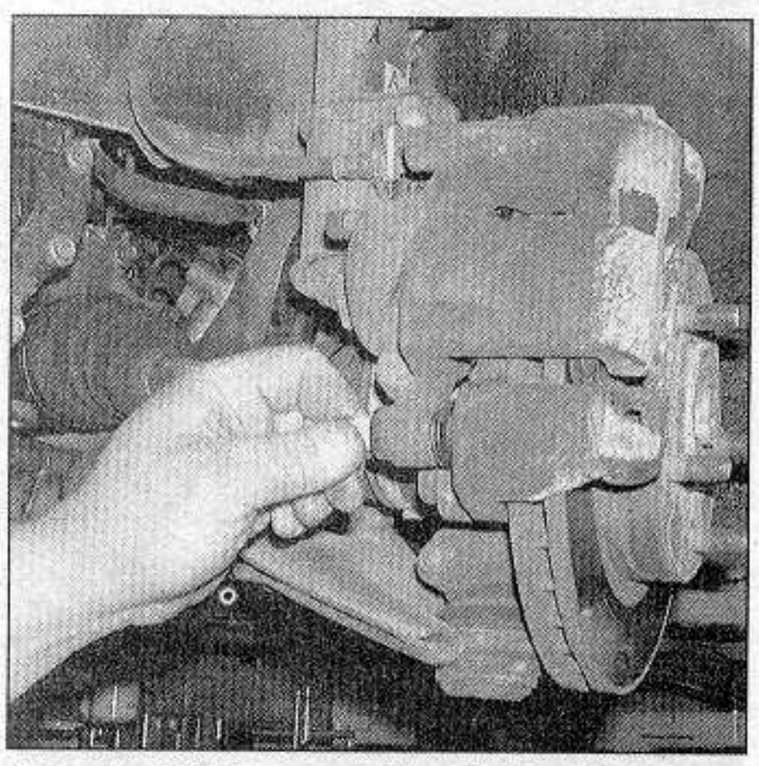
10 Install the pad retainers in the caliper mounting bracket. Lubricate the retainers with a thin film of high-temperature grease.

11 Install the new pads, shims and anti-rattle springs to the caliper mounting bracket.

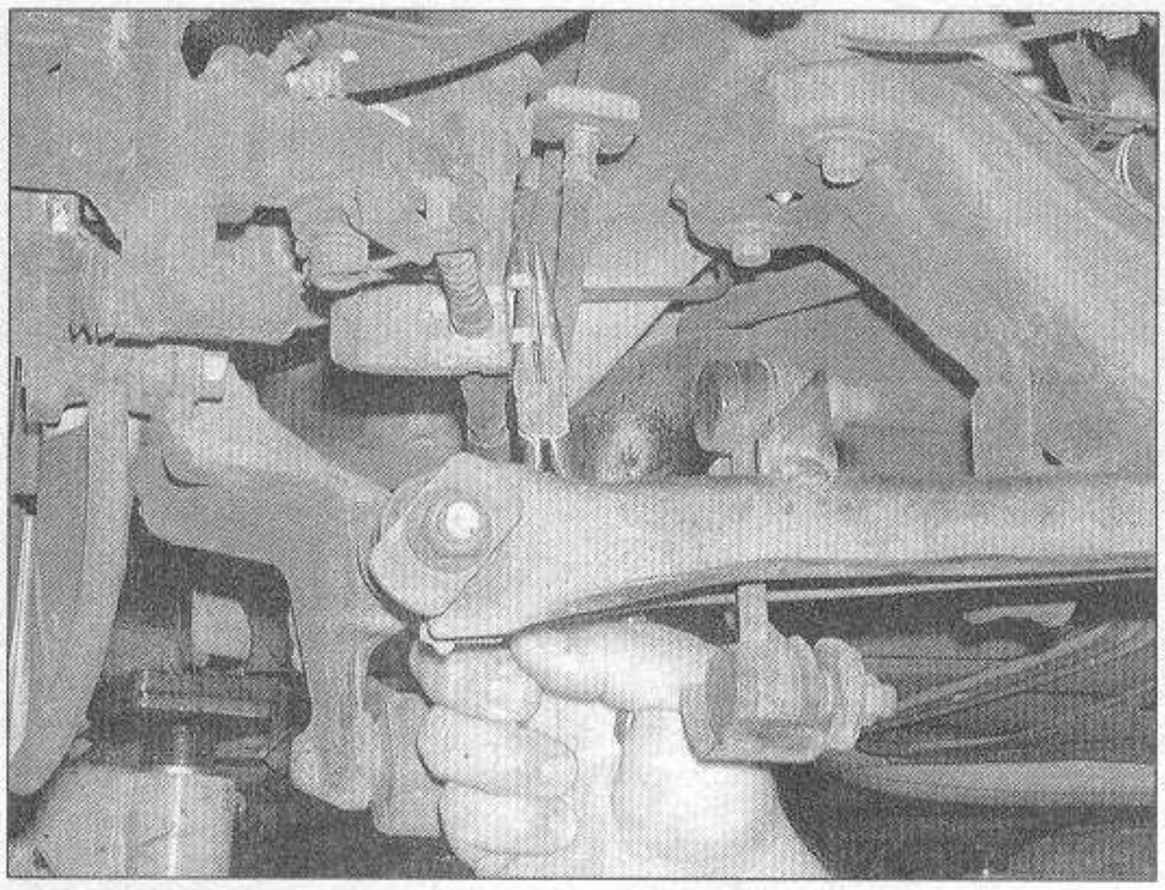
12 Pivot the caliper into position over the pads and install the mounting bolt, tightening it to the torque listed in this Chapter's Speci-



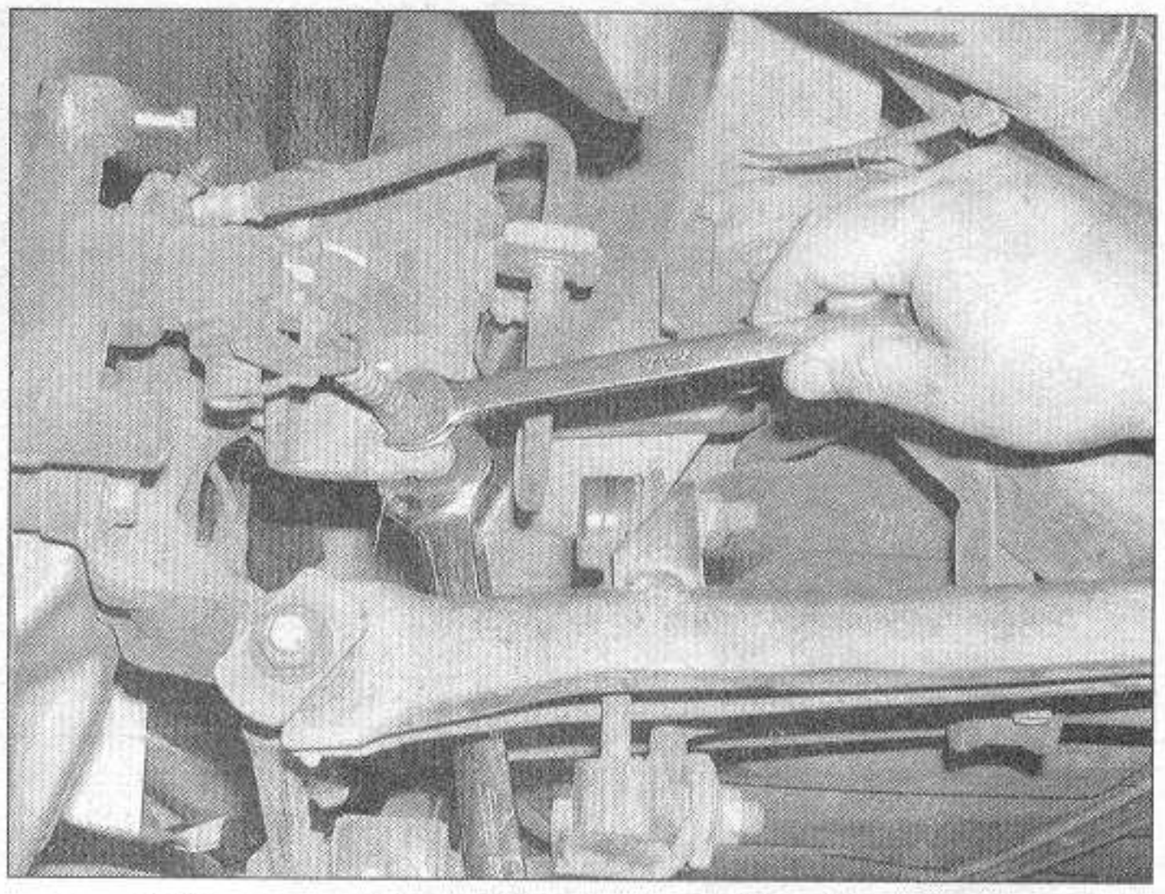
3.6o Swing the caliper down over the disc and new pads (if the piston hits the inner pad, depress the piston further into the caliper bore with your C-clamp) - lubricate the sliding surface of the bolt with high-temperature grease



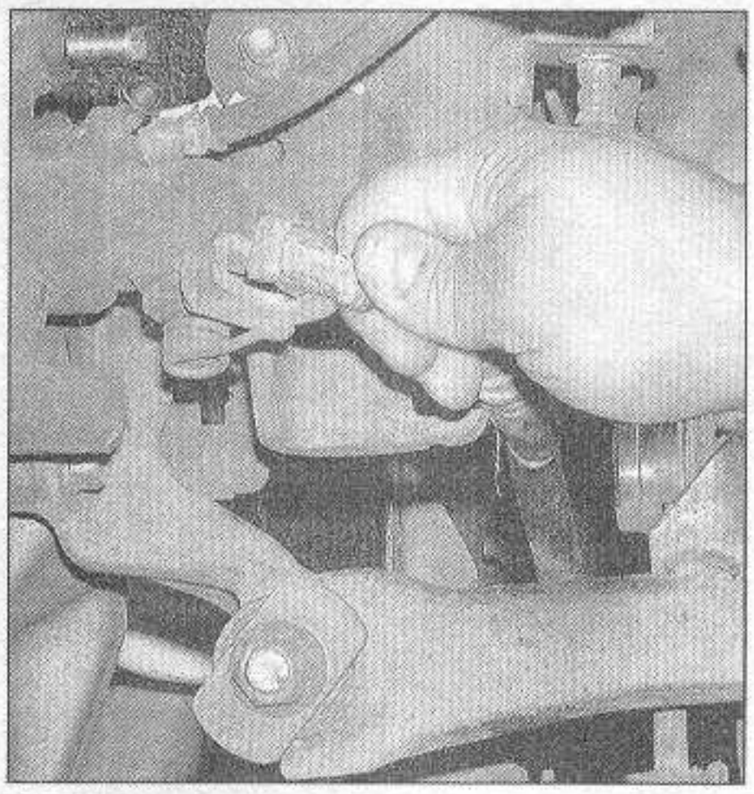
3.6p Install the mounting bolt and tighten it to the torque listed in this Chapter's Specifications



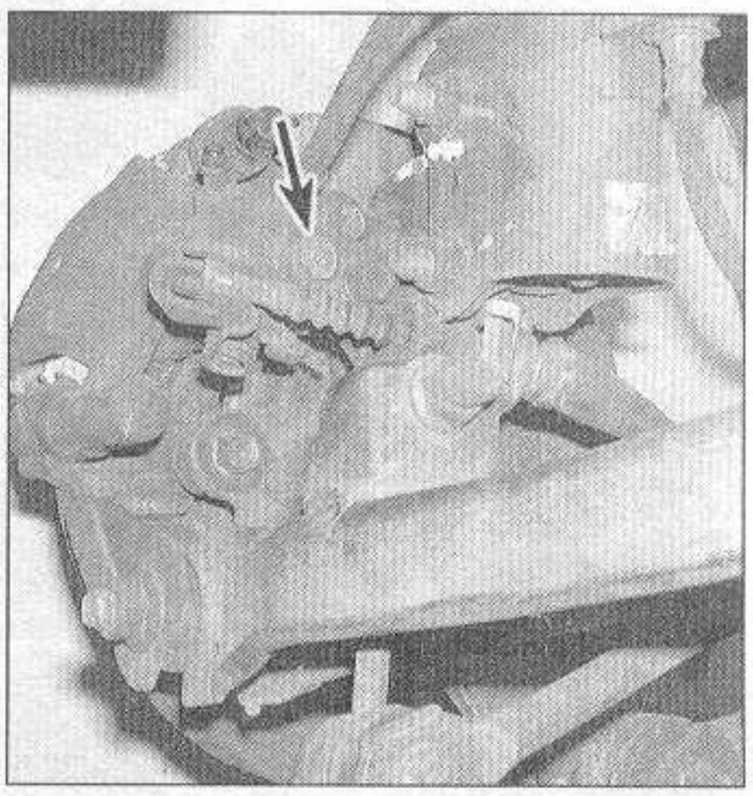
3.7a Remove the clip from the parking brake cable



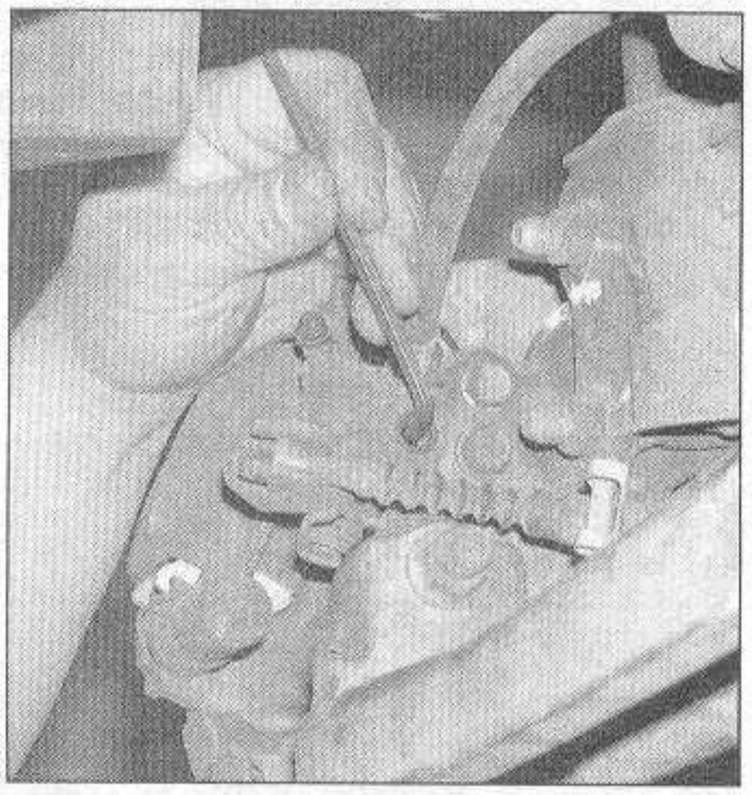
3.7b Loosen the parking brake cable adjusting nut



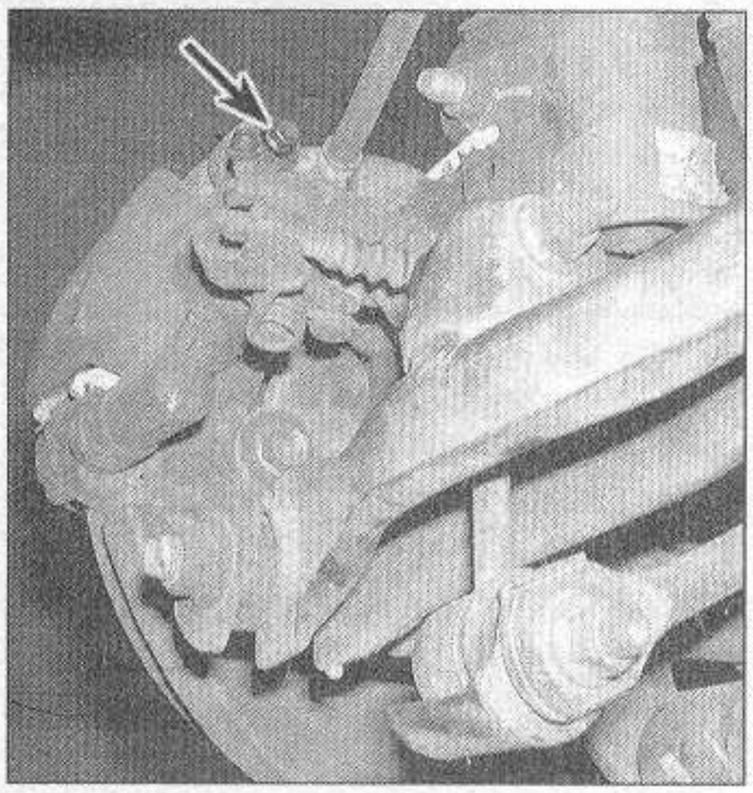
3.7c Detach the parking brake cable from the lever and bracket



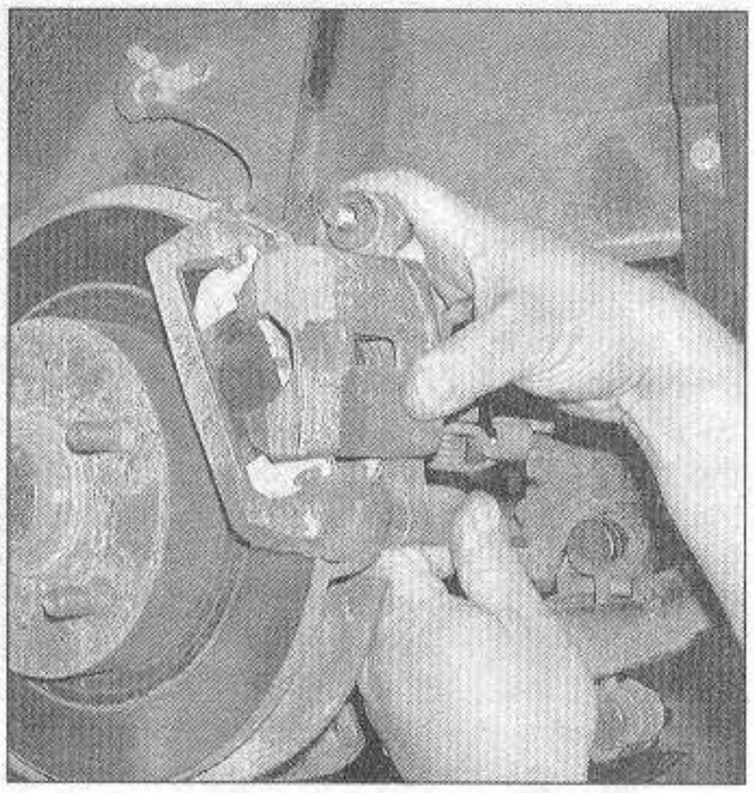
3.7d Remove the access bolt . . .



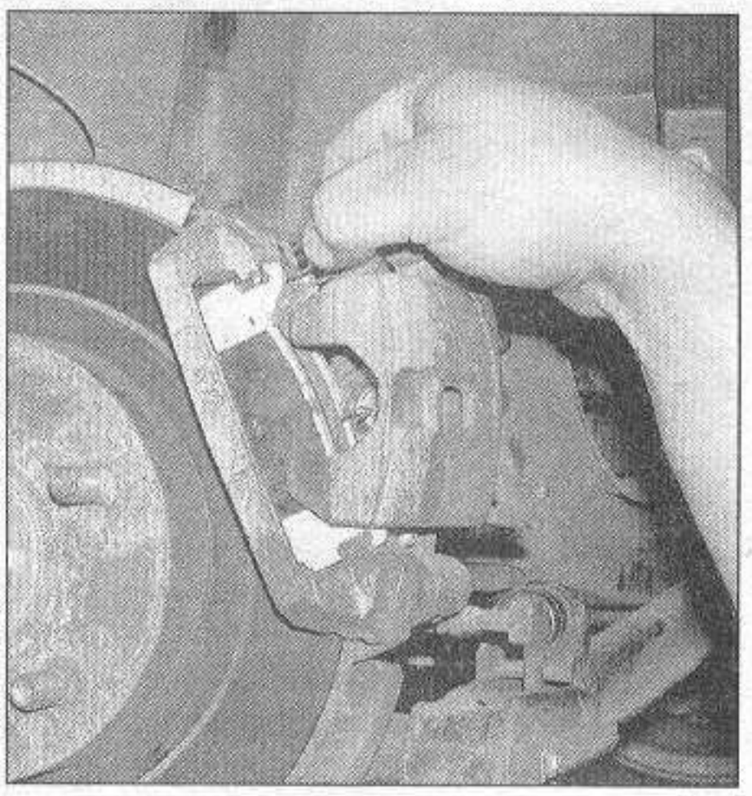
3.7e . . . and, using an Allen wrench, turn the caliper manual adjustment gear counterclockwise to retract the caliper piston; rotate the piston until it bottoms inside the caliper



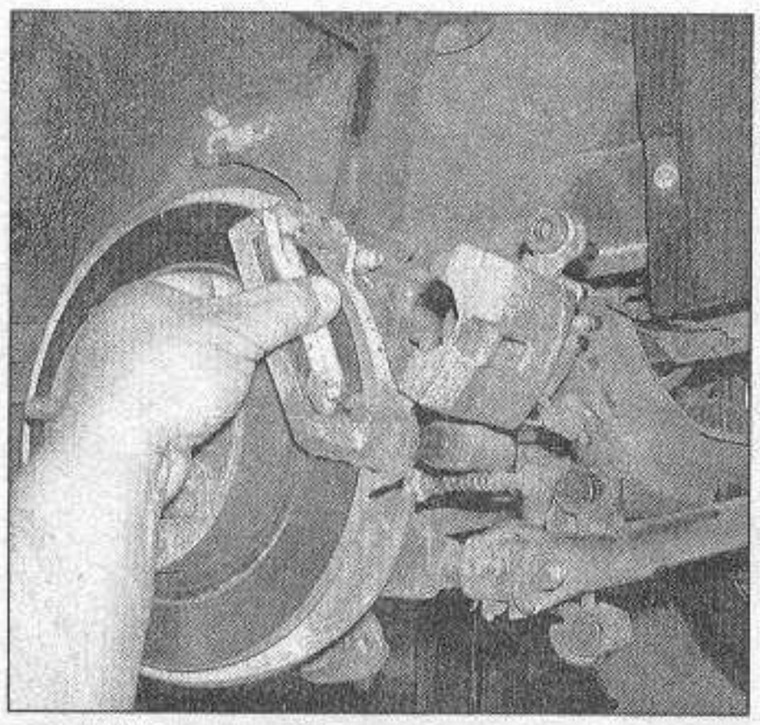
3.7f Remove the caliper mounting bolt (arrow) . . .



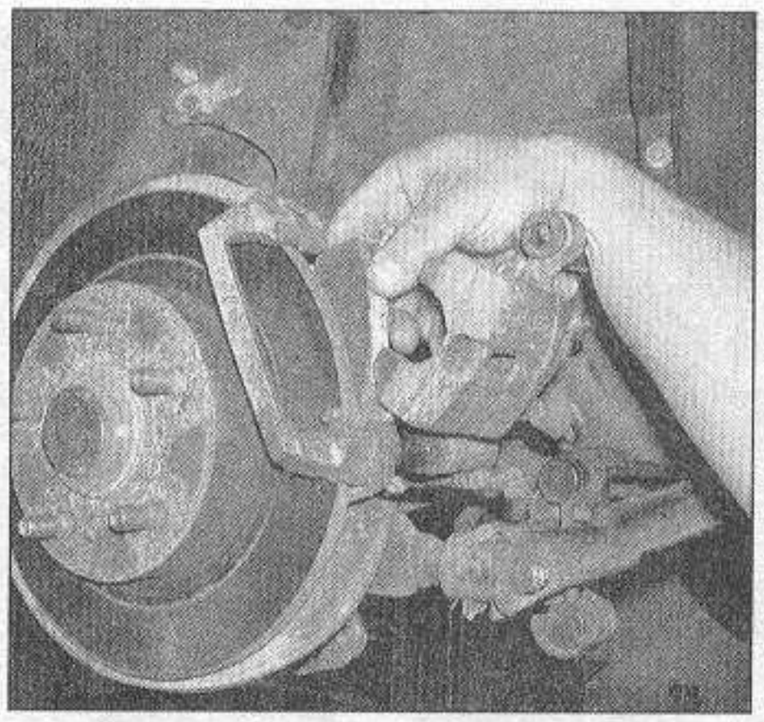
3.7g . . . and pivot the caliper back



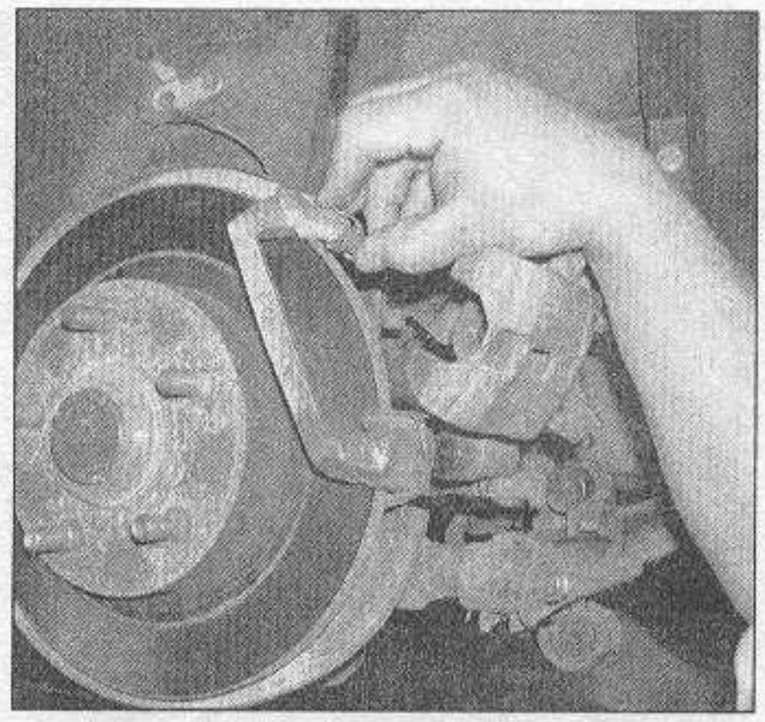
3.7h Remove the upper and lower anti-rattle springs



3.7i Remove the outer pad and shim



3.7j Remove the inner pad and shim



3.7k Remove the brake pad retainers from the mounting bracket

fications. Turn the caliper manual adjustment gear clockwise until the pads just touch the brake disc (see Steps 3.7d and 3.7e). Back the adjuster off (counterclockwise) 1/3 turn. Reinstall the lock bolt.

13 Reconnect the parking brake cable.

Front or rear pads

14 Install the wheel and lug nuts, lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

15 Apply and release the brake pedal several times to bring the pads into contact with the brake discs. Check the brake fluid level and add fluid, if necessary (see Chapter 1).

16 Check the operation of the brakes in an isolated area before driving the vehicle in traffic.

4 Brake caliper - removal and installation

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

Note: *Always replace the calipers in pairs - never replace just one of them.*

Front

Removal

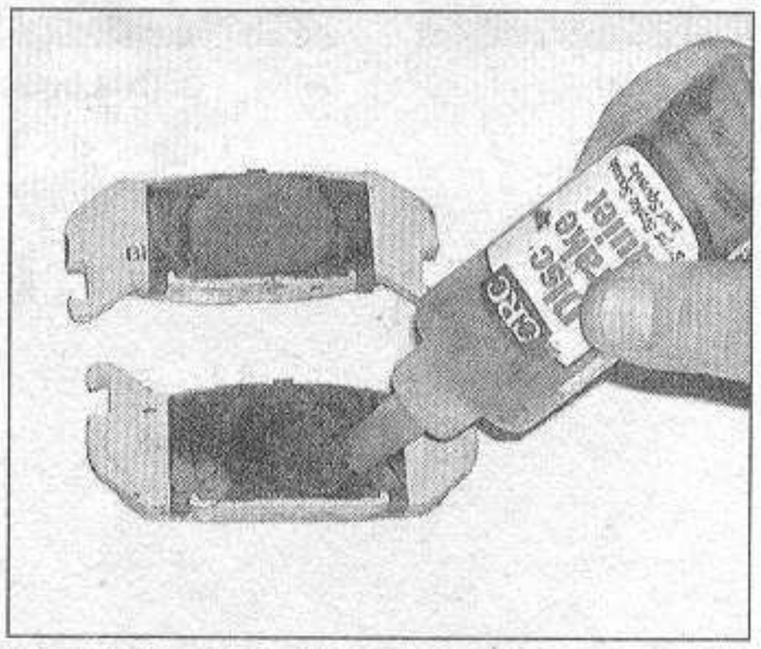
Refer to illustration 4.2

1 Loosen - but don't remove - the lug nuts on the front wheels. Raise the front of the vehicle and place it securely on jackstands. Remove the front wheels.

2 Disconnect the brake line from the caliper **(see illustration 3.6b)** and plug it to keep contaminants out of the brake system and to prevent losing any more brake fluid than necessary **(see illustration)**.

3 Remove the caliper mounting bolt **(see illustration 3.6b)**.

4 Swing the caliper up and slide it off the upper mounting pin.



3.8 Before installing the brake pads, apply a coat of disc brake anti-squeal compound to the backing plates of the pads - follow the manufacturer's instructions on the label

Installation

5 Install the caliper by reversing the removal procedure. Remember to replace the sealing washers on either side of the brake line fitting with new ones. Tighten the caliper mounting bolt and the banjo bolt to the torque listed in this Chapter's Specifications.

6 Bleed the brake system (see Section 10).

7 Install the wheels and lug nuts and lower the vehicle. Tighten the wheel lug nuts to the torque listed in the Chapter 1 Specifications.

Rear

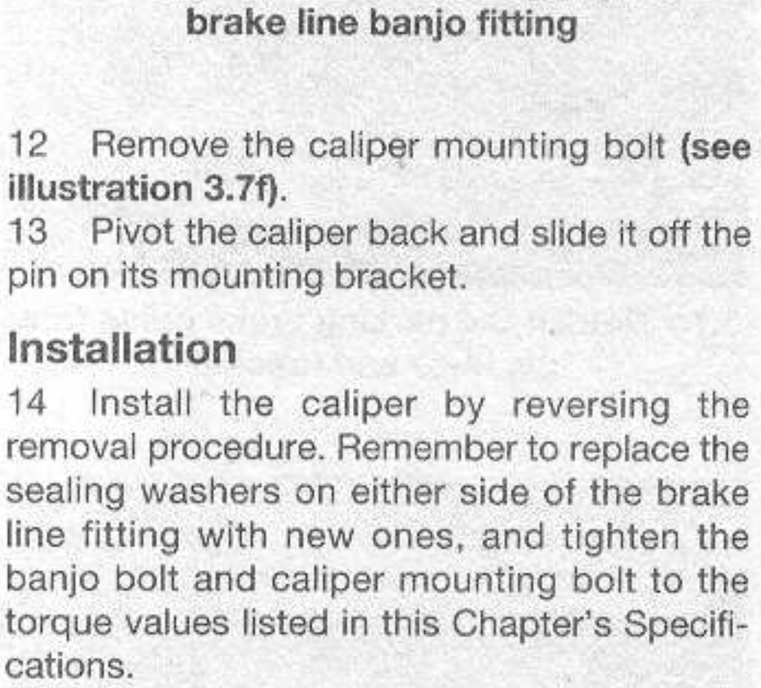
Removal

8 Loosen - but don't remove - the lug nuts on the rear wheels. Raise the rear of the vehicle and place it securely on jackstands. Remove the rear wheels.

9 Release the parking brake and remove the clip from the parking brake cable on the back side of the caliper assembly **(see illustration 3.7a)**.

10 Separate the parking brake cable from the lever on the caliper **(see illustrations 3.7b and 3.7c)**.

11 Unscrew the banjo bolt and detach the brake line from the caliper. Plug the fitting to prevent fluid loss and contamination **(see illustration 4.2)**.



4.2 Using a short piece of rubber hose of the appropriate diameter, plug the brake line banjo fitting

12 Remove the caliper mounting bolt **(see illustration 3.7f)**.

13 Pivot the caliper back and slide it off the pin on its mounting bracket.

Installation

14 Install the caliper by reversing the removal procedure. Remember to replace the sealing washers on either side of the brake line fitting with new ones, and tighten the banjo bolt and caliper mounting bolt to the torque values listed in this Chapter's Specifications.

15 Bleed the brake system (see Section 10).

16 Install the wheels and lug nuts. Lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

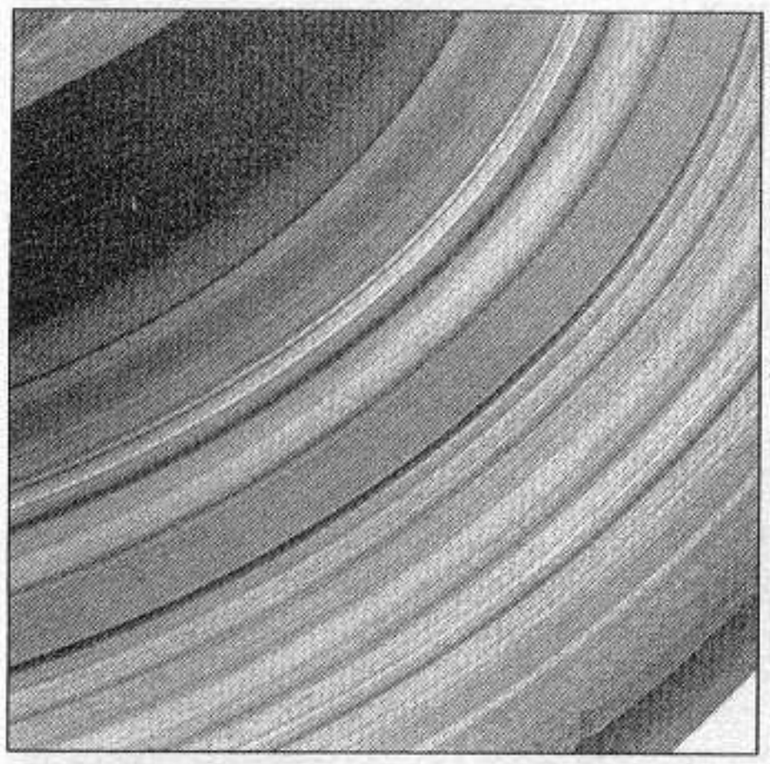
5 Brake disc - inspection, removal and installation

Note: *This procedure applies to both the front and (on vehicles so equipped) rear brake discs.*

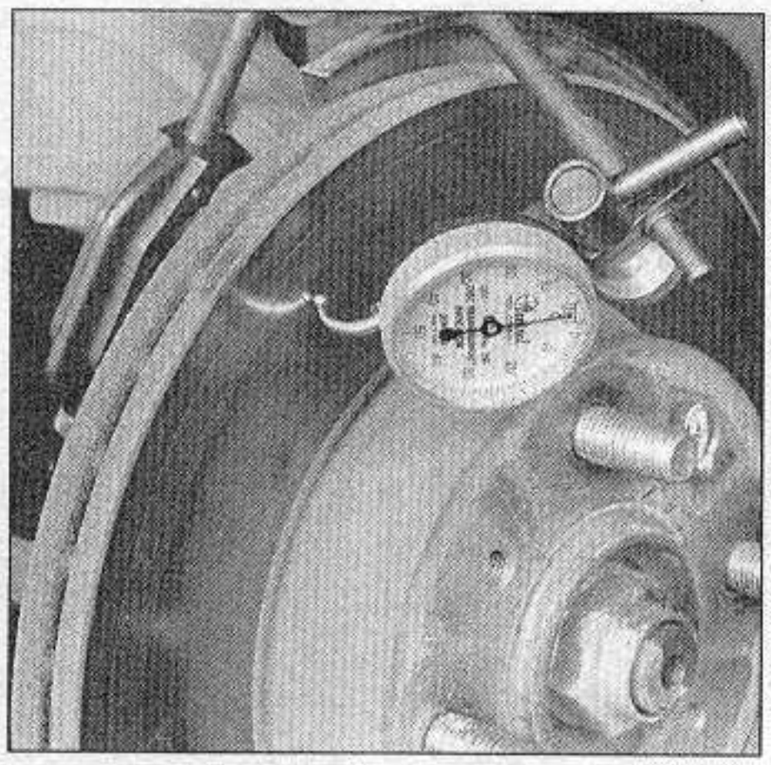
Inspection

Refer to illustrations 5.3, 5.4a, 5.4b, 5.5a and 5.5b

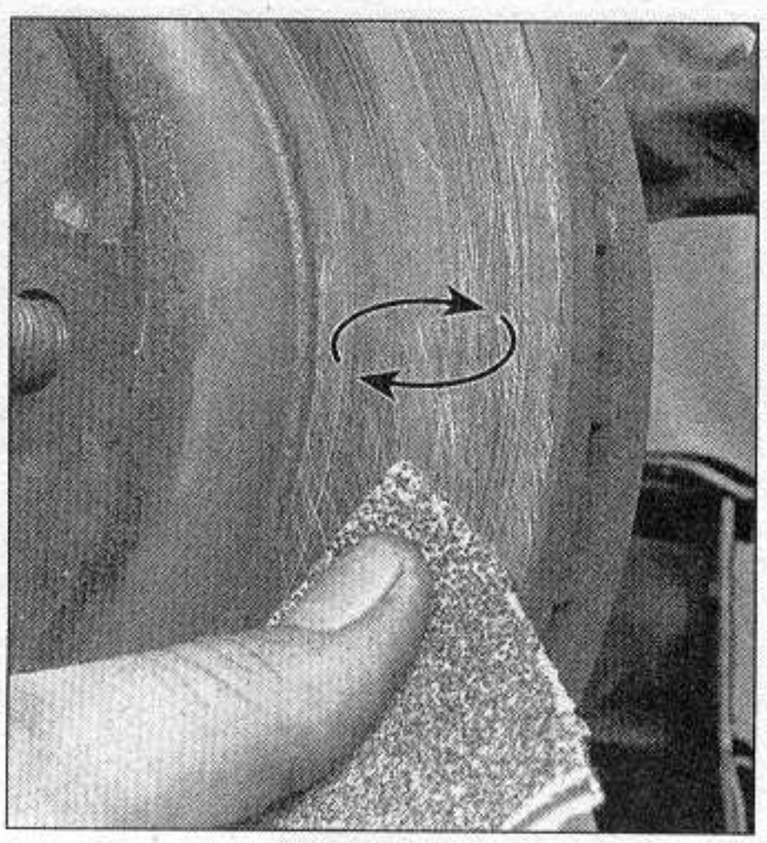
1 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands.



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



5.4a Make sure the disc retaining screws or lug nuts are tight, then rotate the disc and check the runout with a dial indicator - if the reading exceeds the maximum allowable runout limit, the disc will have to be machined or replaced



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

Remove the wheel and install the lug nuts with 3 mm thick washers under them to hold the disc in place (if the two disc retaining screws are still in place, this will be unnecessary). If you're checking the rear disc, release the parking brake.

2 Remove the brake caliper (see Section 4), but don't disconnect the brake hose. After removing the caliper, suspend it out of the way with a piece of wire.

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

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

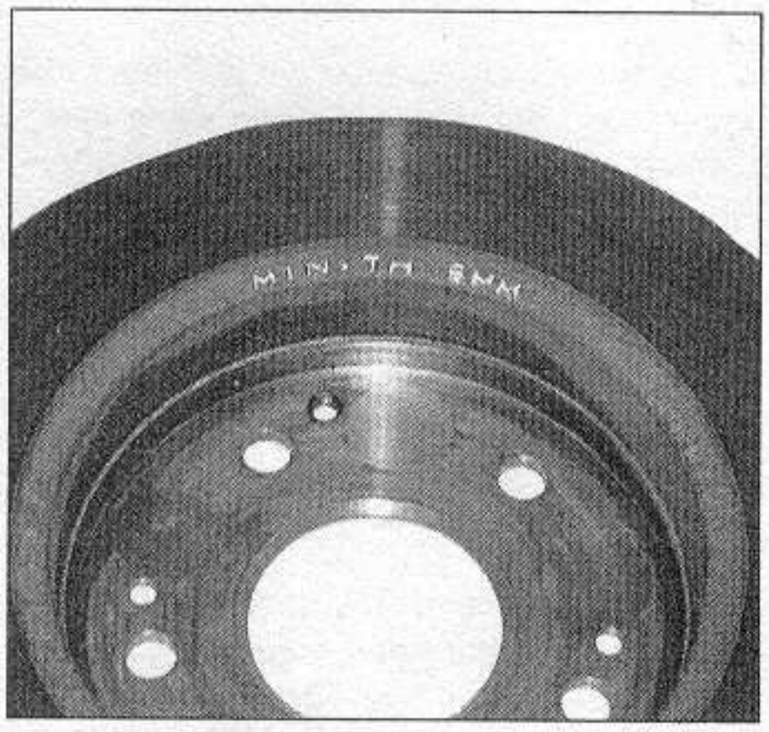
5 It is absolutely critical that the disc not be machined to a thickness less than the minimum allowable thickness. The minimum wear (or discard) thickness is stamped on the disc **(see illustration)**. The disc thickness can be checked with a micrometer **(see illustration)**. Check the thickness at several points.

Removal

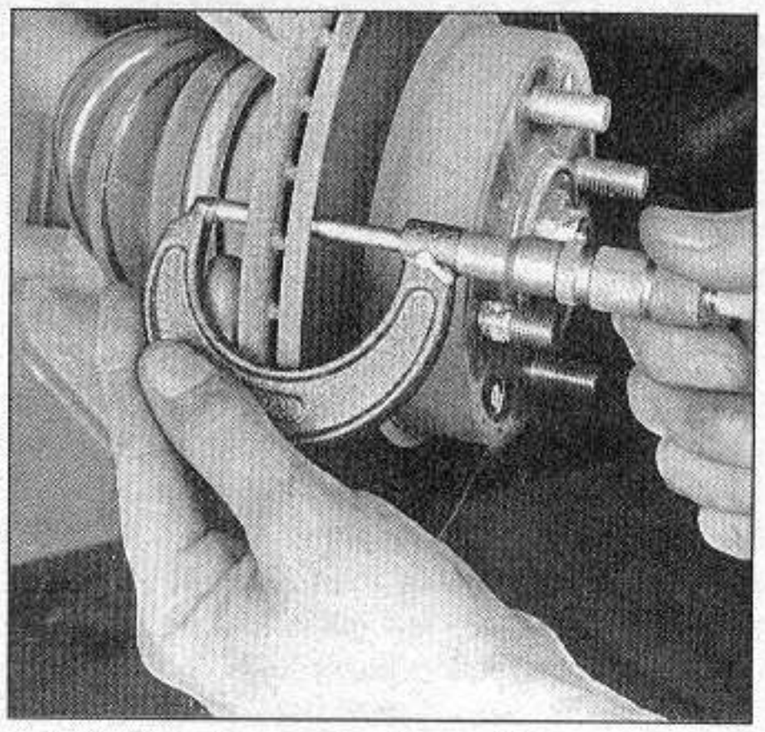
Refer to illustrations 5.6a, 5.6b, 5.7a and 5.7b

6 Remove the brake caliper (if not already done), but don't disconnect the brake hose (see Section 4). Remove the two caliper mounting bracket-to-steering knuckle bolts **(see illustration)** or, on rear calipers, the bracket-to-knuckle bolts **(see illustration)**, and remove the mounting bracket.

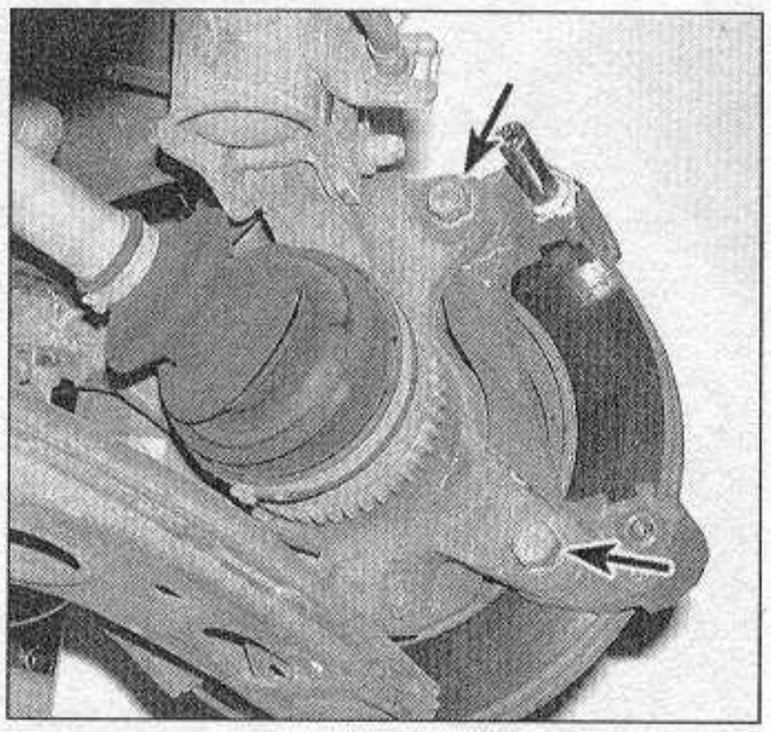
7 Remove the lug nuts which were put on



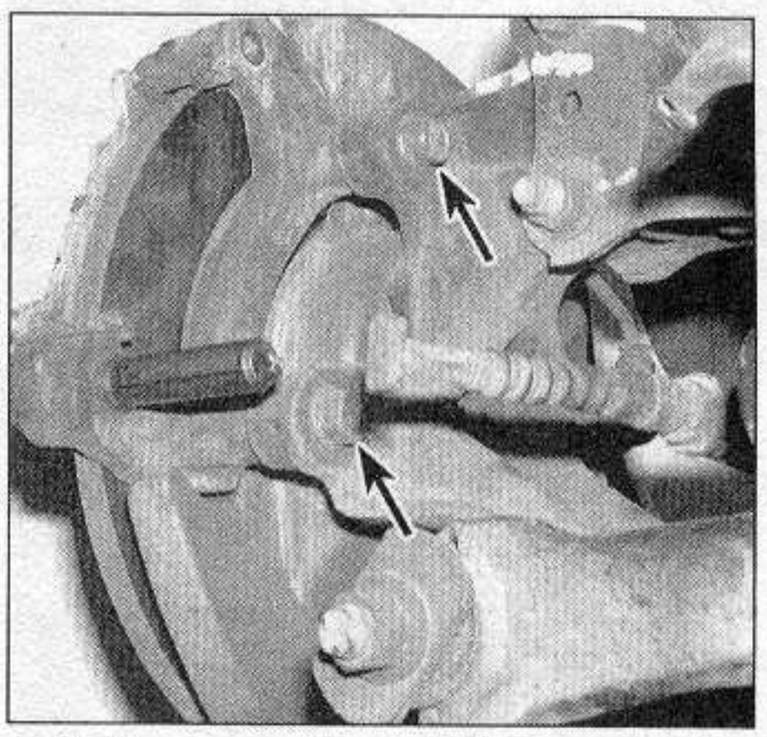
5.5a The minimum allowable thickness is stamped into the disc (typical)



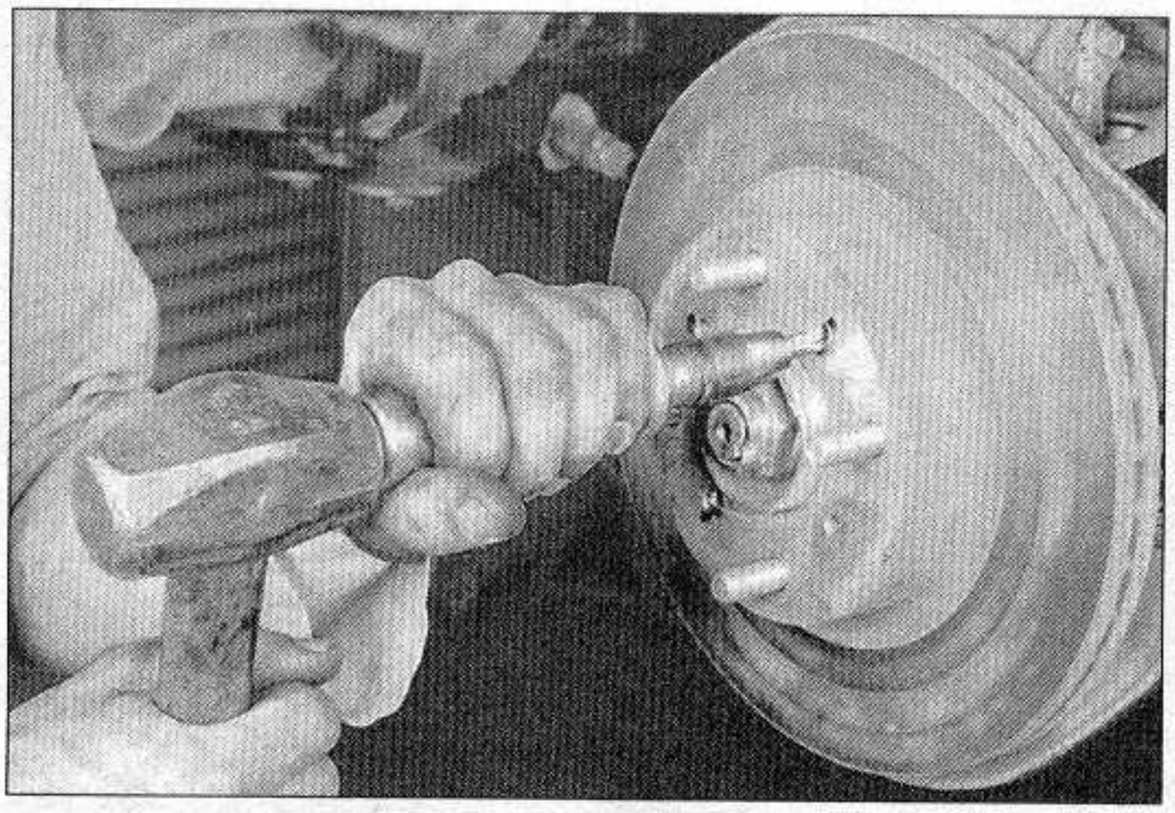
5.5b A micrometer is used to measure disc thickness



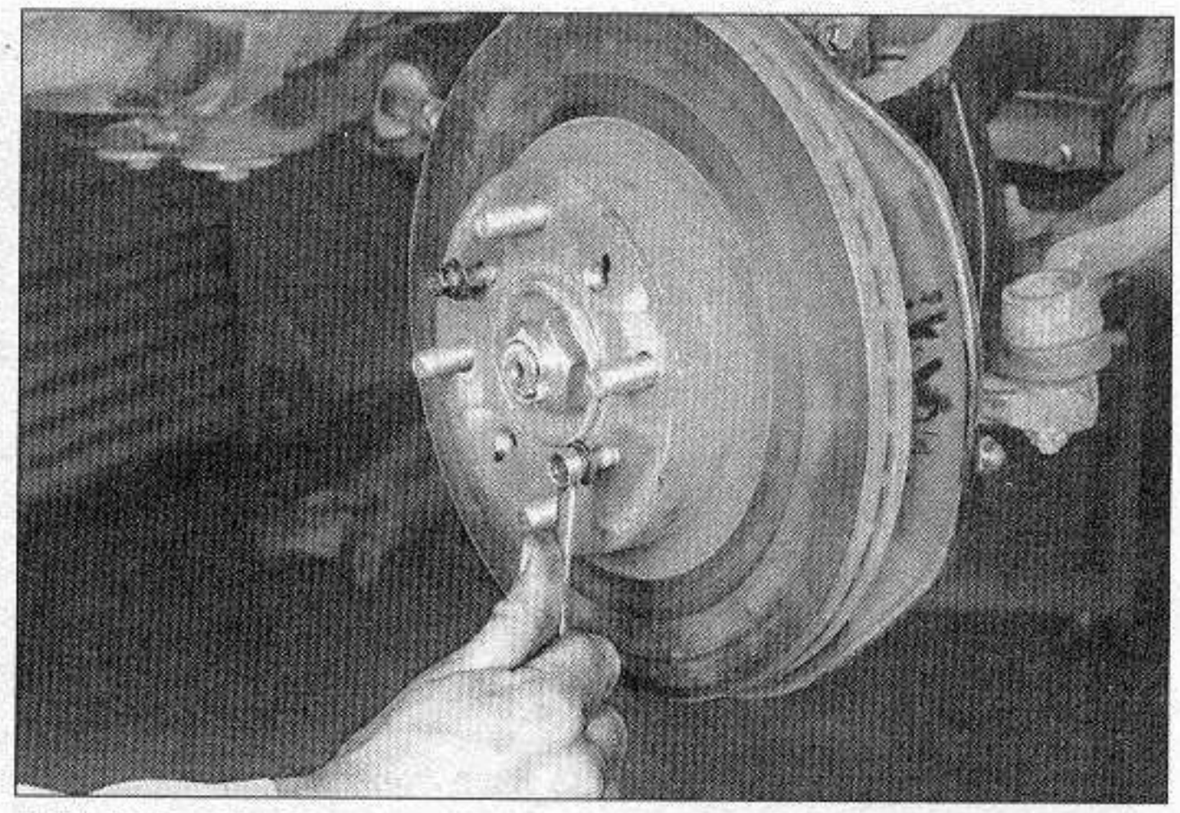
5.6a Before you can remove the front disc, you'll have to remove these caliper mounting bracket-to-steering knuckle bolts (arrows) and the bracket



5.6b To remove the rear disc, remove the caliper mounting bracket-to-knuckle bolts (arrows), then remove the caliper mounting bracket



5.7a If the disc retaining screws are stuck, use an impact screwdriver to loosen them



5.7b If the disc is stuck, thread two bolts into the disc and tighten them to force the disc off the hub

to hold the disc in place, or the two disc retaining screws, if present **(see illustration)** and remove the disc from the hub. If the disc is stuck to the hub and won't come off, thread two bolts into the holes provided **(see illustration)** and tighten them. Alternate between the bolts, turning them a couple of turns at a time, until the disc is free **(see illustration)**.

Installation

8 Place the disc in position over the threaded studs. Install the disc retaining screws and tighten them securely.

9 Install the caliper mounting bracket, brake pads and caliper. Tighten the mounting bracket and caliper bolts to the torque values listed in this Chapter's Specifications. If you're working on the rear disc brake, be sure to adjust the caliper as described in Section 3).

10 Install the wheel, then lower the vehicle to the ground. Depress the brake pedal a few times to bring the brake pads into contact with the disc. Bleeding of the system will not be necessary unless the fluid hose was disconnected from the caliper. Check the operation of the brakes carefully before placing the vehicle into normal service.

6 Drum brake shoes - replacement

Refer to illustrations 6.2, 6.4a through 6.4u, 6.5 and 6.6

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

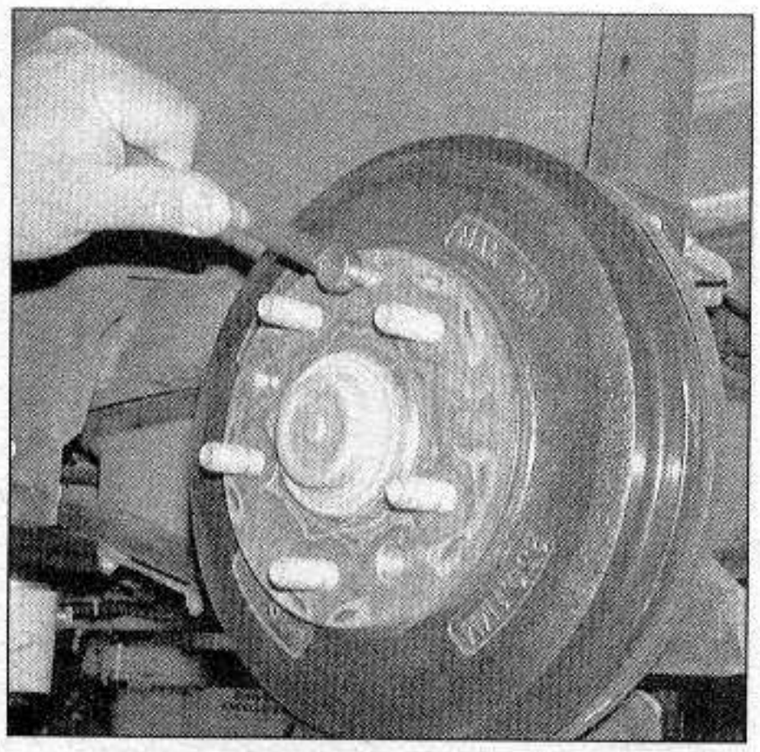
Caution: *Whenever the brake shoes are replaced, the return and hold-down springs should also be replaced. Due to the continuous heating/cooling cycle that the springs are subjected to, they lose their tension over a period of time and may allow the shoes to drag on the drum and wear at a much faster rate than normal.*

1 Loosen the wheel lug nuts, raise the rear of the vehicle and support it securely on jackstands. Block the front wheels to keep the vehicle from rolling. Remove the rear wheels. Release the parking brake.

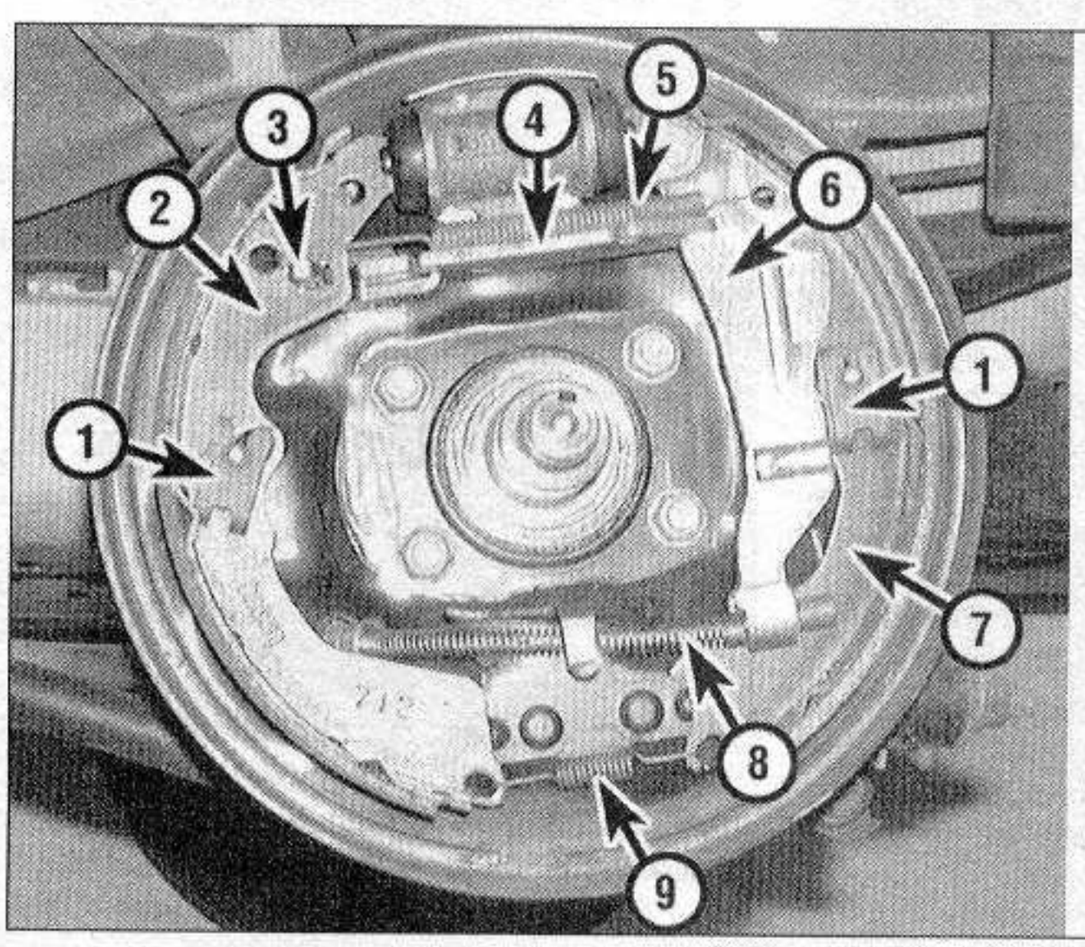
2 Remove the brake drum. It should simply pull straight off the hub. **Note:** *On some models it may be necessary to remove the grease cap from the hub to allow drum removal.* If the drum won't come off, tap it carefully with a soft-faced mallet, or screw an of 8.0 mm bolt into the tapped hole, which will press the drum off **(see illustration)**.

3 Replacing the shoes is a lot easier if you remove the rear wheel bearing cap, spindle nut and washer, and slide off the hub unit (see Chapter 10).

4 Follow **illustrations 6.4a through 6.4u** for the inspection and replacement of the brake shoes. Be sure to stay in order and read the caption under each illustration. All four rear brake shoes must be replaced at the same time, but to avoid mixing up parts, work

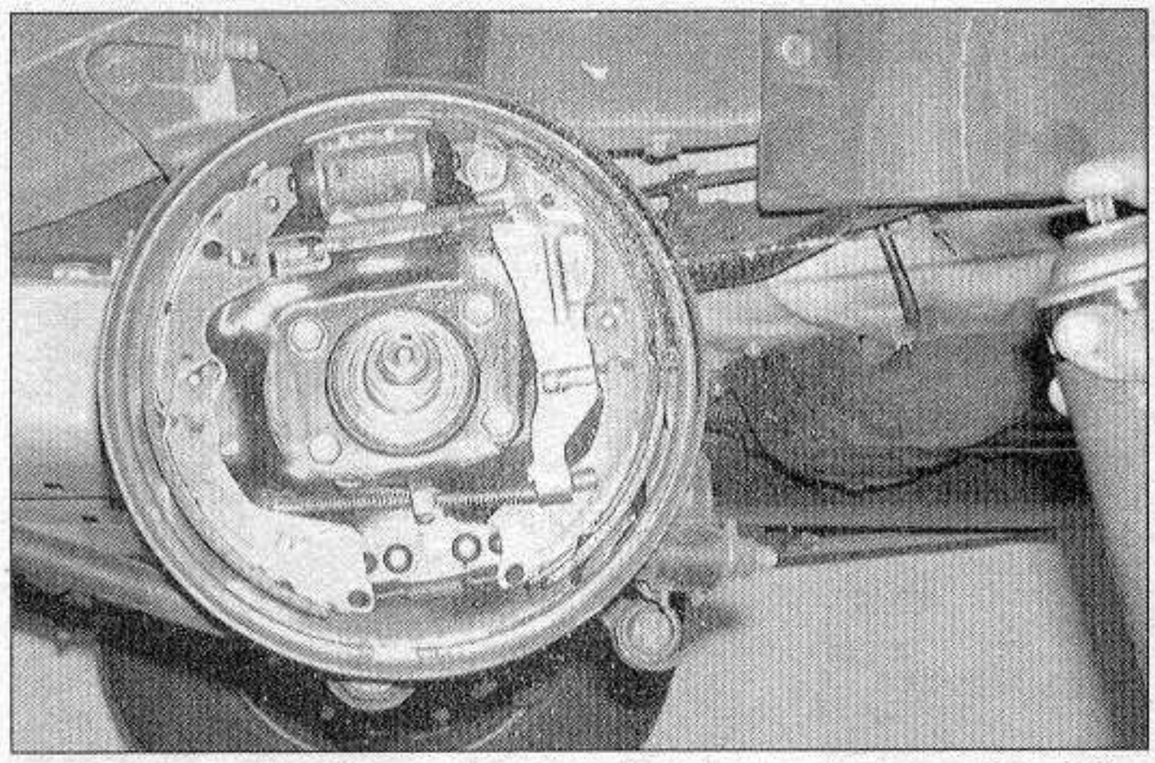


6.2 If the drum is hard to pull off, thread an 8 mm bolt into the hole provided to force the drum off

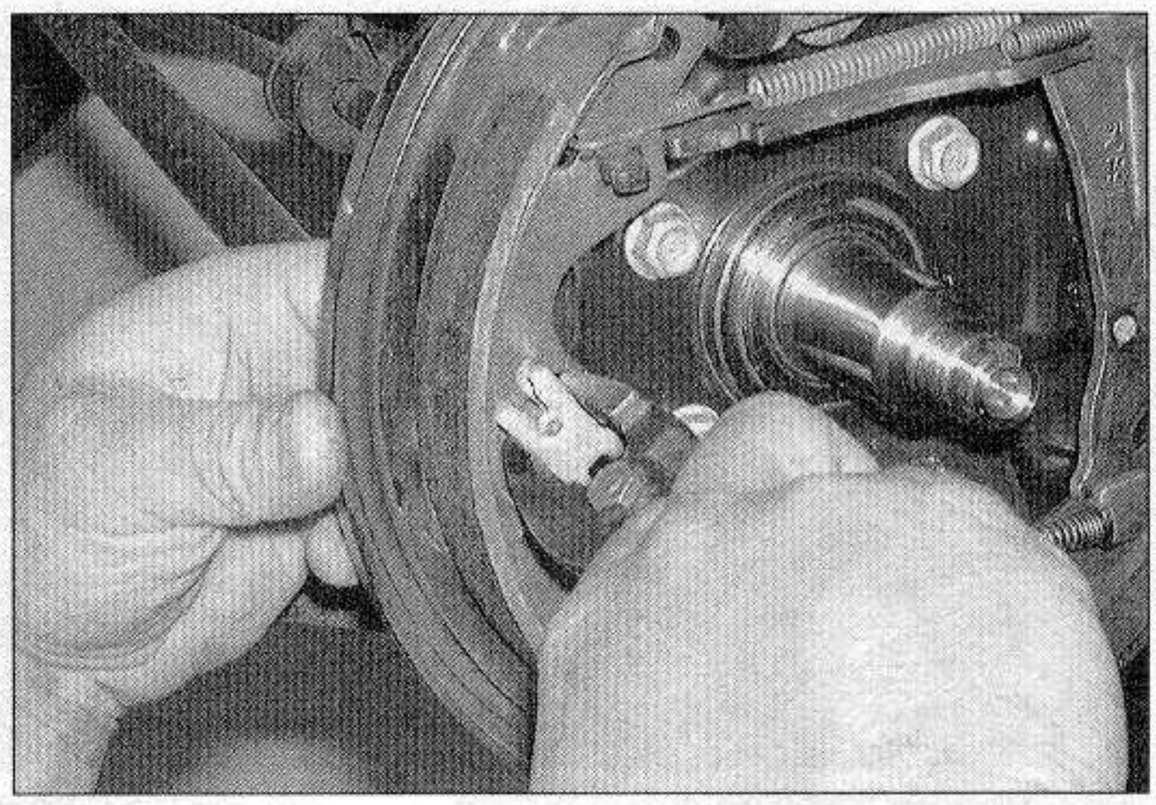


6.4a Details of the rear drum brake assembly

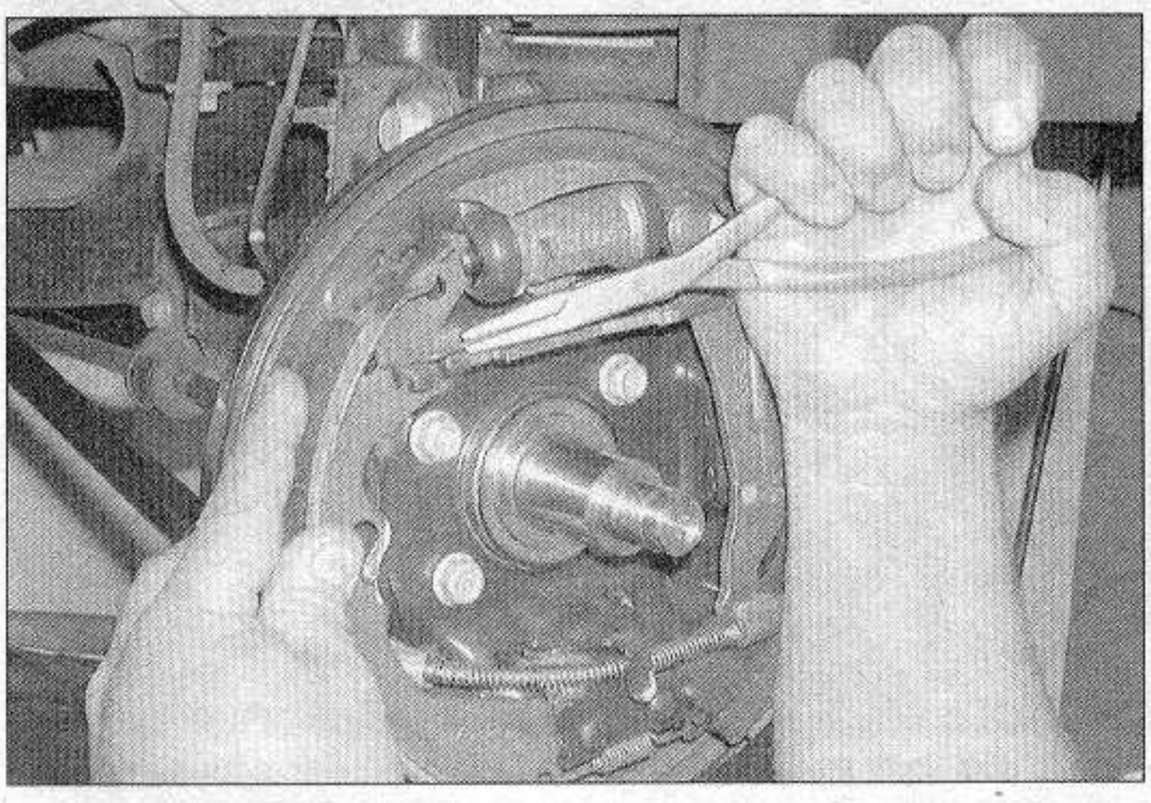
1 *Hold-down spring*
2 *Leading brake shoe*
3 *Knurled quadrant*
4 *Parking brake strut/adjuster quadrant*
5 *Shoe return spring*
6 *Parking brake lever*
7 *Trailing brake shoe*
8 *Parking brake cable*
9 *Shoe return spring*



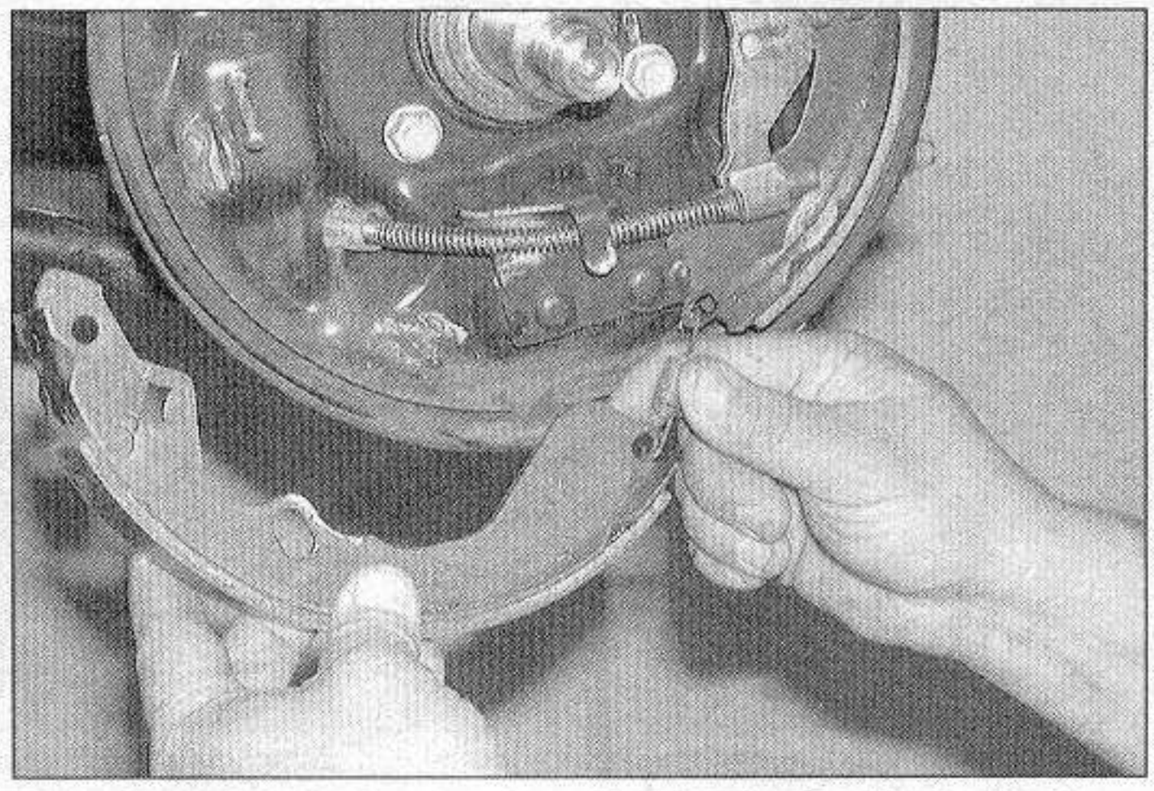
6.4b Before removing anything, clean the brake assembly with brake cleaner and allow it to dry - position a drain pan under the brake assembly to catch the residue - **DO NOT USE COMPRESSED AIR TO BLOW BRAKE DUST OFF THE PARTS!**



6.4c Push down on the hold-down spring, then turn the pin to align its blade with the slot



6.4d Unhook the upper return spring from the leading shoe

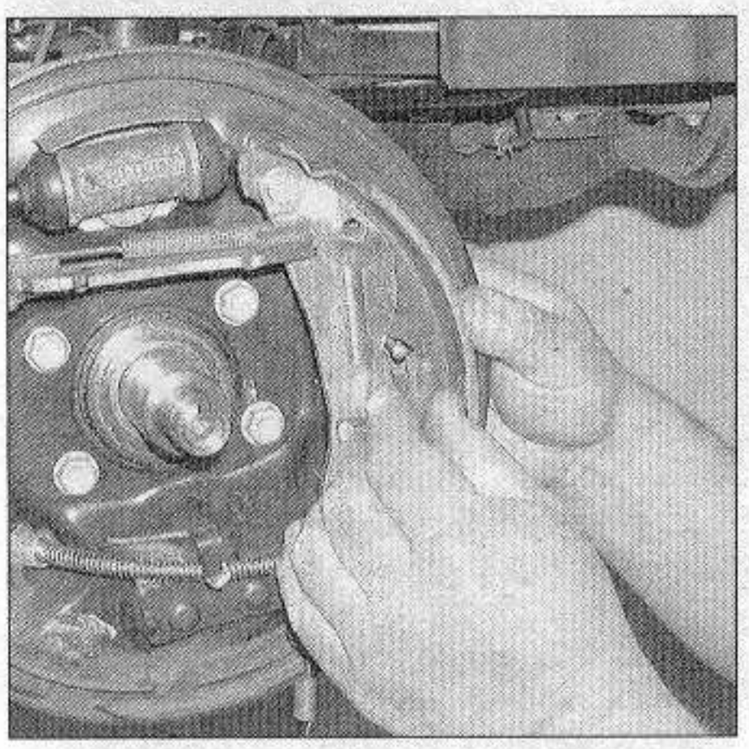


6.4e Detach the adjuster assembly from the leading brake shoe and detach the lower return spring

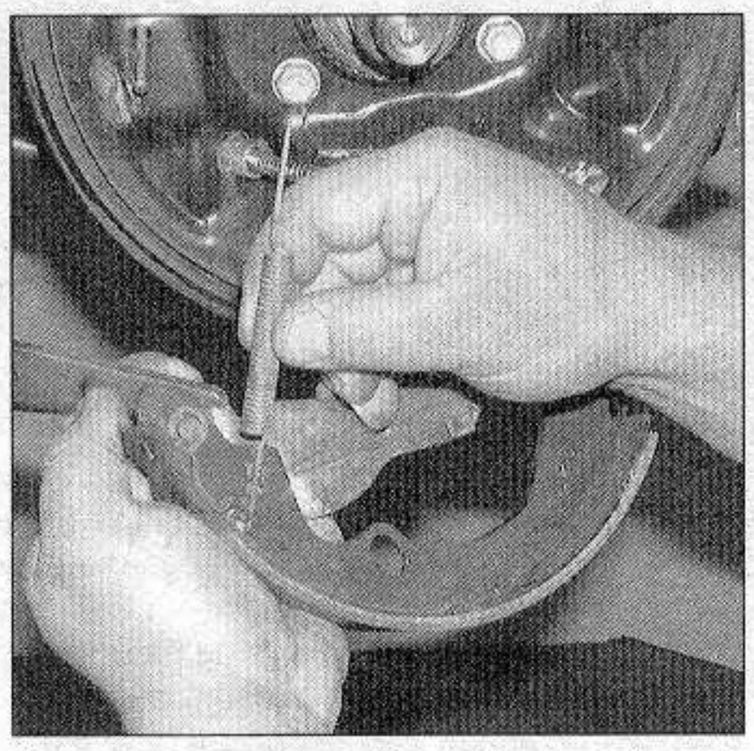
on only one brake assembly at a time.

5 Before reinstalling the drum, make sure the brake shoes are retracted to allow easy installation of the drum. Install a screwdriver into the knurled quadrant of the parking brake spring/adjuster assembly **(see illustration)** and rotate the ratchet mechanism to decrease brake shoe expansion.

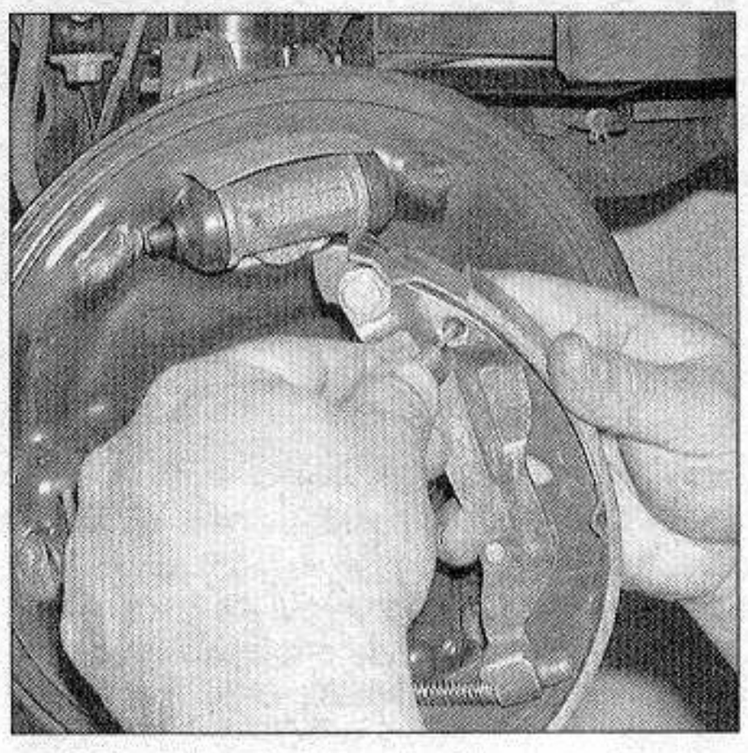
6 Also, before reinstalling the drum, it should be checked for cracks, score marks, deep scratches and hard spots, which will appear as small discolored areas. If the hard spots cannot be removed with fine emery cloth or if any of the other conditions listed above exist, the drum must be taken to an



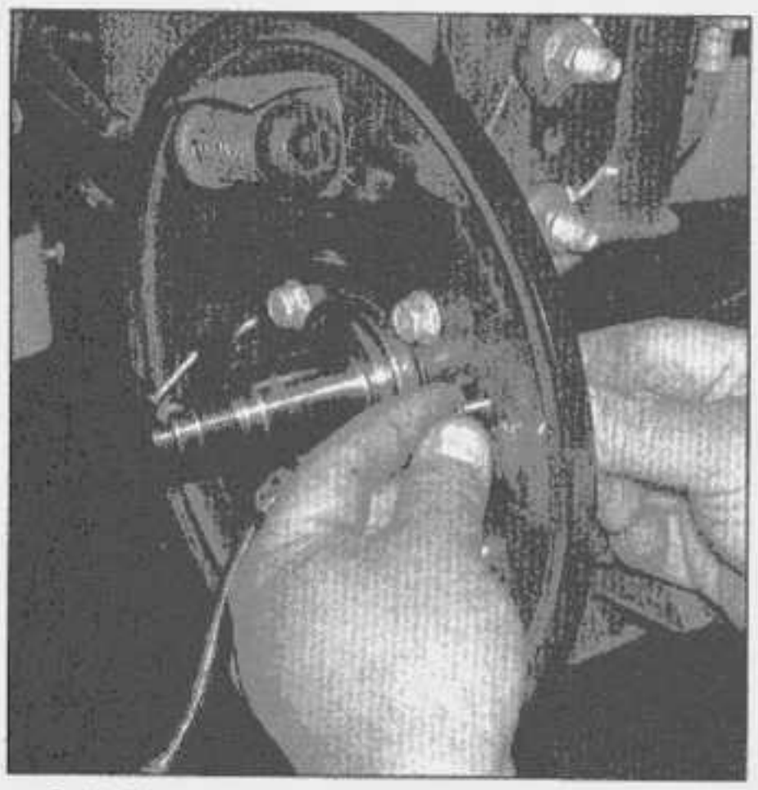
6.4f Remove the hold-down spring from the trailing brake shoe



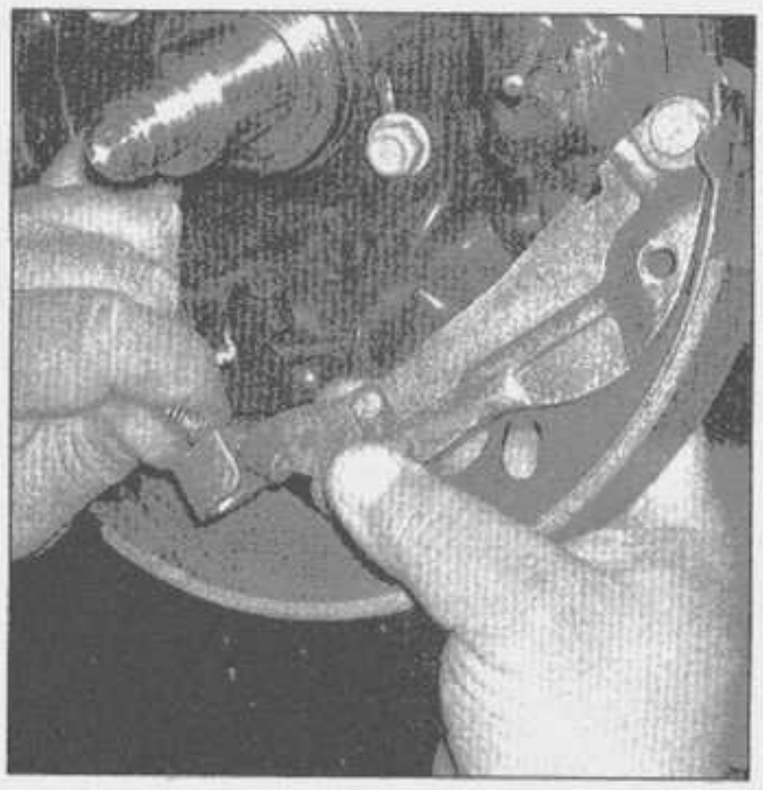
6.4g Remove the trailing shoe and detach the return spring



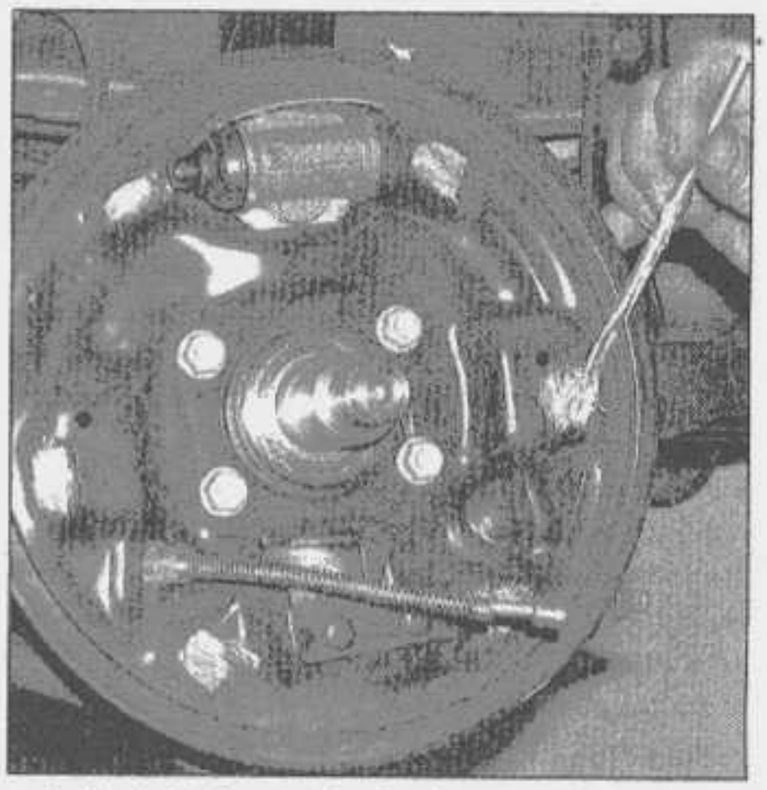
6.4h Unhook the adjusting quadrant spring from the shoe



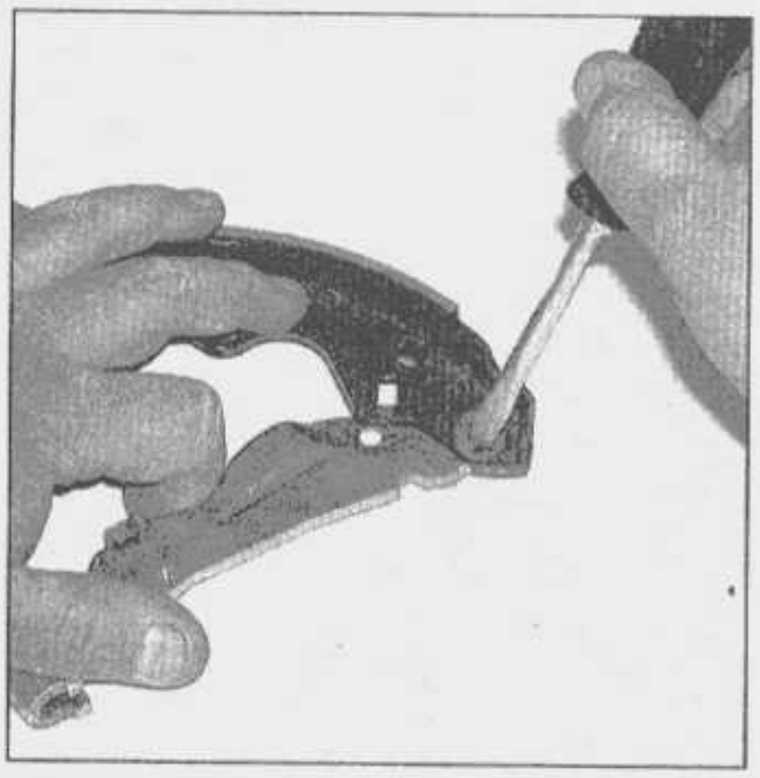
6.4i Remove the hold-down pins from the backing plate



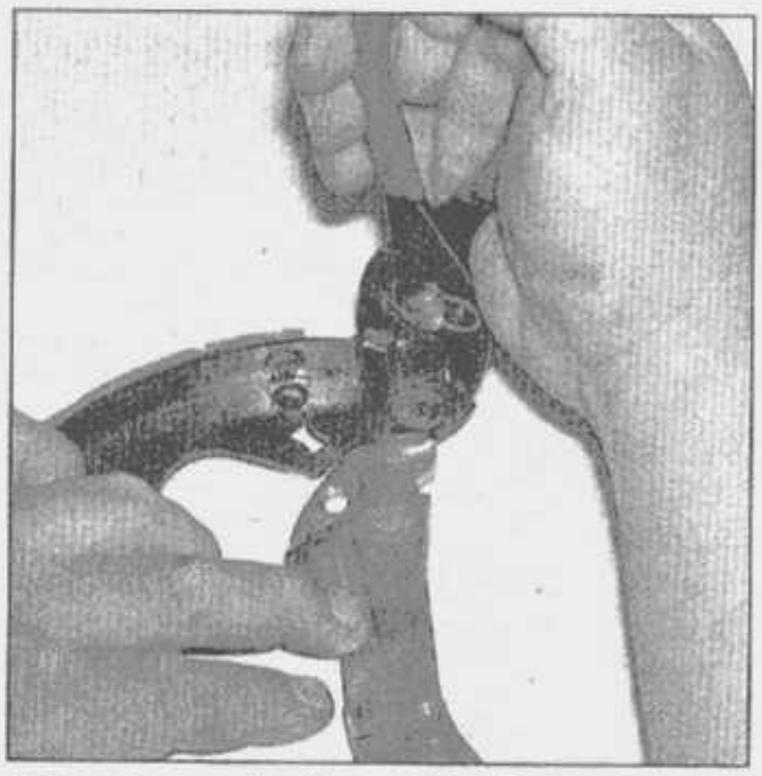
6.4j Detach the parking brake cable from the lever on the trailing shoe



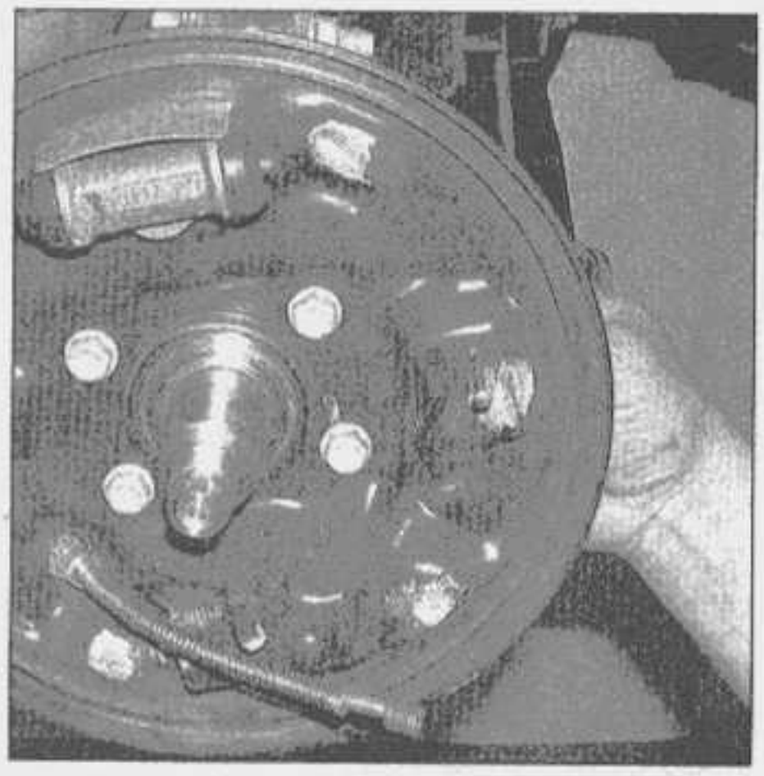
6.4k Lubricate the brake shoe contact areas on the backing plate with high-temperature grease



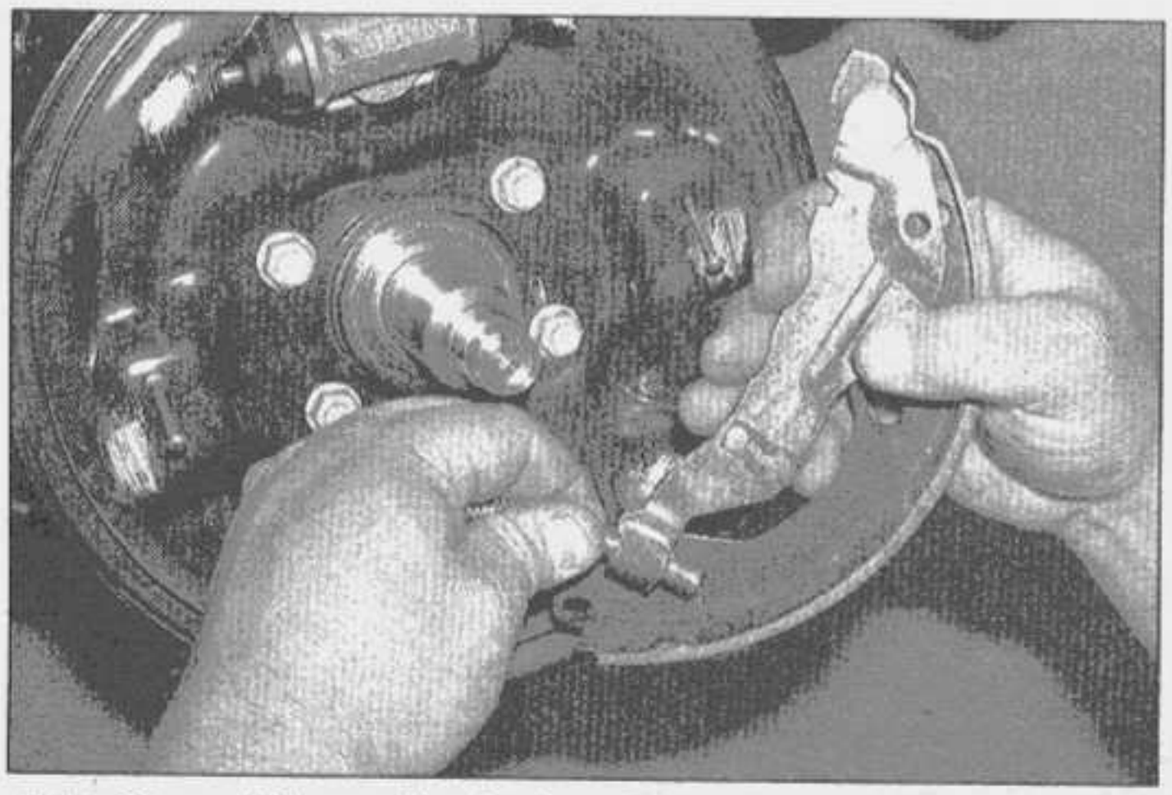
6.4l To separate the parking brake lever from the trailing shoe, pry the retaining clip off with a screwdriver



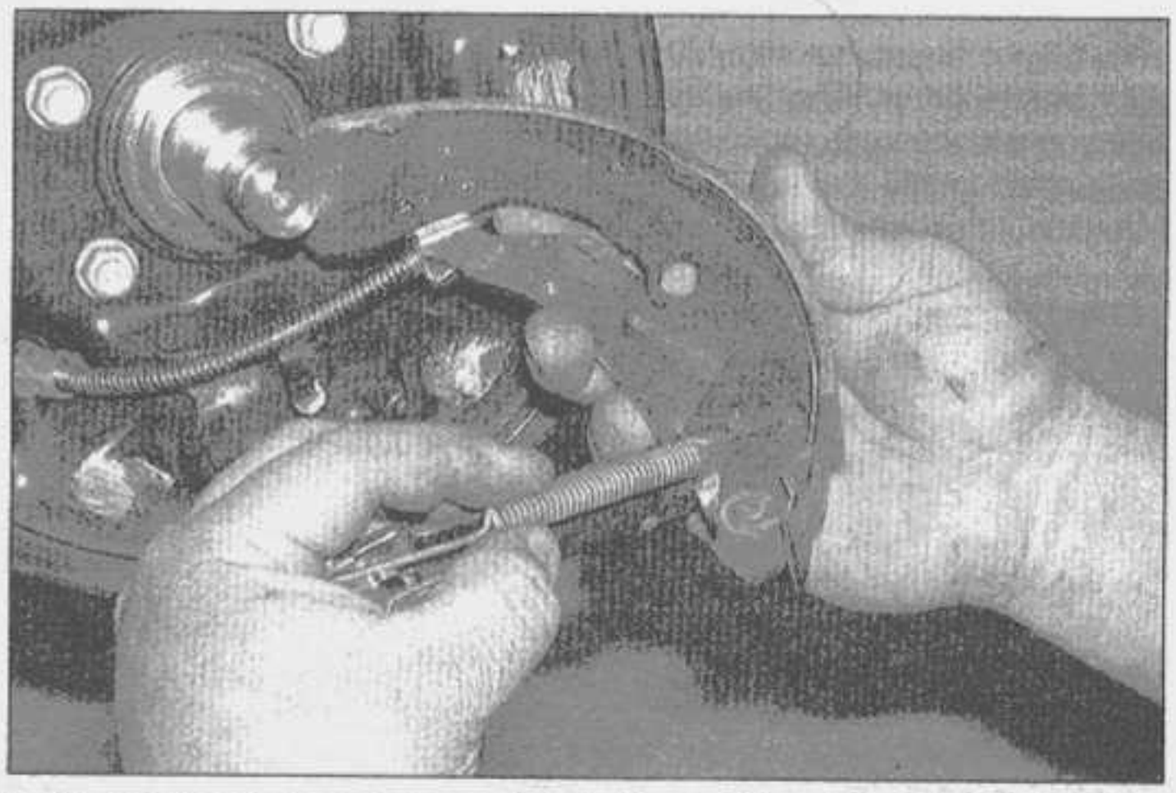
6.4m Assemble the parking brake lever to the new shoe and secure it with a new clip



6.4n Install the hold-down pins into the backing plate



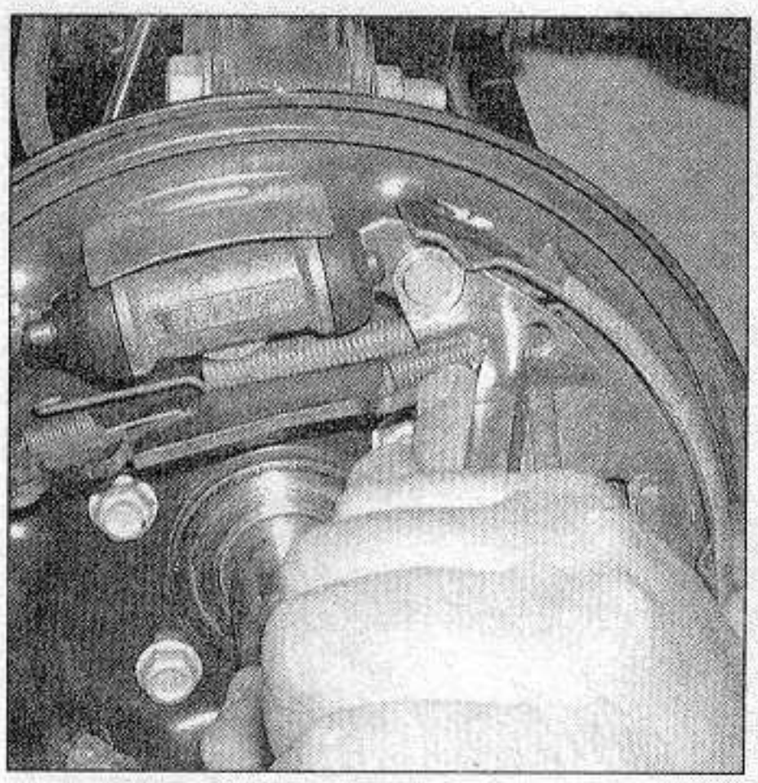
6.4o Connect the parking brake cable to the parking brake lever



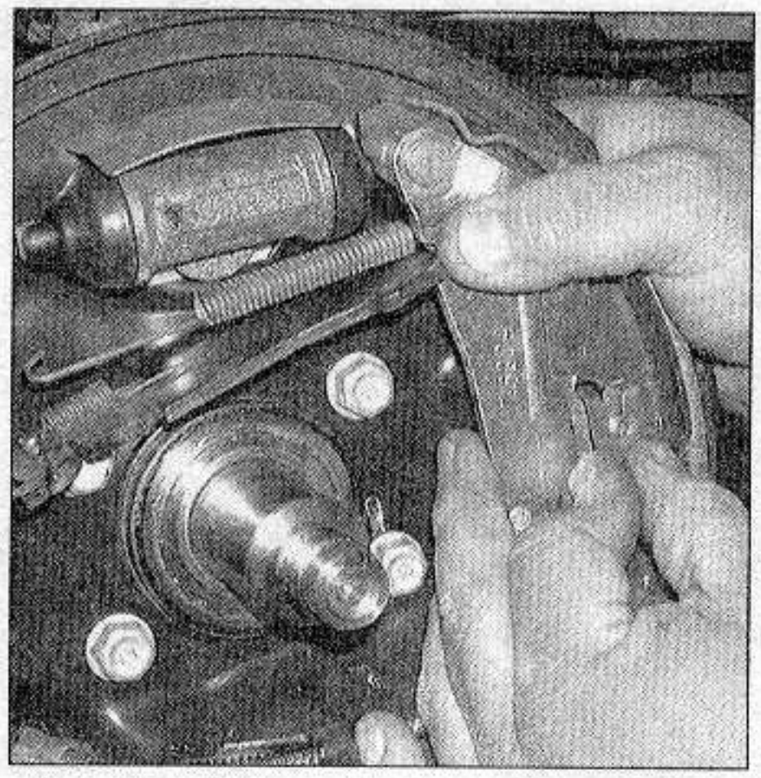
6.4p Connect the return spring to the trailing shoe along with the parking brake strut/adjuster quadrant assembly

automotive machine shop to have it machined. **Note:** *Professionals recommend resurfacing the drums whenever a brake job is done. Resurfacing will eliminate the possibility of out-of-round drums.* If the drums are worn so much that they can't be resurfaced without exceeding the maximum allowable diameter (stamped into the drum) **(see illustration)**, then new ones will be required. At the very least, if you elect not to have the drums resurfaced, remove the glazing from the surface with sandpaper or emery cloth using a swirling motion.

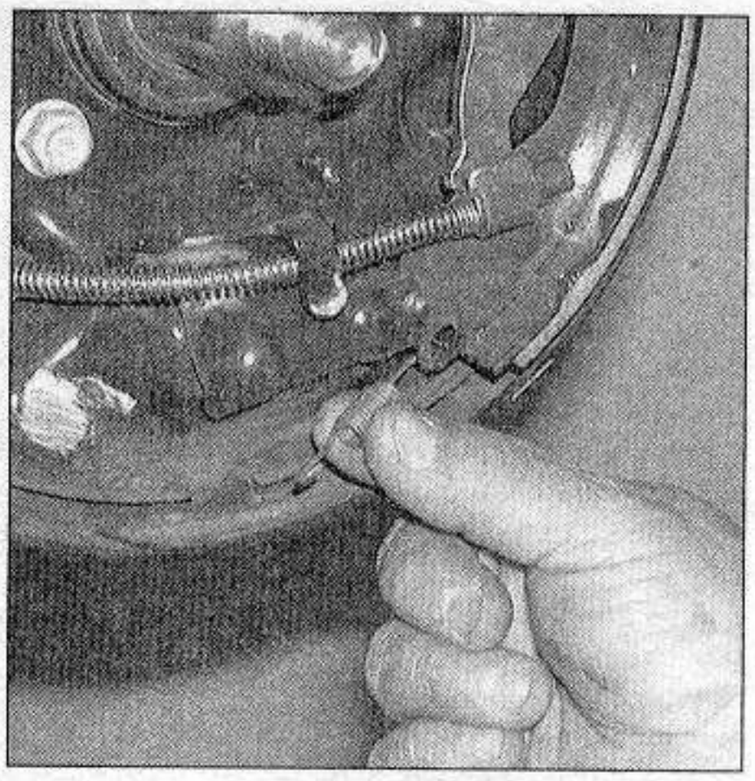
7 Install the hub and bearing unit, the washer and a *new* spindle nut if removed pre-



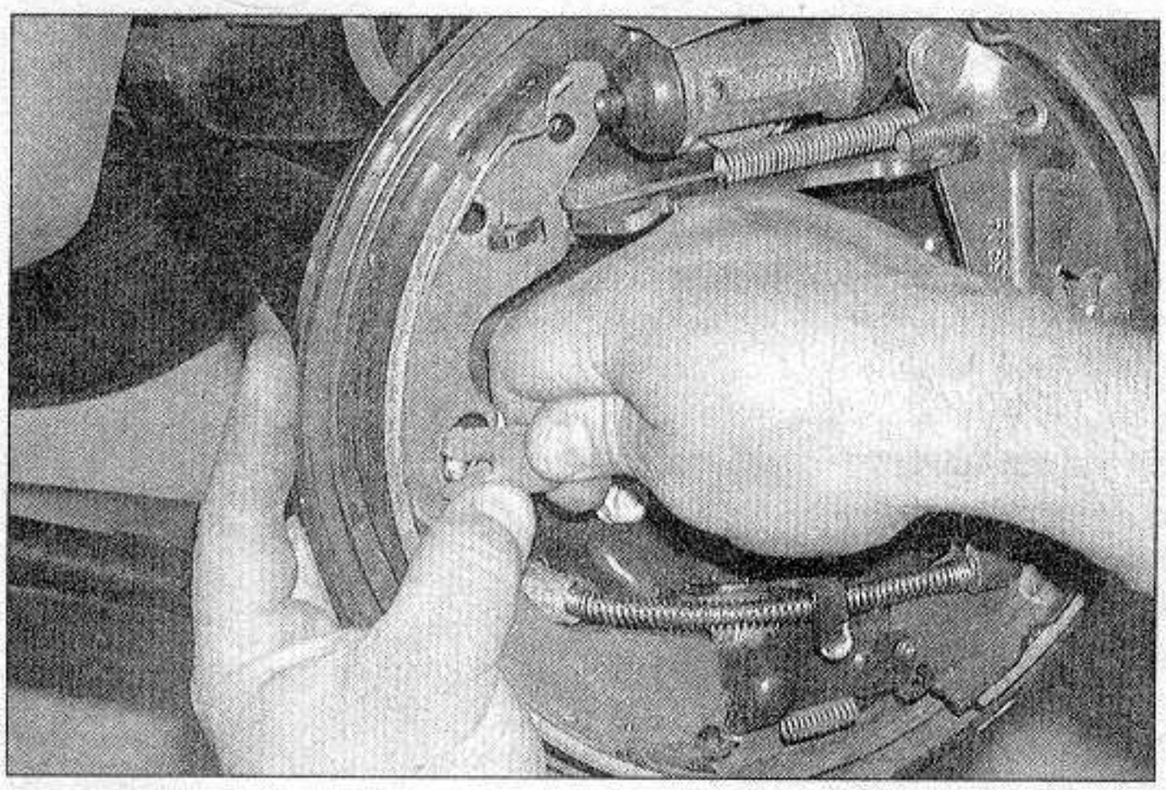
6.4q Install the trailing shoe assembly onto the backing plate, making sure it engages correctly with the wheel cylinder



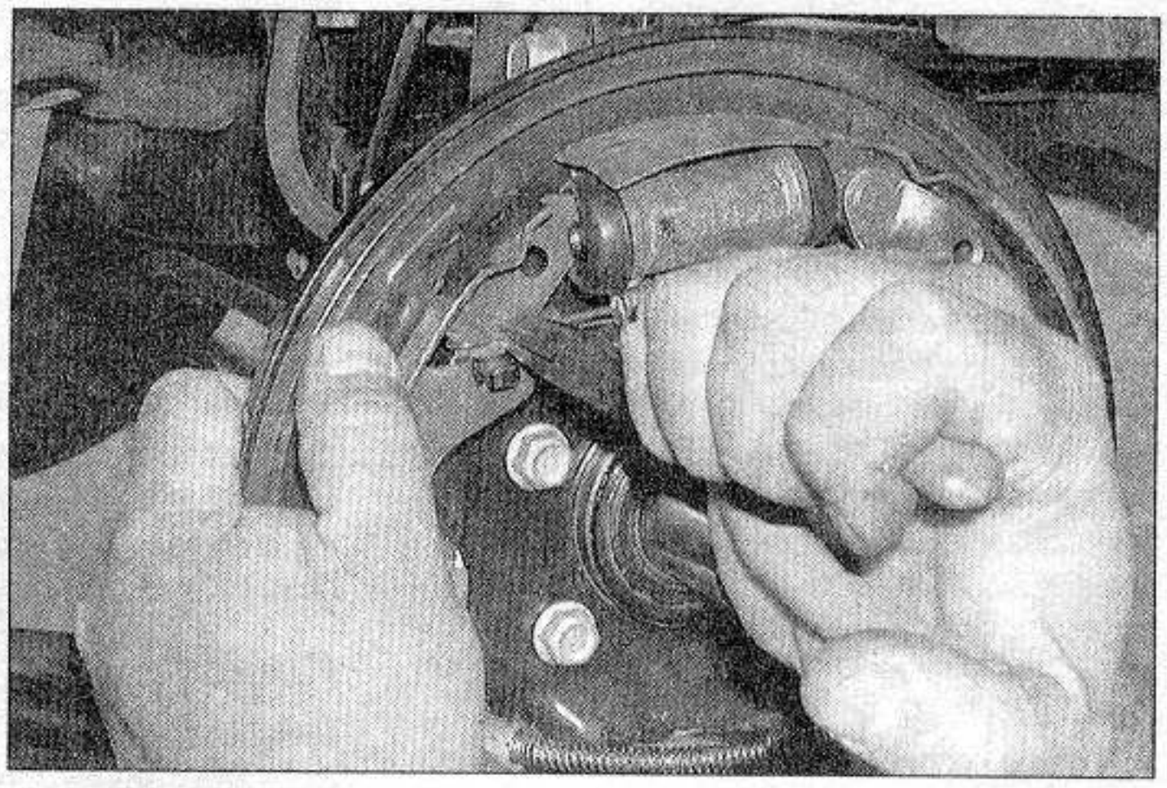
6.4r Install the hold-down clip onto the hold-down pin



6.4s Connect the lower return spring to the trailing shoe



6.4t Place the leading shoe in position, connect the lower return spring, then install the hold-down clip



6.4u Connect the upper return spring to the leading brake shoe

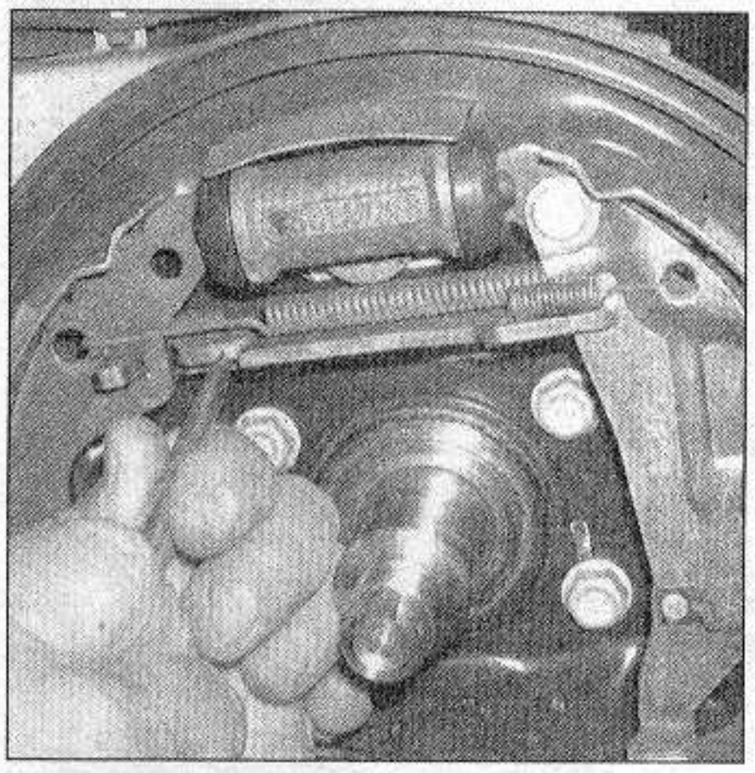
viously (see Chapter 10). Tighten the nut to the torque listed in the Chapter 10 Specifications.

8 Install the brake drum.

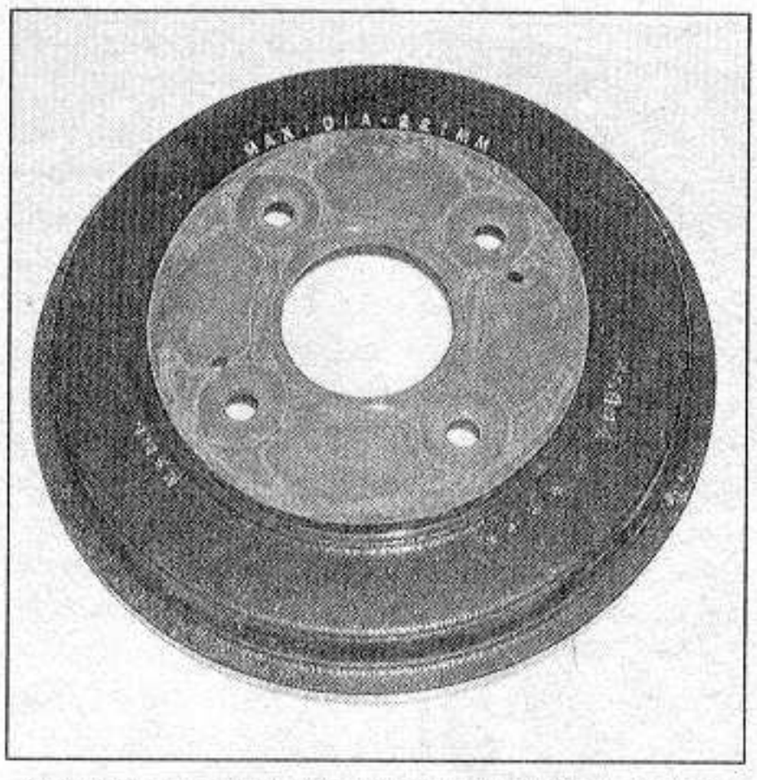
9 Mount the wheel, install the lug nuts, then lower the vehicle. Tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

10 Depress the brake pedal several times to bring the brake shoes into the proper adjustment. Then, drive the vehicle backwards and forwards and apply the brakes forcefully a number of times. This action will allow the brake shoes to adjust while the brake shoes are expanding.

11 Check brake operation carefully before driving the vehicle in traffic. **Warning:** *Do not operate the vehicle if you are in doubt about the effectiveness of the brake system.*



6.5 Use a screwdriver to release the knurled quadrant in the adjuster assembly to retract the brake shoes



6.6 The maximum allowable diameter is cast into the drum (typical)

7 Wheel cylinder - removal and installation

Refer to illustration 7.4

Note: *If the wheel cylinders leak, they must be replaced with new ones - the manufacturer does not recommend rebuilding them.*

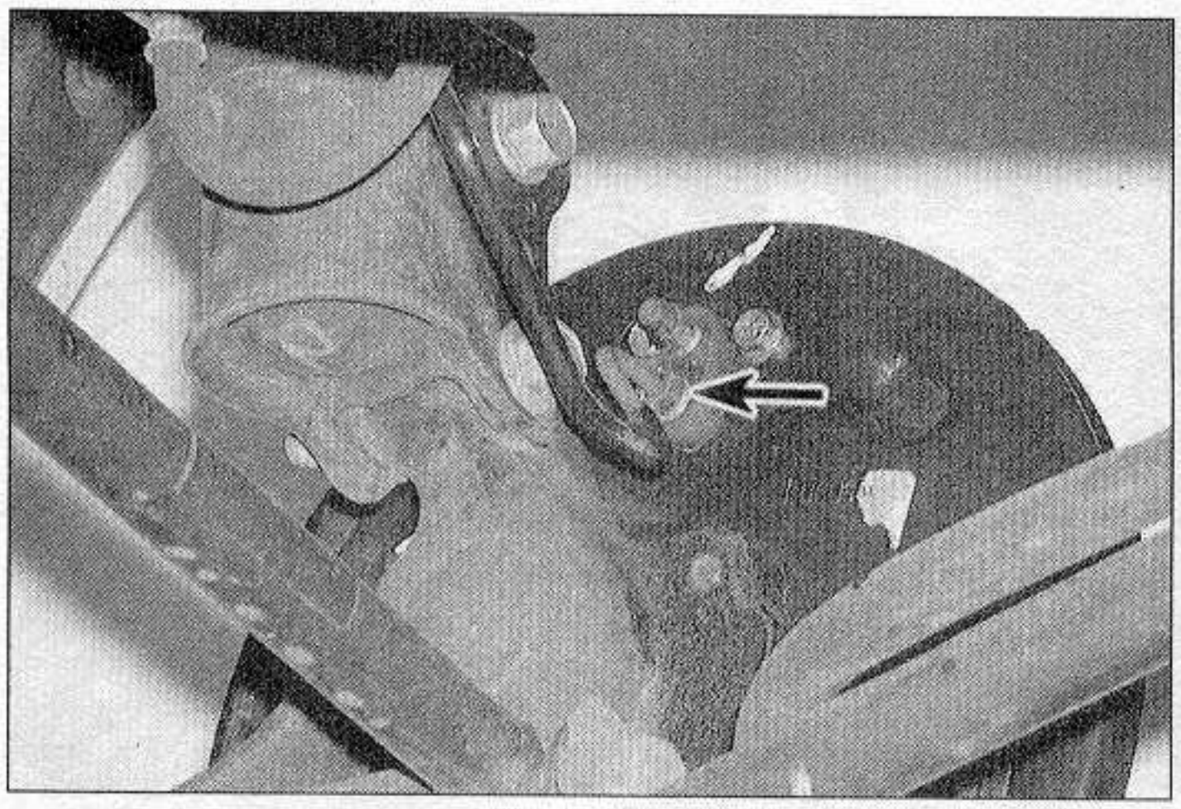
Removal

1 Raise the rear of the vehicle and support it securely on jackstands. Block the front wheels to keep the vehicle from rolling.

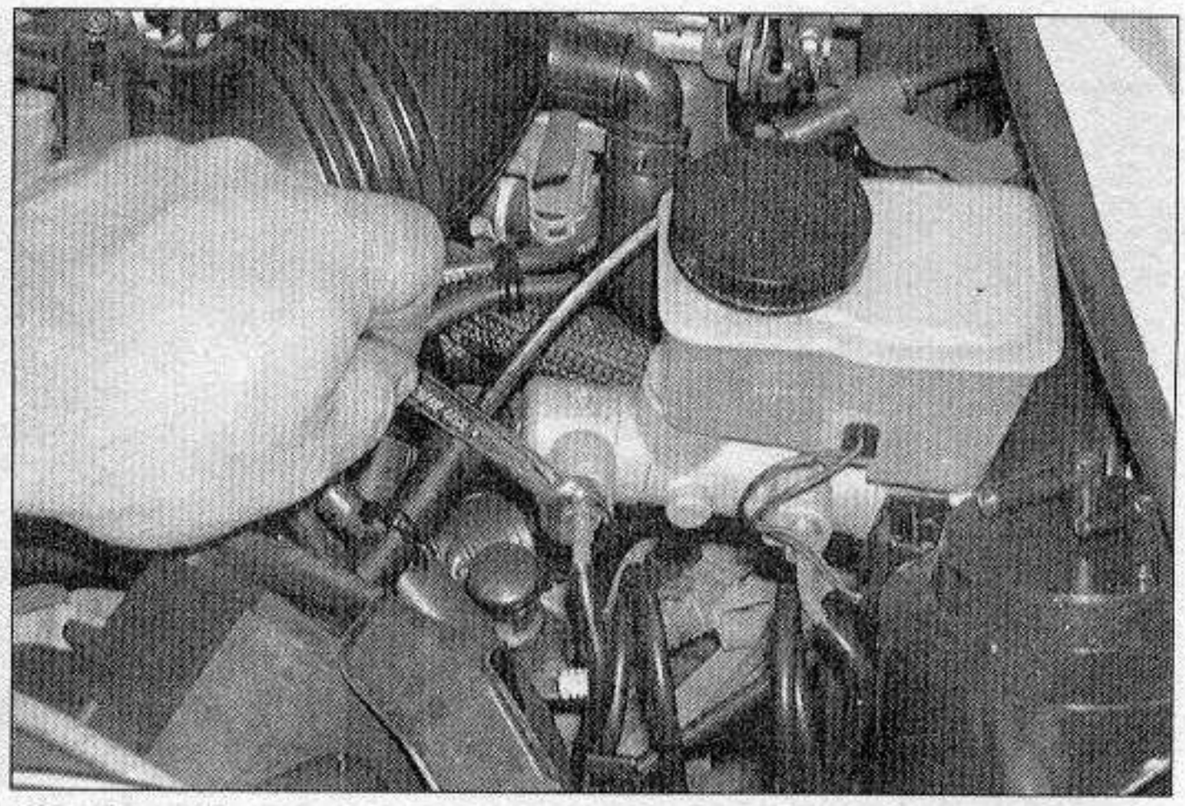
2 Remove the brake shoe assembly (see Section 6).

3 Remove all dirt and foreign material from around the wheel cylinder.

9



7.4 Unscrew the brake line fitting (arrow), then remove the two wheel cylinder bolts



8.6 Use a flare-nut wrench to unscrew the threaded fittings at the master cylinder - a regular wrench can round off the corners

4 Unscrew the brake line fitting **(see illustration)**. **Note:** *If available, use a flare-nut wrench to avoid rounding off the corners of the fittings.* Don't pull the brake line away from the wheel cylinder.

5 Remove the wheel cylinder mounting bolts.

6 Detach the wheel cylinder from the brake backing plate. Immediately plug the brake line to prevent fluid loss and contamination. Golf tees or rubber vacuum caps work well for plugging or capping flared metal lines. **Note:** *If the brake shoe linings are contaminated with brake fluid, install new brake shoes and clean the drums with brake system cleaner.*

Installation

7 Apply RTV sealant to the mating surface of the wheel cylinder and the brake backing plate, place the cylinder in position and connect the brake line. Don't tighten the fitting completely yet.

8 Install the mounting bolts, tightening them to the torque listed in this Chapter's Specifications. Tighten the brake line fitting. Install the brake shoe assembly (see Section 6).

9 Bleed the brakes (see Section 10).

10 Check brake operation before driving the vehicle in traffic. **Warning:** *Do not operate the vehicle if you are in doubt about the effectiveness of the brake system.*

8 Master cylinder - removal and installation

Note: *If the master cylinder is defective, it must be replaced with a new one - the manufacturer does not recommend rebuilding it.*

Removal

Refer to illustrations 8.6 and 8.7

1 The master cylinder is located in the engine compartment, mounted to the power brake booster.

2 If the vehicle is equipped with cruise control, disconnect the cruise control actuator and position it off to the side.

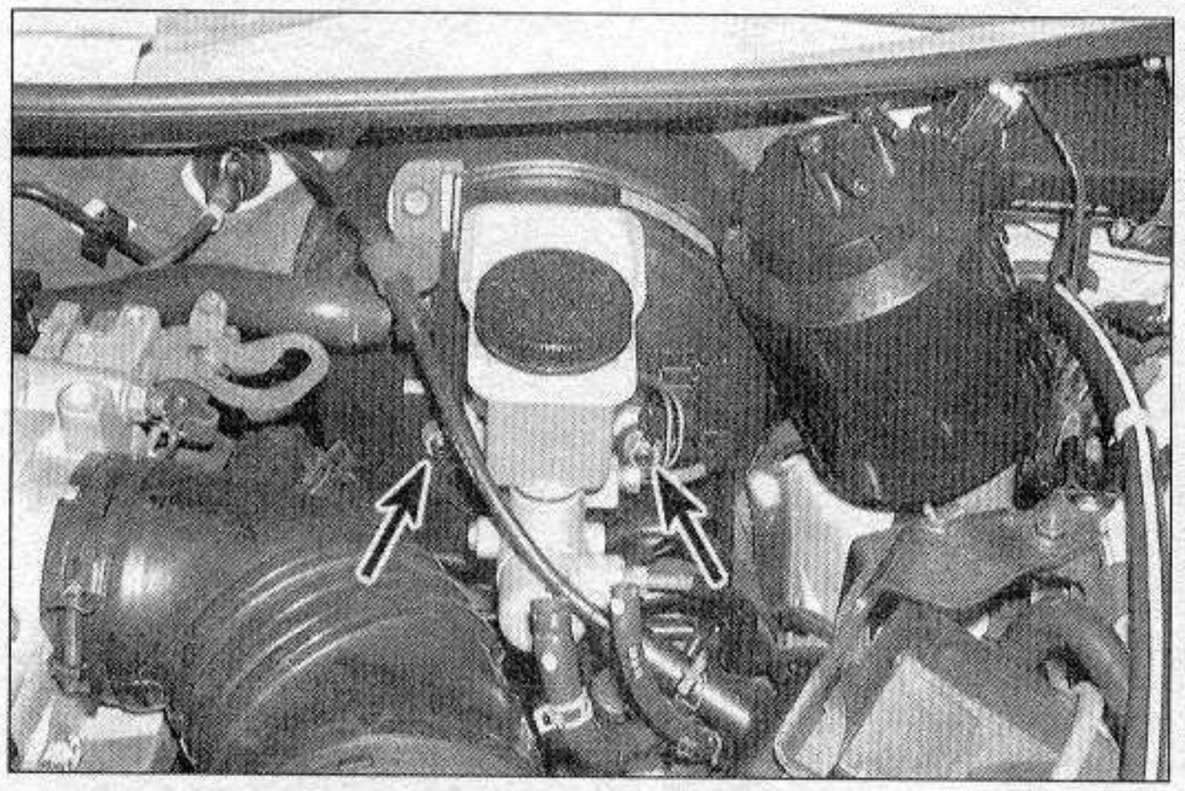
3 On manual transaxle models, disconnect the clutch master cylinder supply hose from the brake fluid reservoir.

4 Remove as much fluid as you can from the reservoir with a syringe, such as an old turkey baster. **Warning:** *If a baster is used, never again use it for the preparation of food.*

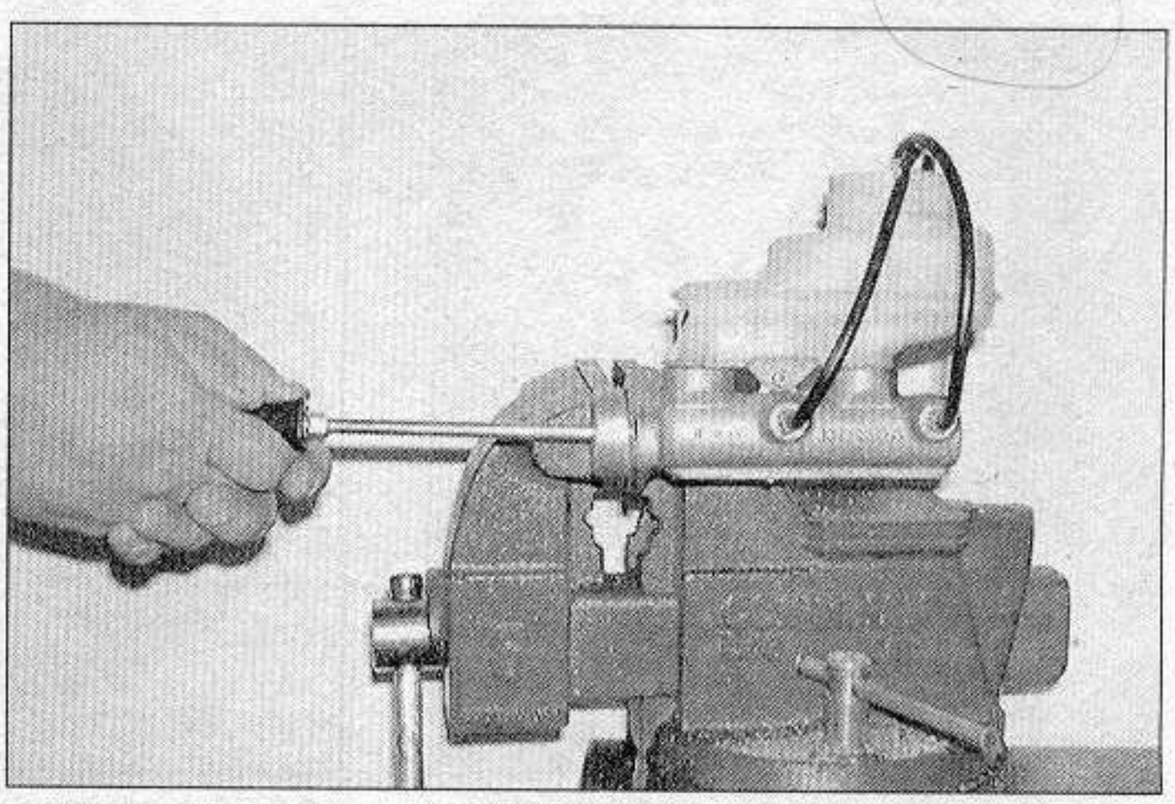
5 Place rags under the fluid fittings and prepare caps or plastic bags to cover the ends of the lines once they are disconnected. **Caution:** *Brake fluid will damage paint. Cover all body parts and be careful not to spill fluid during this procedure.*

6 Loosen the fittings at the ends of the brake lines where they enter the master cylinder **(see illustration)**. To prevent rounding off the corners on these nuts, the use of a flare-nut wrench, which wraps around the nut, is preferred. Pull the brake lines slightly away from the master cylinder and plug the ends to prevent contamination.

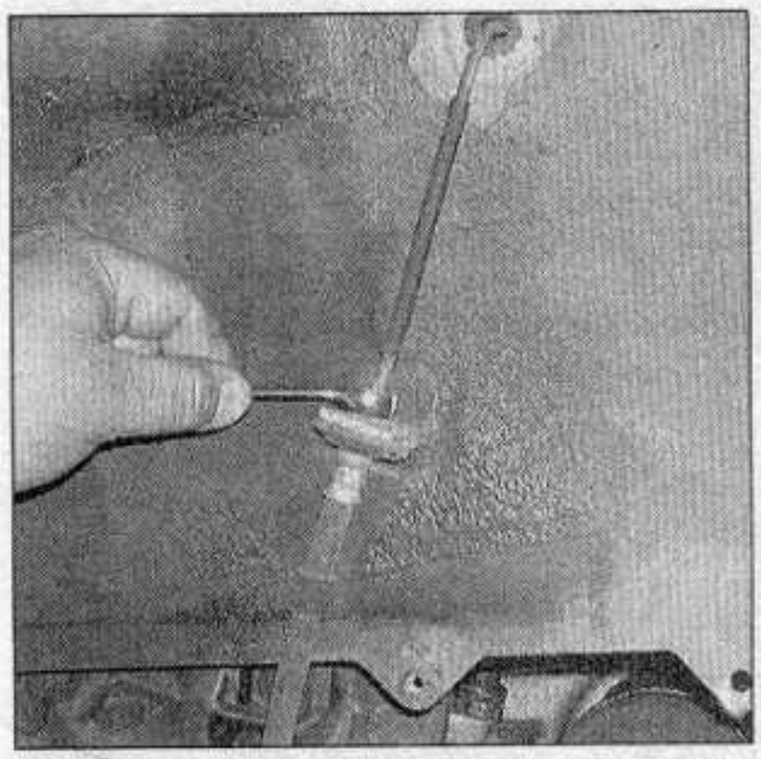
7 Disconnect the electrical connector at the brake fluid level switch on the master cylinder reservoir, then remove the nuts attaching the master cylinder to the power booster **(see illustration)**. Pull the master cylinder off the studs and out of the engine compartment. Again, be careful not to spill the fluid as this is done.



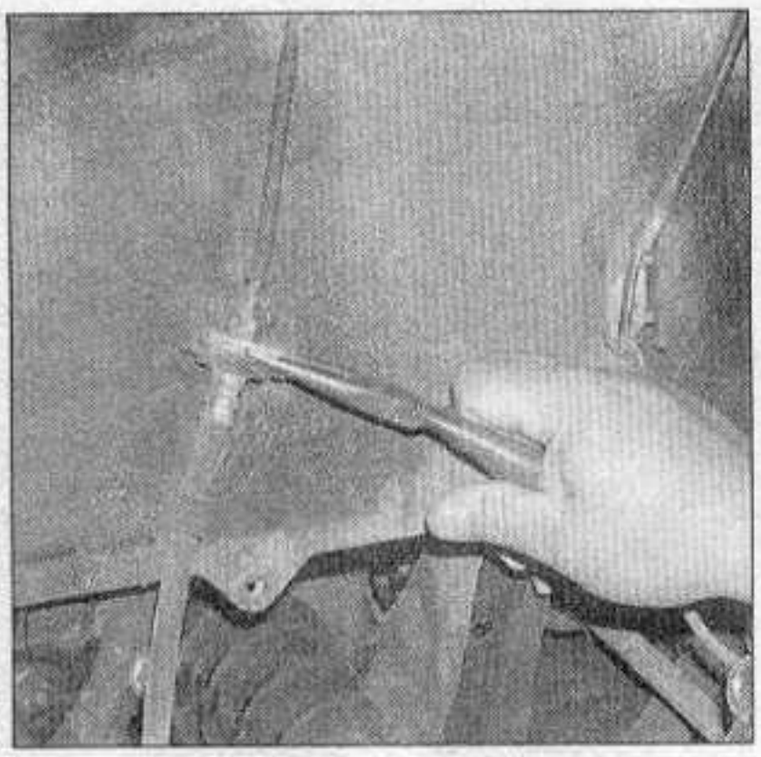
8.7 To detach the master cylinder from the brake booster, remove the two nuts (arrows)



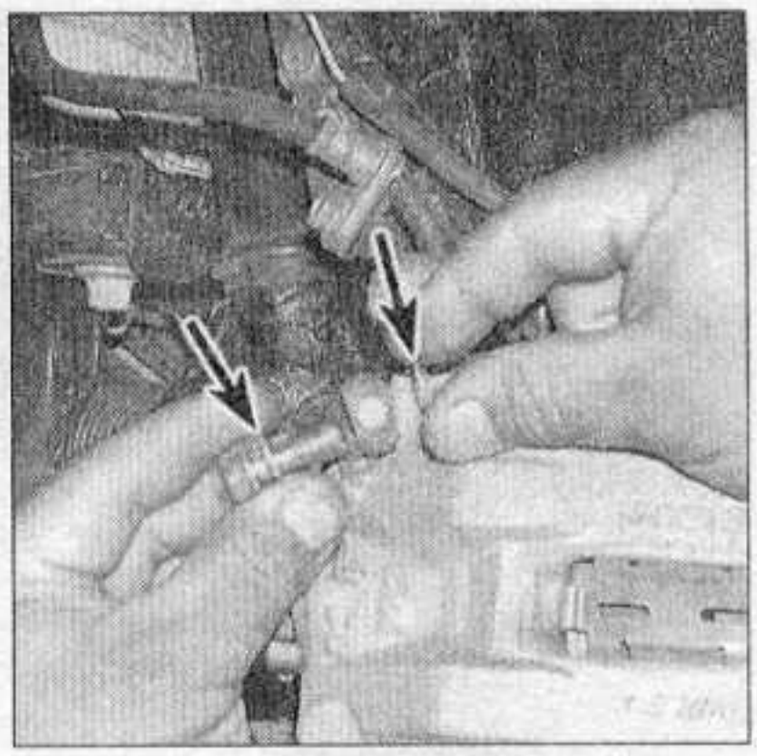
8.9 The best way to bleed air from the master cylinder before installing it on the vehicle is with a pair of bleed tubes that direct brake fluid back into the reservoir during bleeding



9.4a Use a flare-nut wrench to loosen the brake line-to-hose fitting . . .



9.4b . . . then remove the clip and slide the hose out of the bracket



9.5 Always install new sealing washers on either side of the banjo fitting

Installation

Refer to illustration 8.9

8 Bench bleed the new master cylinder before installing it. Mount the master cylinder in a vise, with the jaws of the vise clamping on the mounting flange.

9 Attach a pair of master cylinder bleeder tubes to the outlet ports of the master cylinder **(see illustration)**.

10 Fill the reservoir with brake fluid of the recommended type (see Chapter 1).

11 Slowly push the pistons into the master cylinder (a large Phillips screwdriver can be used for this) - air will be expelled from the pressure chambers and into the reservoir. Because the tubes are submerged in fluid, air can't be drawn back into the master cylinder when you release the pistons.

12 Repeat the procedure until no more air bubbles are present.

13 Remove the bleed tubes, one at a time, and install plugs in the open ports to prevent fluid leakage and air from entering. Install the reservoir cap.

14 Install the master cylinder over the studs on the power brake booster and tighten the attaching nuts only finger tight at this time. **Note:** *Be sure to install a new O-ring into the sleeve of the master cylinder.*

15 Thread the brake line fittings into the master cylinder. Since the master cylinder is still a bit loose, it can be moved slightly in order for the fittings to thread in easily. Do not strip the threads as the fittings are tightened.

16 Fully tighten the mounting nuts, then the brake line fittings. Tighten the nuts to the torque listed in this Chapter's Specifications.

17 Fill the master cylinder reservoir with fluid, then bleed the master cylinder and the brake system as described in Section 10. To bleed the cylinder on the vehicle, have an assistant depress the brake pedal and hold the pedal to the floor. Loosen the fitting to allow air and fluid to escape. Repeat this procedure on both fittings until the fluid is clear of air bubbles. **Caution:** *Have plenty of rags on hand to catch the fluid - brake fluid will ruin painted surfaces. After the bleeding procedure is completed, rinse the area under the master cylinder with clean water.*

18 Test the operation of the brake system carefully before placing the vehicle into normal service. **Warning:** *Do not operate the vehicle if you are in doubt about the effectiveness of the brake system.*

9 Brake hoses and lines - inspection and replacement

Refer to illustrations 9.4a, 9.4b and 9.5

1 About every six months the flexible hoses which connect the steel brake lines with the rear brakes and front calipers should be inspected for cracks, chafing of the outer cover, leaks, blisters, and other damage.

2 Replacement steel and flexible brake lines are commonly available from dealer parts departments and auto parts stores. Do not, under any circumstances, use anything other than genuine steel brake lines or approved flexible brake hoses as replacement items.

3 When installing the brake line, leave at least 3/4-inch clearance between the line and any moving or vibrating parts.

4 To disconnect a hose and line, use a flare-nut wrench **(see illustration)**. Then remove the clip and slide the hose out of the bracket **(see illustration)**.

5 To disconnect a hose from a caliper, unscrew the banjo bolt and discard the sealing washers. Always install new sealing washers when reconnecting the hose fitting **(see illustration)**.

6 When disconnecting two hoses, use normal wrenches on the hose fittings. When connecting two hoses, make sure they are not twisted or strained.

7 Steel brake lines are usually retained along their span with clips. Always remove these clips completely before removing a rigid brake line. Always reinstall these clips, or new ones if the old ones are damaged, when replacing a brake line, as they provide support and keep the lines from vibrating, which can eventually break them.

8 When replacing brake lines, be sure to use the correct parts. NEVER use copper tubing! Purchase genuine steel brake lines from a dealer or auto parts store.

9 When installing a steel line, make sure it's securely supported in the brackets and has plenty of clearance between moving or hot components.

10 After installation, check the fluid level in the master cylinder and add fluid as necessary. Bleed the brake system as described in Section 10 and test the brakes carefully before driving the vehicle in traffic. **Warning:** *Do not operate the vehicle if you are in doubt about the effectiveness of the brake system.*

10 Brake hydraulic system - bleeding

Refer to illustration 10.8

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

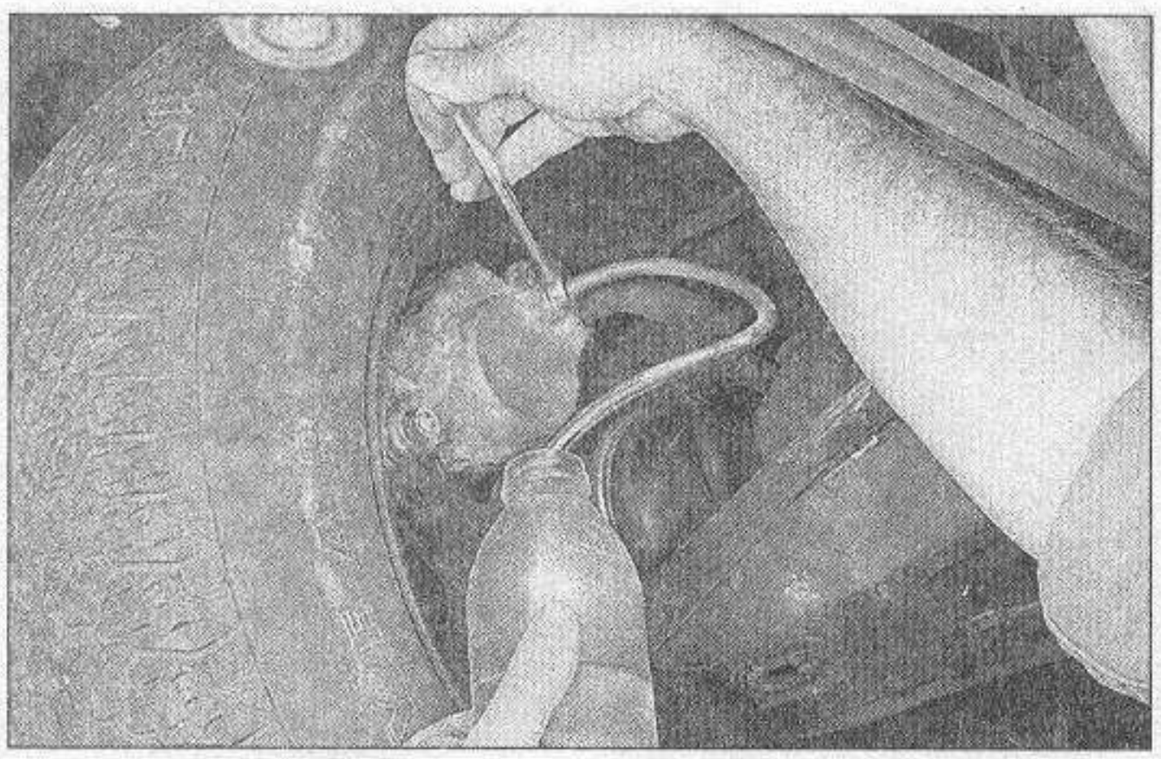
1 Bleeding the hydraulic system is necessary to remove any air that manages to find its way into the system when it's been opened during removal and installation of a hose, line, caliper or master cylinder. It will probably be necessary to bleed the system at all four brakes if air has entered the system due to low fluid level, or if the brake lines have been disconnected at the master cylinder.

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

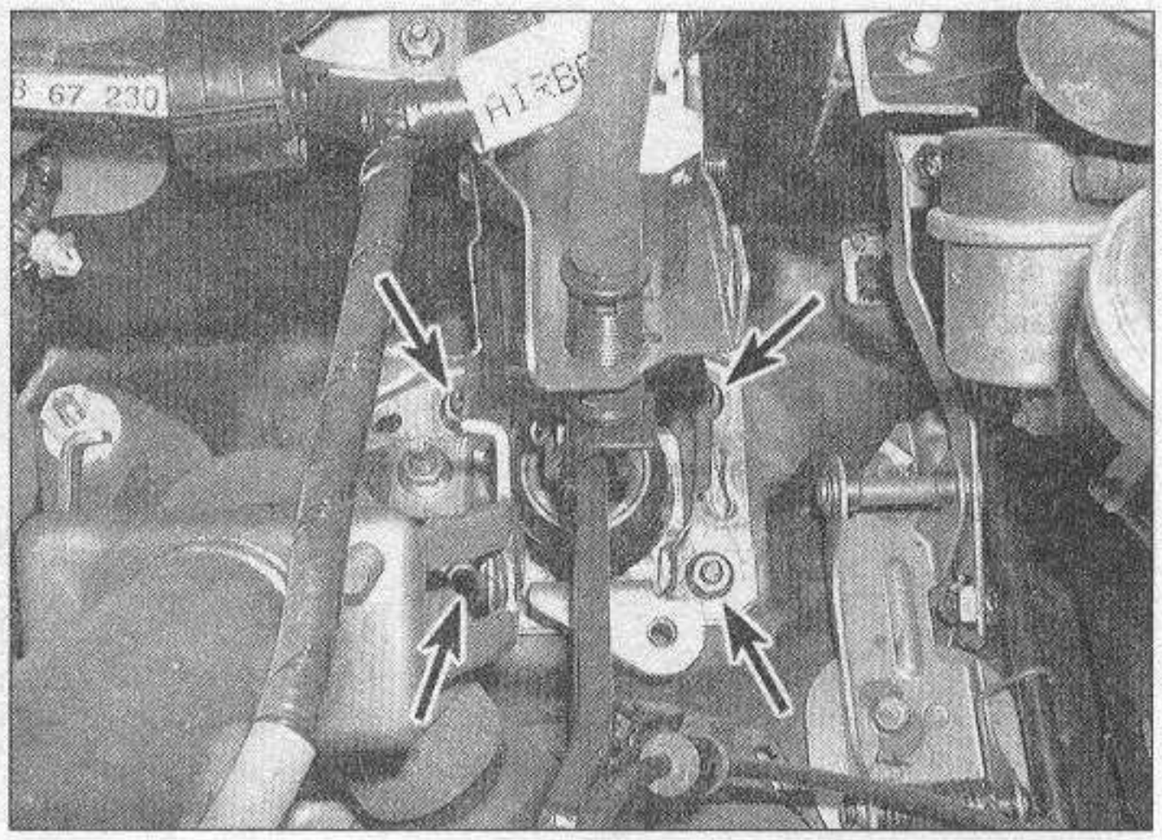
3 If a brake line is disconnected at a fitting located between the master cylinder and any of the brakes, that part of the system served by the disconnected line must be bled.

4 Remove any residual vacuum from the power brake booster by applying the brake several times with the engine off.

5 Remove the master cylinder reservoir



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



11.10 The power brake booster is secured to the firewall with four nuts (arrows)

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

6 Have an assistant on hand, as well as a supply of new brake fluid, a clear container partially filled with clean brake fluid, a length of clear tubing to fit over the bleed screw and a wrench to open and close the bleed screw.

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

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

9 Have the assistant push the brake pedal to the floor and hold the pedal firmly depressed.

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

11 Repeat Steps 9 and 10 until no more air is seen leaving the tube, then tighten the bleed screw and proceed to the left front wheel, then the left rear wheel and then to the right front wheel, in that order, and perform the same procedure. Be sure to check the fluid in the master cylinder reservoir frequently.

12 Never use old brake fluid. It contains moisture which can boil, rendering the brakes inoperative.

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

14 Check the operation of the brakes. The pedal should feel solid when depressed, with no sponginess. If necessary, repeat the entire process. **Warning:** *Do not operate the vehicle if you are in doubt about the effectiveness of the brake system.*

11 Power brake booster - check, removal and installation

Operating check

1 Depress the pedal and start the engine. If the pedal goes down slightly, operation is normal.

2 Depress the brake pedal several times with the engine running and make sure there is no change in the pedal reserve distance (the distance between the pedal and the floor).

Airtightness check

3 Start the engine and turn it off after one or two minutes. Depress the brake pedal several times slowly. If the pedal goes down farther the first time but gradually rises after the second or third depression, the booster is airtight.

4 Depress the brake pedal while the engine is running, then stop the engine with the pedal depressed. If there is no change in the pedal reserve travel after holding the pedal for 30 seconds, the booster is airtight.

Removal

Refer to illustration 11.10

5 Power brake booster units should not be disassembled. They require special tools not normally found in most automotive repair stations or shops. They are fairly complex and because of their critical relationship to brake performance it is best to replace a defective booster unit with a new or rebuilt one.

6 To remove the booster, first remove the brake master cylinder as described in Section 8.

7 Disconnect the vacuum hose leading from the engine to the booster. Be careful not to damage the hose when removing it from the booster fitting.

8 Locate the pushrod clevis pin connecting the booster to the brake pedal.

9 Remove the cotter pin with pliers and pull out the clevis pin.

10 Remove the four mounting nuts holding the brake booster to the firewall **(see illustration)**. You may need a light to see them, because they're up under the dash area.

11 Slide the booster straight out from the firewall until the studs clear the holes, turn the booster to the right (towards the center of the vehicle) so the clevis clears the firewall, then remove the booster from the engine compartment.

Installation

Refer to illustrations 11.13a, 11.13b, 11.13c and 11.14

12 Installation procedures are basically the reverse of those for removal. Tighten the booster mounting nuts to the torque listed in this Chapter's Specifications. Also, be sure to use a new cotter pin on the clevis pin.

13 If a new power brake booster unit is being installed, check the pushrod clearance as follows:

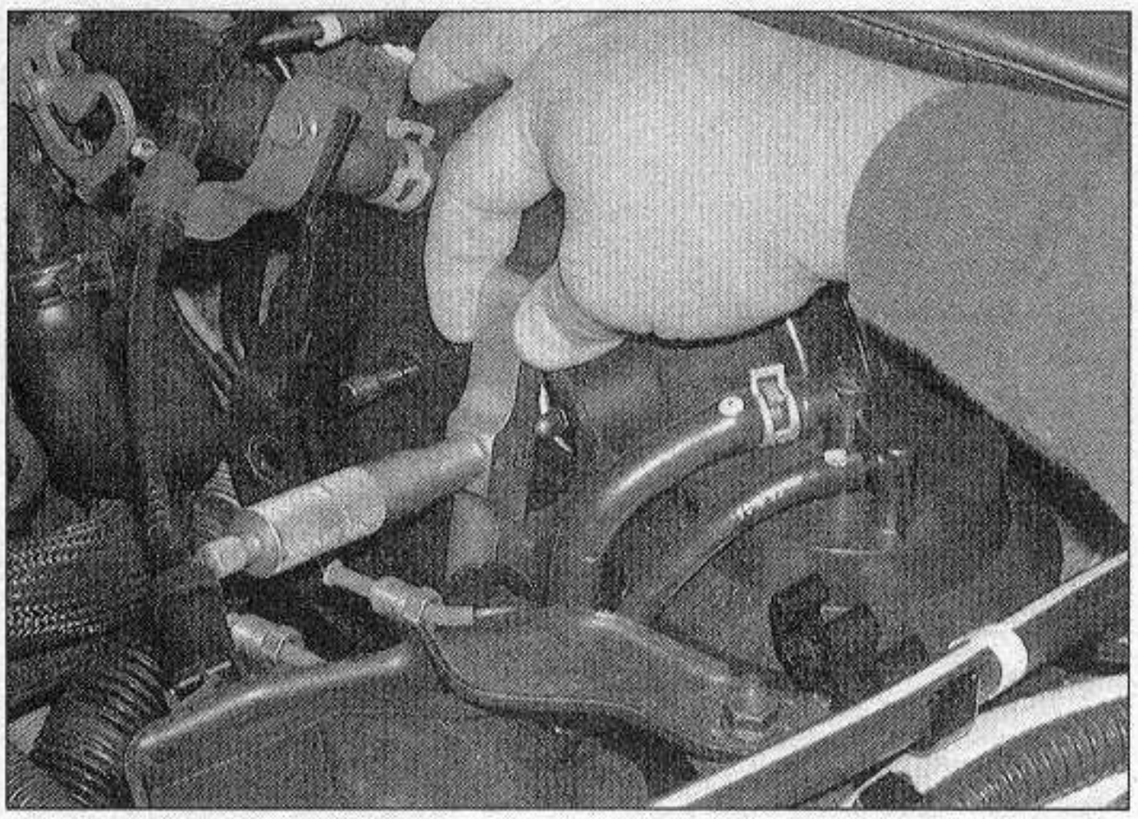
a) *Using a hand-held vacuum pump, apply a vacuum of 20 in-Hg to the booster. Measure the distance that the pushrod is recessed into the power brake booster (from the master cylinder mounting surface to the tip of the pushrod). Write down this measurement* **(see illustration)**. *This is "dimension A."*

b) *Measure the distance from the mounting flange to the end of the master cylinder* **(see illustration)**. *Write down this measurement. This is "dimension B."*

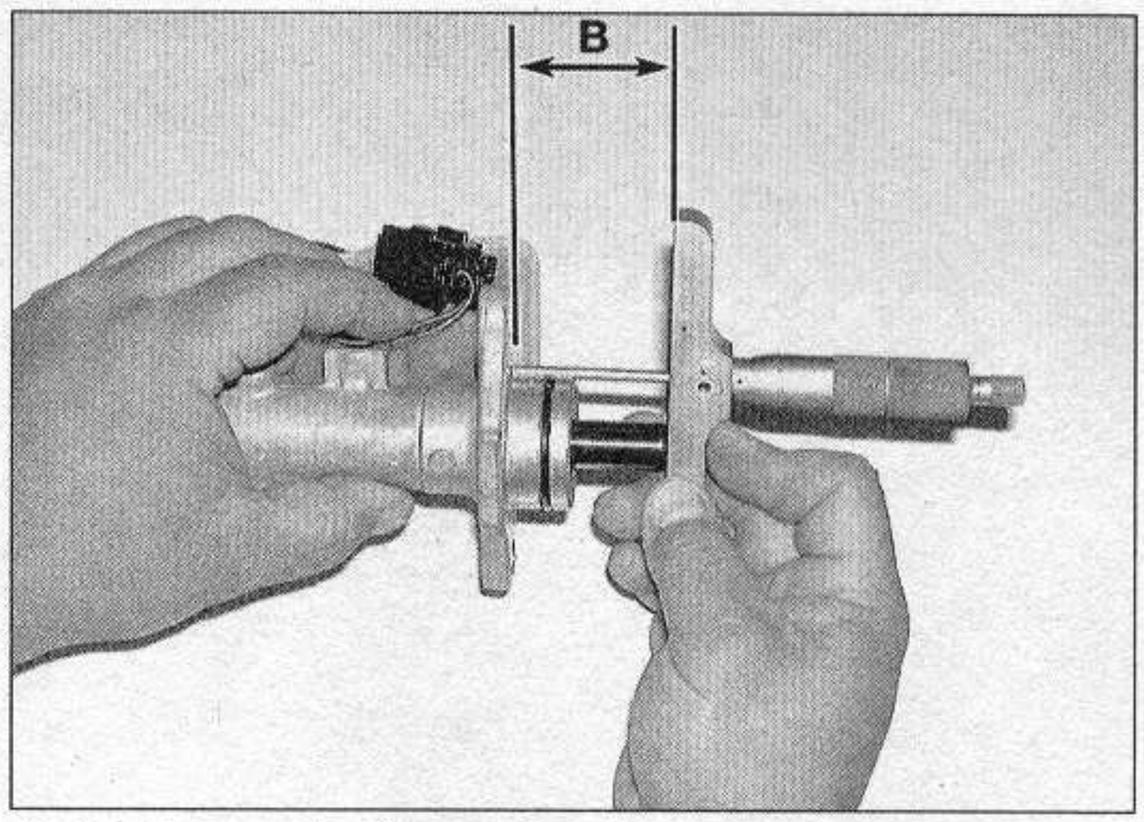
c) *Measure the distance from the end of the master cylinder to the pocket in the piston* **(see illustration)**. *Write down this measurement. This is "dimension C."*

d) *Subtract measurement C from measurement B, then subtract this measurement from measurement A. This is the pushrod clearance.*

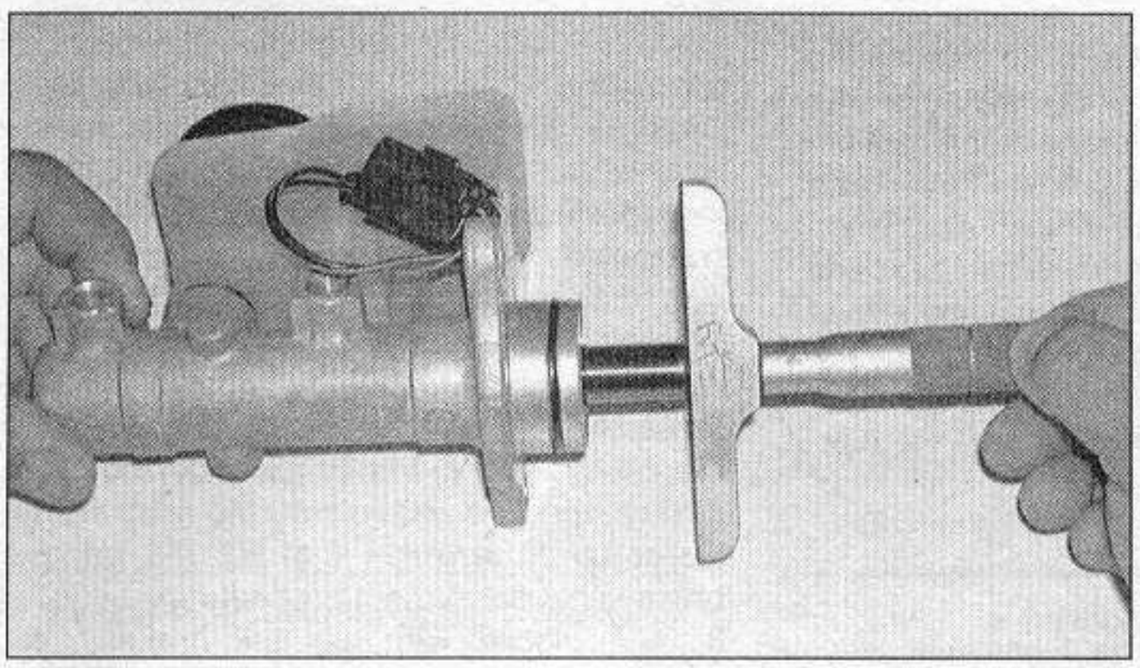
e) *Compare your calculated pushrod clearance to the pushrod clearance listed in this Chapter's Specifications. If neces-*



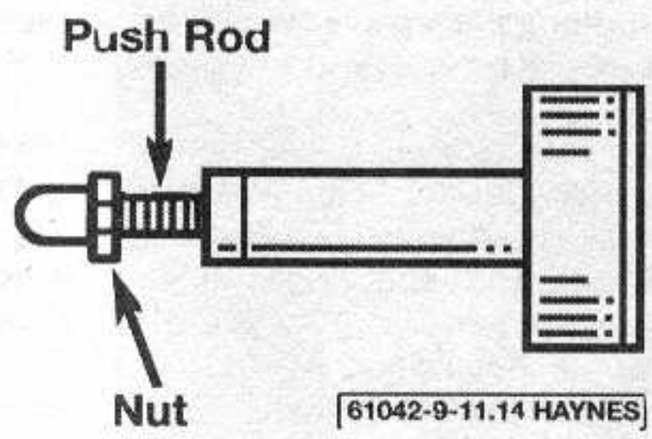
11.13a Measure the distance the pushrod is recessed into the brake booster at the master cylinder mounting surface



11.13b Measure the distance from the mounting flange to the end of the master cylinder – this is distance "B"



11.13c Measure the distance from the piston pocket to the end of the master cylinder – this is distance "C"



11.14 To adjust the length of the booster pushrod, loosen the star locknut and turn the adjuster in or out, as necessary, to achieve the desired setting

sary, adjust the pushrod length to achieve the correct clearance (see the next Step). If the measured distance to the pushrod inside the brake booster (A) is less than the master cylinder piston pocket depth (B - C), then it will be necessary to shorten the pushrod. If distance A is greater than the master cylinder piston pocket depth (B - C), then the pushrod must be lengthened until the correct clearance has been obtained.

14 If the clearance is more or less than specified, loosen the locknut and turn the adjuster on the power booster pushrod until the clearance is within the specified limit **(see illustration)**. After adjustment, tighten the locknut. Recheck the clearance. Repeat this step as often as necessary until the clearance is correct.

15 After the final installation of the master cylinder and brake hoses and lines, bleed the brakes as described in Section 10.

12 Brake pedal height and freeplay - adjustment

Note: *1998 and later models are equipped with a Brake ON OFF switch that can only be adjusted one time. When the brake pedal height is adjusted, it will be necessary to replace the switch with a new one.*

Pedal height

Refer to illustration 12.1

1 The height of the brake pedal is the distance the pedal sits off the floor **(see illustration)**. If the pedal height is not within the specified range, it must be adjusted. Measure the pedal height from the top of the brake pedal pad to the floor with the carpet in place.

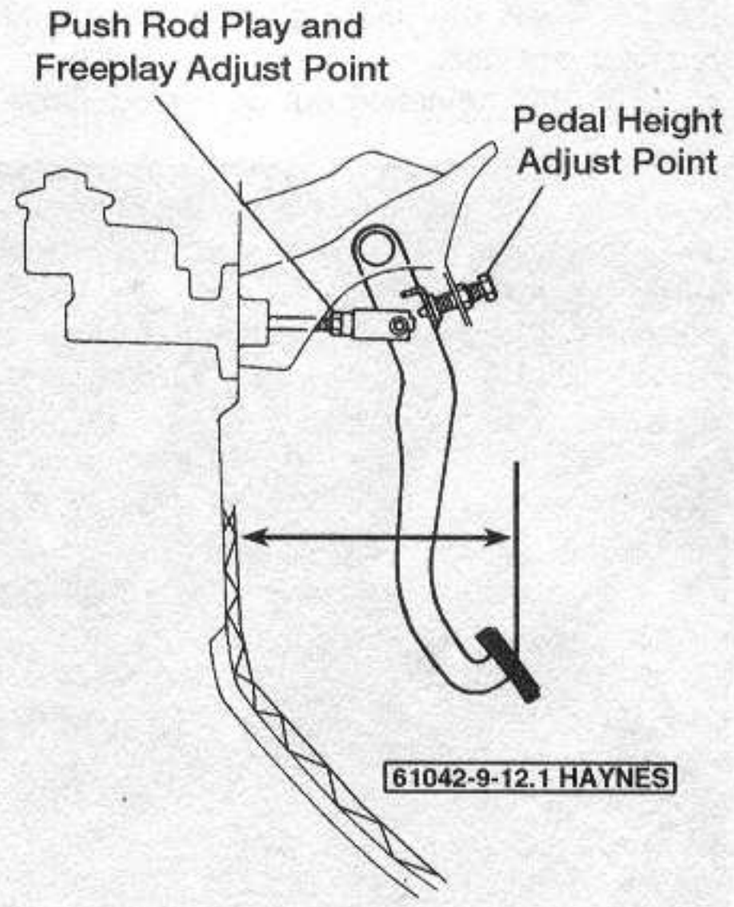
2 To adjust the brake pedal height, loosen the locknut on the pedal height adjusting bolt and back the bolt out to increase the pedal height or turn the bolt in to decrease pedal height. After the pedal height is adjusted, the freeplay must be adjusted (see Step 4). Tighten the locknuts securely.

3 Adjust the brake ON OFF (BOO switch) as described in Chapter 6.

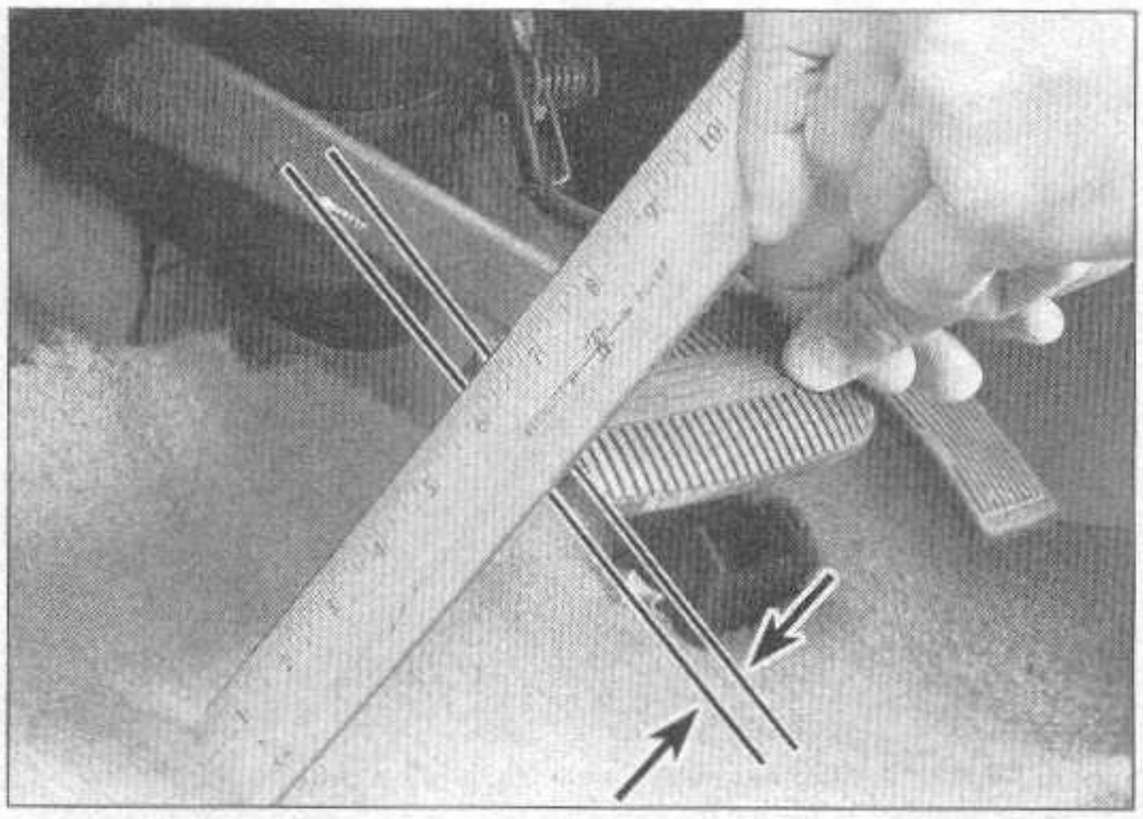
Pedal freeplay

Refer to illustration 12.4

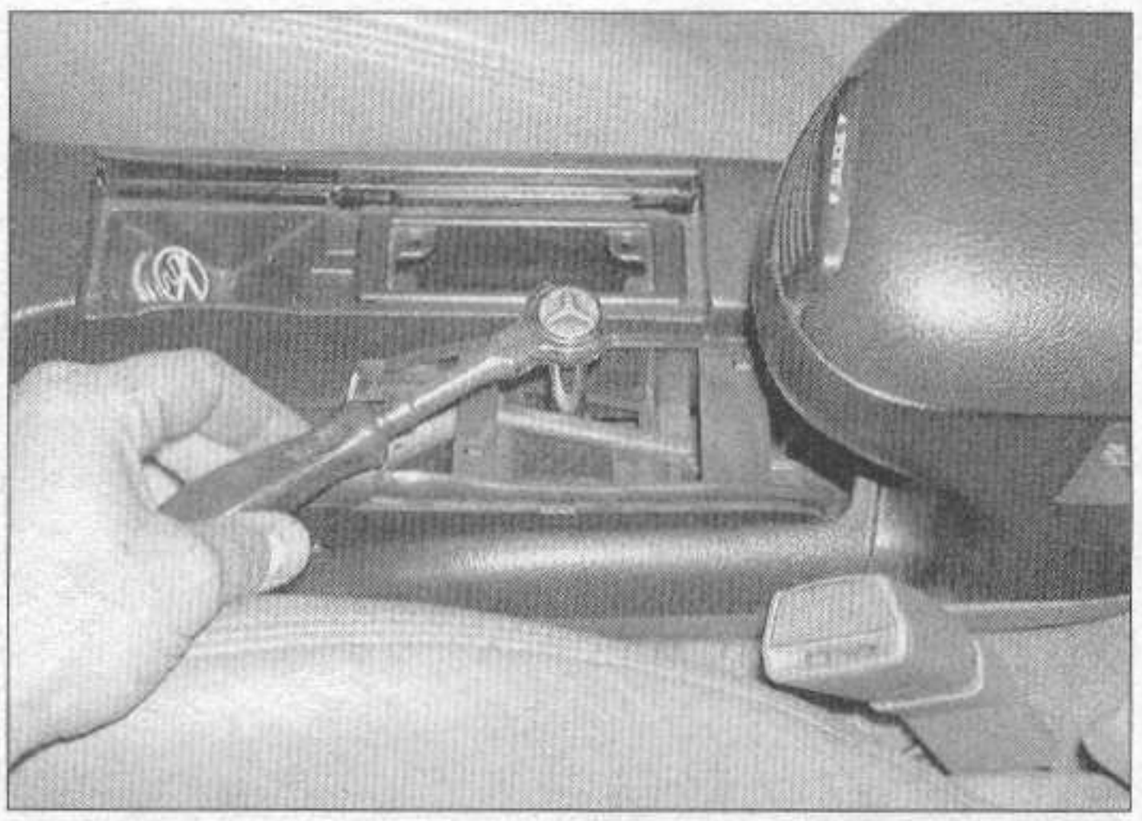
4 The freeplay is the pedal slack, or the distance the pedal can be depressed before



12.1 The brake pedal height is measured from the pedal pad to the floor (with the carpet in place)



12.4 Brake pedal freeplay is the amount of brake pedal travel before the master cylinder is actuated



13.3 Location of the parking brake cable adjusting nut on a Ford Probe equipped with an automatic transaxle

it begins to have any effect on the brake system **(see illustration)**. If the pedal freeplay is not within the specified range, it must be adjusted.

5 To adjust the pedal freeplay, loosen the locknut on the brake pushrod **(see illustration 12.1)**, then turn the pushrod to adjust the pedal freeplay to the specified range. Retighten the locknut.

6 Check and, if necessary, adjust the brake ON OFF switch (see Chapter 9).

13 Parking brake - adjustment

Refer to illustration 13.3

1 Remove the console trim around the parking brake lever (see Chapter 11).

2 Block the front wheels, raise the rear of the vehicle and support it securely on jackstands. Apply the parking brake lever until you hear one click.

3 Turn the adjusting nut on the equalizer **(see illustration)** clockwise while rotating the rear wheels. Stop turning the nut when the brakes just start to drag on the rear wheels.

4 Release the parking brake lever and check to see that the brakes don't drag when the rear wheels are turned. When properly adjusted, the travel on the parking brake lever should be as listed in this Chapter's Specifications.

5 Lower the vehicle and reinstall the console or cover.

14 Parking brake cable(s) - replacement

Refer to illustrations 14.2, 14.4 and 14.5

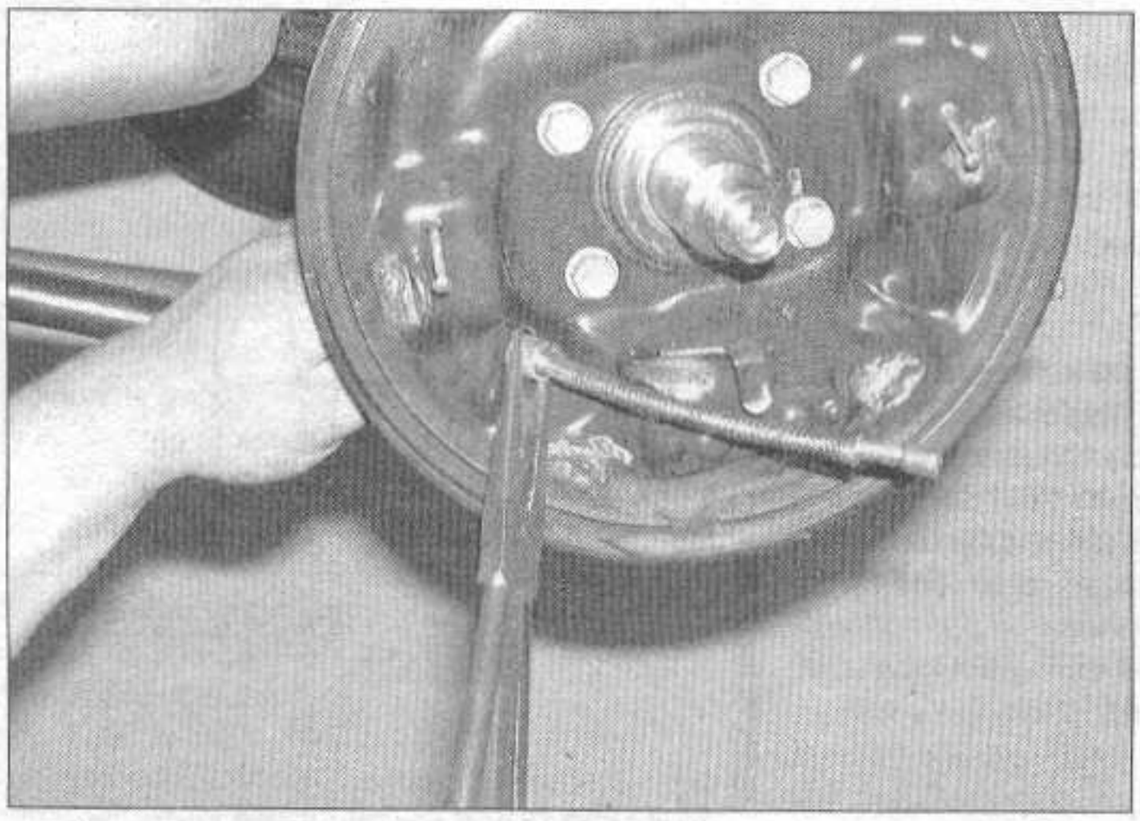
1 Block the front wheels and loosen the rear wheel lug nuts. Raise the rear of the vehicle and support it securely on jackstands.

2 On models with rear drum brakes, remove the brake shoes (see Section 6) and disconnect the cable end from the lever on the trailing brake shoe **(see illustration 6.4j)**. Depress the tangs on the cable casing retainer and pass the cable through the backing plate using needle-nose pliers **(see illustration)** or an off-set wrench of the proper size to fit snugly over the retainer. This compresses all the tangs simultaneously. **Note:** *If you do not have this wrench, you can also use a small screw-type hose clamp. Tighten the clamp around the tangs, start the cable through the hole and remove the hose clamp.* **Refer to illustration 6.4j** for the parking brake cable disconnect procedure.

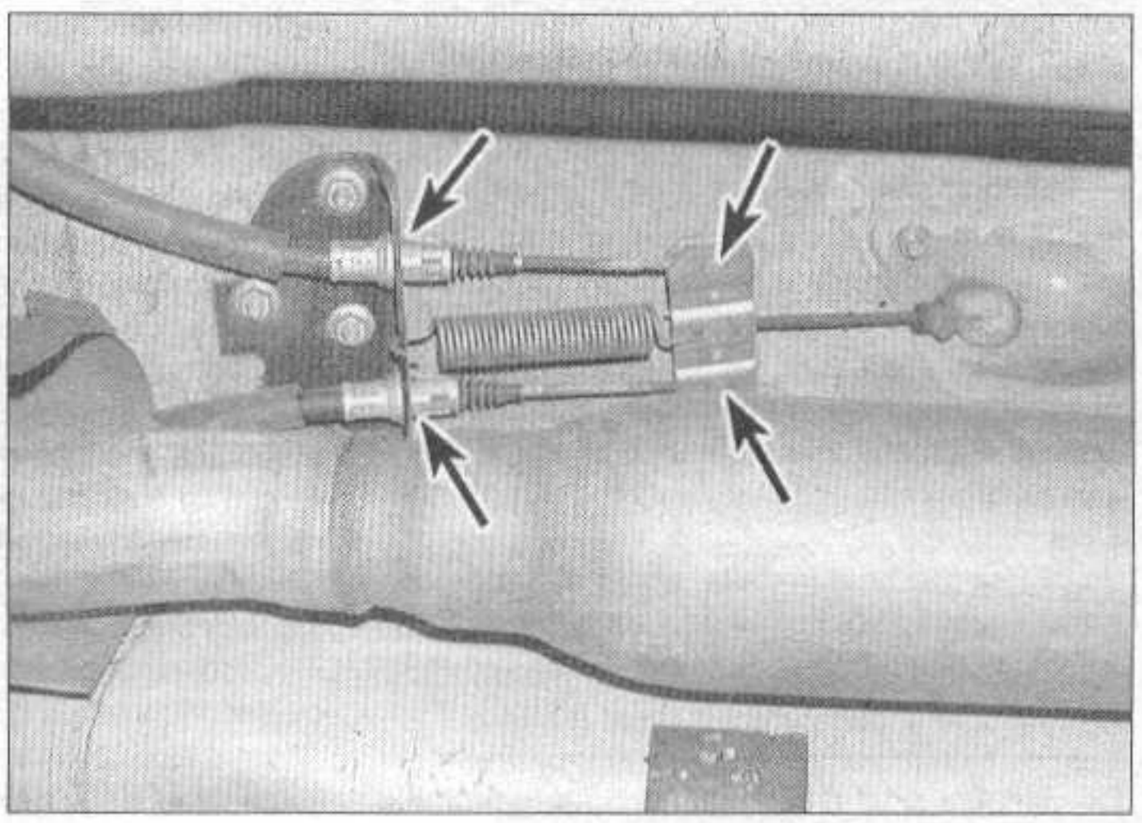
3 On models with rear disc brakes, refer to **illustrations 3.7a, 3.7b and 3.7c** to disconnect the cable from the cable bracket and caliper.

4 Unhook the forward end of the cable from the equalizer, then compress the retainer tangs and pass the cable through the bracket **(see illustration)**.

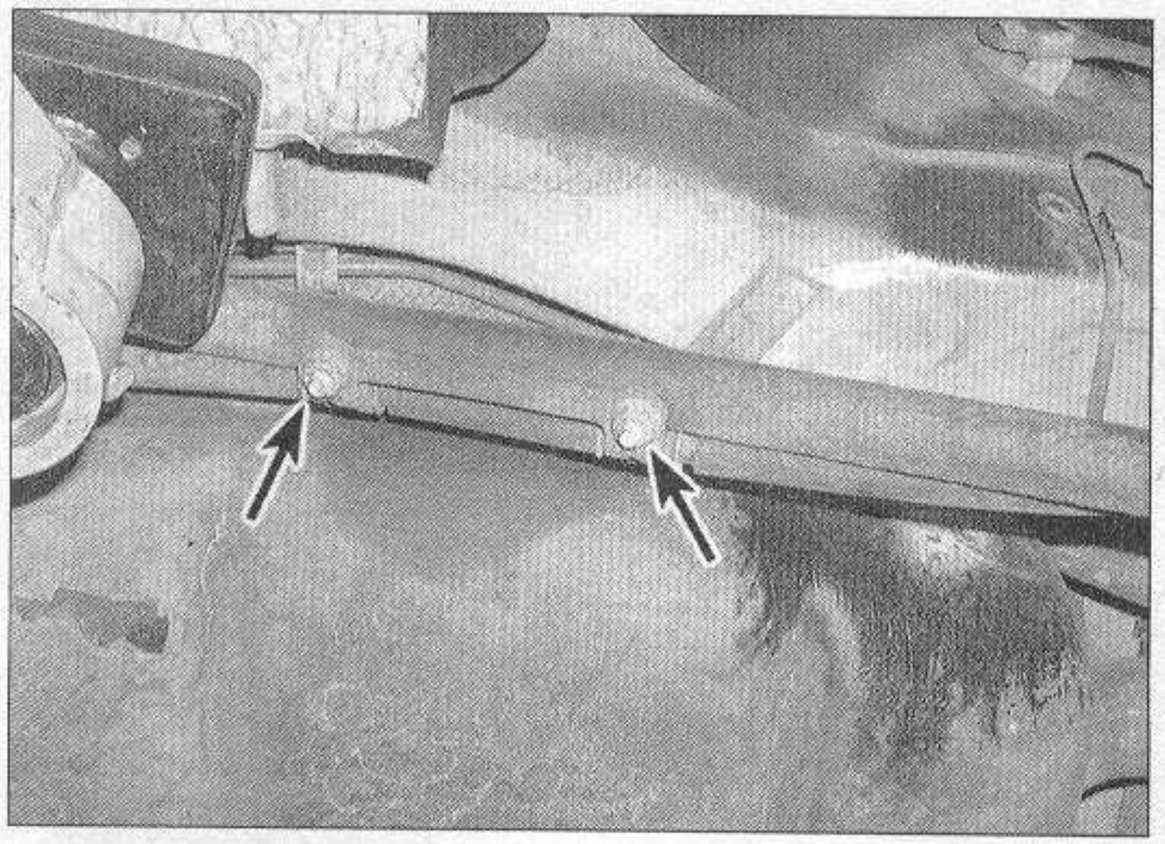
5 Unbolt the cable casing clamps from the underbody, noting how the cable is routed,



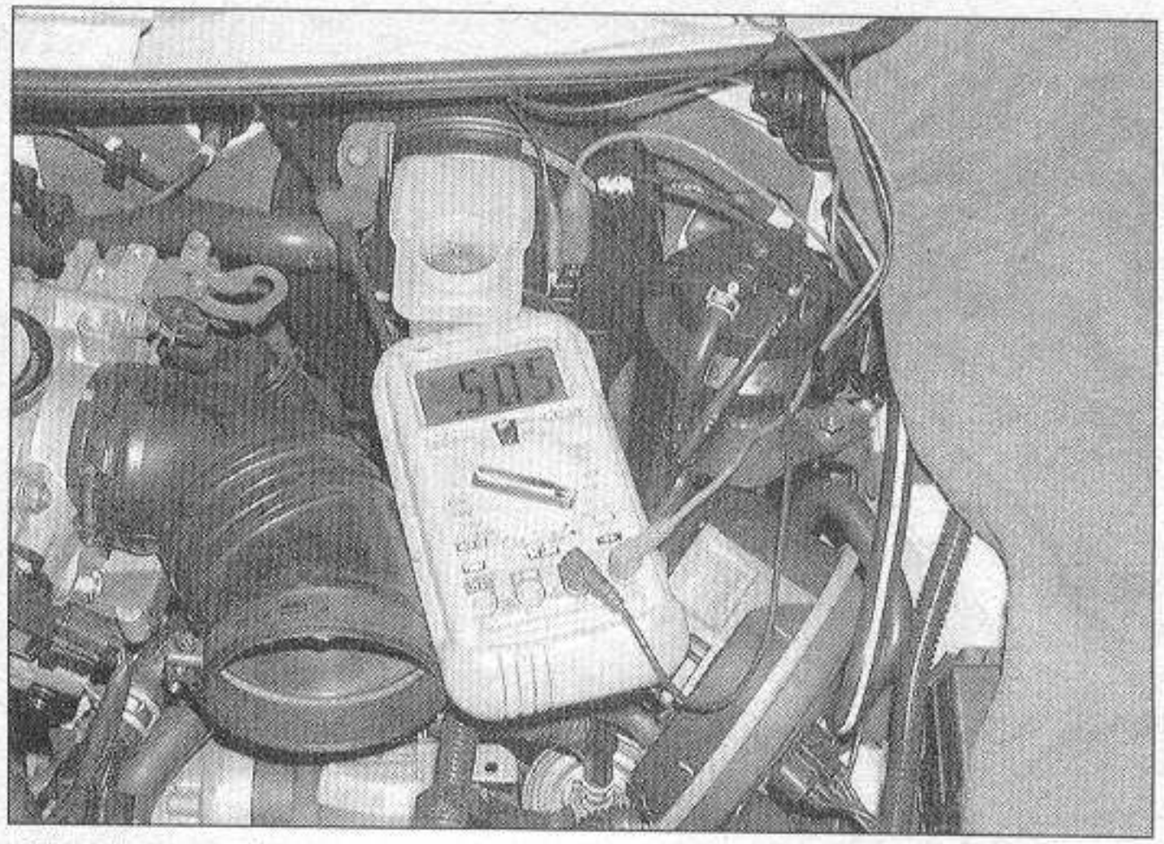
14.2 To detach the parking brake cable from a drum brake backing plate, compress the retainer tangs with a pair of pliers and pass the cable through the backing plate



14.4 Compress the retainer tangs at the forward end of the cable (left arrows), then detach the cable ends from the equalizer (right arrows)



14.5 Remove the cable clamp bolts (arrows) and remove the parking brake cable



15.2 Use an ohmmeter to check the brake fluid level switch - with the float in the UP position, there should be no continuity

then remove the cable from the vehicle **(see illustration)**. It may be necessary to remove the exhaust pipe heat shield bolts at the rear to allow cable removal.

6 If both cables are to be removed, repeat the above steps to remove the remaining cable.

7 Installation is the reverse of the removal procedure. After the cable(s) are installed, be sure to adjust them according to the procedure described in Section 13.

15 Brake fluid level switch - check and replacement

Check

Refer to illustrations 15.2 and 15.3

1 To check the brake fluid level switch, disconnect the harness connector and remove the cap from the brake fluid reservoir on top of the master cylinder.

2 Check the switch continuity with the float in the UP position **(see illustration)**. There should be no continuity.

3 Check the switch continuity with the float in the DOWN position **(see illustration)**. There should be continuity.

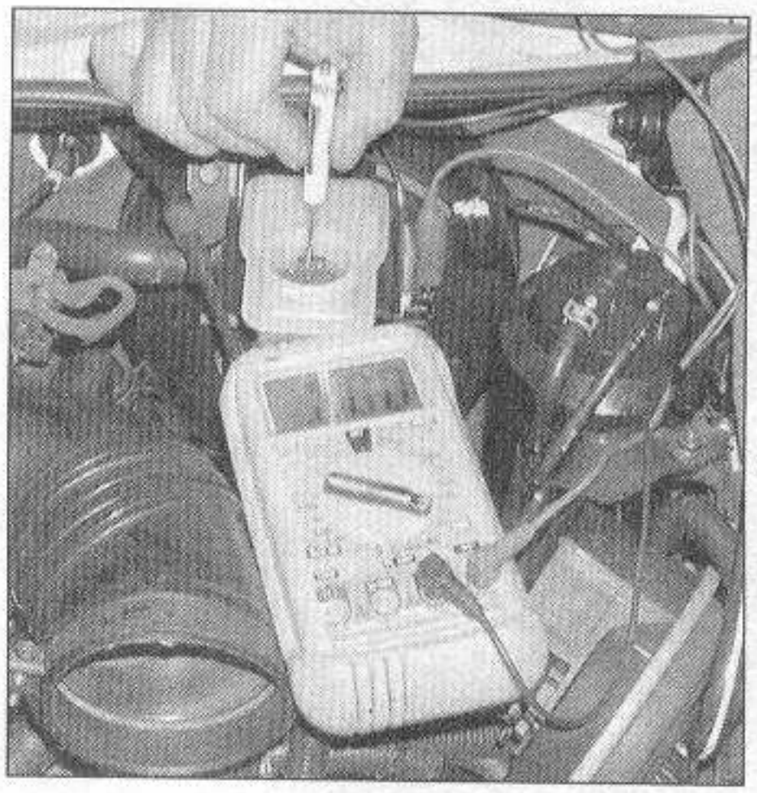
4 If the switch doesn't operate as described, replace it.

Replacement

5 Disconnect the electrical connector from the switch, if you haven't already done so.

6 Remove the fluid from the reservoir with a large syringe, such as a poultry baster. **Warning:** *If a poultry baster is used, never again use it for the preparation of food.* Remove the screw and detach the reservoir from the master cylinder. Replace the reservoir as a complete unit, using new grommets.

7 Installation is the reverse of the removal procedure.



15.3 The ohmmeter should indicate continuity when the float is at the bottom of its travel

Chapter 10
Suspension and steering systems

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Specifications

Torque specifications

	Ft-lbs (unless otherwise indicated)
Front suspension	
Control arm	
Inner pivot bolts	
Front	58 to 78
Rear	69 to 96
Control arm-to-steering knuckle balljoint nut	25 to 42
Stabilizer bar	
Link-to-stabilizer nut	27 to 40
Link-to-control arm bolt	27 to 40
Stabilizer clamp bolts	27 to 40
Strut/coil spring assembly	
Strut-to-steering knuckle bolts/nuts	68 to 86
Strut-to-body upper mounting nuts	34 to 46
Damper shaft nut	
1999 and earlier	66 to 86
2000 and later	59 to 61
Subframe mounting bolts and nuts	68 to 96
Speed sensor mounting bolts	12 to 17
Rear suspension	
Brake backing plate-to-rear knuckle bolts	29 to 38
Crossmember mounting bolts	27 to 40
Hub nut	130 to 174
Rear suspension arms	
Lateral arms	
Lateral arm-to-crossmember bolts	58 to 86
Lateral arm-to-rear knuckle nuts (through bolt)	64 to 86
Trailing arm bolts	
Frame bolt	58 to 86
Knuckle bolt	64 to 86
Stabilizer bar	
Stabilizer bushing clamp nuts	27 to 40
Stabilizer-to-link rod nuts	27 to 40
Stabilizer link rod-to-rear lateral arms	27 to 40

Torque specifications

Ft-lbs (unless otherwise indicated)

Rear suspension (continued)

Strut/coil spring assembly	
Strut-to-rear knuckle bolts/nuts	69 to 87
Strut-to-body upper mounting nuts	36 to 46
Damper shaft nut	
1999 and earlier	66 to 87
2000 and later	59 to 61

Steering

Airbag module bolts	36 to 54 in-lbs
Clockspring mounting screws	18 to 26 in-lbs
Intermediate shaft U-joint pinch bolt	13 to 20
Power steering pump fluid lines	
Supply line bolts	120 to 156 in-lbs
High pressure line banjo bolt	25 to 33
Power steering pump pulley nut	36 to 43
Power steering pump bracket bolts	28 to 38
Steering column mounting bolts and nuts	12 to 17
Steering gear mounting bracket bolts and nuts	27 to 40
Steering wheel nut	29 to 36
Tie-rod end-to-steering knuckle nut	22 to 33
Tie-rod jam nut (adjusting nut)	51 to 72

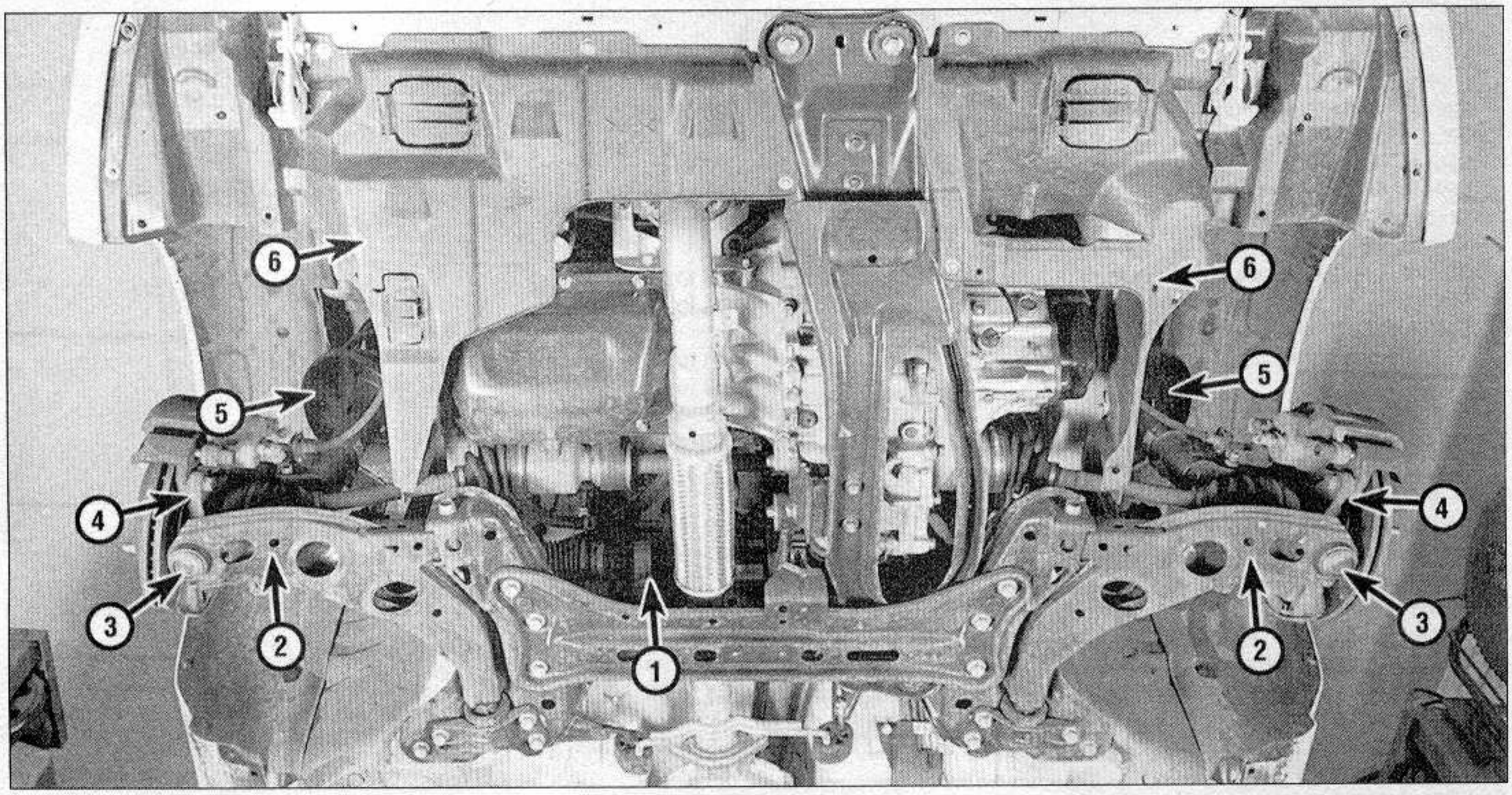
1 General information

Refer to illustrations 1.1, 1.2a and 1.2b

The front suspension system **(see illustration)** is a MacPherson strut design. The upper end of each strut is attached to the vehicle body. The lower end of the strut is connected to the upper end of the steering knuckle. The steering knuckle is attached to a balljoint mounted on the outer end of the control arm. The balljoint is an integral part of the control arm; if the balljoint is worn, the control arm must be replaced. A stabilizer bar is used on all models. The bar is attached to the frame with a pair of clamps and to the control arms with link rods.

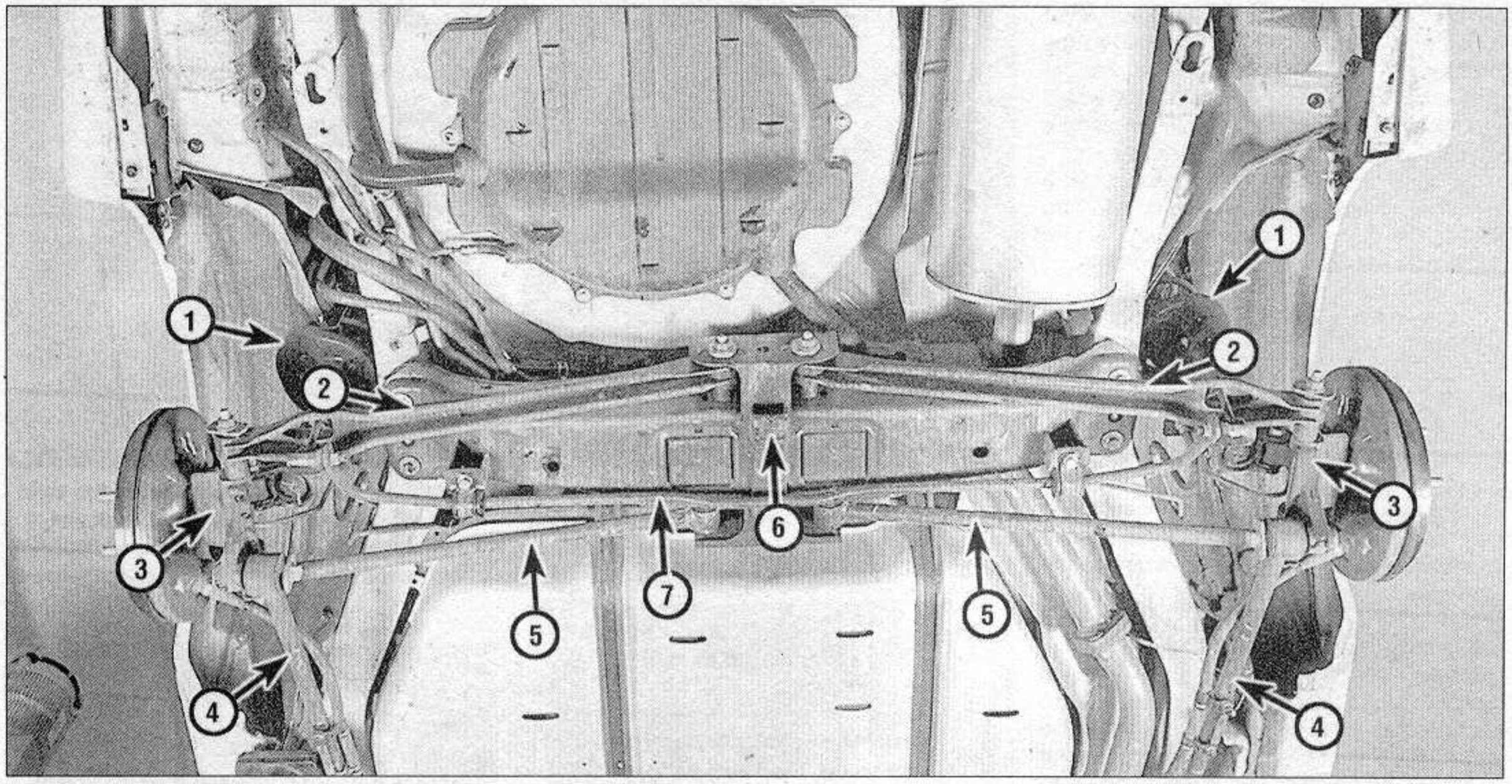
The rear suspension system **(see illustration)** also uses MacPherson struts, a pair of lateral suspension arms (front and rear) and a trailing arm on each side. The upper ends of the struts are attached to the vehicle body and their lower ends are attached to the upper ends of the rear knuckles. The lower ends of the knuckles are attached to the outer ends of the lateral arms using through-bolts. The strut/knuckle/hub assemblies are positioned longitudinally by the trailing arms. A stabilizer bar is attached to the vehicle by a pair of brackets and to the lateral arms by link rods **(see illustration)**.

The rack-and-pinion steering gear is located behind the engine/transaxle assem-



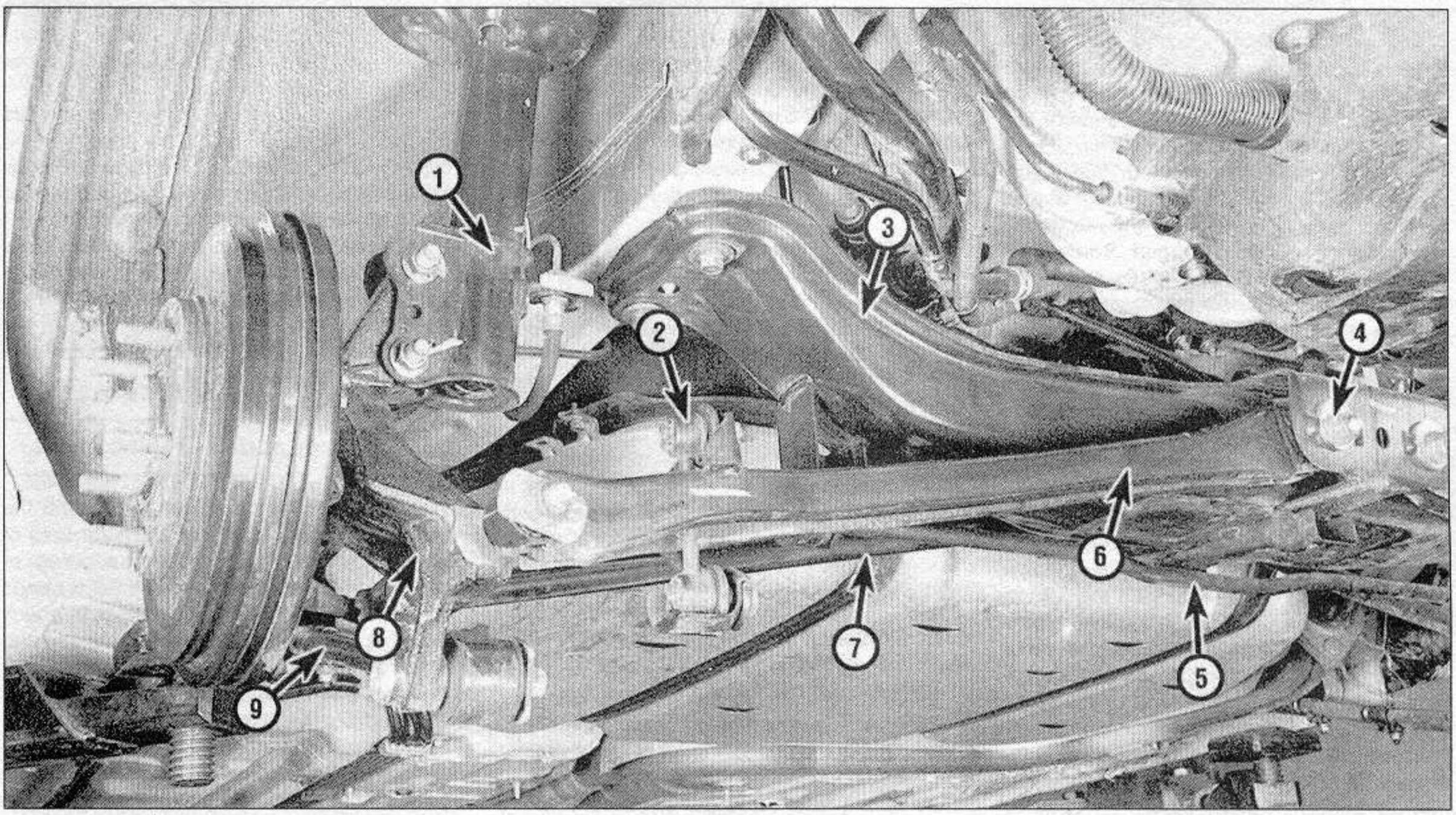
1.1 Front suspension and steering components

1 Steering gear
2 Control arm
3 Balljoint
4 Steering knuckle
5 Strut/coil spring assembly
6 Splash shield



1.2a Rear suspension components (bottom view)

1 *Strut/coil spring assembly*
2 *Rear lateral arm*
3 *Knuckle*
4 *Trailing arm*
5 *Front lateral arm*
6 *Crossmember*
7 *Stabilizer bar*



1.2b Rear suspension components (rear view)

1 *Strut/coil spring assembly*
2 *Stabilizer bar link*
3 *Crossmember*
4 *Adjusting cam*
5 *Stabilizer bar*
6 *Rear lateral arm*
7 *Front lateral arm*
8 *Knuckle*
9 *Trailing arm*

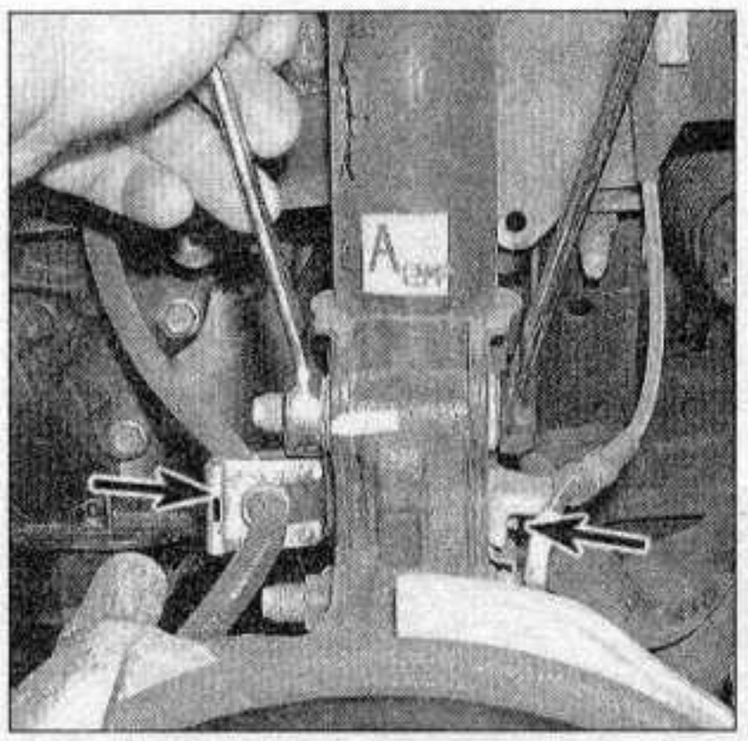
bly, on the subframe. The steering gear actuates the tie-rods, which are attached to the steering knuckles. The inner ends of the tie-rods are protected by rubber boots which should be inspected periodically for secure attachment, tears and leaking lubricant.

The power assist system consists of a belt-driven pump and associated lines and hoses. The fluid level in the power steering pump reservoir should be checked periodically (see Chapter 1).

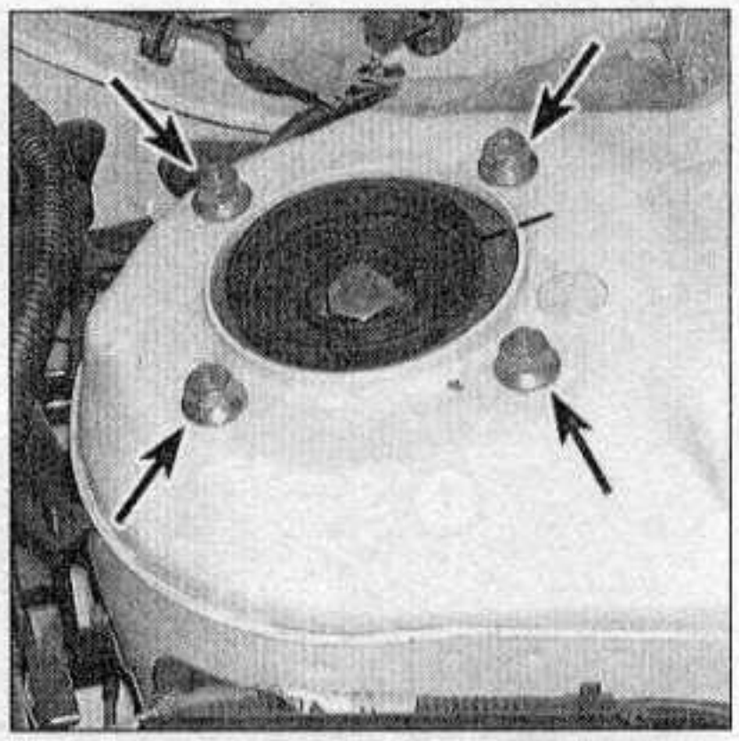
The steering wheel operates the steering shaft, which actuates the steering gear through universal joints. Looseness in the steering can be caused by wear in the steering shaft universal joints, the steering gear, the tie-rod ends and loose retaining bolts.

Frequently, when working on the suspension or steering system components, you may come across fasteners which seem impossible to loosen. These fasteners on the underside of the vehicle are continually subjected to water, road grime, mud, etc., and can become rusted or "frozen," making them extremely difficult to remove. In order to unscrew these stubborn fasteners without damaging them (or other components), be sure to use lots of penetrating oil and allow it to soak in for a while. Using a wire brush to clean exposed threads will also ease removal of the nut or bolt and prevent damage to the threads. Sometimes a sharp blow with a hammer and punch will break the bond between a nut and bolt threads, but care must be taken to prevent the punch from slipping off the fastener and ruining the threads. Heating the stuck fastener and surrounding area with a torch sometimes helps too, but isn't recommended because of the obvious dangers associated with fire. Long breaker bars and extension, or "cheater," pipes will increase leverage, but never use an extension pipe on a ratchet - the ratcheting mechanism could be damaged. Sometimes tightening the nut or bolt first will help to break it loose. Fasteners that require drastic measures to remove should always be replaced with new ones.

Since most of the procedures dealt with in this Chapter involve jacking up the vehicle and working underneath it, a good pair of jackstands will be needed. A hydraulic floor jack is the preferred type of jack to lift the vehicle, and it can also be used to support certain components during various operations. **Warning:** *Never, under any circumstances, rely on a jack to support the vehicle while working on it. Whenever any of the suspension or steering fasteners are loosened or removed they must be inspected and, if necessary, replaced with new ones of the same part number or of original equipment quality and design. Torque specifications must be followed for proper reassembly and component retention. Never attempt to heat or straighten any suspension or steering components. Instead, replace any bent or damaged part with a new one.*



2.2 To detach the strut assembly from the steering knuckle, remove the bracket bolt for the ABS wheel speed sensor (right arrow),remove the brake hose clip (left arrow), remove the two strut nuts, then drive out the strut-to-knuckle bolts with a hammer and punch



2.5 To detach the upper end of the strut assembly from the body, mark the relationship of the strut to the body, then remove the upper mounting nuts (arrows)

2 Strut/coil spring assembly (front) - removal, inspection and installation

Removal

Refer to illustrations 2.2 and 2.5

1 Loosen the front wheel lug nuts, raise the front of the vehicle and support it securely on jackstands. Remove the wheels.

2 Unclip the brake hose from the strut bracket **(see illustration)** and detach it from the bracket. If the vehicle is equipped with ABS, detach the speed sensor wiring harness from the strut by removing the clamp bracket bolt.

3 Remove the strut-to-knuckle nuts and knock the bolts out with a hammer and punch.

4 Separate the strut from the steering knuckle. Be careful not to overextend the inner CV joint and don't let the knuckle fall outward, as this could damage the brake hose.

5 Working in the engine compartment, make alignment marks on the strut and body **(see illustration)**.

6 Support the strut and spring assembly with one hand and remove the strut upper mounting nuts. Remove the assembly out from the fenderwell.

Inspection

7 Check the strut body for leaking fluid, dents, cracks and other obvious damage which would warrant repair or replacement.

8 Check the coil spring for chips or cracks in the spring coating (this will cause premature spring failure due to corrosion). Inspect the spring seat for cuts, hardness and general deterioration.

9 If any undesirable conditions exist, proceed to the strut disassembly procedure (see Section 3).

Installation

10 Guide the strut assembly up into the fenderwell and insert the upper mounting studs through the holes in the strut tower, making sure the marks made in Step 5 are in alignment. Once the studs protrude from the strut tower, install the nuts so the strut won't fall back through. This is most easily accomplished with the help of an assistant, as the strut is quite heavy and awkward.

11 Slide the steering knuckle into the strut flange and insert the bolts. Install the nuts and tighten them to the torque listed in this Chapter's Specifications.

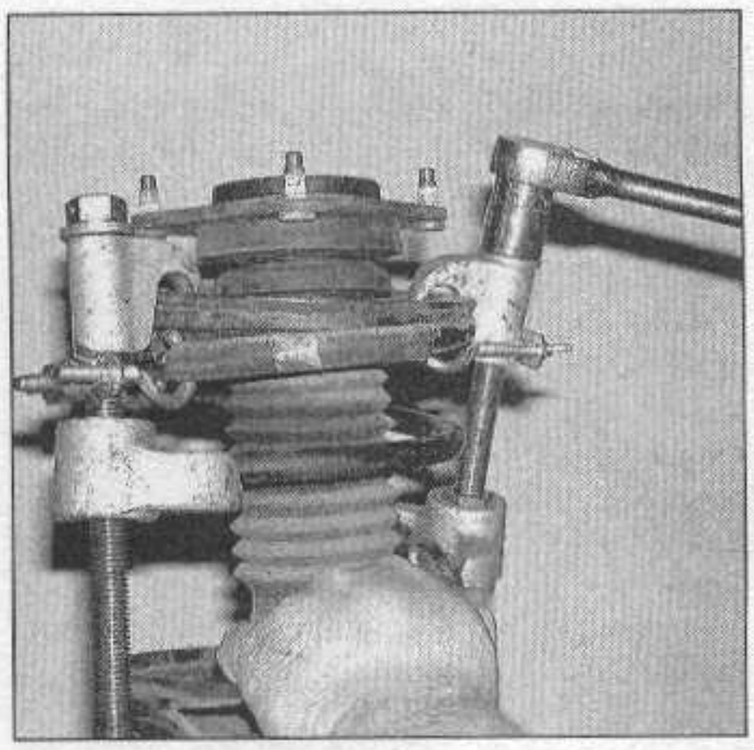
12 Guide the brake hose through its bracket in the strut and install the retaining clip. If equipped with ABS, attach the wheel speed sensor bracket to the strut and tighten the bolt securely.

13 Install the wheel and lug nuts, then lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

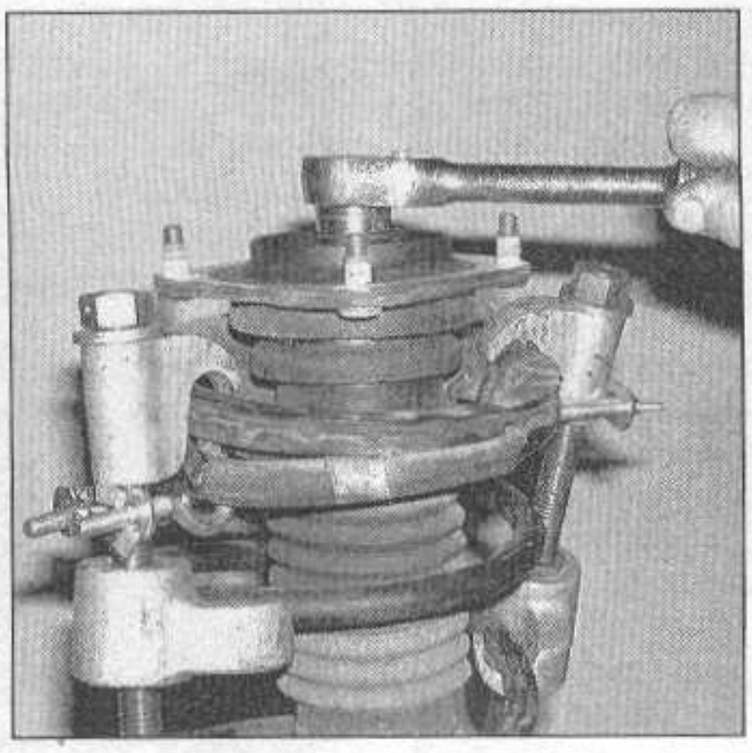
14 Tighten the upper mounting nuts to the torque listed in this Chapter's Specifications.

3 Strut/coil spring - replacement

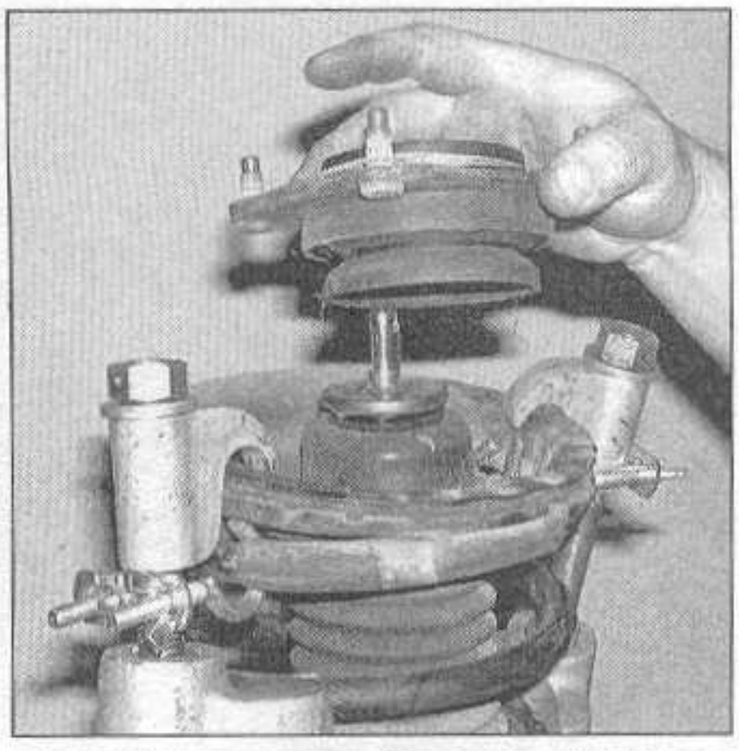
1 If the struts or coil springs exhibit the telltale signs of wear (leaking fluid, loss of damping capability, chipped, sagging or cracked coil springs) explore all options before beginning any work. The strut/shock absorber assemblies are not serviceable and must be replaced if a problem develops. However, 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*



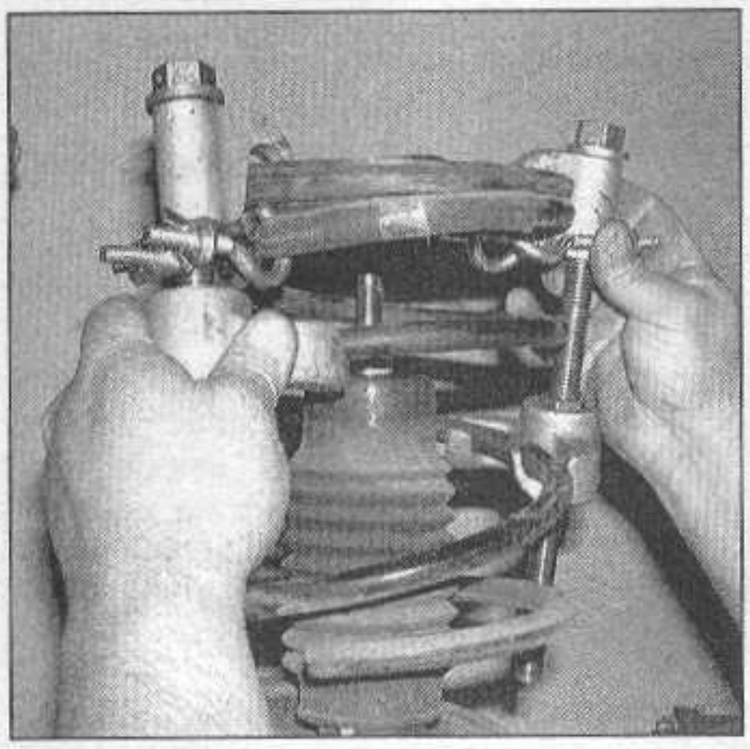
3.3 Install the spring compressor according to the tool manufacturer's instructions and compress the spring until all pressure is relieved from the upper spring seat



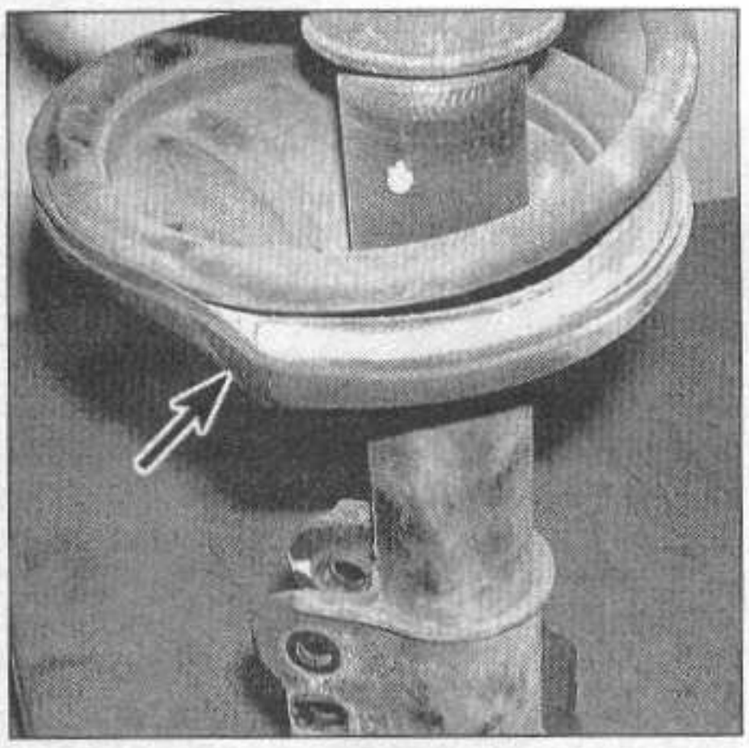
3.4 Remove the damper shaft nut



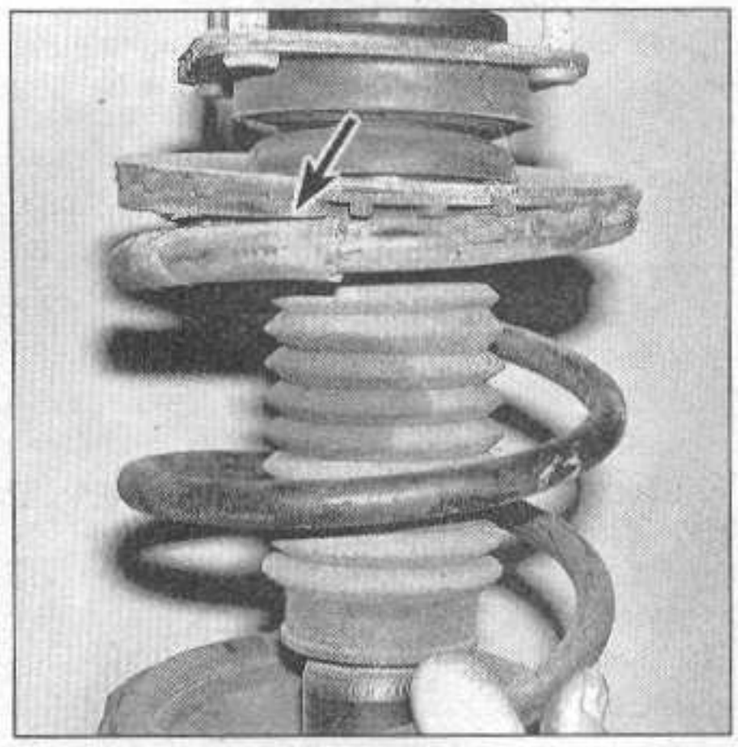
3.5 Lift the suspension support off the damper shaft



3.6 Remove the spring seat and compressed spring from the damper shaft



3.11 When installing the spring, make sure the end fits into the recessed portion of the lower seat (arrow)



3.12 Make sure the notch in the spring seat faces out (aligned with the strut-to-knuckle flange), and the upper end of the coil spring locks into the recess in the spring seat

the manufacturer's instructions furnished with the tool. After removing the coil spring from the strut, set it aside in a safe, isolated area.

Disassembly

Refer to illustrations 3.3, 3.4, 3.5 and 3.6

2 Remove the strut and spring assembly following the procedure described in Section 2 (front) or Section 9 (rear). 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 Following the tool manufacturer's instructions, install the spring compressor (which can be obtained at most auto parts stores or equipment yards on a daily rental basis) on the spring and compress it sufficiently to relieve all pressure from the upper spring seat **(see illustration)**. This can be verified by wiggling the spring.

4 Remove the damper shaft nut **(see illustration)**.

5 Remove the upper suspension support **(see illustration)**. Inspect the bearing in the suspension support for smooth operation. If it does not turn smoothly, replace the suspension support. Check the rubber portion of the suspension support for cracking and general deterioration. If there is any separation of the rubber, replace it.

6 Lift the spring seat and compressed spring as one assembly from the damper shaft **(see illustration)**. Check the rubber spring seat for cracking and hardness, replacing it if necessary. **Warning:** *Carry the spring carefully and never place any part of your body near the end of the spring! Set the compressed spring aside in an isolated area.*

7 Separate the spring seat and rubber seal from the compressed spring.

8 Slide the dust boot off the damper shaft.

9 Check the lower insulator for wear, cracking and hardness and replace it if necessary.

Reassembly

Refer to illustrations 3.11 and 3.12

10 If the lower insulator is being replaced, set it into position with the dropped portion seated in the lowest part of the seat. Extend the damper rod to its full length and install the dust boot.

11 Carefully place the coil spring onto the lower insulator, with the end of the spring resting in the lowest part of the insulator **(see illustration)**.

12 Install the upper insulator and the spring seat. Make sure the cutout on the spring seat is facing in (towards the vehicle), in line with the strut-to-knuckle attachment points **(see illustrations)**.

13 Install the dust seal and suspension support to the damper shaft.

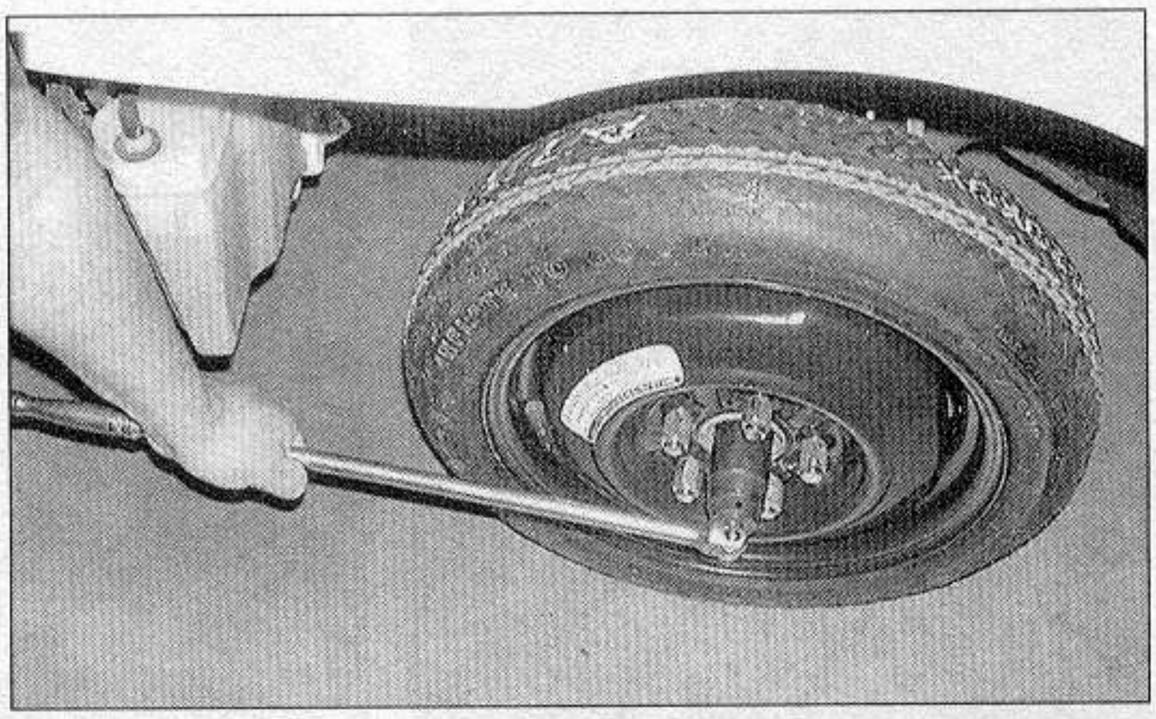
14 Install the nut and tighten it to the torque listed in this Chapter's Specifications.

15 Install the strut/shock absorber and coil spring assembly (see Section 2 [front] or 9 [rear]).

4 Steering knuckle - removal and installation

Warning: *Dust created by the brake system may contain asbestos, which is harmful to your health. Never blow it out with compressed air and don't inhale any of it. Do not,*

4.1 Unstake the driveaxle/hub nut using a chisel and hammer



4.2 Use a breaker bar and socket to loosen the driveaxle/hub nut - install the spare tire onto the hub if the nut is not accessible through the wheel

under any circumstances, use petroleum-based solvents to clean brake parts. Use brake system cleaner only.

Removal

Refer to illustrations 4.1, 4.2 and 4.5

1 Remove the center cap and unstake the driveaxle/hub nut **(see illustration)**.

2 Use a breaker bar and socket and loosen the driveaxle/hub nut **(see illustration)**. **Note:** *If you can't get a socket on the driveaxle/hub nut through the opening in the center of the wheel, install the spare tire and lower the vehicle to the ground.*

3 Loosen the wheel lug nuts slightly, raise the front of the vehicle and support it securely on jackstands. Remove the wheel and the driveaxle/hub nut.

4 Disconnect the brake hose from the strut **(see illustration 2.2)**, then remove the brake caliper, caliper mounting bracket and brake disc (see Chapter 9). **Note:** *Don't disconnect the brake hose from the caliper. Also, be sure to support the caliper with a piece of wire - don't let it hang by the brake hose.*

5 If the vehicle is equipped with ABS, unbolt the wheel speed sensor **(see illustration)**.

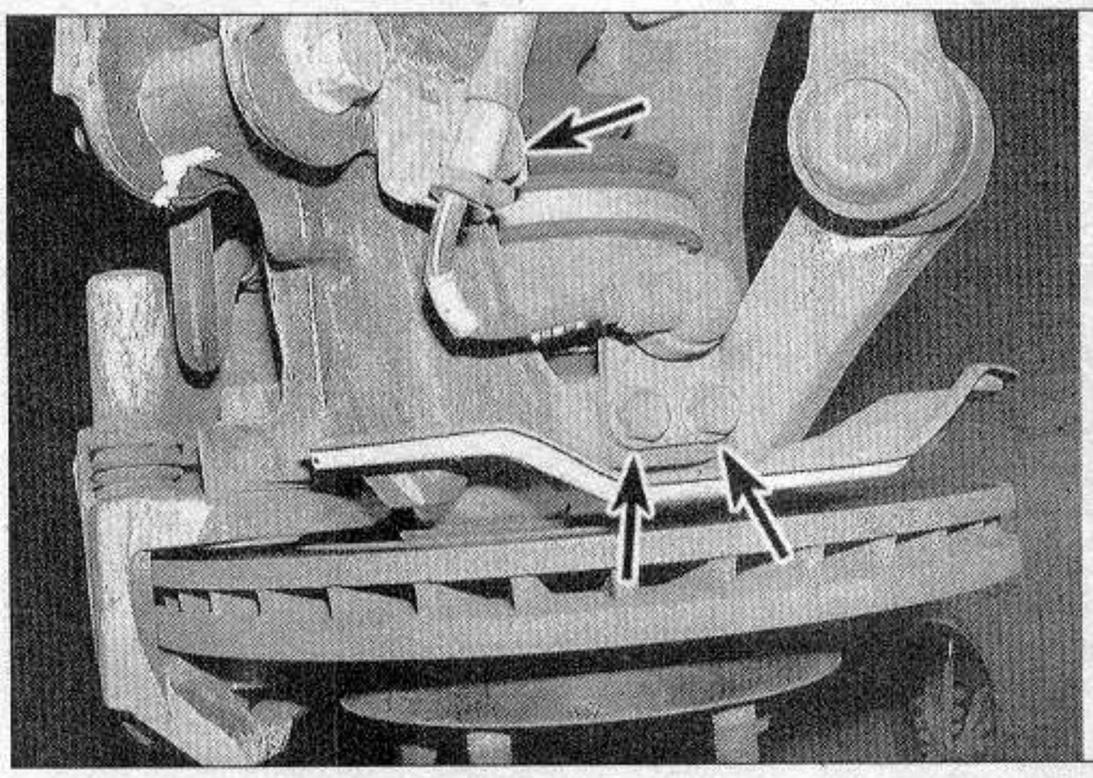
6 Remove the strut-to-steering knuckle nuts, but don't remove the bolts yet (see Section 2).

7 Separate the tie-rod end from the steering knuckle arm (see Section 16).

8 Separate the balljoint from the steering knuckle (see Section 7).

9 Push the driveaxle from the hub (see Chapter 8). Support the end of the driveaxle with a length of wire.

10 Remove the strut-to-knuckle bolts and separate the knuckle from the strut.



4.5 Remove the three ABS wheel speed sensor mounting bolts (arrows)

Installation

11 Guide the knuckle and hub assembly into position, inserting the driveaxle into the hub.

12 Push the knuckle into the strut flange and install the bolts and nuts, but don't tighten them yet.

13 Attach the control arm balljoint to the steering knuckle (see Section 7).

14 Attach the tie-rod end to the steering knuckle arm (see Section 16). Tighten the strut-to-knuckle nuts to the torque listed in this Chapter's Specifications.

15 Place the brake disc on the hub and install the caliper mounting bracket and caliper (see Chapter 9). Tighten the mounting bracket bolts and the caliper bolt to the torque listed in the Chapter 9 Specifications.

16 Install the driveaxle/hub nut and tighten it securely, but not completely yet.

17 Install the wheel and lug nuts, lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications. Tighten the driveaxle/hub nut to the torque listed in the Chapter 8 Specifications.

5 Hub and wheel bearing assembly (front) - removal and installation

Due to the special tools and expertise required to press the hub and bearing from the steering knuckle, this job should be left to a professional mechanic. However, the steering knuckle and hub may be removed and the assembly taken to a dealer service department or other qualified repair shop. See Section 4 for the steering knuckle removal procedure.

6 Stabilizer bar (front) - removal and installation

Refer to illustrations 6.8 and 6.9

1 Loosen the wheel lug nuts, raise the front of the vehicle and support it securely on jackstands. Remove the wheels.

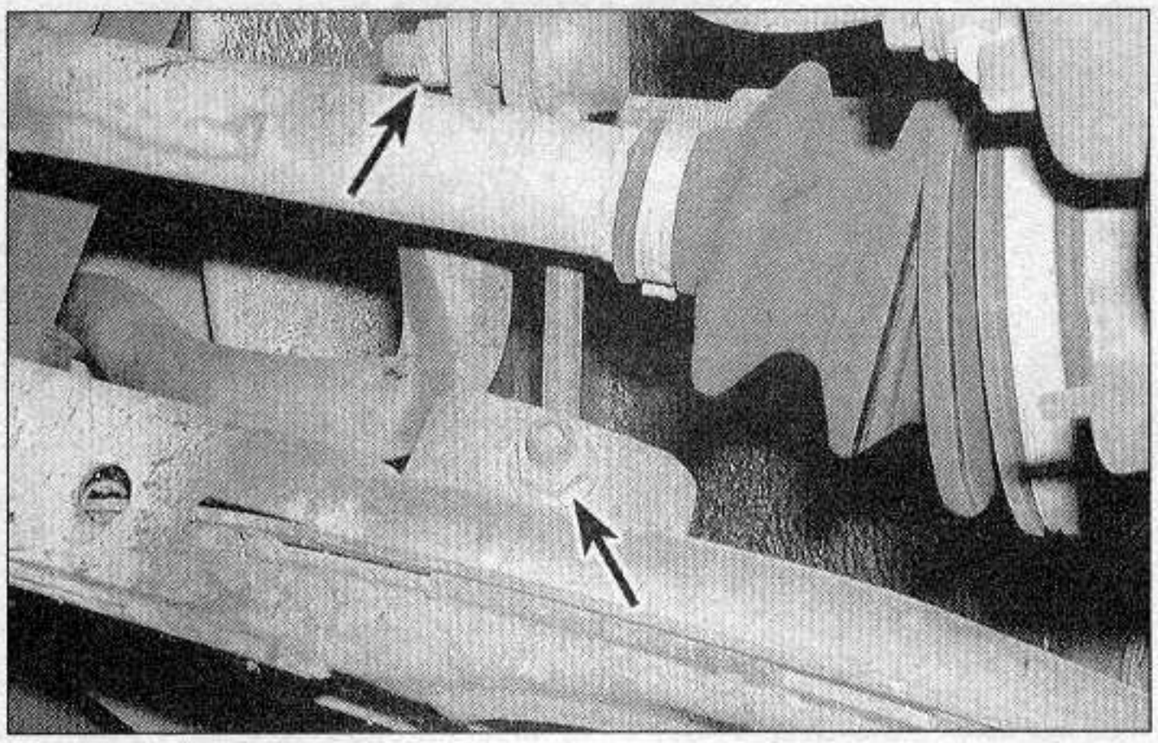
2 Remove the crossmember from below the engine compartment. Refer to Chapter 7B for mounting bolt locations and removal procedures.

3 Remove the transaxle cradle. Refer to Chapter 7B for mounting bolt locations and removal procedures.

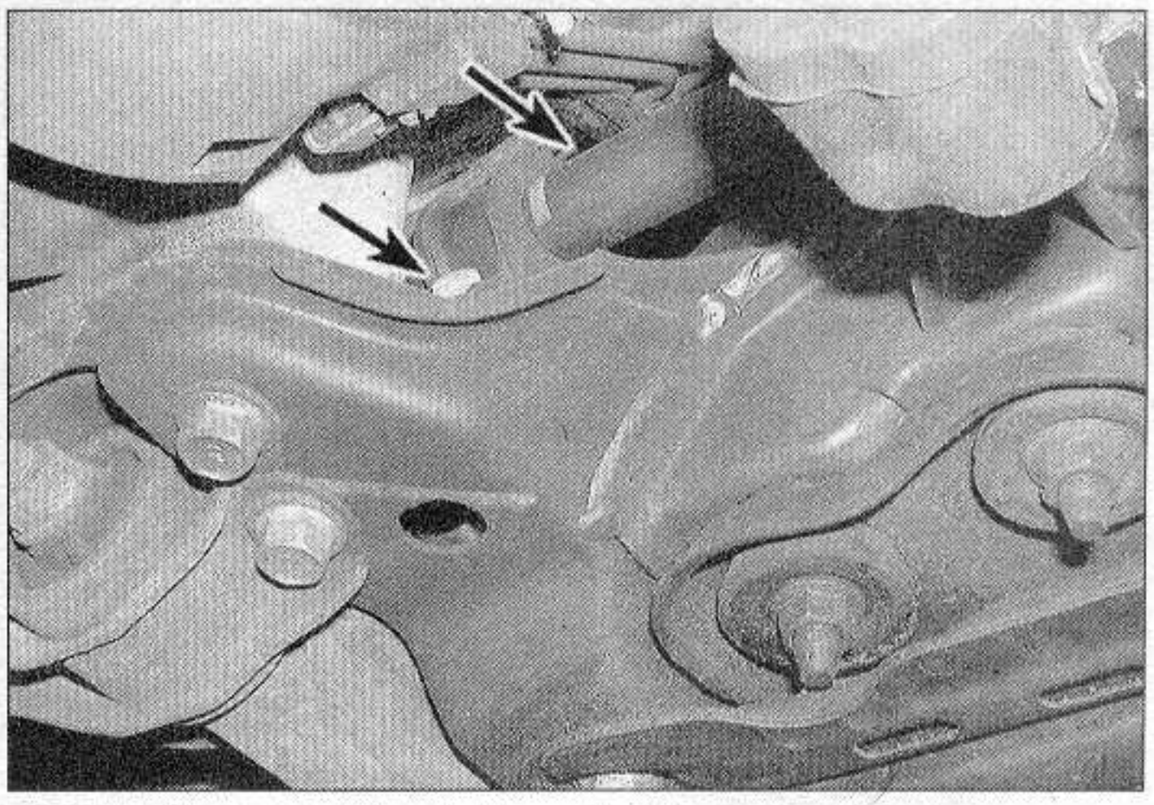
4 Disconnect the oxygen sensor electrical connectors (see Chapter 6).

5 Unbolt the exhaust pipe(s) from the exhaust manifold(s) (see Chapter 4) and position the pipe(s) off to the side. Use wire to tie the exhaust system up to keep it from straining the exhaust system mounts.

6 On manual transaxle models, disconnect the shift linkage and the extension bar (see Chapter 7A). Use wire to tie the linkage and the extension bar out of the way to pre-



6.7 To disconnect the stabilizer link from the stabilizer bar, remove the nut indicated by the upper arrow; to disconnect the link from the control arm, remove the nut that attaches the link to the control arm (lower arrow)



6.8 To disconnect the stabilizer bar from the subframe, remove the bushing clamp nuts and bolts (arrows) from both sides

vent them from bending.

7 Disconnect both stabilizer bar links from the stabilizer bar **(see illustration)**.

8 Remove both stabilizer bar clamps **(see illustration)**.

9 Position a floor jack under the subframe and loosen the four bolts and two nuts. Remove the bolts and nuts and lower the subframe enough to access the stabilizer bar. This procedure will require a transaxle jack that can span across the center section of the subframe or two floor jacks positioned at the outer ends of the subframe to allow balance. **Warning:** *Do not position your body under the subframe or the front end of the vehicle while performing this removal procedure.*

10 Remove the stabilizer bar, guiding it out from the right (passenger's) side of the vehicle.

11 Inspect the clamp bushings and the link balljoints. If the bushings are cracked or torn, replace them. If the link balljoints are loose, replace the links.

12 Installation is the reverse of removal. Be sure to tighten all fasteners to the torque values listed in this Chapter's Specifications. Refer to Chapter 7 for the locations and the torque specifications for the crossmember and transaxle cradle fasteners. Refer to this Chapter's Specifications for the subframe mounting bolts and nuts torque specifications.

7 Control arm - removal, inspection and installation

Removal

Refer to illustrations 7.3, 7.4, 7.5 and 7.6

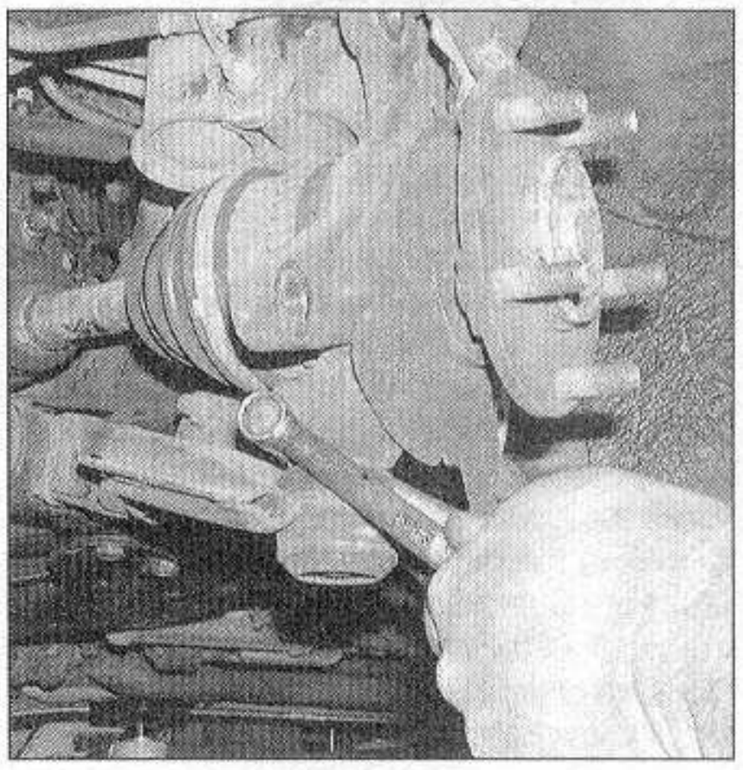
1 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands. Remove the wheel.

2 Detach the stabilizer link from the control arm (see Section 6).

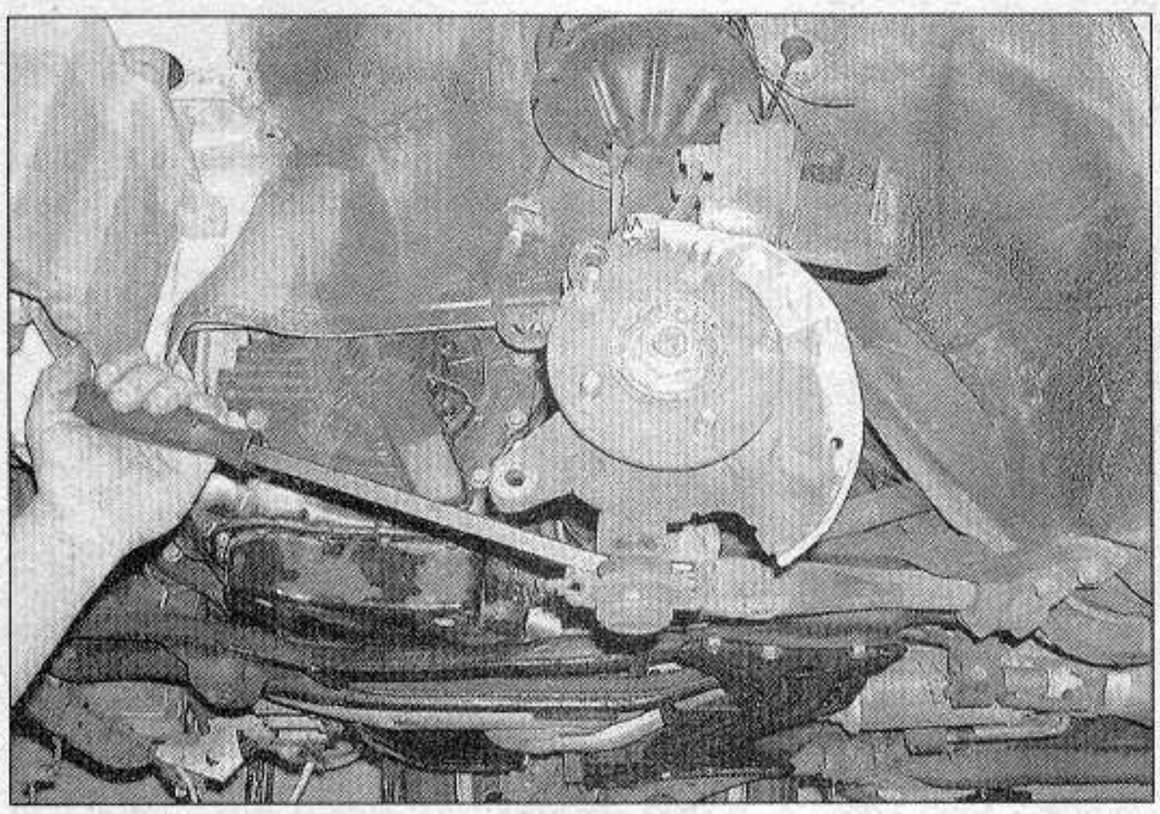
3 Remove the balljoint clamp bolt and nut **(see illustration)**.

4 Separate the balljoint stud from the steering knuckle using a large screwdriver **(see illustration)**. Be sure not to damage the balljoint boot. Separate the arm from the steering knuckle.

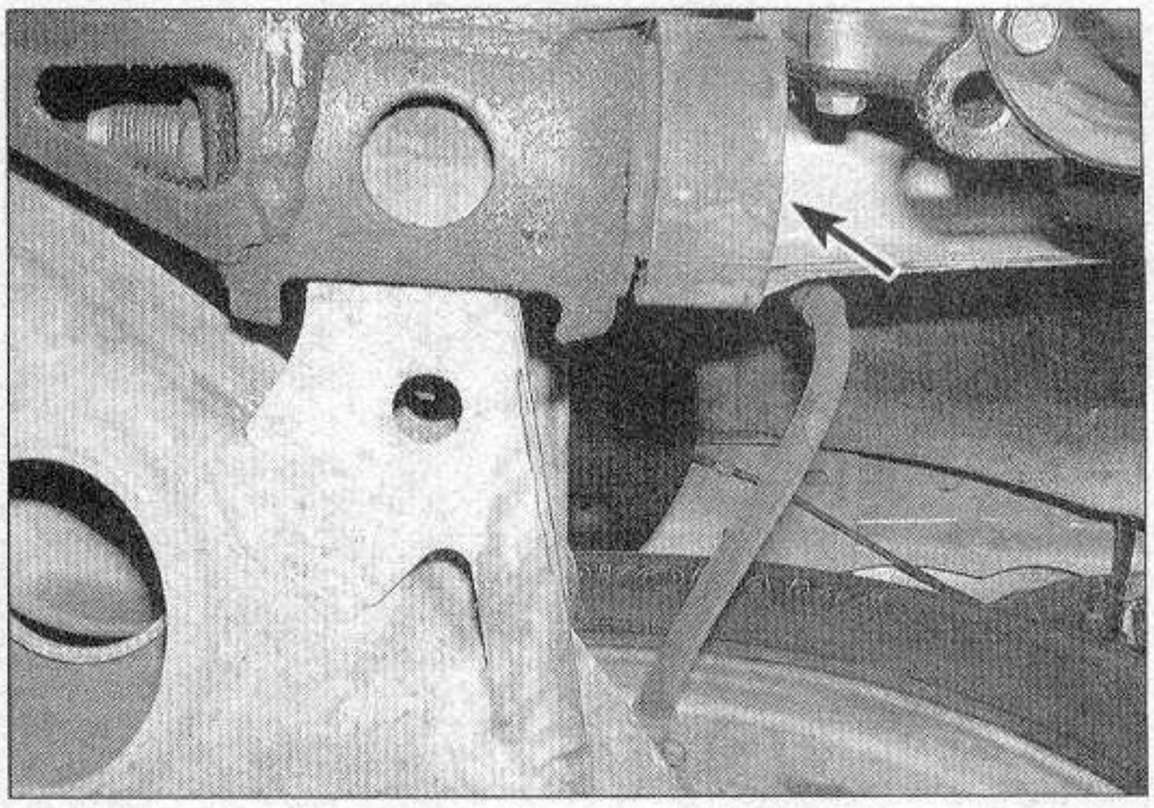
5 Remove the front pivot bolt **(see illustration)**.



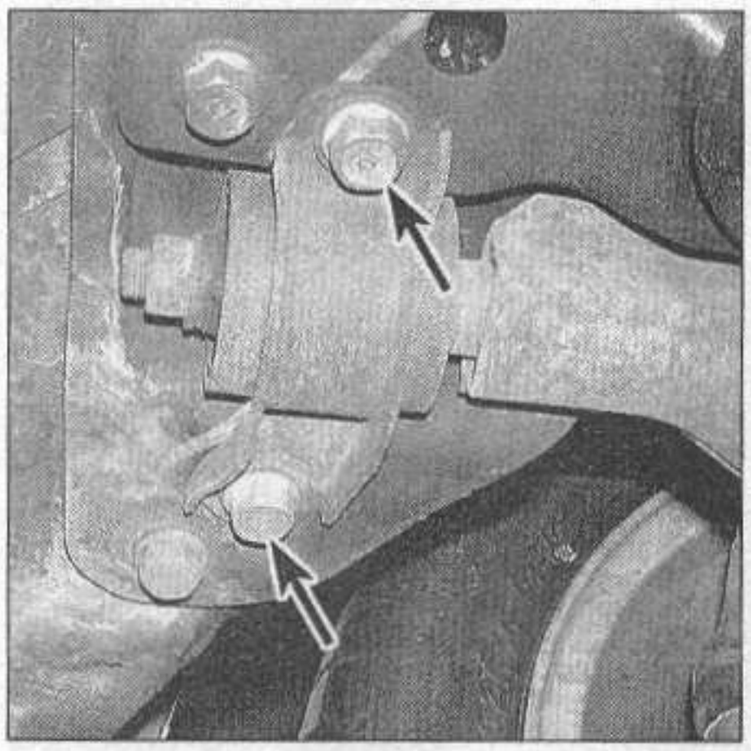
7.3 Remove the balljoint clamp bolt and nut



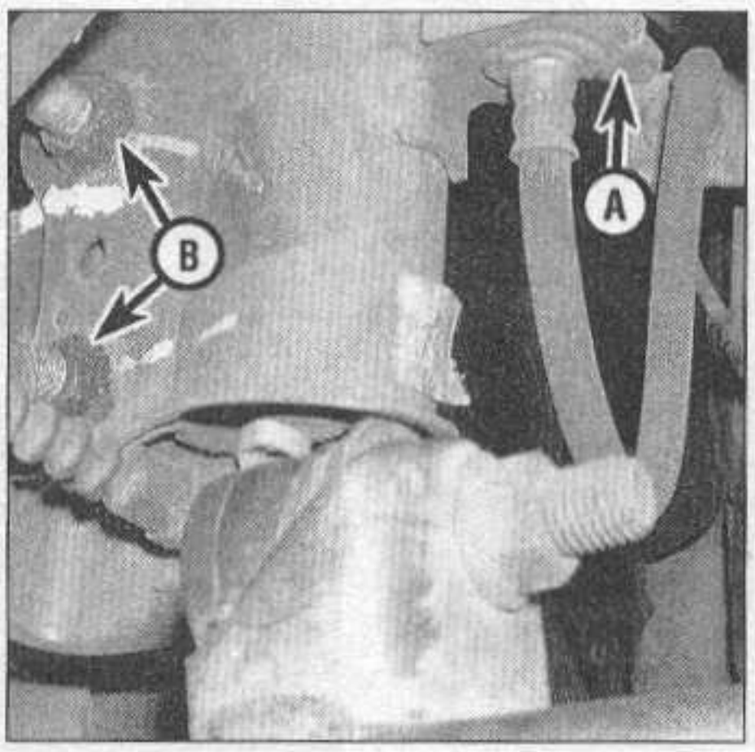
7.4 Pry the balljoint stud out of the steering knuckle with a large screwdriver, being careful not to damage the balljoint boot



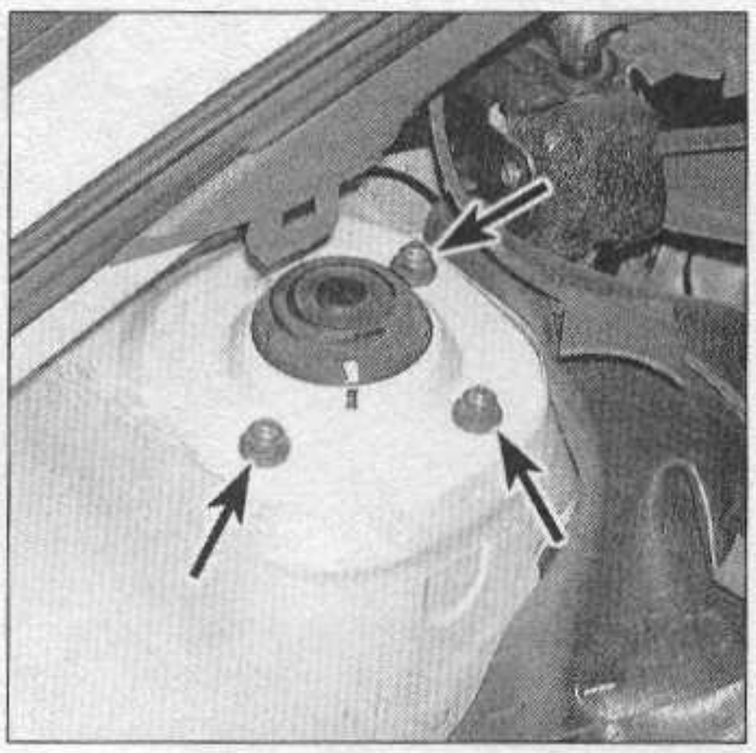
7.5 Remove the front pivot bolt (arrow)



7.6 Remove the rear pivot bushing bolts (arrows)



9.2 To disconnect the strut from the rear knuckle, remove the brake hose clip (A), then remove the two nuts (B) and bolts



9.6 Remove the strut upper mounting nuts (arrows)

6 Remove the rear bushing clamp bolts **(see illustration)**. Remove the control arm.

Inspection

7 Inspect the front and rear bushings for cracks and general deterioration. If the front bushing is in need of replacement, take the control arm to an automotive machine shop to have the old one pressed out and the new one pressed in. If the rear bushing is in need of replacement, remove the nut from the rear of the control arm and slide the bushing and bracket assembly off the control arm pivot. Install the new bushing, lockwasher and nut, tightening the nut to the torque listed in this Chapter's Specifications.

8 Inspect the control arm for straightness. If it's bent, replace it. Do not attempt to straighten a bent control arm.

Installation

9 Installation is the reverse of removal. Tighten all of the fasteners to the torque values listed in this Chapter's Specifications.

10 Install the wheel and lug nuts, lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

8 Balljoints - replacement

The balljoint on these models is not serviceable. The control arm and balljoint must be replaced as a complete assembly. See Section 7 for the control arm removal procedure.

The balljoint boot, however, is replaceable.

9 Strut/coil spring assembly (rear) - removal, inspection and installation

Removal

Refer to illustrations 9.2 and 9.6

1 Loosen the rear wheel lug nuts, raise the rear of the vehicle and support it securely on jackstands. Remove the wheels.

2 Remove the brake hose clip from the bracket on the strut **(see illustration)**. If the vehicle is equipped with ABS, remove the speed sensor harness bracket bolt.

3 Remove the strut-to-knuckle nuts **(see illustration 9.2)** and knock the bolts out with a hammer and punch.

4 Separate the strut from the knuckle. Don't allow the knuckle to fall outward, as this may damage the brake hose.

5 Remove the luggage compartment trim panel for access to the upper mounting nuts.

6 Have an assistant support the strut and spring assembly while you remove the three upper mounting nuts **(see illustration)**. Remove the assembly through the fenderwell.

Inspection

7 Inspect the strut and spring as outlined in Section 2. If any undesirable conditions exist, replace the strut or spring (see Section 3).

Installation

8 Guide the strut assembly up into the fenderwell and insert the upper mounting studs through the holes in the strut tower. Once the studs protrude from the strut tower, install the nuts so the strut won't fall back through. This is most easily accomplished with the help of an assistant, as the strut is quite heavy and awkward.

9 Slide the rear knuckle into the strut flange and insert the two bolts. Install the nuts and tighten them to the torque listed in this Chapter's Specifications.

10 Connect the brake hose to the strut bracket and install the clip. If the vehicle is equipped with ABS, connect the speed sensor wiring harness bracket and tighten the bolt securely.

11 Install the wheel and lug nuts, then lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

12 Tighten the upper mounting nuts to the torque listed in this Chapter's Specifications. Install the trim panel.

10 Rear knuckle - removal and installation

Refer to illustration 10.6

1 Loosen the rear wheel lug nuts, raise the rear of the vehicle and support it securely on jackstands. Remove the wheels.

2 Remove the rear hub and bearing assembly (see Section 11).

3 On models with rear drum brakes, remove the clips securing the brake line to the strut (see Chapter 9). Detach the parking brake cable from the parking brake lever and the brake backing plate (see Chapter 9). **Note:** *The brake shoes can remain attached to the backing plate.*

4 Remove the four bolts and detach the brake backing plate from the knuckle (see Chapter 9). On models with drum brakes, lift the backing plate and brake shoe assembly off the knuckle and hang it from the strut spring with a length of wire. **Caution:** *Do not disconnect the brake line from the wheel cylinder, but be careful not to twist or otherwise damage the brake hose.*

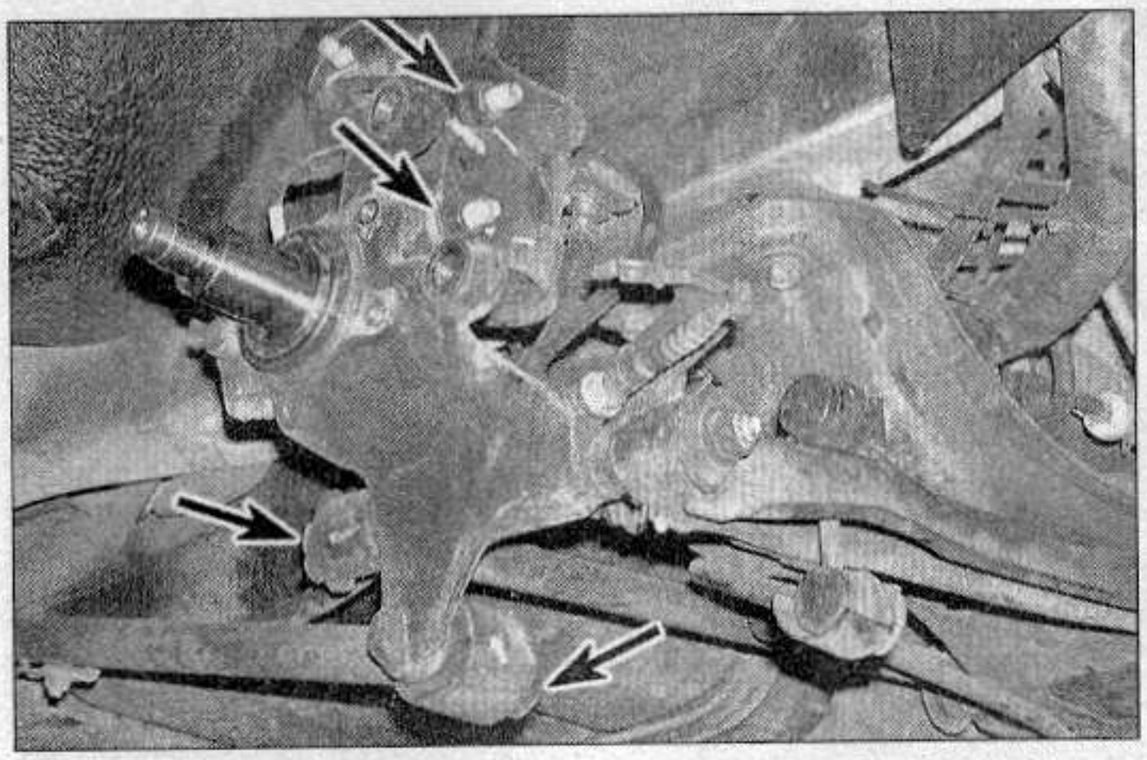
5 On models with ABS, remove the rear wheel sensor.

6 Loosen the strut-to-knuckle nuts, then disconnect the suspension arms from the knuckle **(see illustration)**.

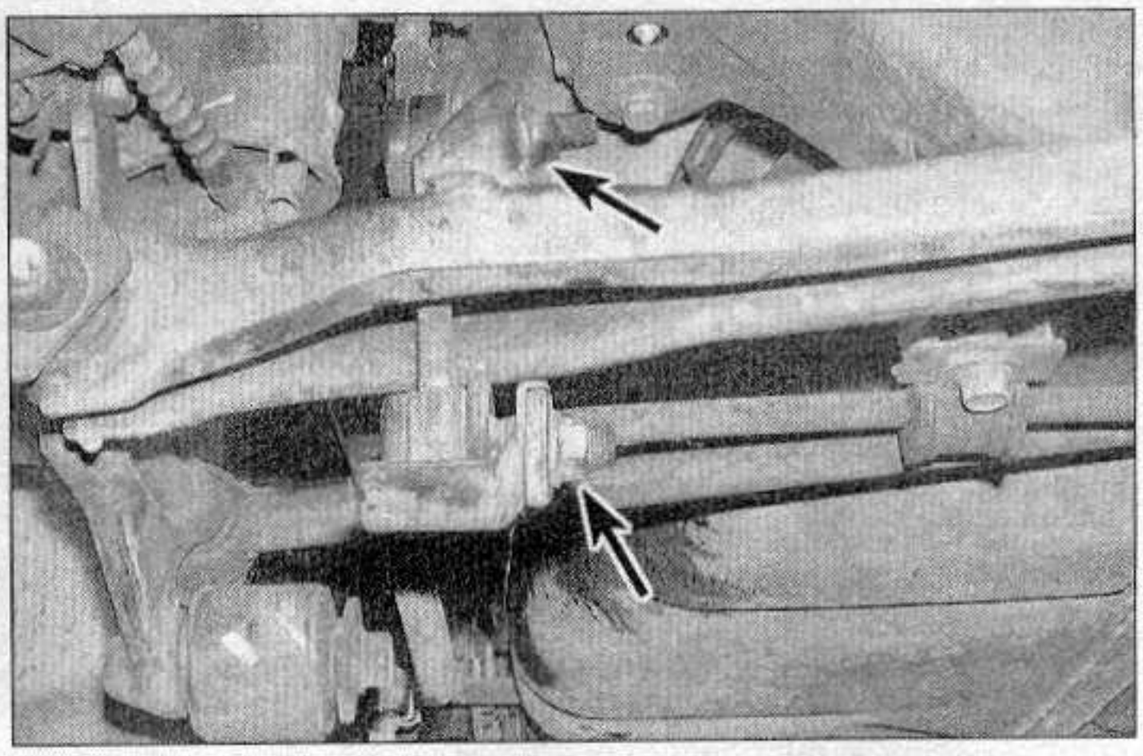
7 Remove the strut-to-knuckle nuts and drive the bolts out with a hammer and punch, then detach the knuckle from the strut.

8 Installation is the reverse of removal. Be sure to tighten the suspension and brake backing plate fasteners to the torque values listed in this Chapter's Specifications. If equipped with rear disc brakes, tighten the caliper mounting bracket bolts and caliper mounting bolt to the torque values listed in the Chapter 9 Specifications. The brake hydraulic system will not require bleeding unless the brake line was detached from the caliper or wheel cylinder

9 Install the wheel and lug nuts. Lower the



10.6 Once the brake assembly has been detached from the knuckle, the knuckle can be removed by removing the bolts and nuts that attach it to the rear knuckle and suspension arms (arrows)



12.2 If you're just removing the stabilizer bar, remove the nut that attaches it to the link (A); if you're removing a lateral link, remove the nut from the upper end of the link (B)

vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

11 Hub and wheel bearing assembly (rear) - removal and installation

Note: *The hub and bearing assembly is a sealed unit and is not serviceable. If found to be defective it must be replaced with a new one.*

1 Loosen the rear wheel lug nuts, raise the rear of the vehicle and support it securely on jackstands. Remove the wheel.

2 Remove the center cap and unstake the hub nut.

3 Using a breaker bar and socket, loosen the hub nut.

4 Remove the brake drum or disc (see Chapter 9).

5 Unscrew the hub nut.

6 Remove the hub and bearing assembly from the knuckle.

7 Installation is the reverse of removal. Be sure to tighten the hub nut to the torque listed in this Chapter's Specifications. If equipped with disc brakes, tighten the caliper mounting bracket bolts and the caliper mounting bolt to the torque values listed in the Chapter 9 Specifications.

12 Stabilizer bar (rear) - removal and installation

Refer to illustrations 12.2 and 12.3

1 Loosen the rear wheel lug nuts, raise the rear of the vehicle and support it securely on jackstands. Remove the wheels.

2 Remove the stabilizer bar-to-link nuts **(see illustration)**. Separate the links from the bar.

3 Remove the bushing clamp bolts and nuts from the rear crossmember **(see illustration)**. Remove the stabilizer bar.

4 Inspect the clamp bushings and the link balljoints. If the bushings are cracked or torn, replace them. If the link balljoints are loose, replace the links.

5 Installation is the reverse of removal. Be sure to tighten all fasteners to the torque values listed in this Chapter's Specifications.

13 Rear suspension arms - removal and installation

1 Loosen the rear wheel lug nuts, raise the rear of the vehicle and support it securely on jackstands. Remove the wheels.

Lateral arms

Front

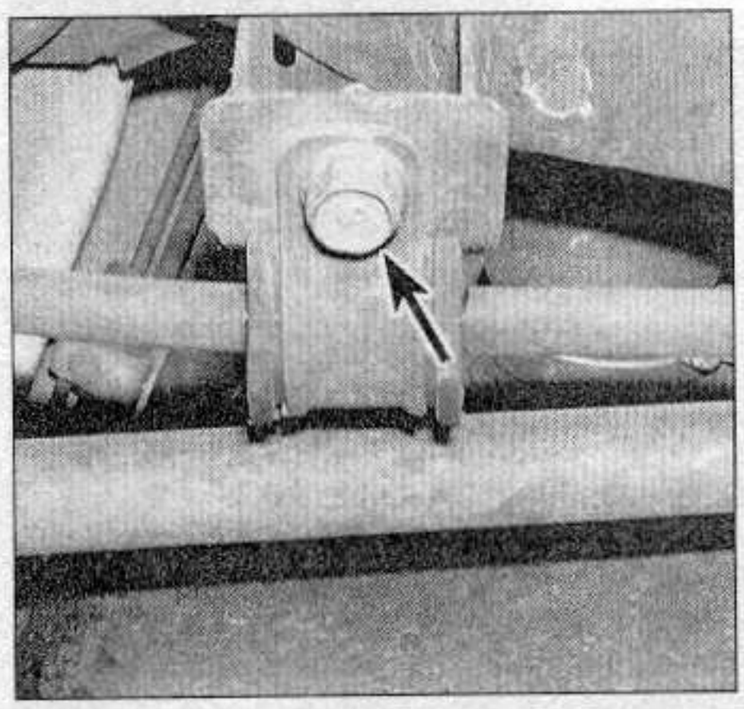
Refer to illustrations 13.2 and 13.4

2 Remove the through-bolt that attaches the lateral arms to the rear knuckle **(see illustration)**.

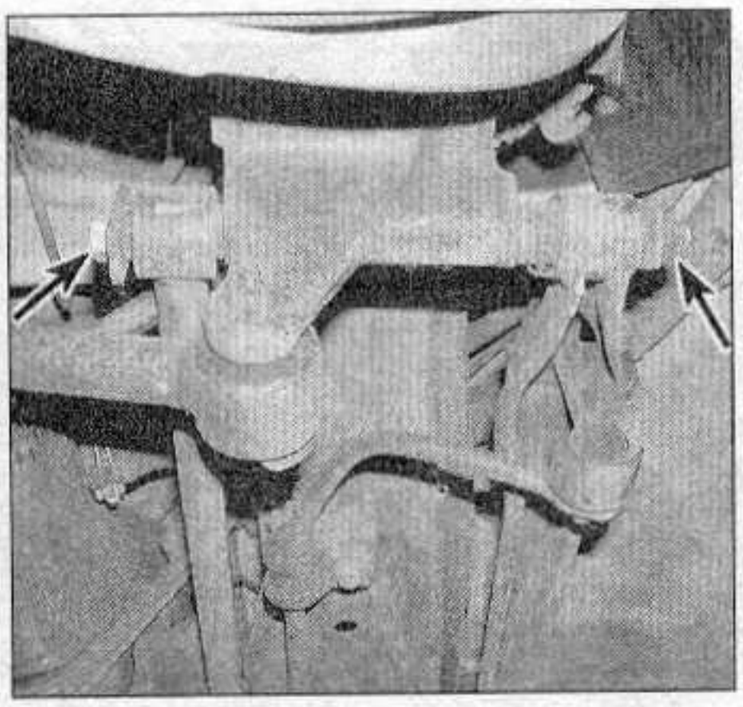
3 Remove the plastic covers from the center of the rear crossmember.

4 Loosen (but do not remove) the nuts and bolts securing the inner ends of the lateral arms to the crossmember **(see illustration)**.

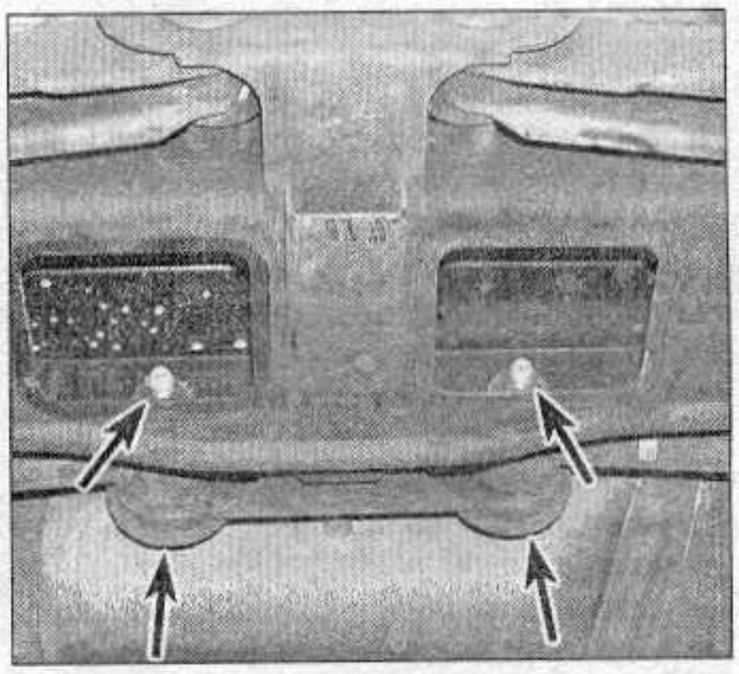
5 Mark the relationship of the rear crossmember to the floorpan of the vehicle (do this



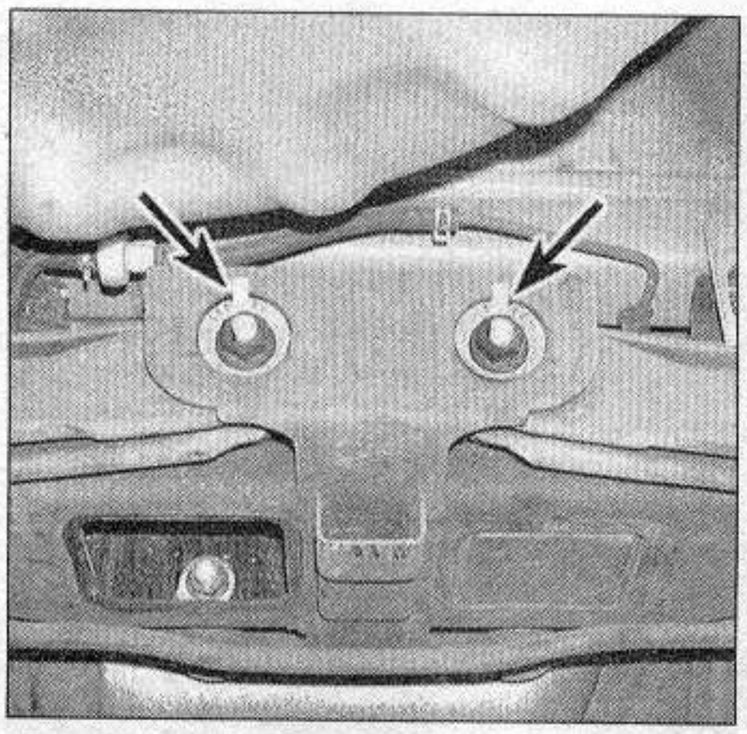
12.3 To disconnect the rear stabilizer bar bushing clamps, remove the bolt (arrow) and nut (not visible in this photo) from each clamp



13.2 To disconnect the lateral arms from the knuckle, remove the through-bolt and nut (arrows)



13.4 Loosen the nuts and bolts (arrows) securing the inner ends of the front lateral arms to the crossmember (the bolts can't be removed until the crossmember is lowered)



13.12 Mark the relationship of the toe adjusting cams to the crossmember (arrows)

on both sides. This will help to preserve rear wheel alignment.

6 Support the rear crossmember with a floor jack, then remove the crossmember mounting bolts (there are two at each end of the crossmember). Lower the crossmember enough to allow removal of the inner pivot bolts. Remove the bolts and detach the arms.

7 Installation is the reverse of removal. Be sure to align the matchmarks you made in Step 5 before tightening the crossmember mounting bolts, and be sure to tighten the bolts to the torque listed in this Chapter's Specifications. Before tightening the lateral arm fasteners, place a floor jack under the rear knuckle and raise the suspension to simulate normal ride height, then tighten the fasteners to the torque values listed in this Chapter's Specifications.

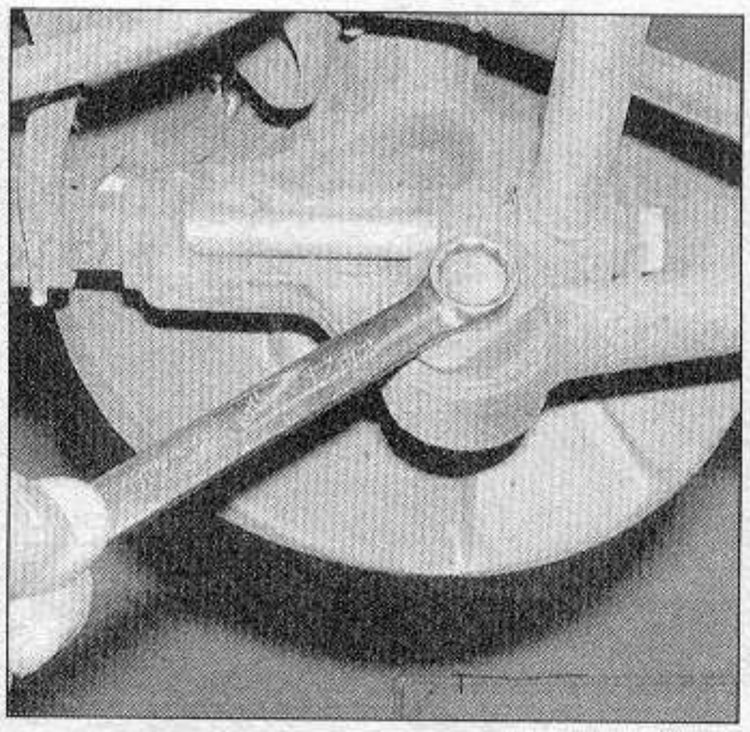
8 Lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

Rear

Refer to illustration 13.12

9 Disconnect the stabilizer bar link from the rear lateral arm (see Section 12).

10 Remove the through-bolt that attaches the outer ends of the lateral arms to the rear knuckle **(see illustration 13.2).**



13.17 Remove the bolt that attaches the rear end of the trailing arm to the knuckle

11 Mark the relationship of the toe-in adjusting cams on the inner ends of the rear lateral arms to the crossmember to preserve rear wheel alignment **(see illustration).**

12 Remove the plastic covers from the center of the rear crossmember, then remove the inner pivot nuts **(see illustration).** Remove the rear lateral arm.

13 Installation is the reverse of removal. Before tightening the lateral arm fasteners, align the matchmarks you made in Step 11. Place a floor jack under the rear knuckle and raise the suspension to simulate normal ride height, then tighten the fasteners to the torque values listed in this Chapter's Specifications.

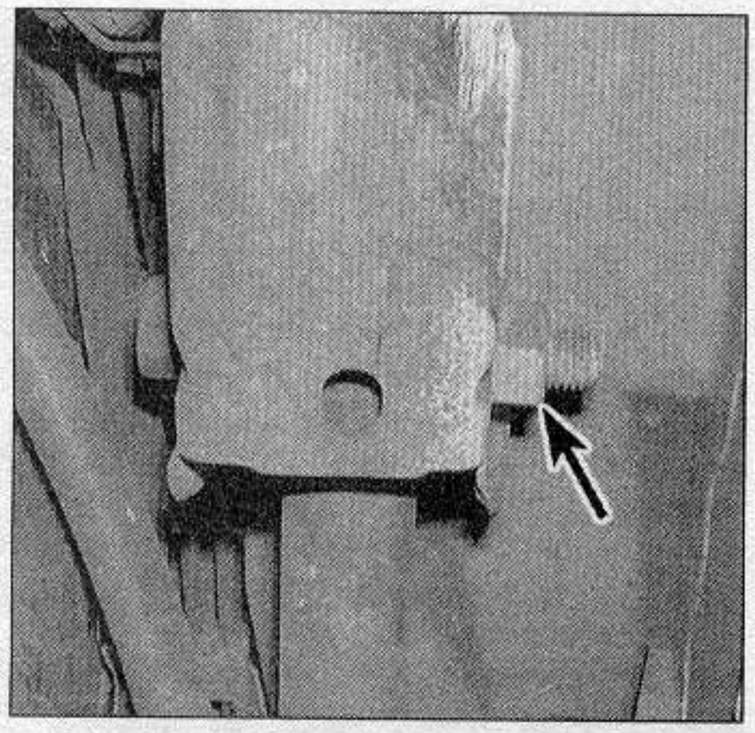
14 Lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

15 When you're done, drive the vehicle to an alignment shop and have the rear-wheel toe checked and, if necessary, adjusted.

Trailing arms

Refer to illustrations 13.17 and 13.18

16 Remove the bolts and disconnect the parking brake cable from the trailing arm.



13.18 To disconnect the forward end of the trailing arm from the body, remove this nut and pivot bolt (arrow)

17 Remove the bolt that attaches the rear end of the arm to the knuckle **(see illustration).**

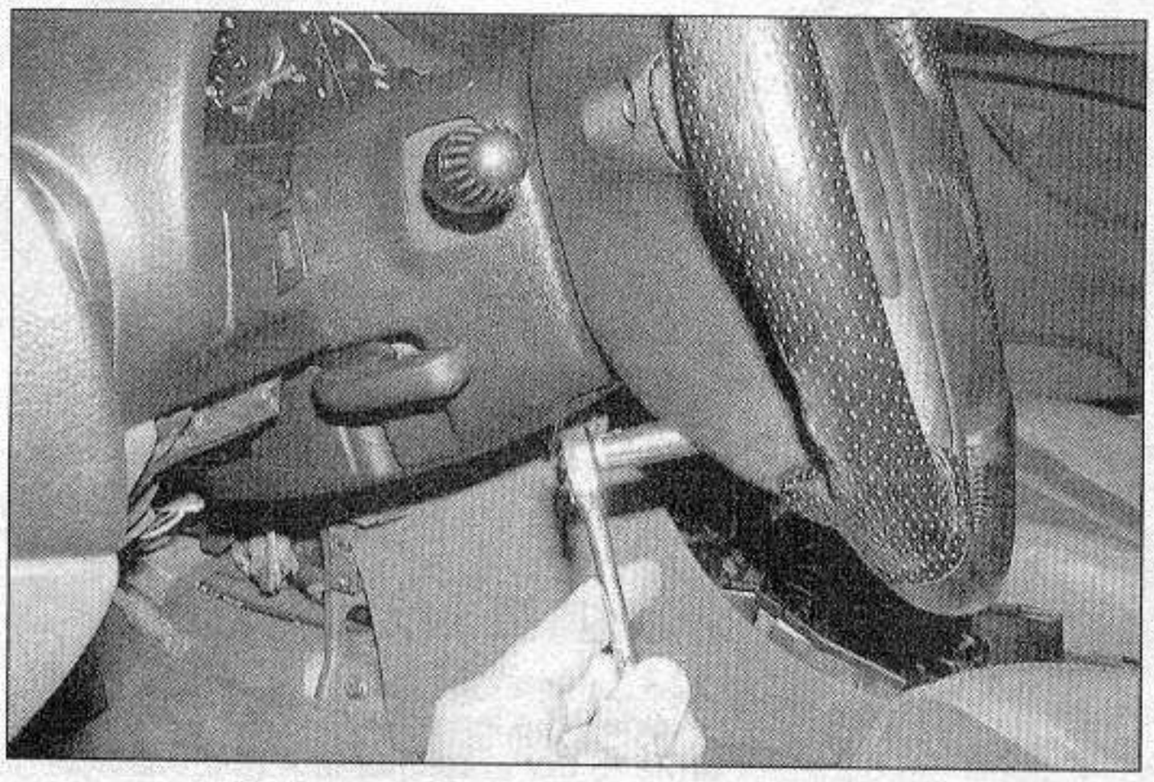
18 Remove the pivot bolt and nut from the forward end of the trailing arm **(see illustration).** Remove the trailing arm.

19 Installation is the reverse of removal. Place a floor jack under the rear knuckle and raise the suspension to simulate normal ride height, then tighten the fasteners to the torque listed in this Chapter's Specifications.

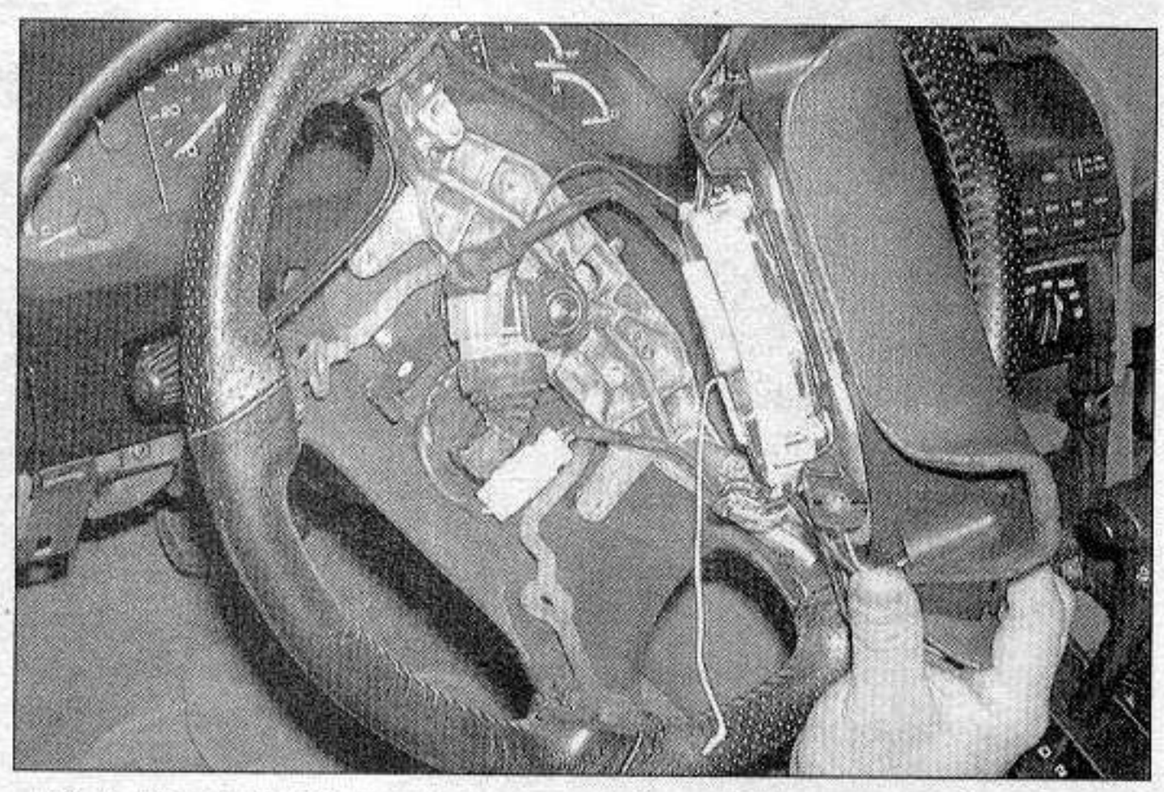
20 Lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

14 Steering wheel - removal and installation

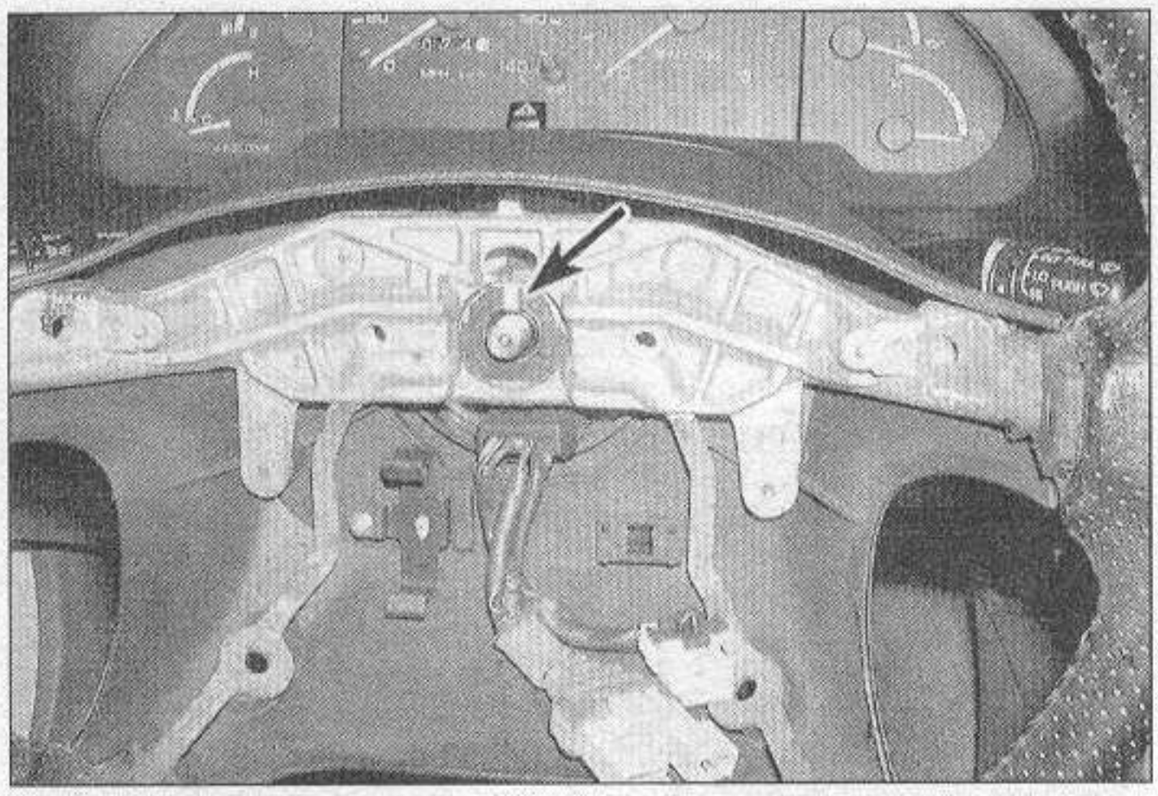
Warning: *The models covered by this manual are equipped with Supplemental Restraint Systems (SRS), more commonly known as airbags. Always disable the airbag system before working in the vicinity of any airbag system components to avoid the possibility of accidental deployment of the airbag, which could cause personal injury* (see Chapter 12).



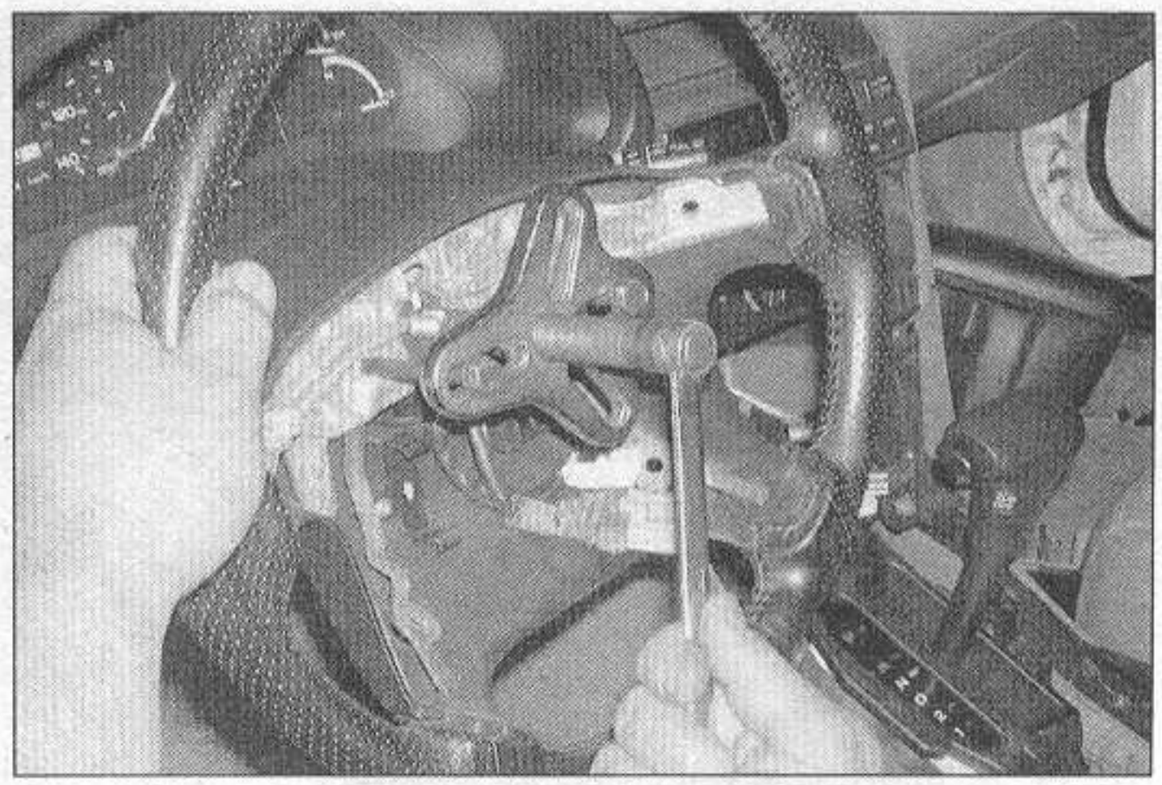
14.3 Remove the four airbag mounting bolts



14.4 Carefully lift the airbag module and disconnect the airbag and cruise control electrical connectors



14.6 After the steering wheel retaining nut has been removed, mark the relationship of the steering wheel to the steering shaft (arrow)



14.7 Use a steering wheel puller to separate the steering wheel from the steering shaft

Removal

Refer to illustrations 14.3, 14.4, 14.6, 14.7 and 14.8

1 Park the vehicle with the front wheels pointing straight ahead.

2 Disconnect the cable from the negative battery terminal, then the positive battery terminal and wait at least two minutes before proceeding. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

3 Remove the four airbag module bolts from the backside of the steering wheel **(see illustration)**.

4 Unplug the airbag module connector **(see illustration)** while holding the airbag module assembly off to the side. Also disconnect the cruise control electrical connector, if equipped.

5 Lift the airbag module off the steering wheel. **Warning:** *Handle the airbag module with care, carry the module with the trim cover side facing away from your body and store it in an isolated area with the trim side facing up.*

6 Remove the steering wheel retaining nut, then mark the relationship of the steering wheel to the steering shaft **(see illustration)**.

7 Use a steering wheel puller to separate the steering wheel from the steering shaft **(see illustration)**. When removing the wheel, make sure the electrical leads for the airbag module and the cruise control system don't snag on the wheel. **Warning:** *Do not turn the steering shaft while the steering wheel is removed.*

8 Place two large strips of tape across the clockspring and housing to prevent accidental movement of the clockspring **(see illustration)**.

Installation

9 Make absolutely sure that the clockspring is centered with the arrow on the clockspring pointing up. This shouldn't be a problem as long as you have not turned the steering shaft while the wheel was removed. If for some reason the shaft was turned, center the clockspring as follows:

a) Rotate the clockspring clockwise until it stops.

b) Rotate the clockspring counterclockwise about 2-3/4 turns until the arrow on the clockspring points straight up.

10 Pull the electrical leads for the airbag module and the cruise control system through the steering wheel and install the wheel, making sure the matchmarks line up.

11 Install the steering wheel retaining nut and tighten it to the torque listed in this Chapter's Specifications.

12 Connect the airbag and (if equipped) cruise control electrical connectors. Install the airbag module and tighten the mounting bolts to the torque listed in this Chapter's Specification.

13 Verify that the airbag circuit is operational by turning the ignition key to the On position. The "AIR BAG" warning light should illuminate for about seven seconds, then turn off.

15 Steering column - removal and installation

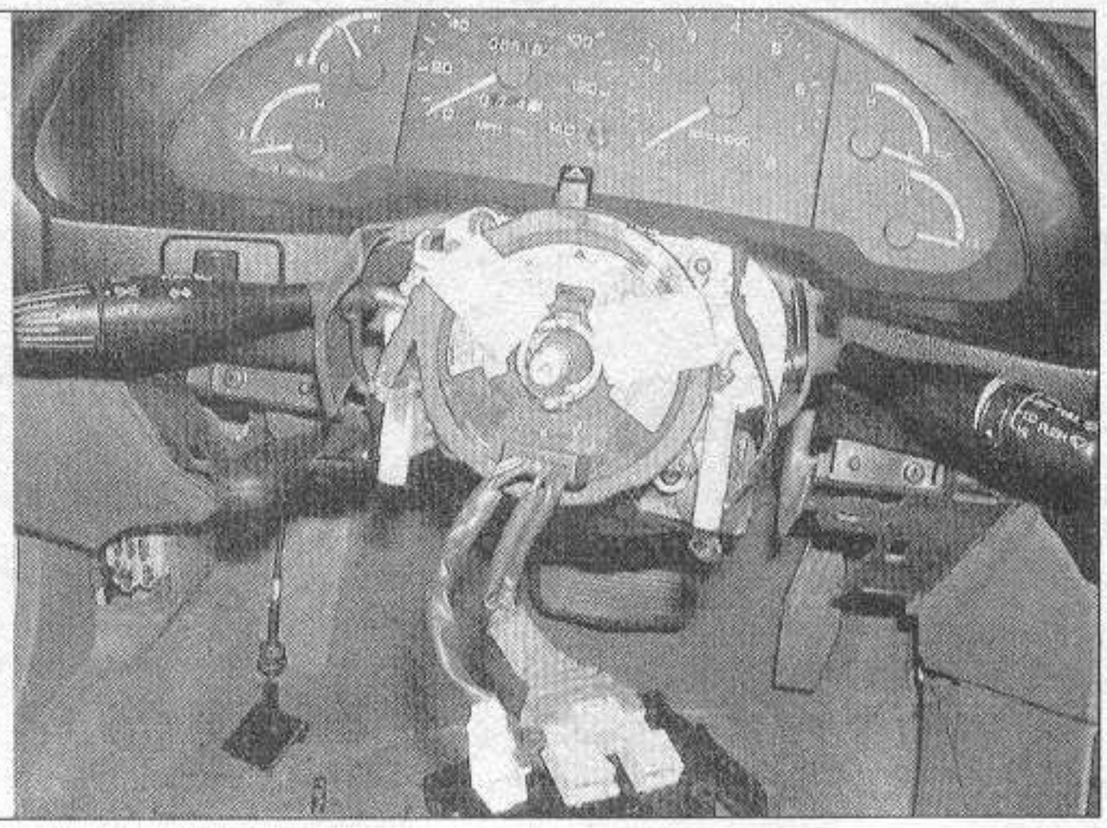
Warning 1: *The models covered by this manual are equipped with Supplemental Restraint Systems (SRS), more commonly known as airbags. Always disable the airbag system before working in the vicinity of any airbag system components to avoid the possibility of accidental deployment of the airbag, which could cause personal injury* (see Chapter 12).

Warning 2: *Make sure the steering shaft is not turned while the steering wheel is removed or you could damage the airbag system. To prevent the shaft from turning, position the wheels straight ahead, turn the ignition key to the lock position and remove the key before beginning work. Due to the possible damage to the airbag system, we recommend only experienced mechanics attempt this procedure.*

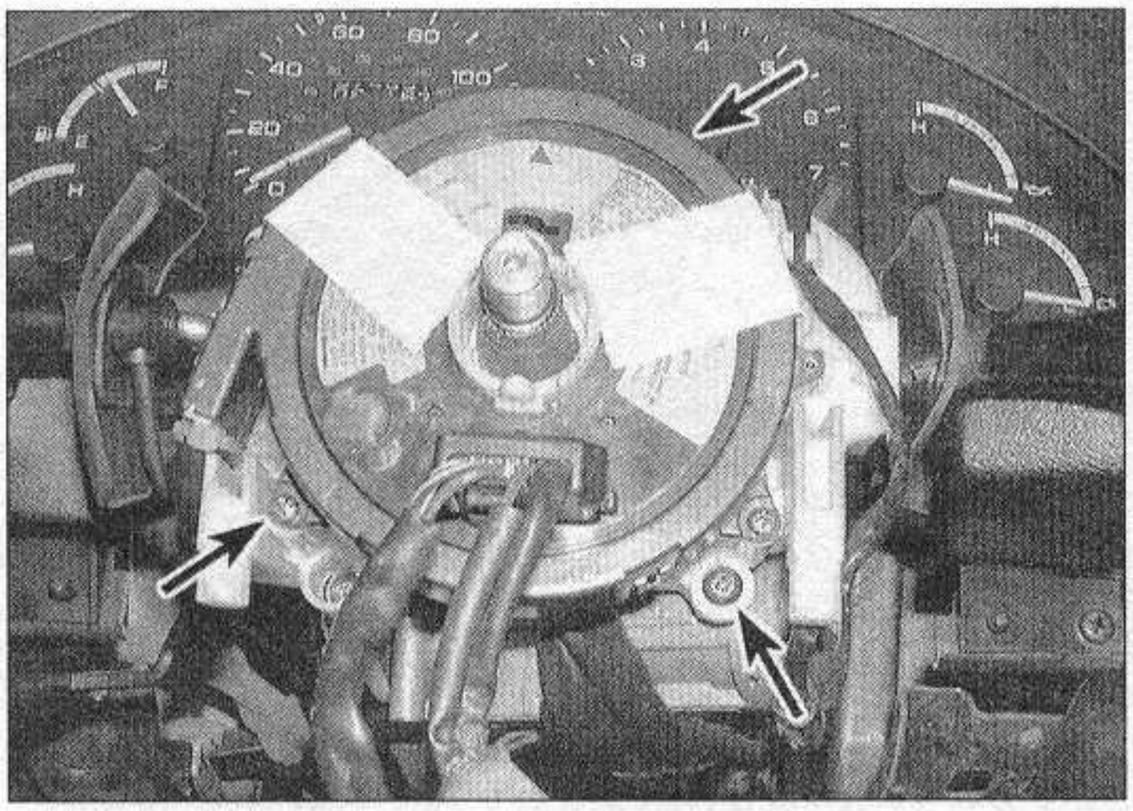
Removal

Refer to illustrations 15.2, 15.3, 15.9, 15.10 and 15.11

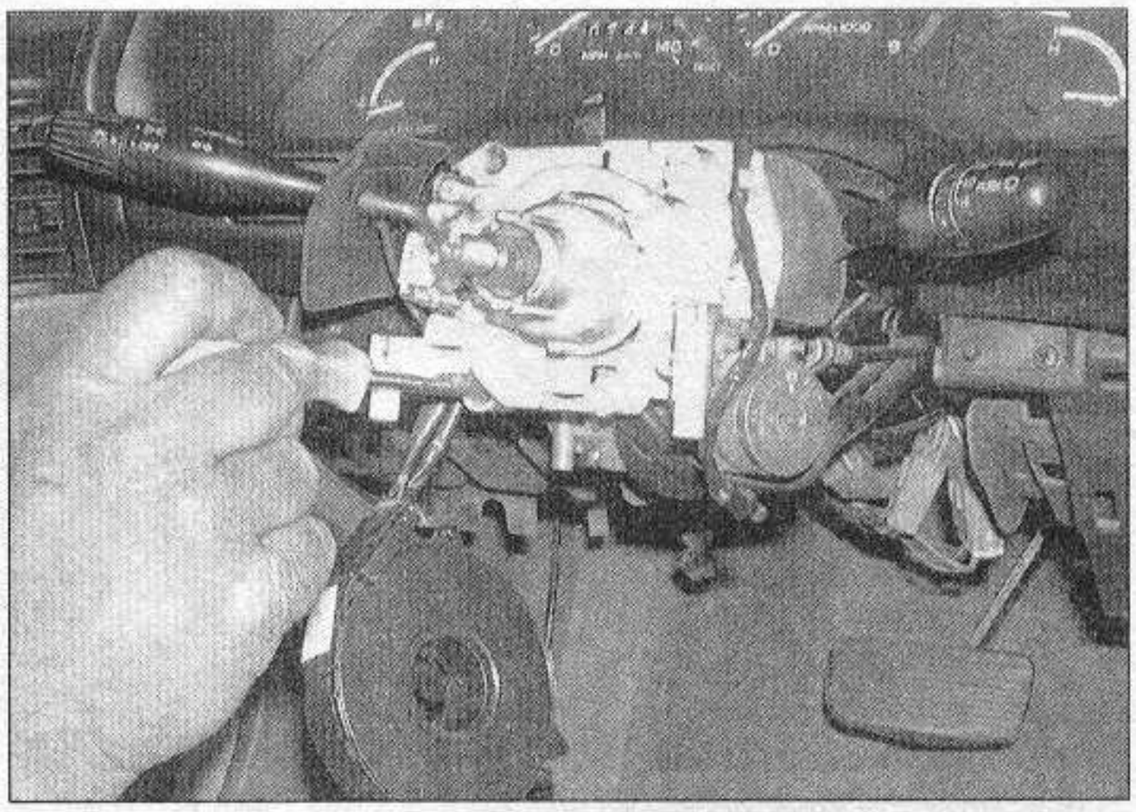
1 Disconnect the cable from the negative



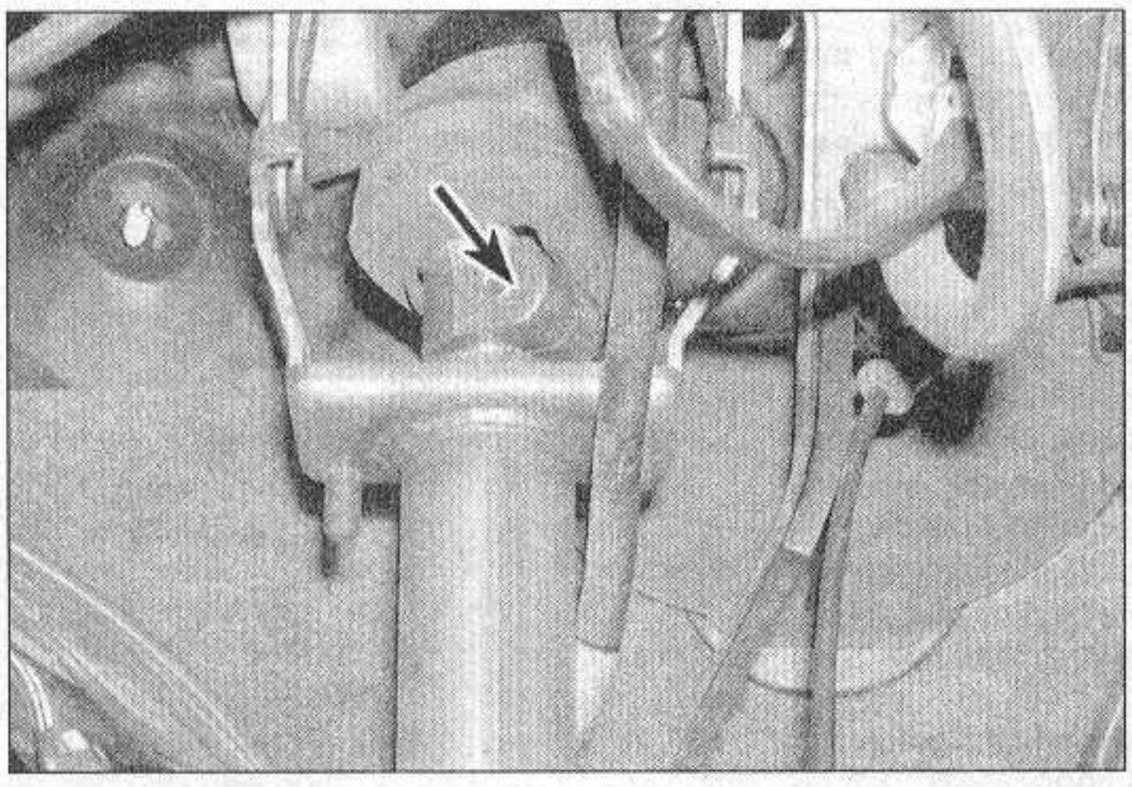
14.8 Be sure to install two pieces of tape to keep the clockspring from turning while the steering wheel is removed



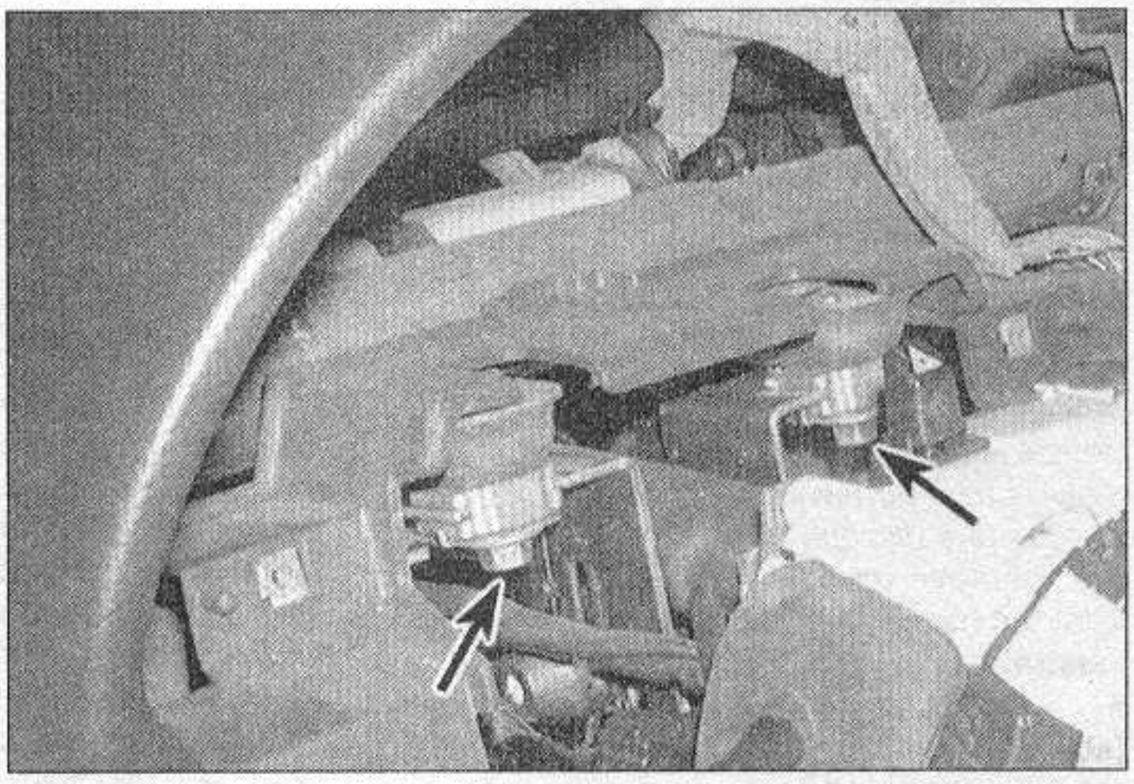
15.2 Remove the clockspring mounting screws (arrows)



15.3 Disconnect the clockspring ground wire screw



15.9 Remove the intermediate shaft pinch bolt (arrow)



15.10 Remove the steering column mounting bolts (arrows)

battery terminal, then the positive battery terminal and wait at least two minutes. Remove the steering wheel (see Section 14). **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Remove the clockspring mounting screws **(see illustration)**.

3 Remove the clockspring ground wire mounting screw **(see illustration)**.

4 Disconnect the clockspring ground connector and separate the clockspring from the steering wheel. **Note:** *On 1995 and later models, the airbag clockspring is an integral part of the combination switch. See Chapter 12 for the removal procedure.*

5 Remove the combination switch (see Chapter 12).

6 Loosen the hood release cable nut and remove the hood release cable from the lower section of the instrument panel (see Chapter 11).

7 Remove the lower instrument panel (see Chapter 11).

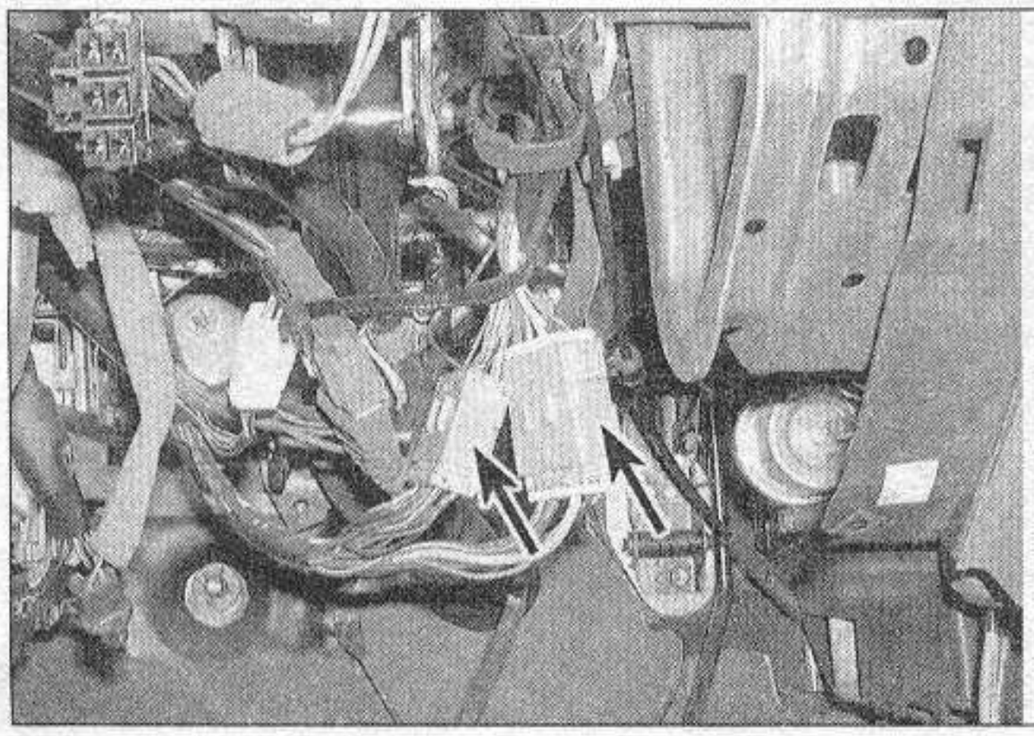
8 On automatic transaxle models, disconnect the shift lock cable (see Chapter 7B).

9 Remove the pinch bolt from the intermediate shaft **(see illustration)**.

10 Remove the steering column bracket bolts located on the upper end of the steering column **(see illustration)**. Remove the two steering column nuts located on the lower end of the steering column.

11 Disconnect the electrical connectors from the steering column wiring harness **(see illustration)**.

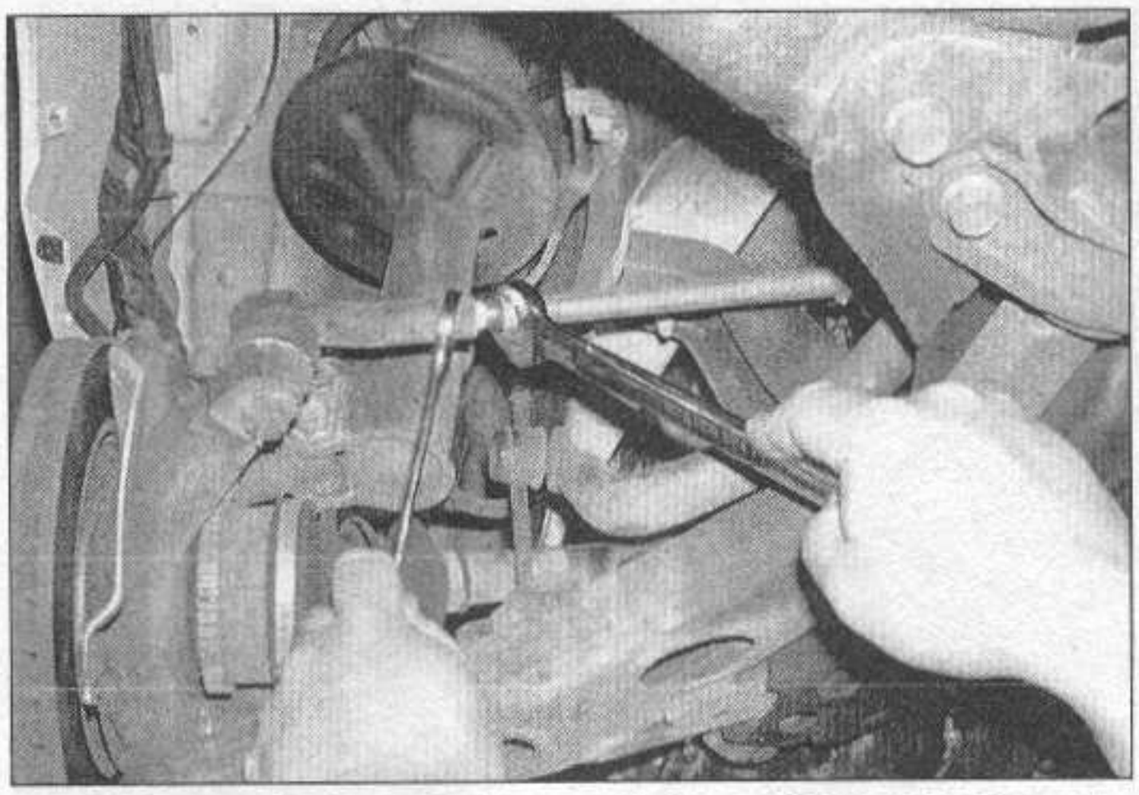
12 Remove the steering column.



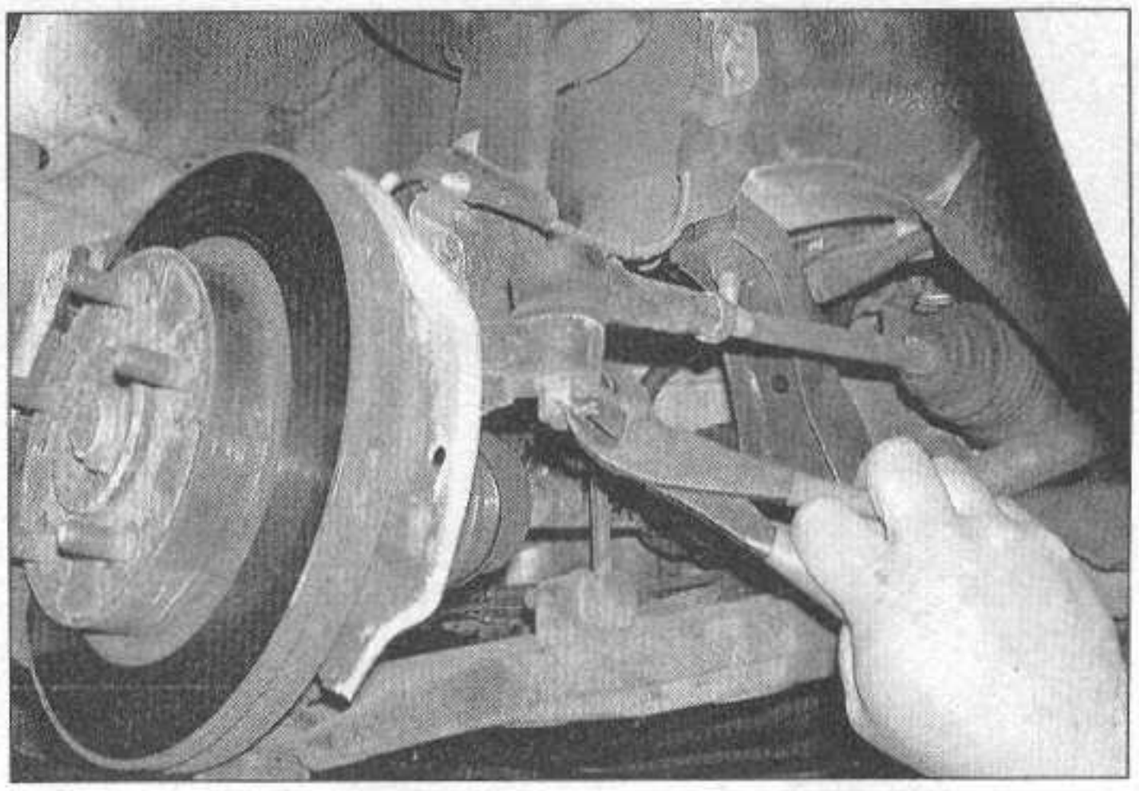
15.11 Disconnect the steering column harness connectors (arrows)

Installation

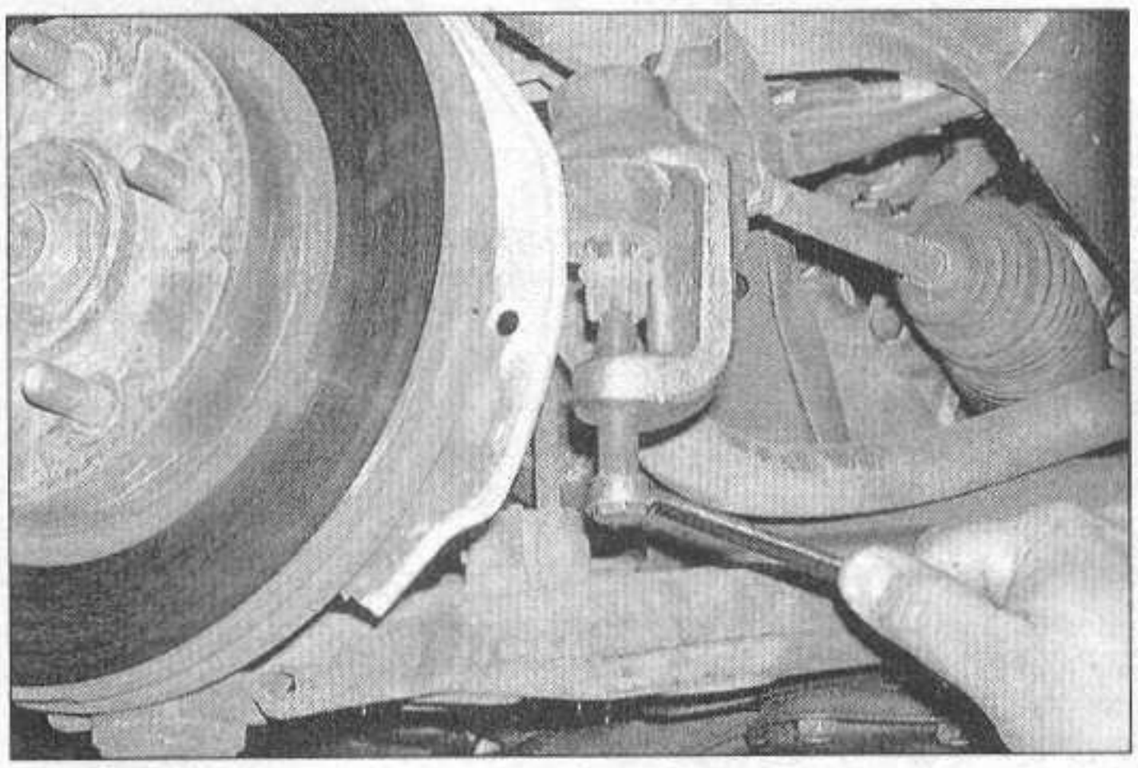
13 Installation is the reverse of removal. Be sure to tighten all fasteners to the torque listed in this Chapter's Specifications. When installing the clockspring, be sure to align the marks following the procedure in Section 14.



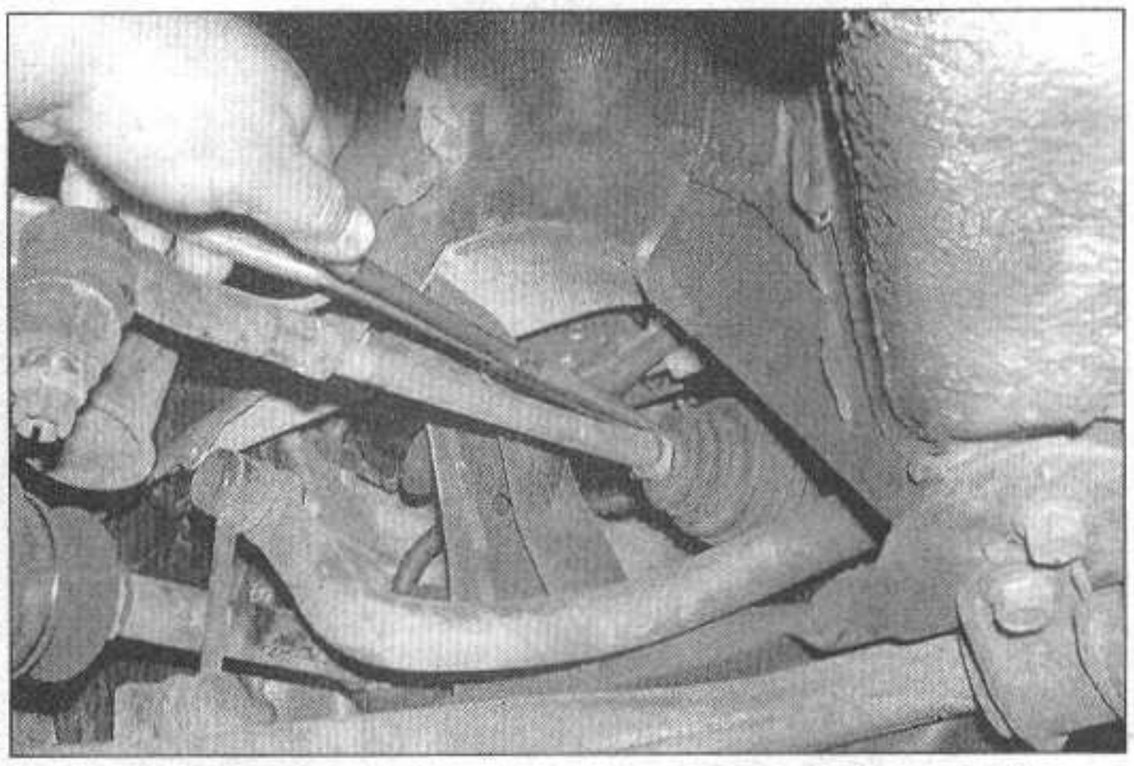
16.2 Loosen the jam nut, then mark the position of the tie-rod end in relation to the threads



16.3 Remove the cotter pin



16.4 Loosen, but don't remove, the tie-rod end ballstud nut and disconnect the tie-rod end from the steering knuckle arm with a puller



17.3a The outer end of each steering gear boot is secured by a spring-type clamp which can be slid off simply by pinching the ends together

16 Tie-rod ends - removal and installation

Removal

Refer to illustrations 16.2, 16.3 and 16.4

1 Loosen the wheel lug nuts, raise the front of the vehicle and support it securely on jackstands. Block the rear wheels and set the parking brake. Remove the front wheel.

2 Loosen the jam nut enough to mark the position of the tie-rod end in relation to the threads **(see illustration)**.

3 Remove the cotter pin **(see illustration)** and loosen, but don't remove, the nut on the tie-rod end stud.

4 Disconnect the tie-rod end from the steering knuckle arm with a puller **(see illustration)**. Remove the nut and separate the tie-rod.

5 Unscrew the tie-rod end from the steering rod.

Installation

6 Thread the tie-rod end on to the marked position and insert the tie-rod stud into the steering knuckle arm. Tighten the jam nut securely.

7 Install the castle nut on the stud and tighten it to the torque listed in this Chapter's Specifications. Install a new cotter pin. If necessary, tighten the nut a little more to allow cotter pin insertion (don't loosen the nut to do this).

8 Install the wheel and lug nuts. Lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

9 Have the alignment checked and, if necessary, adjusted.

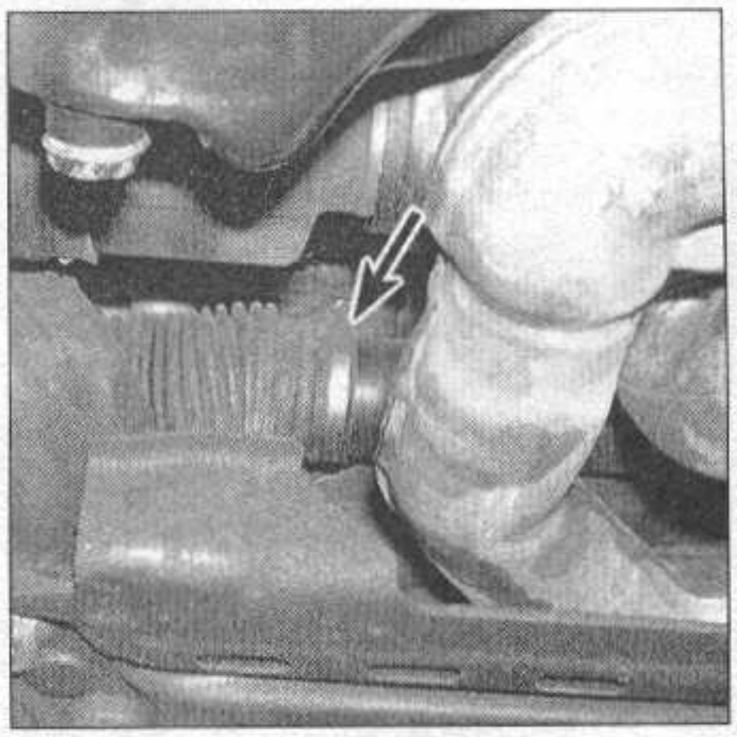
17 Steering gear boots - replacement

Refer to illustrations 17.3a and 17.3b

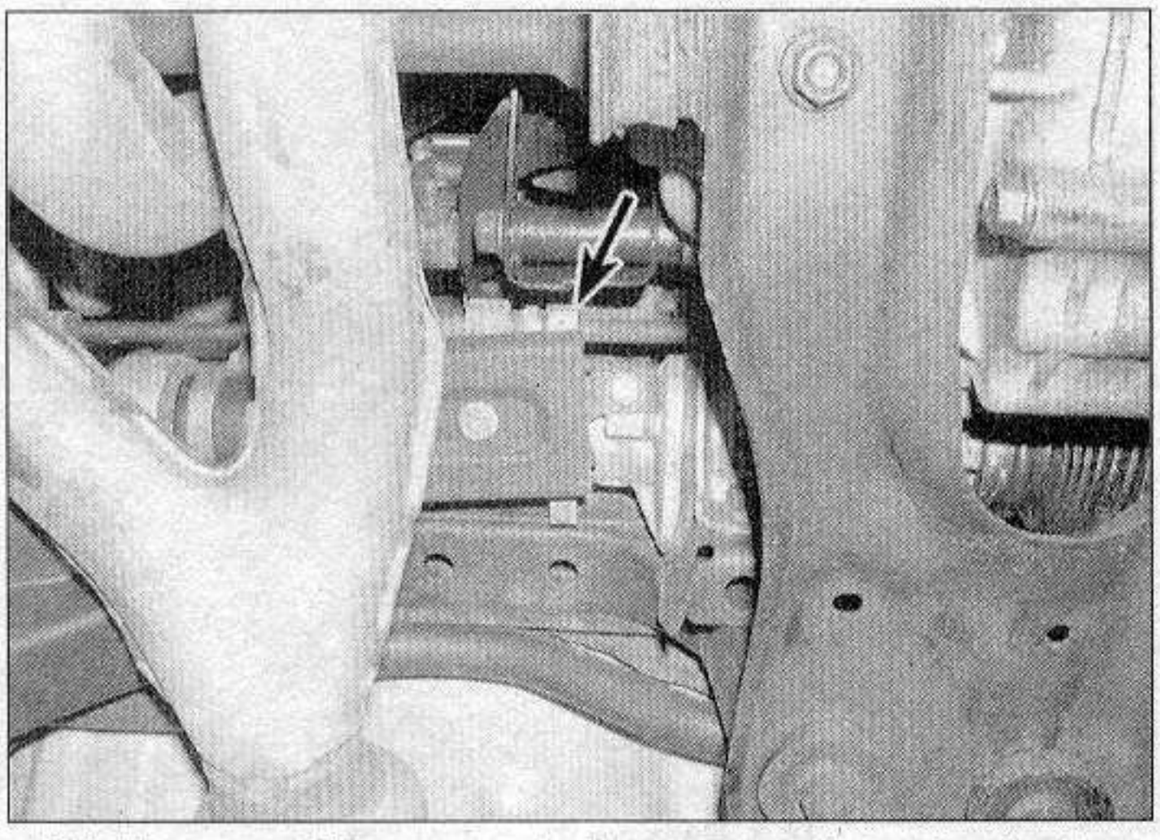
1 Loosen the wheel lug nuts, raise the vehicle and support it securely on jackstands. Remove the wheel.

2 Remove the tie-rod end and jam nut (see Section 16).

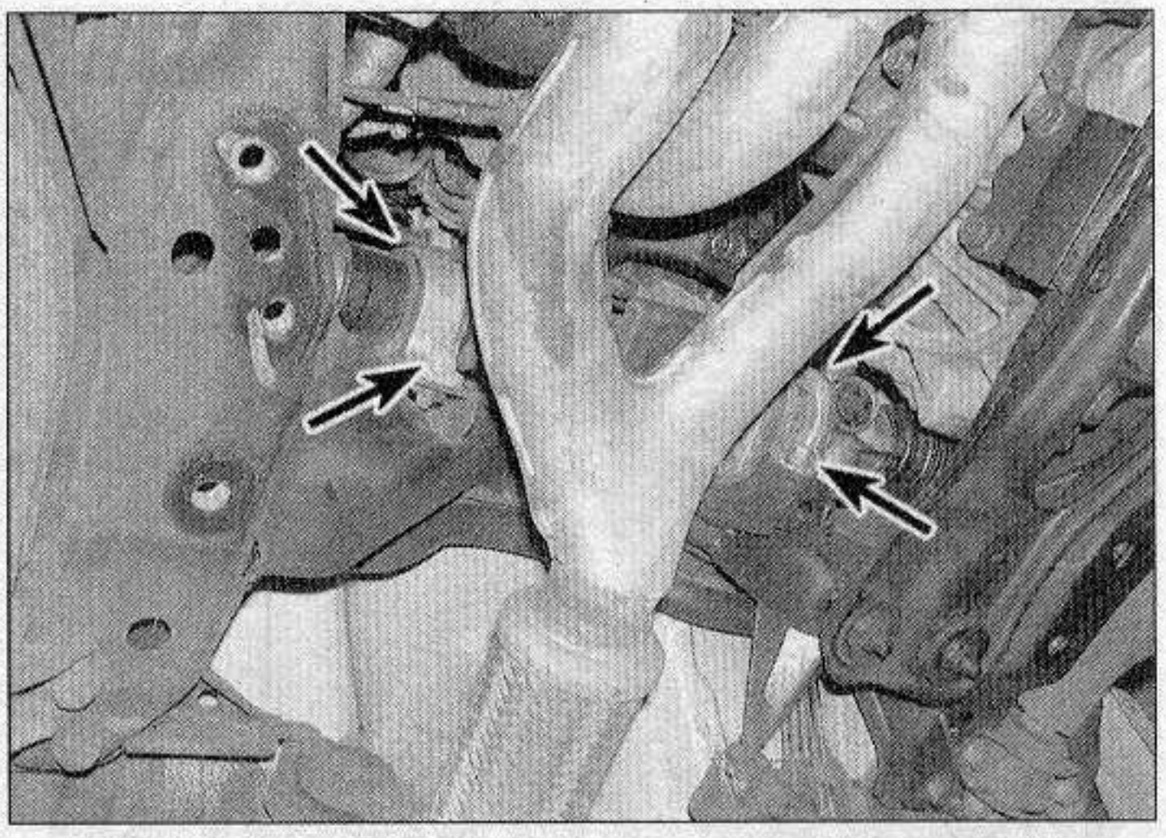
3 Remove the outer clamp from the steering gear boot **(see illustration)** with a pair of pliers. Cut off the inner boot clamp **(see illustration)** with a pair of diagonal cutters. Slide the boot off.



17.3b The inner end of each steering gear boot is retained by a clamp (arrow) which must be cut off and discarded



18.9 Disconnect the power steering pressure (arrow) and return line fittings from the steering gear (return line not visible)



18.16 To remove the steering gear assembly, remove the retaining nuts, bolts and clamps (arrows)

4 Before installing the new boot, wrap the threads on the end of the steering rod with tape so the small end of the new boot isn't damaged.

5 Slide the new boot into position on the steering gear until it seats in the groove in the steering rod and install new clamps.

6 Remove the tape and install the tie-rod end (see Section 16).

7 Install the wheel and lug nuts. Lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications.

18 Steering gear - removal and installation

Warning 1: *The models covered by this manual are equipped with Supplemental Restraint Systems (SRS), more commonly known as airbags. Always disable the airbag system before working in the vicinity of any airbag system components to avoid the possibility of accidental deployment of the airbag, which could cause personal injury* (see Chapter 12).

Warning 2: *Make sure the steering shaft is not turned while the steering wheel is removed or you could damage the airbag system. To prevent the shaft from turning, position the wheels straight ahead, turn the ignition key to the lock position and remove the key before beginning work, or thread the seat belt through the steering wheel and clip it into place.*

Removal

Refer to illustrations 18.9 and 18.16

1 Park the vehicle with the wheels pointing straight ahead. Loosen the front wheel lug nuts, raise the front of the vehicle and support it securely on jackstands. Apply the parking brake and remove the wheels. Remove the engine splash shields.

2 Support the engine from above with an engine support fixture. These are available at most equipment rental yards.

3 Disconnect the tie-rod ends from the steering knuckles (see Section 16).

4 Remove the splash shields from below the engine compartment.

5 Remove the crossmember (refer to Chapter 7).

6 Remove the transaxle cradle (refer to Chapter 7).

7 On V6 models, disconnect the oxygen sensor connectors.

8 On V6 models, disconnect the exhaust pipes from the exhaust manifolds and position the pipes off to the side (see Chapter 6).

9 Place a drain pan under the steering gear. Detach the power steering pressure and return lines **(see illustration)** and cap the ends to prevent excessive fluid loss and contamination.

10 Working inside the vehicle, remove the universal joint cover at the bottom of the steering column. Mark the relationship of the lower universal joint to the steering gear input shaft. Remove the lower intermediate shaft pinch bolt.

11 Remove the ground wire connection from the rear engine mount bracket.

12 Remove the three rear engine mount bolts (see Chapters 2A or 2B). Remove the rear engine mount.

13 On manual transaxle models, disconnect the extension bar from the transaxle and position it off to the side (see Chapter 7A).

14 This Step will require a transaxle jack that can span across the center section of the subframe or two floor jacks positioned near the inner ends of the control arms to support the subframe equally from side-to-side. Support the subframe with the jack(s) and loosen the four bolts and two nuts. Slowly remove the bolts and nuts and lower the subframe. **Warning:** *Do not position your body under the subframe or the front end of the vehicle while performing this Step.*

15 Remove the stabilizer bar (see Section 6).

16 Remove the steering gear mounting bolts **(see illustration)**. Separate the intermediate shaft from the steering gear input shaft and remove the steering gear assembly.

17 Check the steering gear rubber mounts for excessive wear or deterioration, replacing them if necessary.

Installation

Note: *Make sure the steering gear is centered from side-to-side before installing it.*

18 Raise the steering gear into position and connect the U-joint, aligning the marks.

19 Install the mounting brackets and bolts and tighten them to the torque listed in this Chapter's Specifications.

20 Install the vent tube.

21 Install the stabilizer bar (see Section 6).

22 Connect the tie-rod ends to the steering knuckle arms (see Section 16).

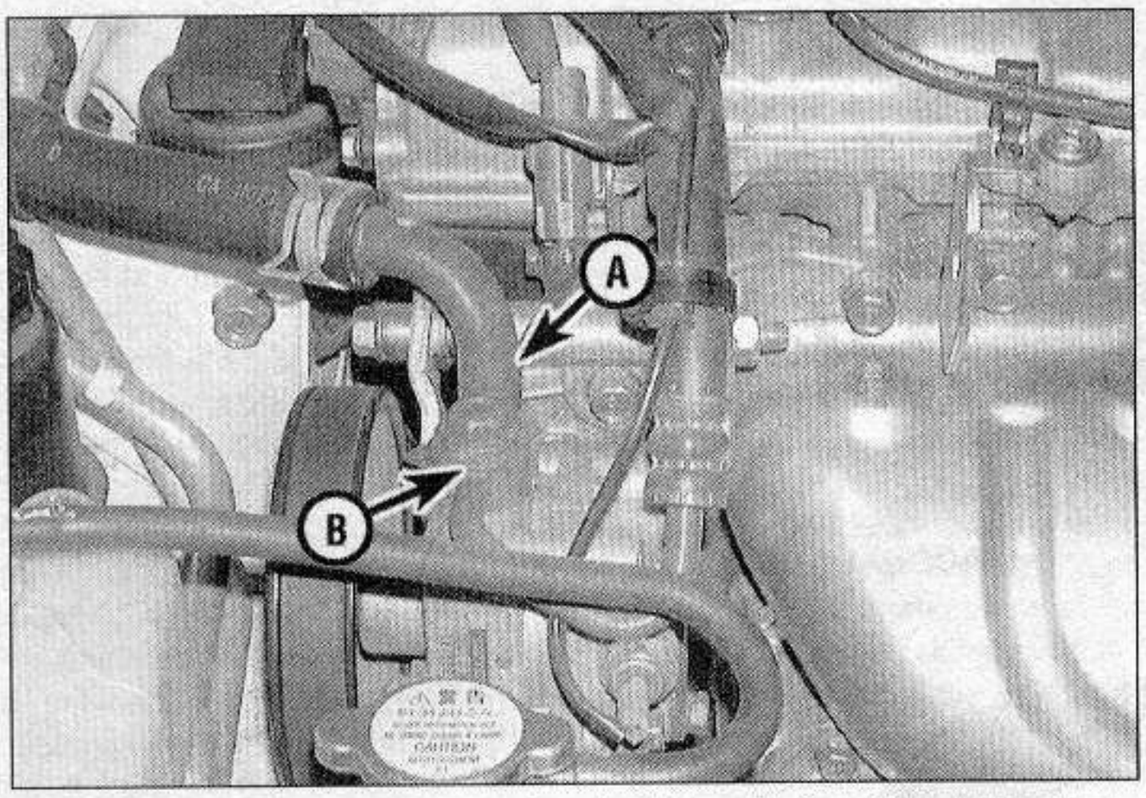
23 Install the U-joint pinch bolt and tighten it to the torque listed in this Chapter's Specifications.

24 Connect the power steering pressure and return lines to the steering gear and fill the power steering pump reservoir with the recommended fluid (see Chapter 1).

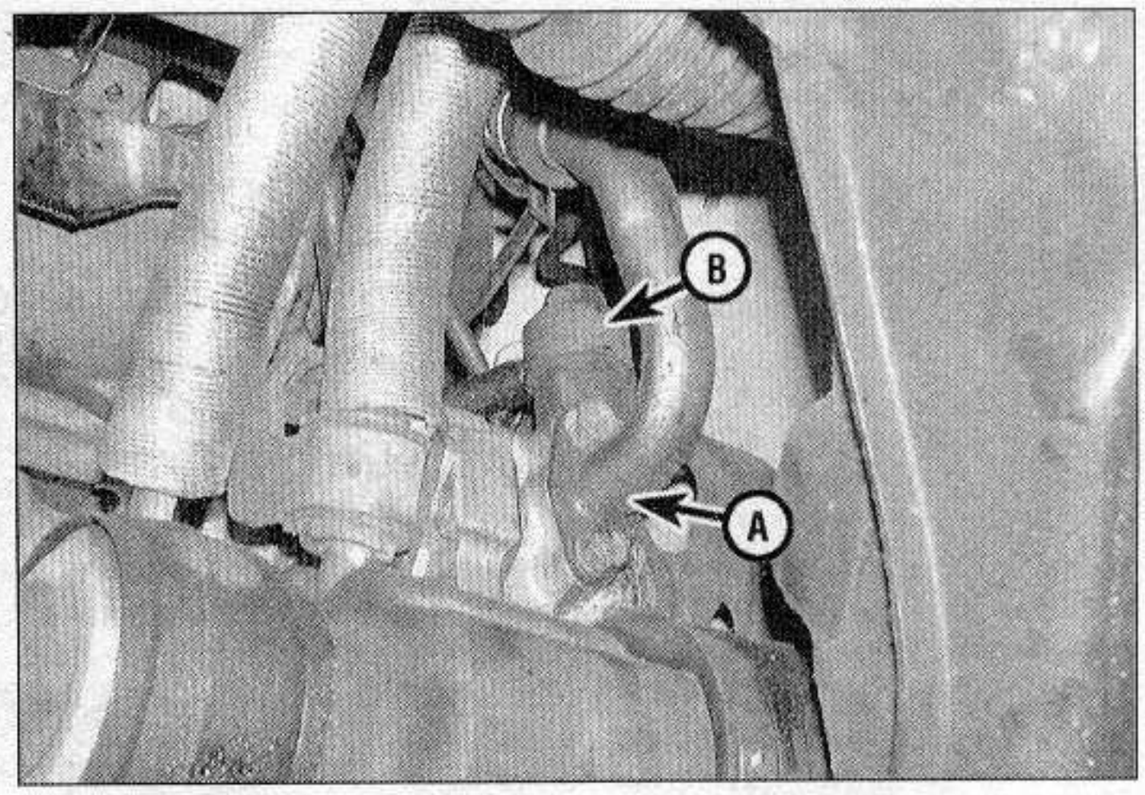
25 The remainder of installation is the reverse of removal.

26 Be sure to tighten all suspension and steering fasteners to the torque listed in this Chapter's Specifications. Refer to Chapter 7 for the locations and the torque specifications for the crossmember and the transaxle cradle. Refer to this Chapter's Specifications for the subframe mounting bolts and nuts torque specifications.

27 Install the wheels and lug nuts, then lower the vehicle and tighten the lug nuts to the torque listed in the Chapter 1 Specifications. Bleed the steering system (see Section 20).



19.6 Remove the power steering fluid supply line (A) and the high pressure line (B) from the power steering pump (four-cylinder engine shown)



19.10 Remove the power steering fluid supply line (A) and the high pressure line (B) from the power steering pump (B) (V6 engine shown)

19 Power steering pump - removal and installation

Removal

Refer to illustrations 19.6, 19.10 and 19.16

1 Disconnect the cable from the negative battery terminal. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Using a large syringe or suction gun, suck as much fluid out of the power steering fluid reservoir as possible. Place a drain pan under the vehicle to catch any fluid that spills out when the hoses are disconnected.

Four-cylinder models

3 Remove the two belt shield bolts and separate the shield from the pump. Some models are not equipped with a belt shield.

4 Loosen the power steering pump pulley bolt using a breaker bar but do not remove the pulley at this time. The pulley will be removed from the pump after the belt has been removed.

5 Remove the lock bolt and the adjusting bolt and remove the power steering belt (see Chapter 1).

6 Remove the fluid supply line, from power steering fluid reservoir **(see illustration)**, mounting bolts and separate the fluid line from the pump.

7 Remove the high pressure line-to-pump banjo bolt then detach the line from the pump. Remove and discard the sealing washers. They must be replaced when installing the pump.

8 Disconnect the power steering pump switch connector.

9 Remove the pump mounting bolts then remove the pump from the vehicle.

V6 models

10 Working in the engine compartment, remove the high pressure line bracket bolt from the power steering pump adjustment bracket. Remove the high pressure line banjo bolt from the pump **(see illustration)**. Remove and discard the copper sealing washers. They must be replaced when installing the pump.

11 Slightly loosen the front wheel lug nuts on the front passenger side, raise the front of the vehicle and support it securely on jackstands. Apply the parking brake and remove the wheel from the passenger side. Remove the engine splash shield.

12 Loosen the power steering pump pulley bolt using a breaker bar but do not remove the pulley at this time. The pulley will be removed from the pump after the belt has been removed.

13 Remove the lock bolt and the adjusting bolt and remove the power steering belt (see Chapter 1).

14 Remove the supply line mounting bolts **(see illustration 19.10)**.

15 Disconnect the power steering pump switch connector.

16 Remove the pump belt adjusting bracket **(see illustration)**.

17 Remove the pump mounting bolts then remove the pump from the vehicle.

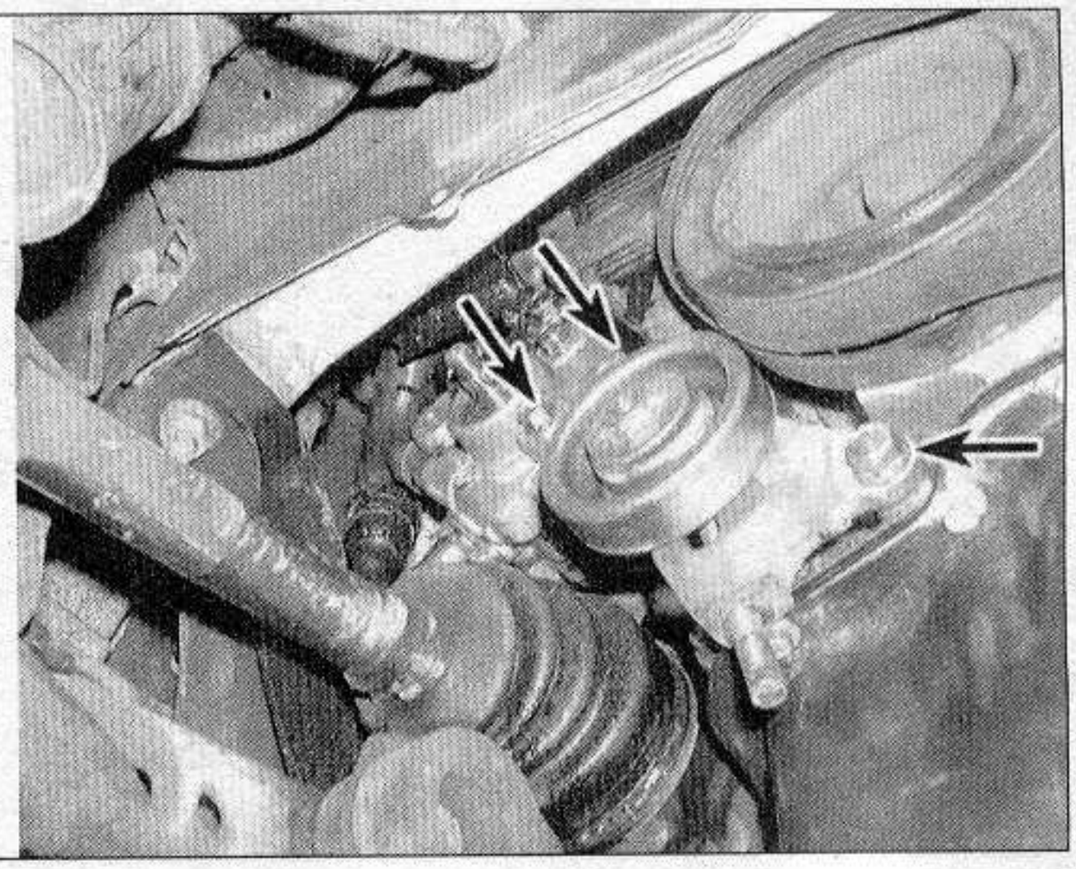
Installation

18 Installation is the reverse of removal. Be sure to tighten the pressure line banjo bolt to the torque listed in this Chapter's Specifications. Adjust the drivebelt tension following the procedure described in Chapter 1.

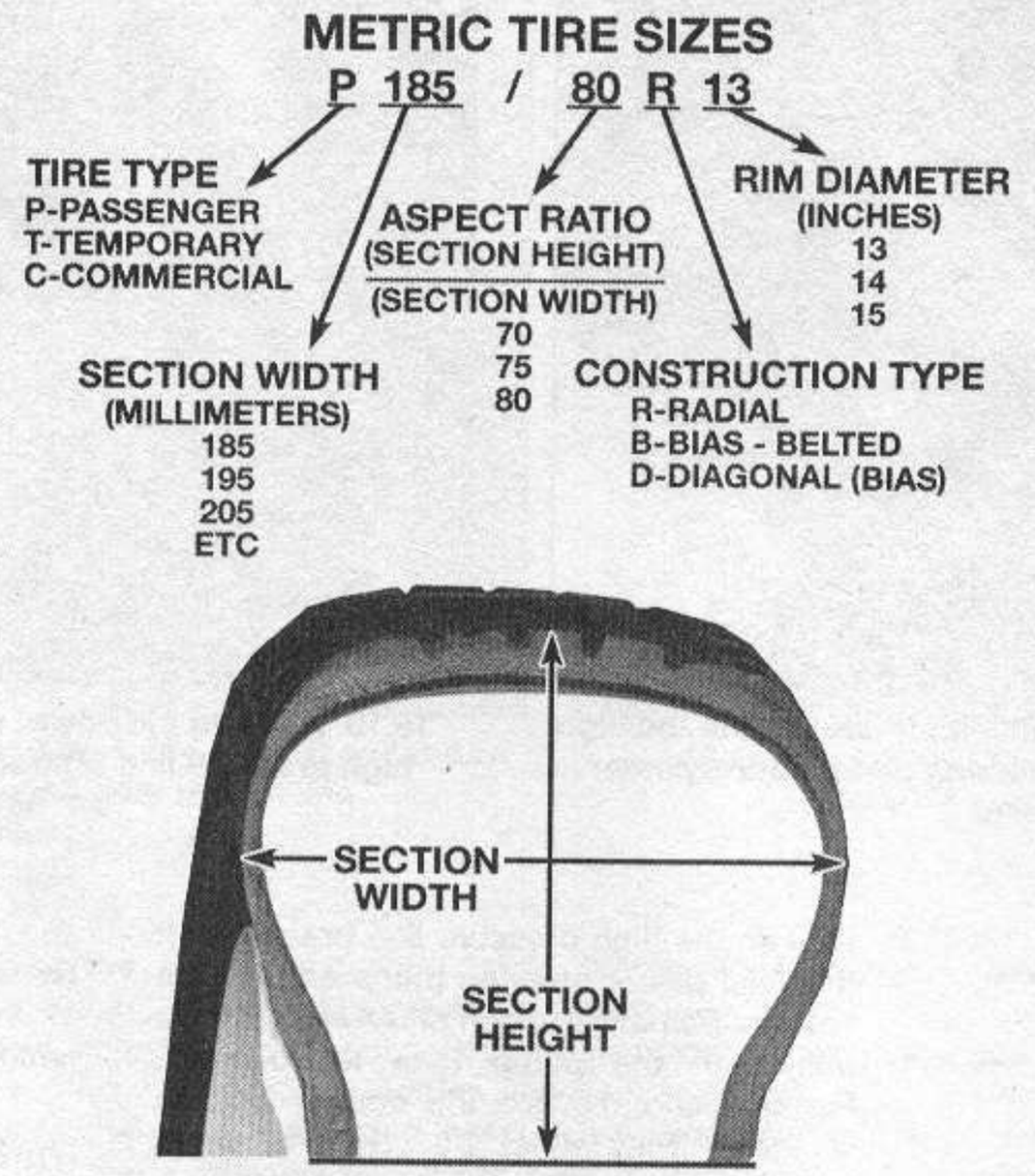
19 Top up the fluid level in the reservoir (see Chapter 1) and bleed the system (see Section 20).

20 Power steering system - bleeding

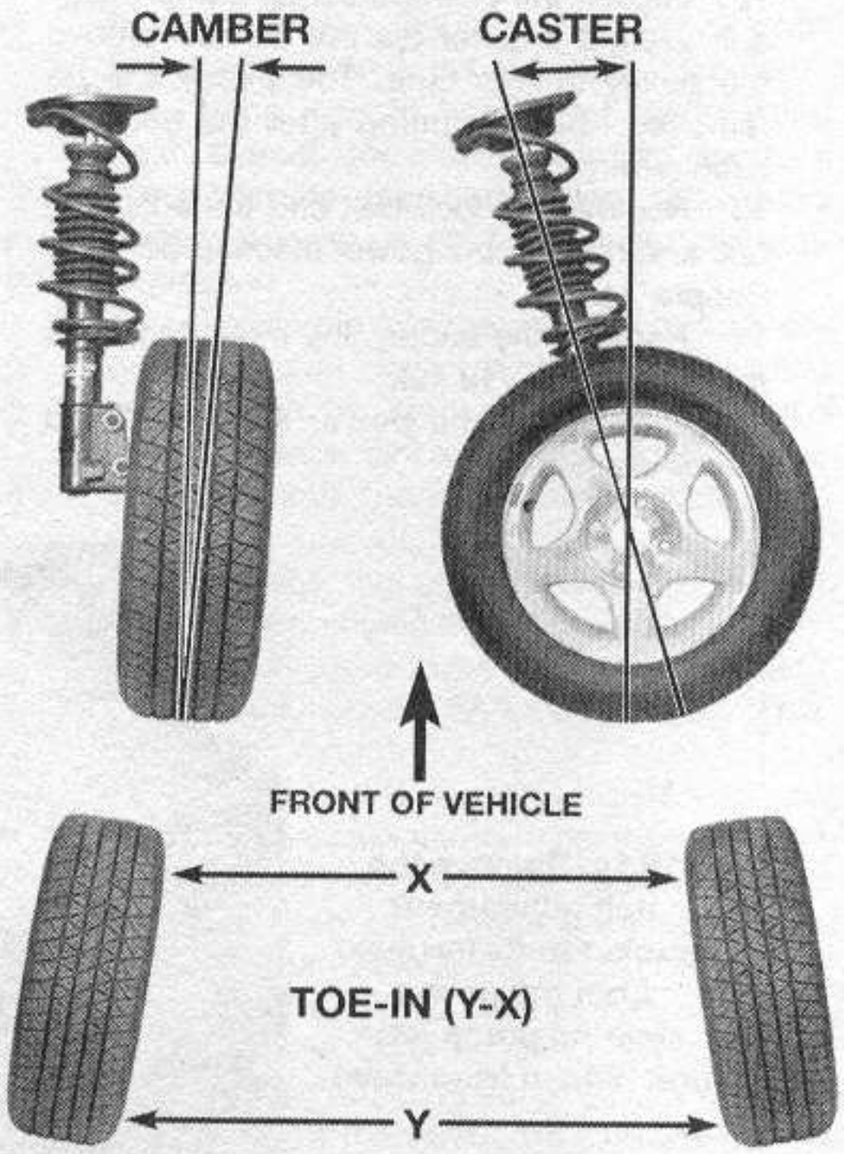
1 Following any operation in which the power steering fluid lines have been disconnected, the power steering system must be bled to remove all air and obtain proper steering performance.



19.16 Remove the belt adjustment bracket bolts (arrows) from the power steering pump (one bolt hidden from view)



21.1 Metric tire size code



22.1 Camber, caster and toe-in angles

2 With the front wheels in the straight ahead position, check the power steering fluid level and, if low, add fluid until it reaches the Cold mark on the dipstick.

3 Start the engine and allow it to run at fast idle. Recheck the fluid level and add more if necessary to reach the Cold mark on the dipstick.

4 Bleed the system by turning the wheels from side to side, without hitting the stops. This will work the air out of the system. Keep the reservoir full of fluid as this is done.

5 When the air is worked out of the system, return the wheels to the straight ahead position and leave the vehicle running for several more minutes before shutting it off.

6 Road test the vehicle to be sure the steering system is functioning normally and noise free.

7 Recheck the fluid level to be sure it is up to the Hot mark on the dipstick while the engine is at normal operating temperature. Add fluid if necessary (see Chapter 1).

21 Wheels and tires - general information

Refer to illustration 21.1

1 All vehicles covered by this manual are equipped with metric-sized steel belted radial tires **(see illustration)**. Use of other size or type of tires may affect the ride and handling of the vehicle. Don't mix different types of tires, such as radials and bias belted, on the same vehicle as handling may be seriously affected. It's recommended that tires be replaced in pairs on the same axle, but if only one tire is being replaced, be sure it's the same size, structure and tread design as the other.

2 Because tire pressure has a substantial effect on handling and wear, the pressure on all tires should be checked at least once a month or before any extended trips (see Chapter 1).

3 Wheels must be replaced if they are bent, dented, leak air, have elongated bolt holes, are heavily rusted, out of vertical symmetry or if the lug nuts won't stay tight. Wheel repairs that use welding or peening are not recommended.

4 Tire and wheel balance is important in the overall handling, braking and performance of the vehicle. Unbalanced wheels can adversely affect handling and ride characteristics as well as tire life. Whenever a tire is installed on a wheel, the tire and wheel should be balanced by a shop with the proper equipment.

22 Wheel alignment - general information

Refer to illustration 22.1

A wheel alignment refers to the adjustments made to the wheels so they are in proper angular relationship to the suspension and the ground. Wheels that are out of proper alignment not only affect vehicle control, but also increase tire wear. The front end angles normally measured are camber, caster and toe-in **(see illustration)**. Camber and caster are slightly adjustable by altering the position of the upper strut mount in the strut tower; toe-in is adjustable by altering the position of the tie-rod ends on the tie-rods. The rear toe-in can also be adjusted, but the camber and caster cannot (however, camber and caster are usually measured to check for bent or worn suspension parts).

Getting the proper wheel alignment is a very exacting process, one in which complicated and expensive machines are necessary to perform the job properly. Because of this, you should have a technician with the proper equipment perform these tasks. We will, however, use this space to give you a basic idea of what is involved with a wheel alignment so you can better understand the process and deal intelligently with the shop that does the work.

Toe-in is the turning in of the wheels. The purpose of a toe specification is to ensure parallel rolling of the wheels. In a vehicle with zero toe-in, the distance between the front edges of the wheels will be the same as the distance between the rear edges of the wheels. The actual amount of toe-in is normally only a fraction of an inch. On the front end, toe-in is controlled by the tie-rod end position on the tie-rod. On the rear end, it's controlled by adjuster cams on the inner ends of the rear (number two) suspension arms. Incorrect toe-in will cause the tires to wear improperly by making them scrub against the road surface.

Camber is the tilting of the wheels from vertical when viewed from one end of the vehicle. When the wheels tilt out at the top, the camber is said to be positive (+). When the wheels tilt in at the top the camber is negative (-). The amount of tilt is measured in degrees from vertical and this measurement is called the camber angle. This angle affects the amount of tire tread which contacts the road and compensates for changes in the suspension geometry when the vehicle is cornering or traveling over an undulating surface.

Caster is the tilting of the front steering axis from the vertical. A tilt toward the rear is positive caster and a tilt toward the front is negative caster.

Chapter 11 Body

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1 General information

These models feature a "unibody" layout, using a floor pan with front and rear frame side rails which support the body components, front and rear suspension systems and other mechanical components.

Certain components are particularly vulnerable to accident damage and can be unbolted and repaired or replaced. Among these parts are the body moldings, bumpers, the hood and trunk lid, doors and all glass.

Only general body maintenance practices and body panel repair procedures within the scope of the do-it-yourselfer are included in this Chapter.

2 Body - maintenance

1 The condition of your vehicle's body is very important, because the resale value depends a great deal on it. It's much more difficult to repair a neglected or damaged body than it is to repair mechanical components. The hidden areas of the body, such as the wheel wells, the frame and the engine compartment, are equally important, although they don't require as frequent attention as the rest of the body.

2 Once a year, or every 12,000 miles, it's a good idea to have the underside of the body steam cleaned. All traces of dirt and oil will be removed and the area can then be inspected carefully for rust, damaged brake lines, frayed electrical wires, damaged cables and other problems.

3 At the same time, clean the engine and the engine compartment with a steam cleaner or water-soluble degreaser.

4 The wheel wells should be given close attention, since undercoating can peel away and stones and dirt thrown up by the tires can cause the paint to chip and flake, allowing rust to set in. If rust is found, clean down to the bare metal and apply an anti-rust paint.

5 The body should be washed about once a week. Wet the vehicle thoroughly to soften the dirt, then wash it down with a soft sponge and plenty of clean soapy water. If the surplus dirt is not washed off very carefully, it can wear down the paint.

6 Spots of tar or asphalt thrown up from

the road should be removed with a cloth soaked in kerosene. Scented lamp oil is available in most hardware stores and the smell is easier to work with than straight kerosene.

7 Once every six months, wax the body and chrome trim. If a chrome cleaner is used to remove rust from any of the vehicle's plated parts, remember that the cleaner also removes part of the chrome, so use it sparingly. On any plated parts where chrome cleaner is used, use a good paste wax over the plating for extra protection.

3 Vinyl trim - maintenance

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

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

4 Upholstery and carpets - maintenance

1 Every three months remove the floormats and clean the interior of the vehicle (more frequently if necessary). Use a stiff whiskbroom to brush the carpeting and loosen dirt and dust, then vacuum the upholstery and carpets thoroughly, especially along seams and crevices.

2 Dirt and stains can be removed from carpeting with basic household or automotive carpet shampoos available in spray cans. Follow the directions and vacuum again, then use a stiff brush to bring back the "nap" of the carpet.

3 Most interiors have cloth or vinyl upholstery, either of which can be cleaned and maintained with a number of material-specific cleaners or shampoos available in auto supply stores. Follow the directions on the product for usage, and always spot-test any upholstery cleaner on an inconspicuous area (bottom edge of a backseat cushion) to ensure that it doesn't cause a color shift in the material.

4 After cleaning, vinyl upholstery should be treated with a protectant. **Note:** *Make sure the protectant container indicates the product can be used on seats - some products may make a seat too slippery.* **Caution:** *Do not use protectant on vinyl-covered steering wheels.*

5 Leather upholstery requires special care. It should be cleaned regularly with saddlesoap or leather cleaner. Never use alcohol, gasoline, nail polish remover or thinner to clean leather upholstery.

6 After cleaning, regularly treat leather upholstery with a leather conditioner, rubbed in with a soft cotton cloth. Never use car wax on leather upholstery.

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

5 Body repair - minor damage

Repair of flexible plastic body panels (front and rear bumper covers)

The following repair procedures are for minor scratches and gouges. Repair of more serious damage should be left to a dealer service department or qualified auto body shop. Below is a list of the equipment and materials necessary to perform the following repair procedures on plastic body panels. 3M and other manufacturers produce the materials listed, many of which are available from auto parts stores.

Wax, grease and silicone removing solvent
Cloth-backed body tape
Sanding discs
Drill motor with three-inch disc holder
Hand sanding block
Rubber squeegees
Sandpaper
Non-porous mixing palette
Wood paddle or putty knife
Curved-tooth body file
Flexible parts repair kit (includes adhesive material and fiberglass-type material)

1 Remove the damaged panel, if necessary or desirable. In most cases, repairs can be carried out with the panel installed.

2 Clean the area(s) to be repaired with a wax, grease and silicone removing solvent applied with a water-dampened cloth.

3 If the damage is structural, that is, if it extends through the panel, clean the backside of the panel area to be repaired as well. Wipe dry.

4 Sand the rear surface about 1-1/2 inches beyond the break.

5 Cut two pieces of fiberglass cloth large enough to overlap the break by about 1-1/2 inches. Cut only to the required length.

6 Mix the adhesive material according to the instructions and apply a layer of the mixture approximately 1/8-inch thick on the backside of the panel. Overlap the break by at least 1-1/2 inches.

7 Apply one piece of fiberglass cloth to the adhesive and cover the cloth with additional adhesive. Apply a second piece of fiberglass cloth to the adhesive and immediately cover the cloth with additional adhesive in sufficient quantity to fill the weave.

8 Allow the repair to cure for 20 to 30 minutes at 60-degrees to 80-degrees F.

9 If necessary, trim the excess repair material at the edge.

10 Remove all of the paint film over and around the area(s) to be repaired. The repair material should not overlap the painted surface.

11 With a drill motor and a sanding disc (or a rotary file), cut a "V" along the break line approximately 1/2-inch wide. Remove all dust and loose particles from the repair area.

12 Mix and apply the repair material. Apply a light coat first over the damaged area; then continue applying material until it reaches a level slightly higher than the surrounding finish.

13 Cure the mixture for 20 to 30 minutes at 60-degrees to 80-degrees F.

14 Roughly establish the contour of the area being repaired with a body file. If low areas or pits remain, mix and apply additional adhesive.

15 Block sand the damaged area with sandpaper to establish the actual contour of the surrounding surface.

16 If desired, the repaired area can be temporarily protected with several light coats of primer. Because of the special paints and techniques required for flexible body panels, it is recommended that the vehicle be taken to a paint shop for completion of the body repair.

Steel body panels

See photo sequence

Repair of minor scratches

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

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

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

Repair of dents

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

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

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

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

Repair of rust holes or gashes

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

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

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

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

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

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

Filling and painting

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

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

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

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

34 Spray the entire area with a light coat of primer. This will reveal any imperfections in the surface of the filler. Repair the imperfections with fresh filler paste or glaze filler and once more smooth the surface with sandpaper. Repeat this spray-and-repair procedure until you are satisfied that the surface of the filler and the feathered edge of the paint are perfect. Rinse the area with clean water and allow it to dry completely.

35 The repair area is now ready for painting. Spray painting must be carried out in a warm, dry, windless and dust free atmosphere. These conditions can be created if you have access to a large indoor work area, but if you are forced to work in the open, you will have to pick the day very carefully. If you are working indoors, dousing the floor in the work area with water will help settle the dust that would otherwise be in the air. If the repair area is confined to one body panel, mask off the surrounding panels. This will help minimize the effects of a slight mismatch in paint color. Trim pieces such as chrome strips, door handles, etc., will also need to be masked off or removed. Use masking tape and several thickness of newspaper for the masking operations.

36 Before spraying, shake the paint can thoroughly, then spray a test area until the spray painting technique is mastered. Cover the repair area with a thick coat of primer. The thickness should be built up using several thin layers of primer rather than one thick one. Using 600-grit wet-or-dry sandpaper, rub down the surface of the primer until it is very smooth. While doing this, the work area should be thoroughly rinsed with water and the wet-or-dry sandpaper periodically rinsed as well. Allow the primer to dry before spraying additional coats.

37 Spray on the top coat, again building up the thickness by using several thin layers of paint. Begin spraying in the center of the repair area and then, using a circular motion, work out until the whole repair area and about two inches of the surrounding original paint is covered. Remove all masking material 10 to 15 minutes after spraying on the final coat of paint. Allow the new paint at least two weeks to harden, then use a very fine rubbing compound to blend the edges of the new paint into the existing paint. Finally, apply a coat of wax.

6 Body repair - major damage

1 Major damage must be repaired by an auto body shop specifically equipped to perform unibody repairs. These shops have the specialized equipment required to do the job properly.

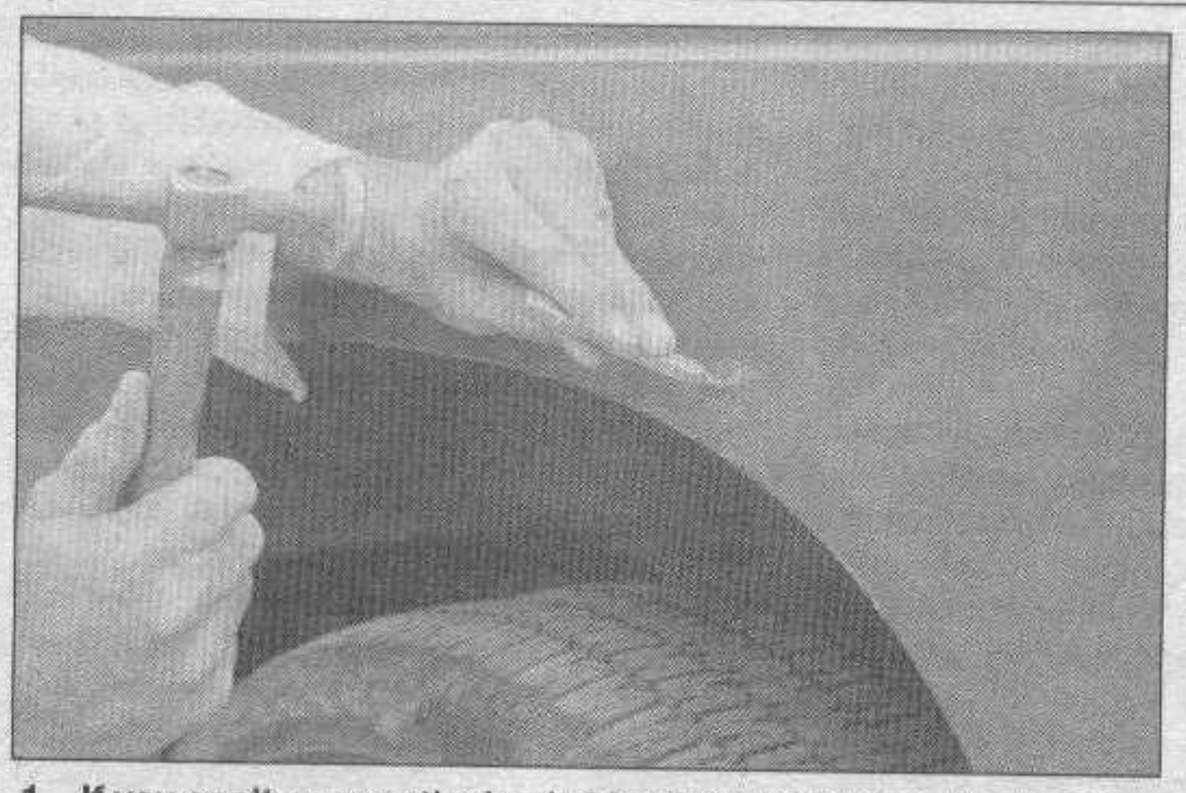
2 If the damage is extensive, the body must be checked for proper alignment or the vehicle's handling characteristics may be adversely affected and other components may wear at an accelerated rate.

3 Due to the fact that some of the major body components (hood, fenders, doors, etc.) are separate and replaceable units, any seriously damaged components should be replaced rather than repaired. Sometimes the components can be found in a wrecking yard that specializes in used vehicle components, often at considerable savings over the cost of new parts.

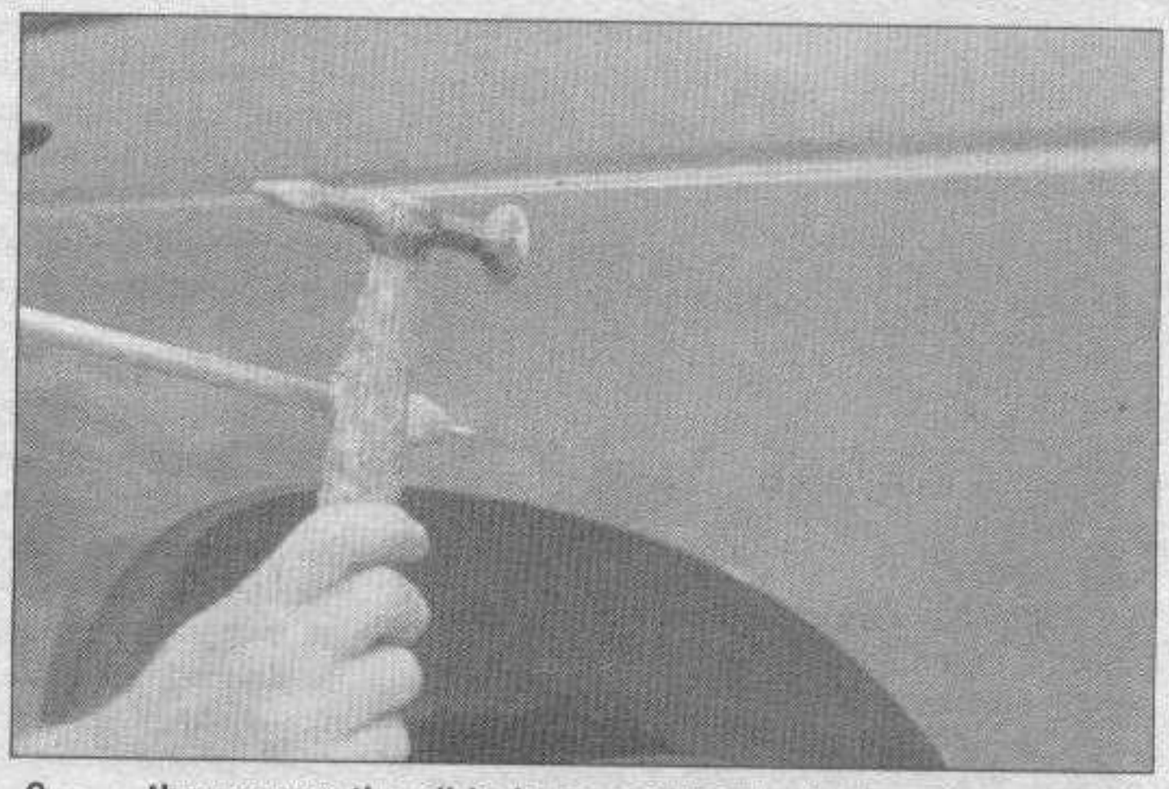
7 Hinges and locks - maintenance

Once every 3000 miles, or every three months, the hinges and latch assemblies on the doors, hood and trunk (or liftgate) should be given a few drops of light oil or lock lubricant. The door latch strikers should also be lubricated with a thin coat of grease to reduce wear and ensure free movement. Lubricate the door and trunk (or liftgate) locks with spray-on graphite lubricant.

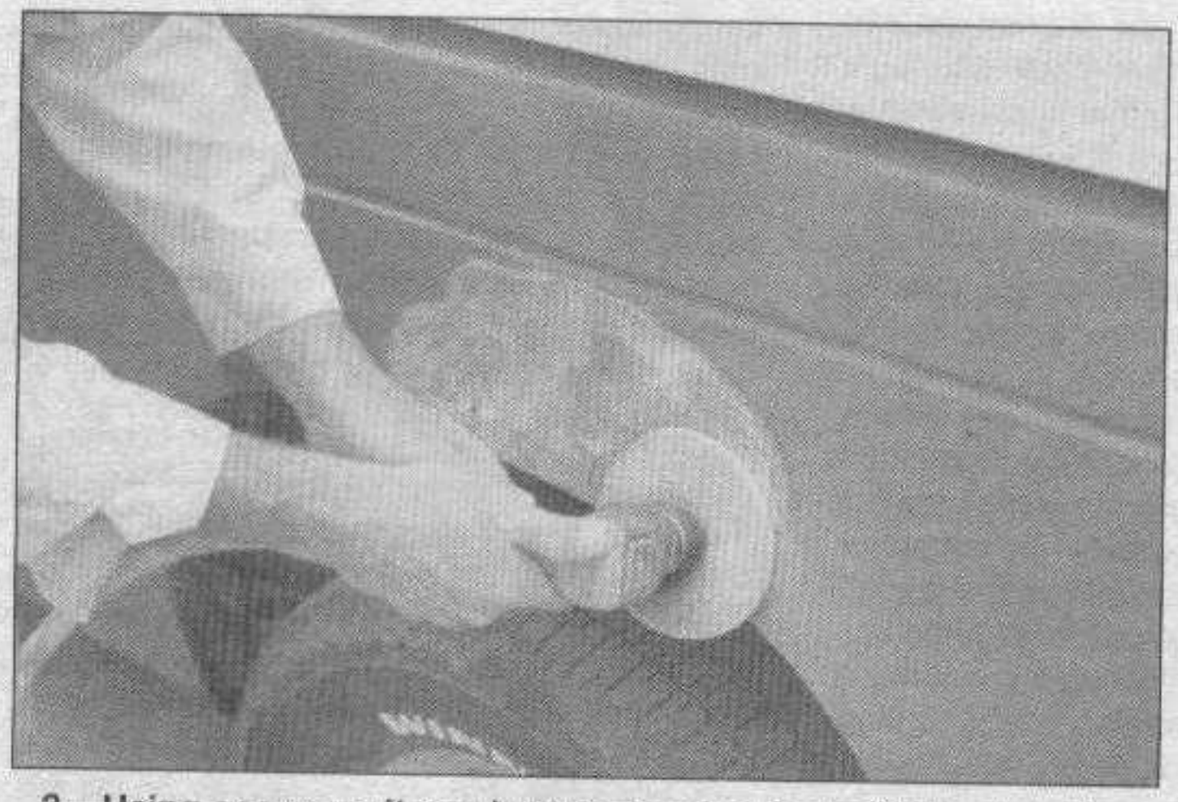
These photos illustrate a method of repairing simple dents. They are intended to supplement *Body repair - minor damage* in this Chapter and should not be used as the sole instructions for body repair on these vehicles.



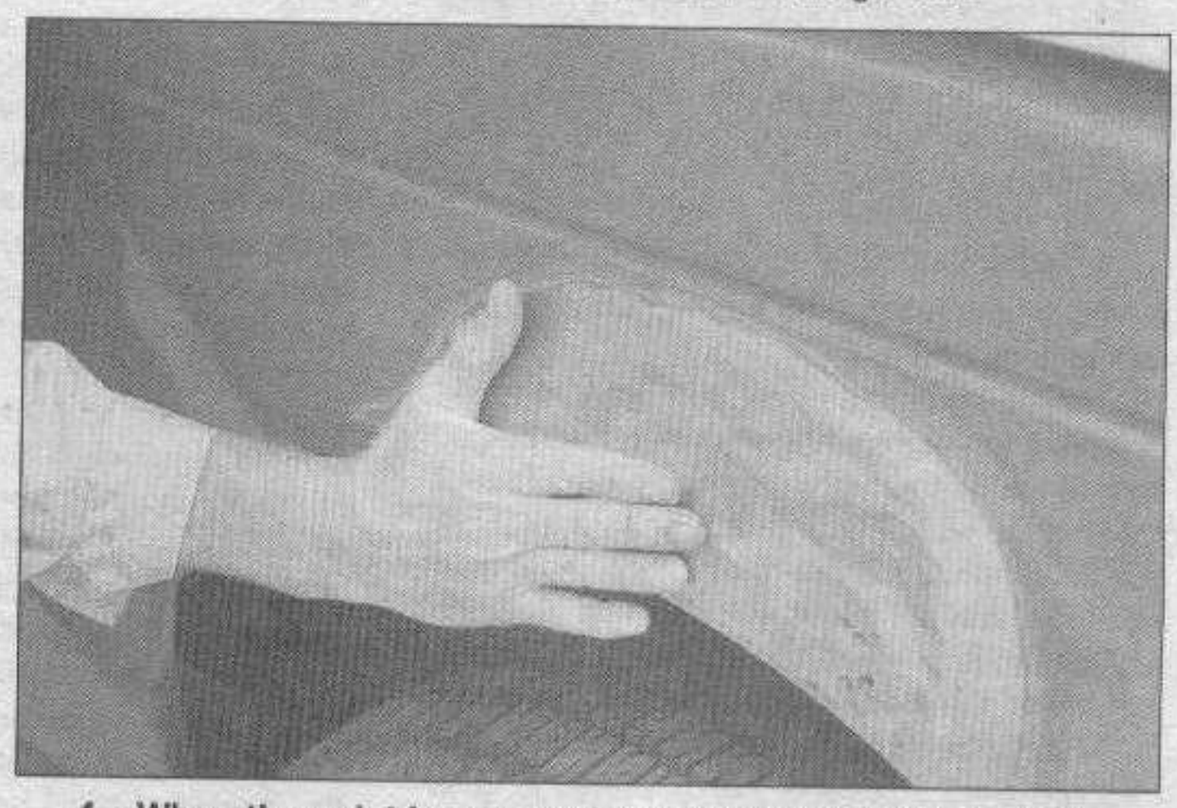
1 If you can't access the backside of the body panel to hammer out the dent, pull it out with a slide-hammer-type dent puller. In the deepest portion of the dent or along the crease line, drill or punch hole(s) at least one inch apart . . .



2 . . . then screw the slide-hammer into the hole and operate it. Tap with a hammer near the edge of the dent to help 'pop' the metal back to its original shape. When you're finished, the dent area should be close to its original contour and about 1/8-inch below the surface of the surrounding metal

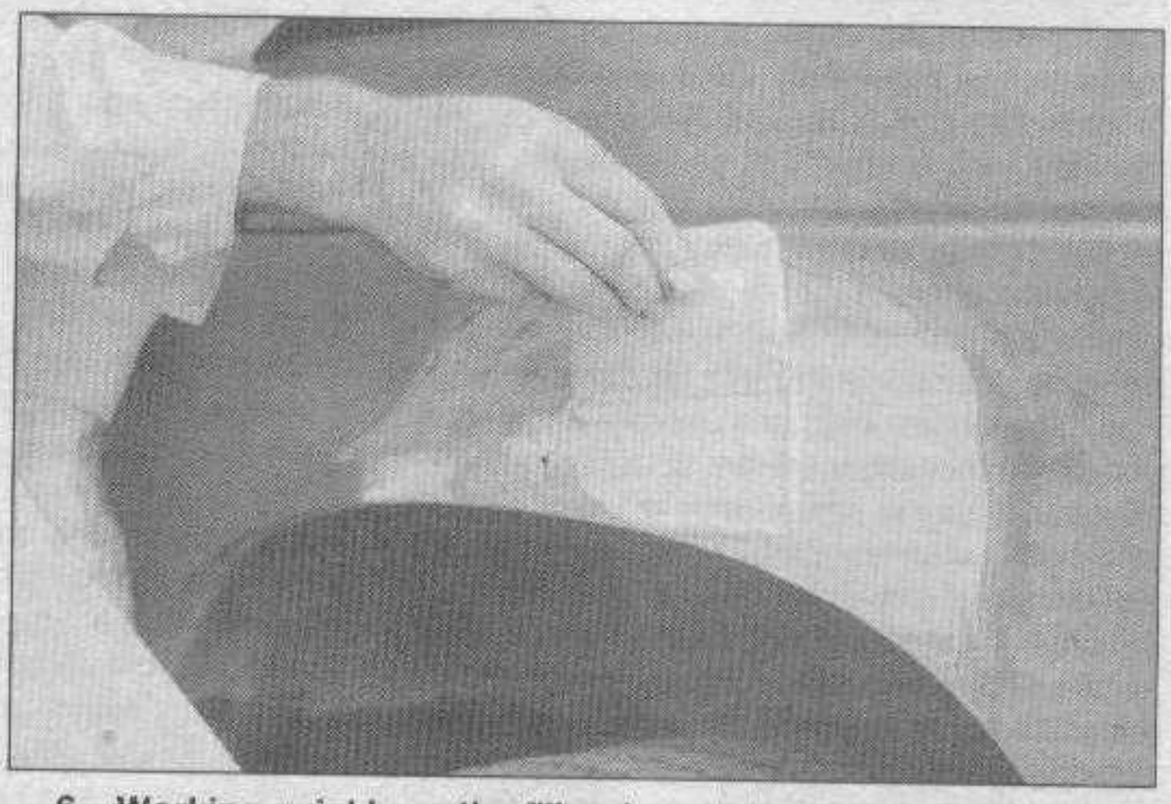


3 Using coarse-grit sandpaper, remove the paint down to the bare metal. Hand sanding works fine, but the disc sander shown here makes the job faster. Use finer (about 320-grit) sandpaper to feather-edge the paint at least one inch around the dent area

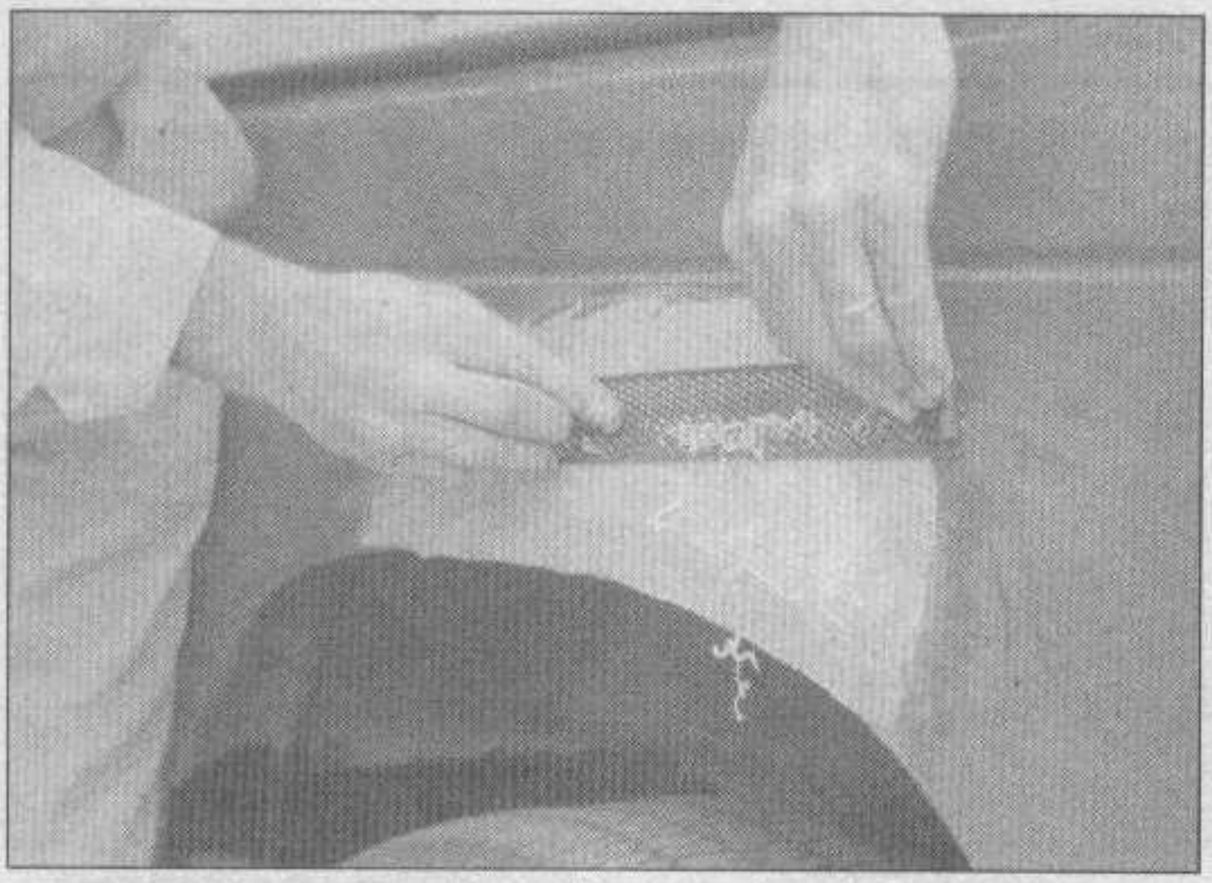


4 When the paint is removed, touch will probably be more helpful than sight for telling if the metal is straight. Hammer down the high spots or raise the low spots as necessary. Clean the repair area with wax/silicone remover

5 Following label instructions, mix up a batch of plastic filler and hardener. The ratio of filler to hardener is critical, and, if you mix it incorrectly, it will either not cure properly or cure too quickly (you won't have time to file and sand it into shape)

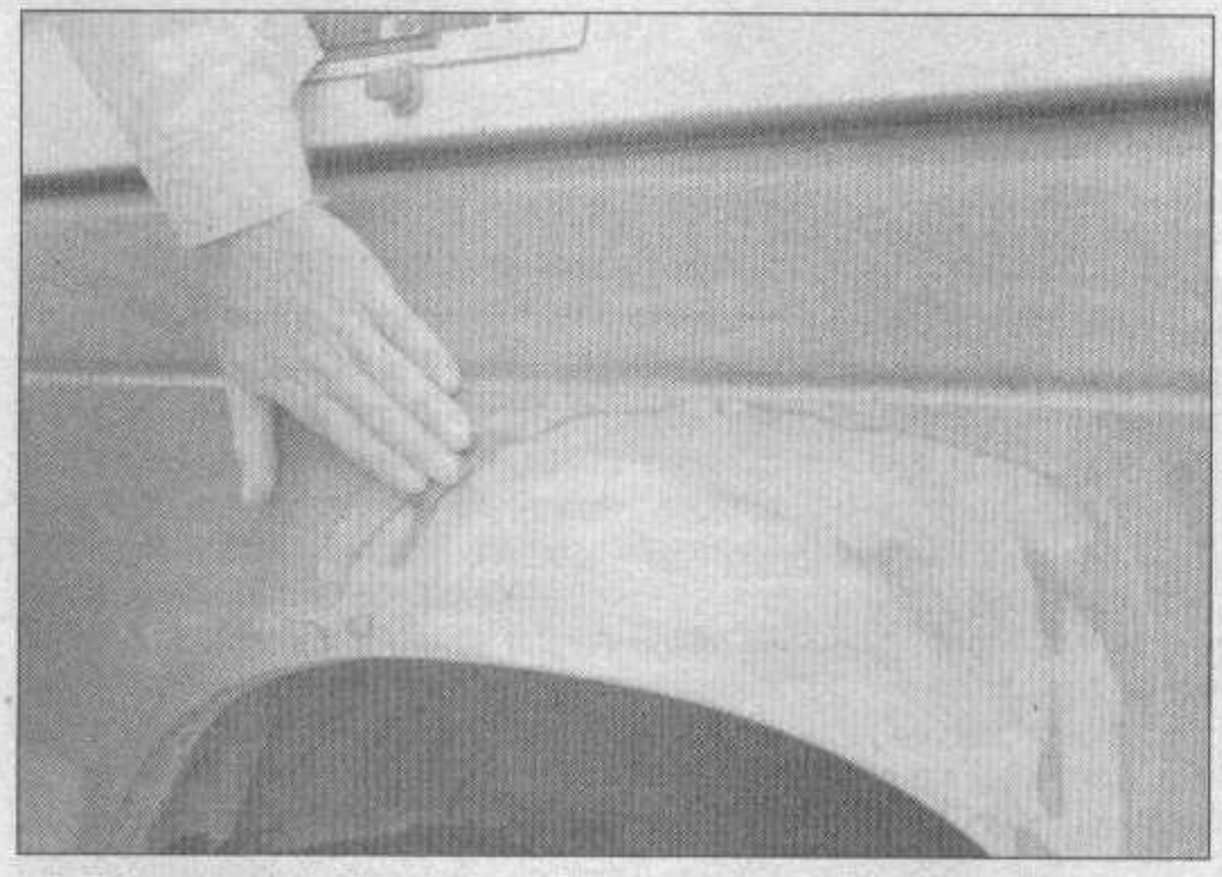


6 Working quickly so the filler doesn't harden, use a plastic applicator to press the body filler firmly into the metal, assuring it bonds completely. Work the filler until it matches the original contour and is slightly above the surrounding metal

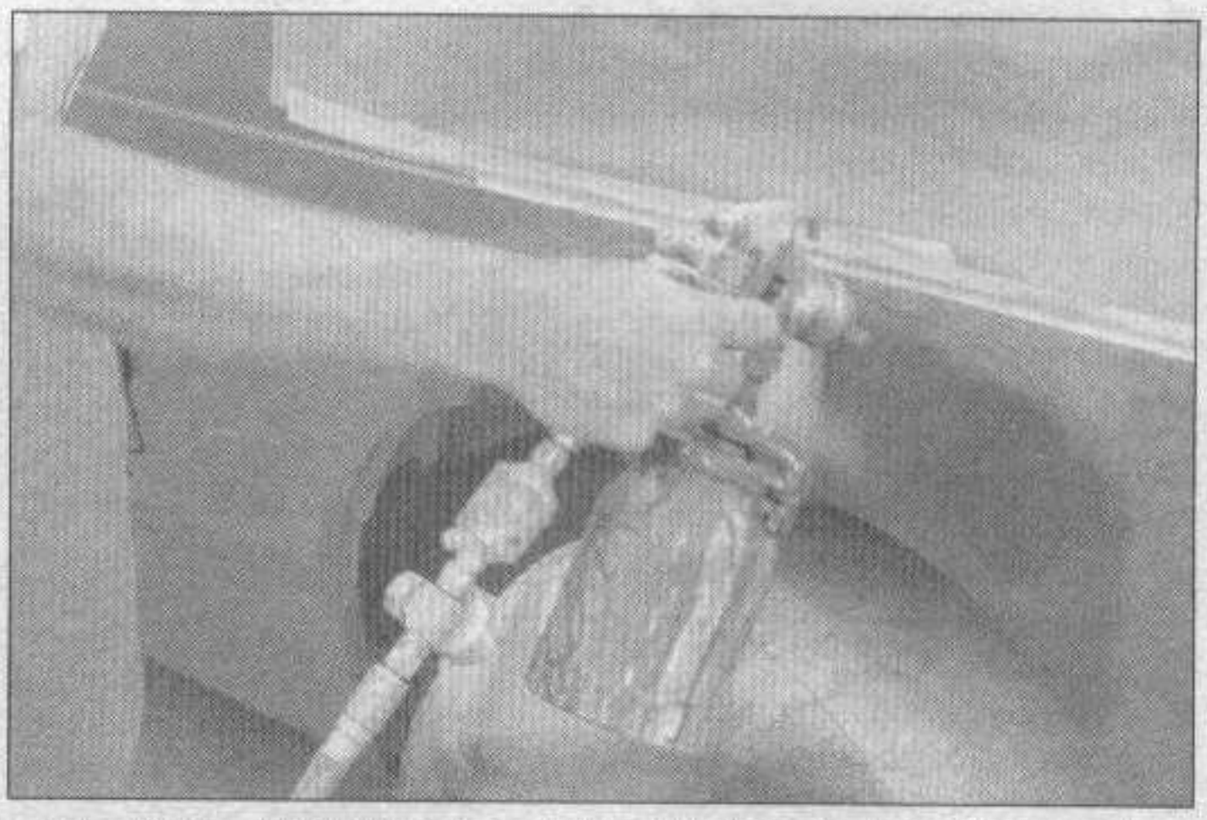


7 Let the filler harden until you can just dent it with your fingernail. Use a body file or Surform tool (shown here) to rough-shape the filler

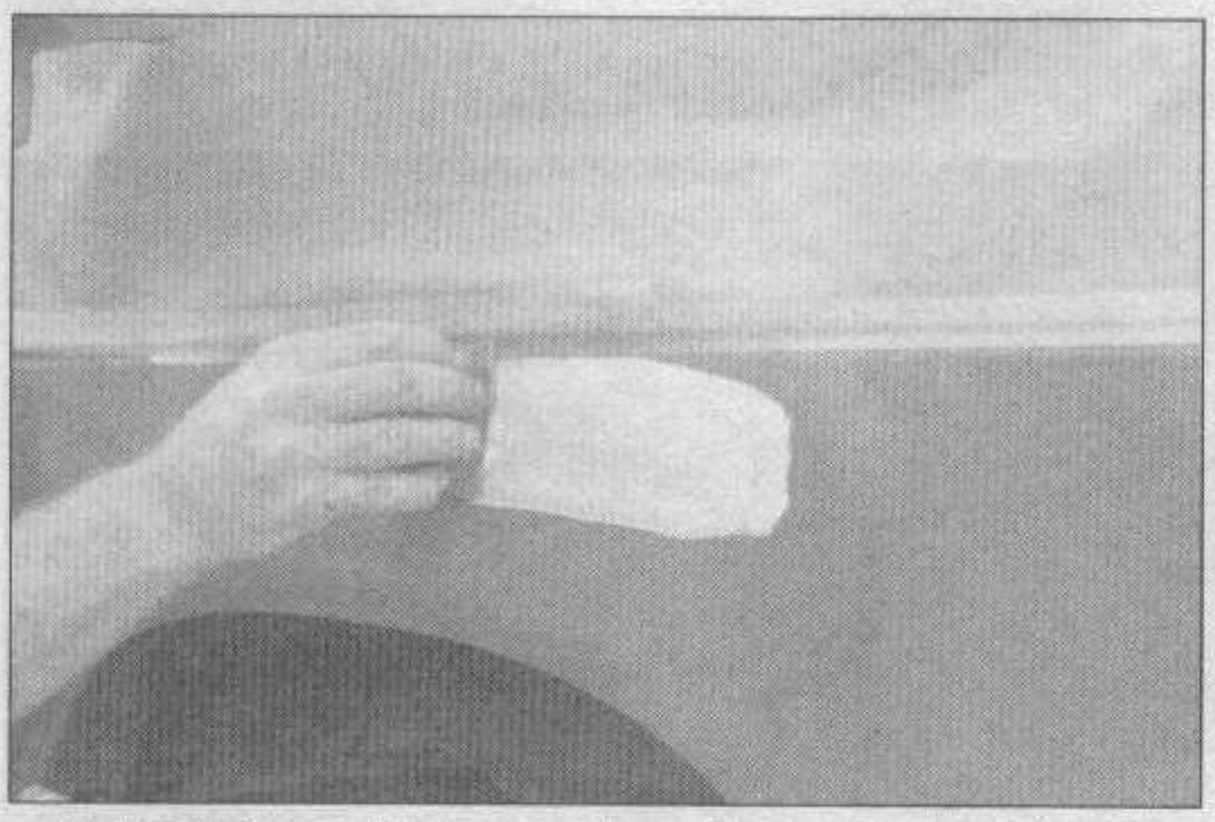
8 Use coarse-grit sandpaper and a sanding board or block to work the filler down until it's smooth and even. Work down to finer grits of sandpaper - always using a board or block - ending up with 360 or 400 grit



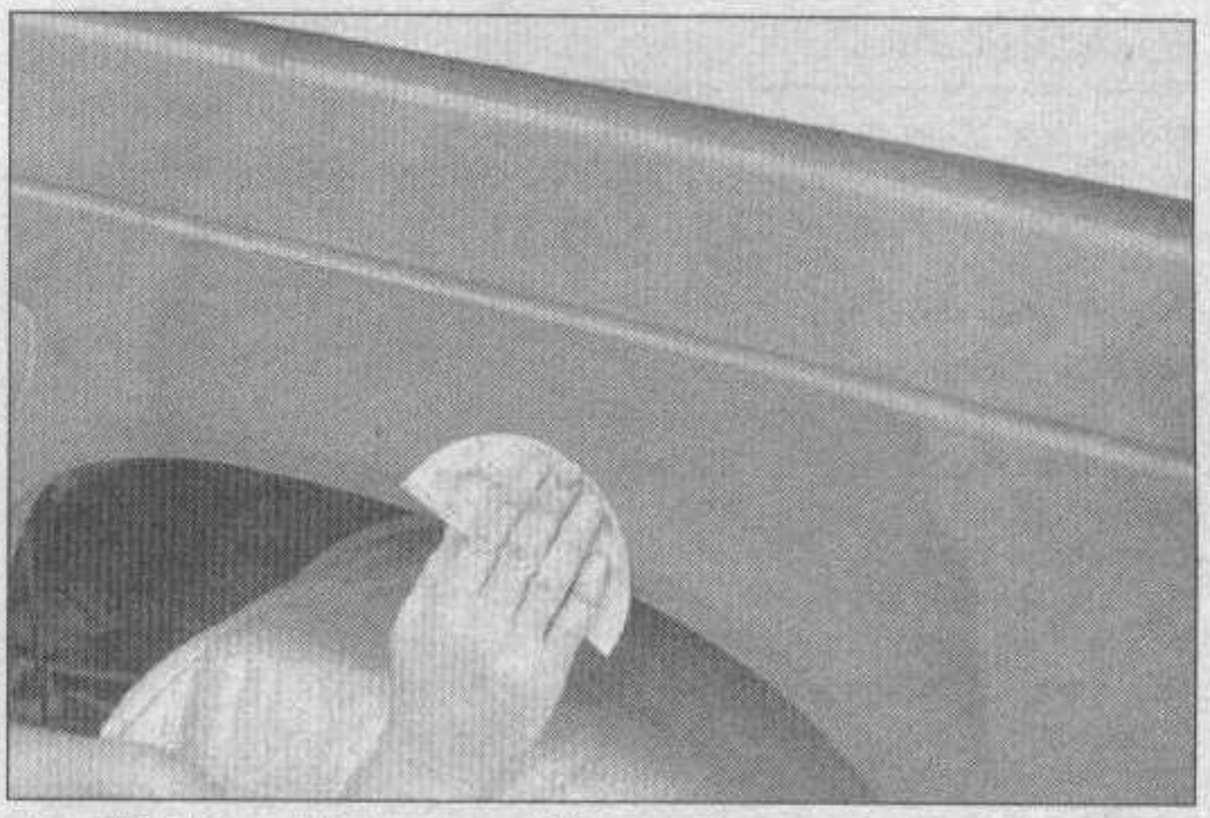
9 You shouldn't be able to feel any ridge at the transition from the filler to the bare metal or from the bare metal to the old paint. As soon as the repair is flat and uniform, remove the dust and mask off the adjacent panels or trim pieces



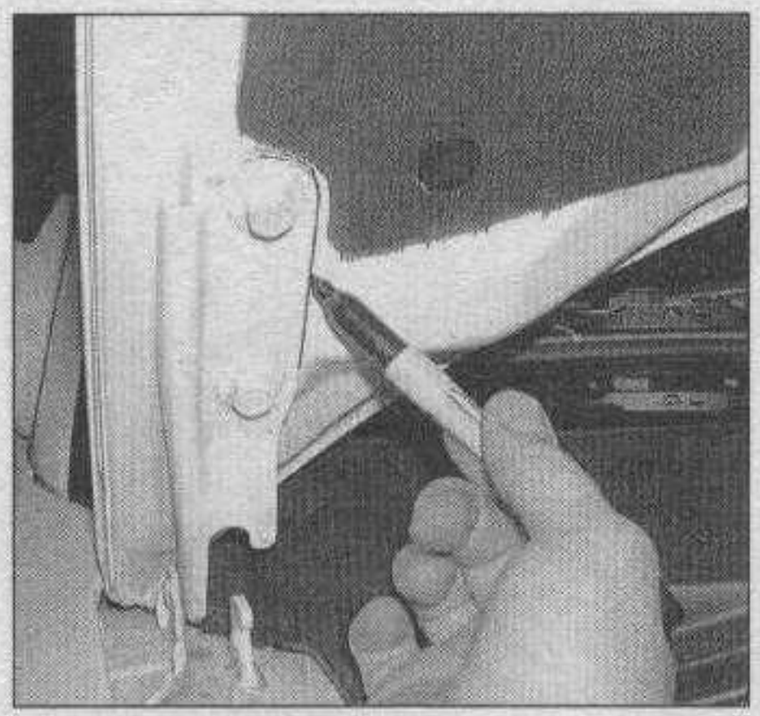
10 Apply several layers of primer to the area. Don't spray the primer on too heavy, so it sags or runs, and make sure each coat is dry before you spray on the next one. A professional-type spray gun is being used here, but aerosol spray primer is available inexpensively from auto parts stores



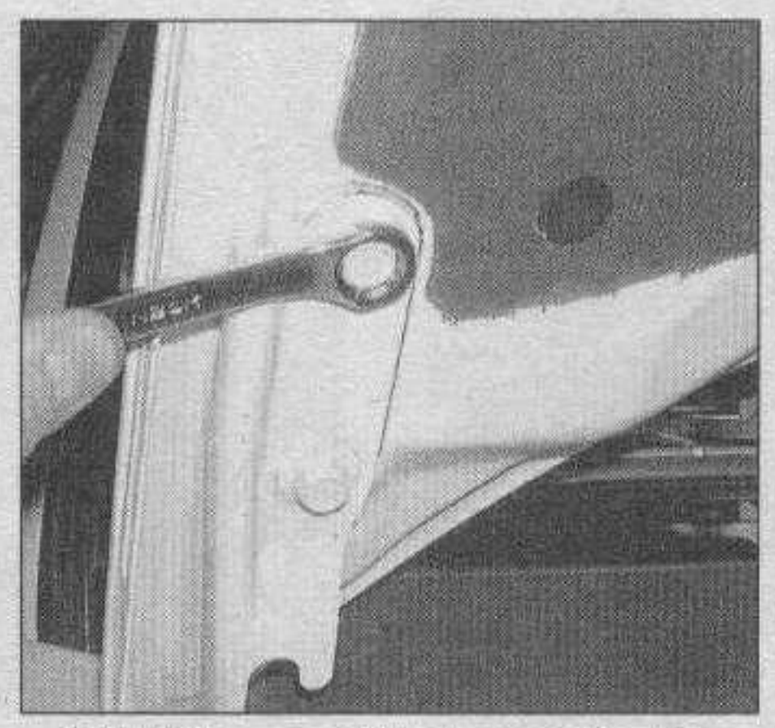
11 The primer will help reveal imperfections or scratches. Fill these with glazing compound. Follow the label instructions and sand it with 360 or 400-grit sandpaper until it's smooth. Repeat the glazing, sanding and respraying until the primer reveals a perfectly smooth surface



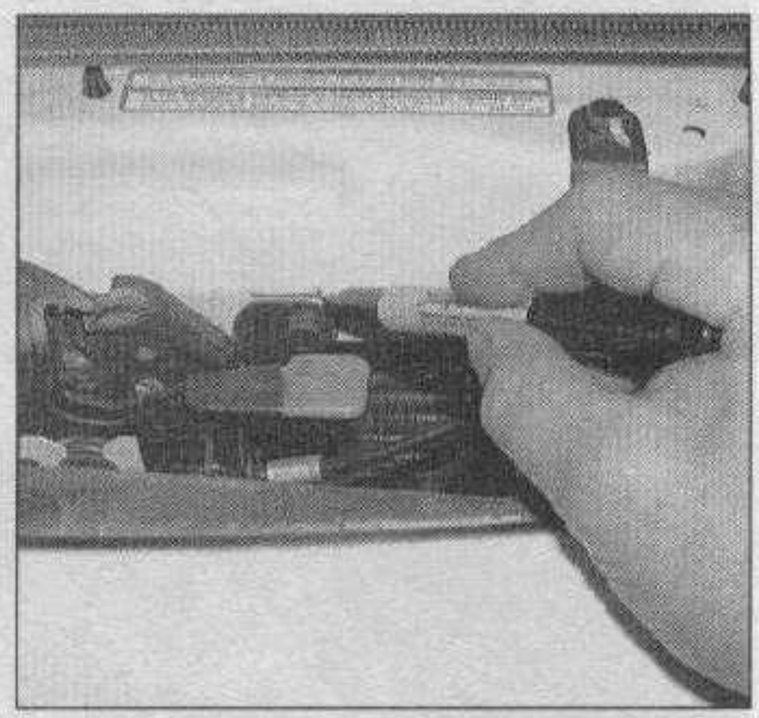
12 Finish sand the primer with very fine sandpaper (400 or 600-grit) to remove the primer overspray. Clean the area with water and allow it to dry. Use a tack rag to remove any dust, then apply the finish coat. Don't attempt to rub out or wax the repair area until the paint has dried completely (at least two weeks)



10.3 Scribe or draw alignment marks around the hood hinges to ensure proper alignment of the hood when it's reinstalled



10.4 With an assistant supporting the weight of the hood, remove the bolts and lift the hood off



10.9 Before adjusting the hood latch horizontally or vertically, mark its position, then loosen the bolts

8 Windshield and fixed glass - replacement

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

9 Radiator grille (Mazda 626 models) - replacement

1 Open the hood.
2 Remove the retaining screw in the center of the top edge of the grille.
3 Using a screwdriver, release the two clips and detach the grille by pulling straight out.
4 Press the grille into place until the clips click, then install the retaining screw.

10 Hood - removal, installation and adjustment

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

Removal and installation

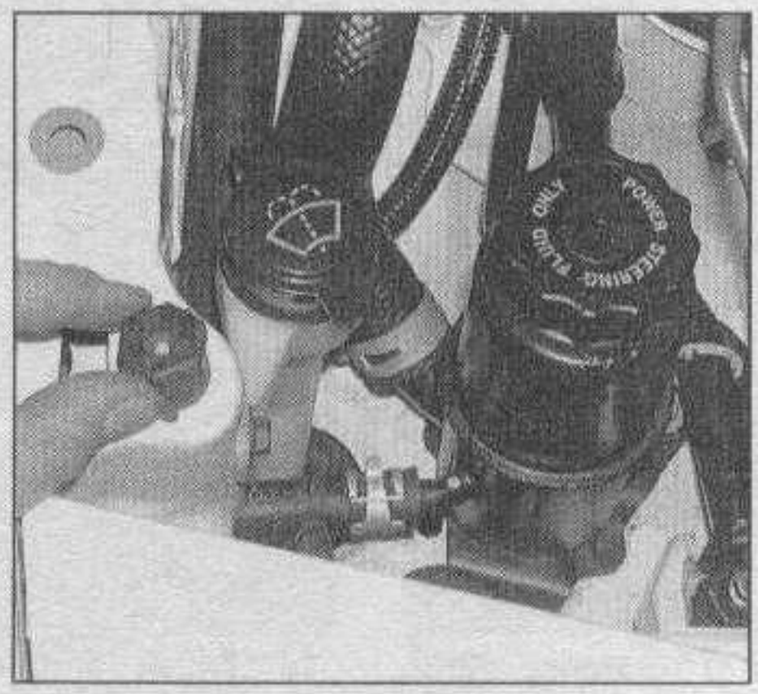
Refer to illustrations 10.3 and 10.4

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 Disconnect any cables or wires that will interfere with removal. Disconnect the windshield washer tubing from the nozzles on the hood.
3 Make marks or scribe a line around the hood hinge to ensure proper alignment during installation **(see illustration)**.
4 Remove the hinge-to-hood bolts and lift off the hood **(see illustration)**.
5 Installation is the reverse of removal. Align the hinge bolts with the marks made in Step 3.

Adjustment

Refer to illustrations 10.9 and 10.10

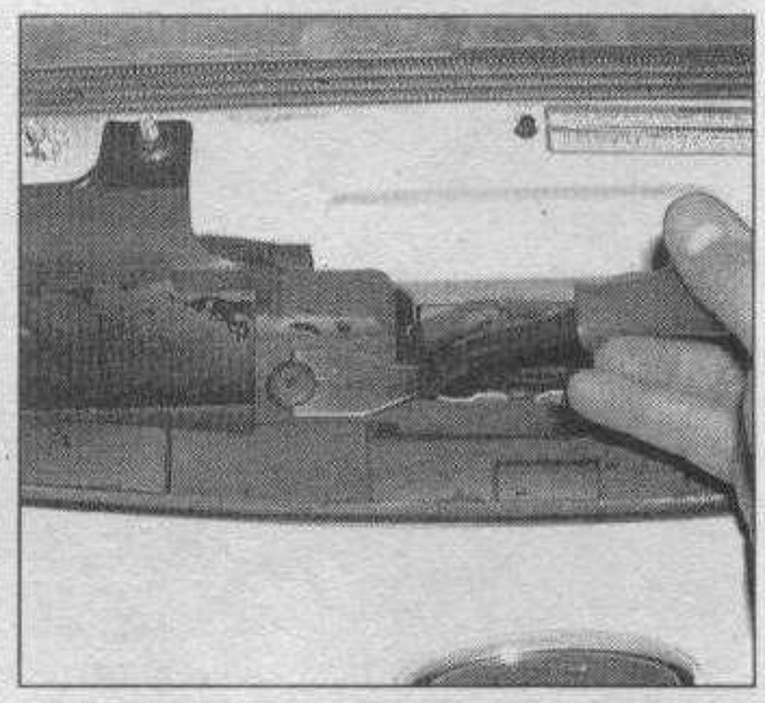
6 Fore-and-aft and side-to-side adjustment of the hood is done by moving the hinge plate slot after loosening the bolts or nuts.
7 Scribe a line around the entire hinge plate so you can determine the amount of movement **(see illustration 10.3)**.
8 Loosen the bolts or nuts and move the hood into correct alignment. Move it only a little at a time. Tighten the hinge bolts and carefully lower the hood to check the position.
9 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. Scribe a line or mark around the hood latch mounting bolts to provide a reference point, then loosen them and reposition the latch assembly, as necessary **(see illustration)**. Following adjustment, retighten the mounting bolts.
10 Finally, adjust the hood bumpers on the radiator support so the hood, when closed, is flush with the fenders **(see illustration)**.
11 The hood latch assembly, as well as the hinges, should be periodically lubricated with white, lithium-base grease to prevent binding and wear.



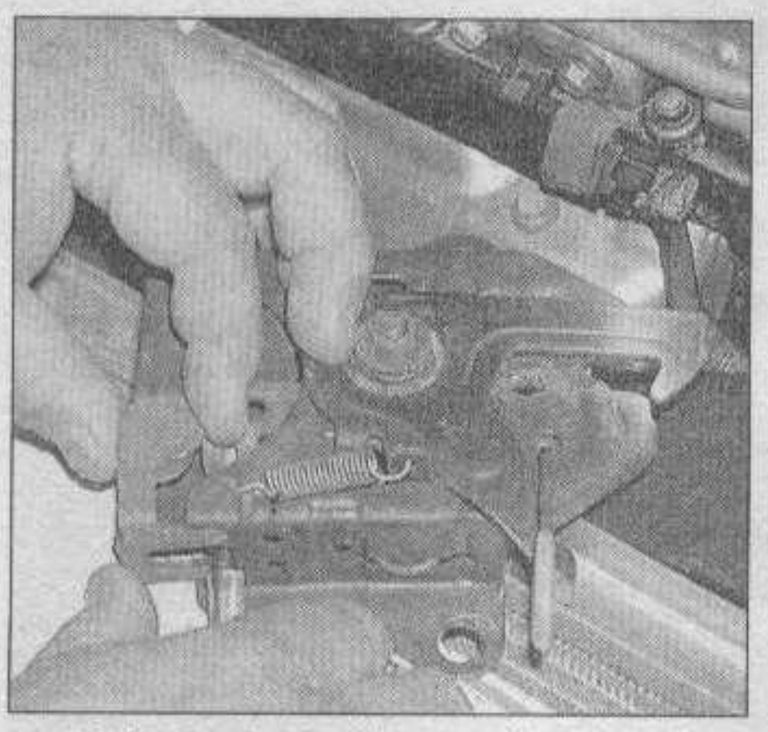
10.10 To adjust the vertical height of the front edge of the hood so that it's flush with the fenders, turn each edge cushion clockwise (to lower the hood) or counterclockwise (to raise the hood)

11 Hood latch and release cable - removal and installation

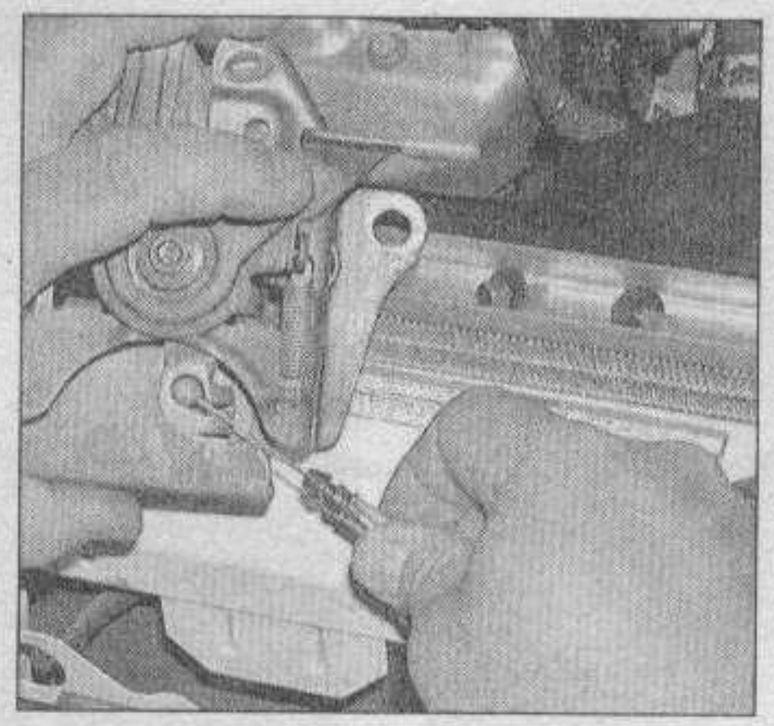
Warning: *The models covered by this manual are equipped with Supplemental Restraint systems (SRS), more commonly known as airbags. Always disconnect the negative battery cable, then the positive battery cable and wait three minutes before working in the vicinity of the impact sensors, steering column or instrument panel to avoid the possibility of accidental deployment of the airbag, which could cause personal injury* (see Chapter 12). *The yellow wiring harnesses and connectors routed through the console and instrument panel are for this system. Do not use electrical test equipment on any of the airbag system wiring or tamper with them in any way.*
Caution: *The stereo in your vehicle is equipped with an anti-theft system. Make sure you have the correct activation code before disconnecting the battery.*



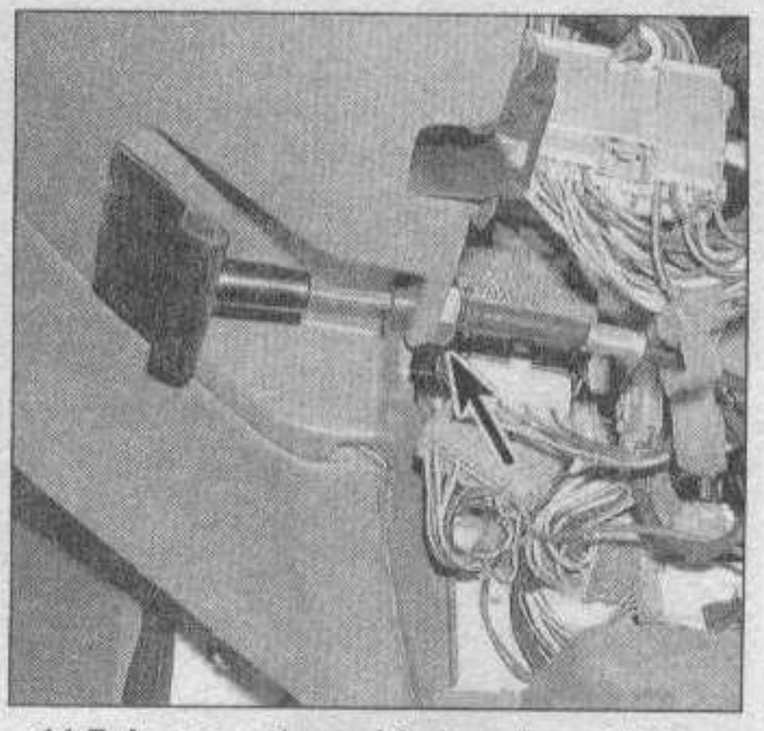
11.1 Detach the plastic pins and remove the cover over the latch



11.2a Pry the cable clip off, then . . .



11.2b . . . detach the cable end with a small screwdriver



11.7 Loosen the cable handle retaining nut (arrow)

Latch

Refer to illustrations 11.1, 11.2a and 11.2b

1 Scribe a line around the latch to aid alignment when installing **(see illustration 10.9)**, then remove the plastic cover over the latch, retained by plastic pins **(see illustration)**. Remove the retaining bolts and nut securing the hood latch to the radiator support. Remove the latch.

2 Disconnect the hood release cable by prying off the retaining clip, then disengaging the cable from the latch assembly with a small screwdriver **(see illustrations)**.

3 Installation is the reverse of removal.

Note: *Adjust the latch so the hood engages securely when closed and the hood bumpers are slightly compressed.*

Cable

Refer to illustration 11.7

4 Disconnect the hood release cable from the latch assembly as described in Step 1.

5 Attach a piece of thin wire or string to the end of the cable and unclip all remaining cable retaining clips at the radiator support.

6 Refer to Section 13 and remove the plastic inner fenderwell.

7 Working under the dash, loosen the hood release handle mounting nut and detach the hood release handle and cable assembly **(see illustration)**.

8 Pull the cable and grommet rearward into the passenger compartment until you can see the wire or string. Ensure that the new cable has a grommet attached, then remove the wire or string from the old cable and fasten it to the new cable.

9 With the new cable attached to the wire or string, pull the wire or string back through the firewall until the new cable reaches the latch assembly.

10 Working in the passenger compartment, install the new cable and handle assembly.

11 The remainder of installation is the reverse of removal.

12 Bumpers - removal and installation

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

Caution: *If the stereo in your vehicle is equipped with an anti-theft system. Make sure you have the correct activation code before disconnecting the battery.*

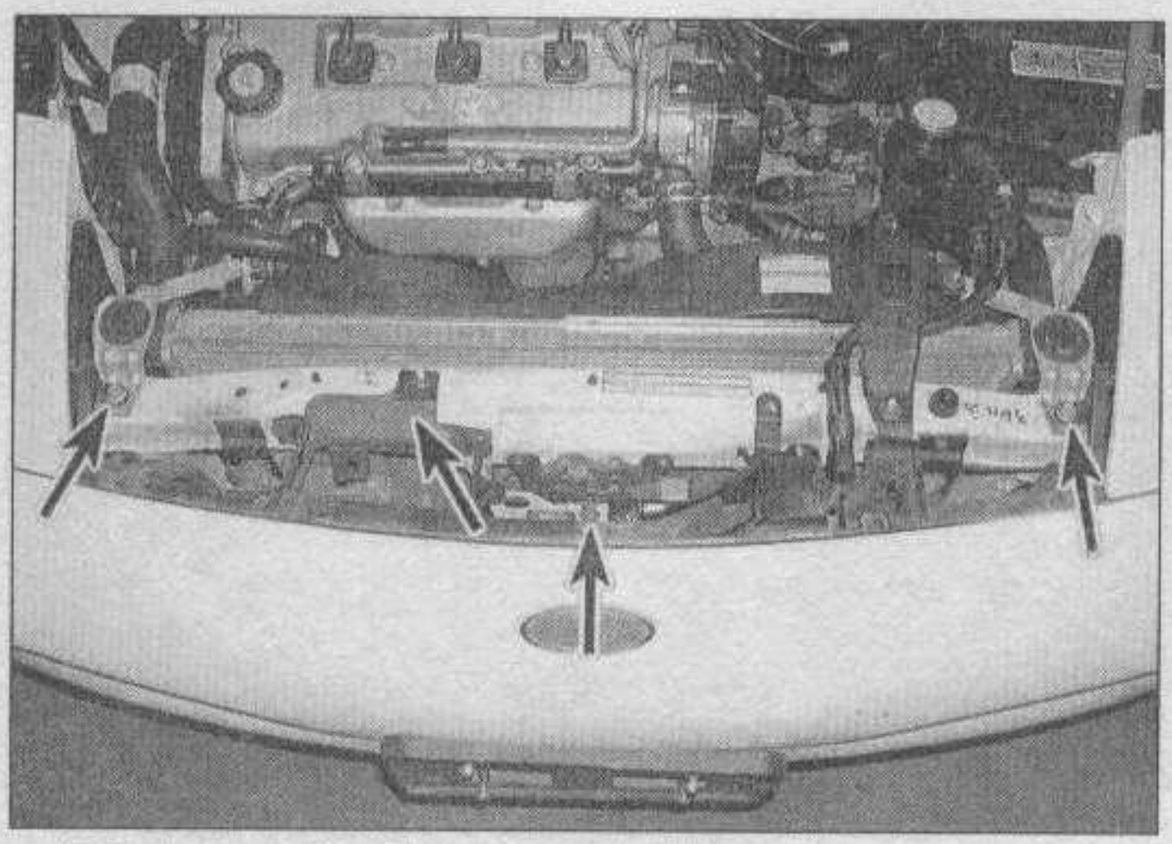
Front bumper

Refer to illustrations 12.3a, 12.3b, 12.4a, 12.4b and 12.5

1 Apply the parking brake, raise the vehicle and support it securely on jackstands.

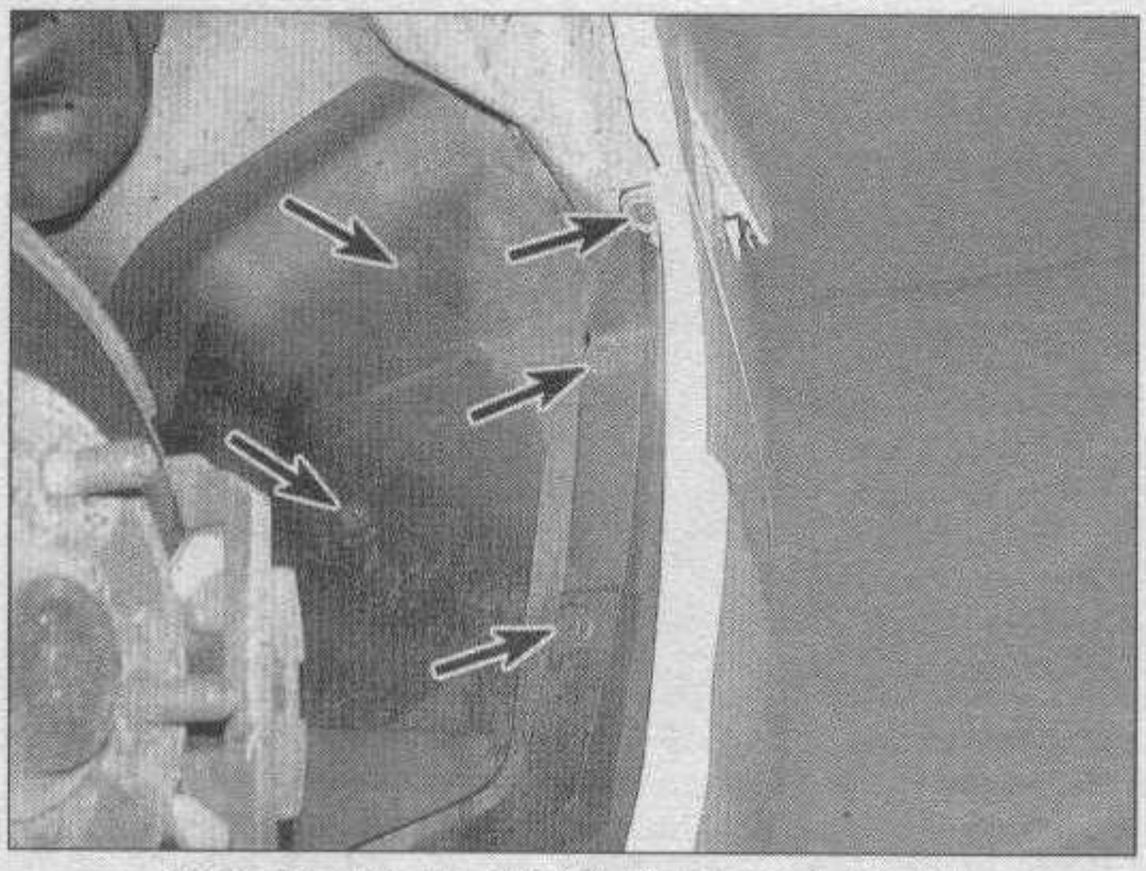
2 Disconnect the negative battery cable, then the positive battery cable and wait two minutes before proceeding any further.

3 Remove the retaining bolts securing the air deflector, radiator, bumper cover support and air cleaner intake tube brackets **(see illustrations)**.

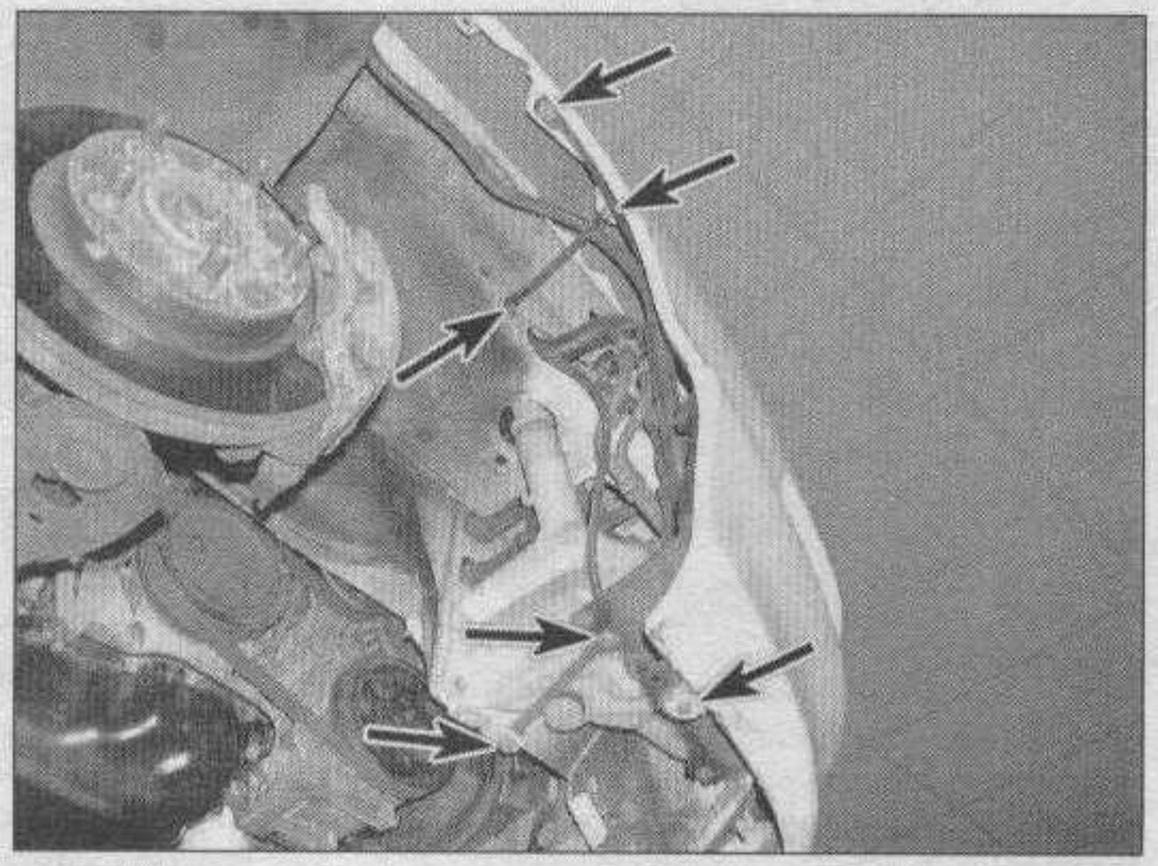


12.3a Remove the air deflector, radiator support and bumper cover support bracket screws (arrows)

12.3b Remove the air intake tube bracket bolt (arrow)



12.4a Remove the wheelwell and bumper cover retaining screws (arrows)



12.4b Remove the bumper cover bolts on both sides (arrows) and detach the bumper cover

4 Detach the screws securing the fenderwell cover and bumper cover **(see illustrations)**.

5 Once the cover is removed, remove the retaining nuts and detach the bumper assembly **(see illustration)**.

6 Installation is the reverse of removal. Make sure the alignment tabs on the bumper cover fit into the corresponding notches on the body before attaching the bolts and screws. An assistant is helpful.

Rear bumper

Refer to illustrations 12.8a, 12.8b, 12.9, 12.10 and 12.11

7 If necessary for working clearance, raise the rear of the vehicle and support it securely on jackstands.

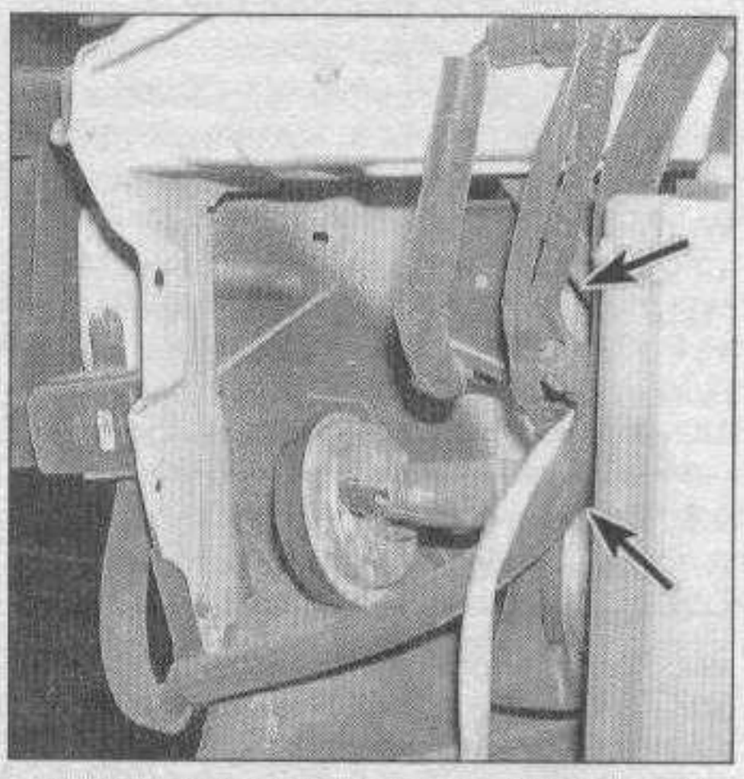
8 Working under the vehicle, remove the screws and nuts securing the lower edge of the bumper cover **(see illustrations)**.

9 Remove the tail light housings (Chapter 12) for access, and remove the upper bumper cover retaining screws **(see illustration)**.

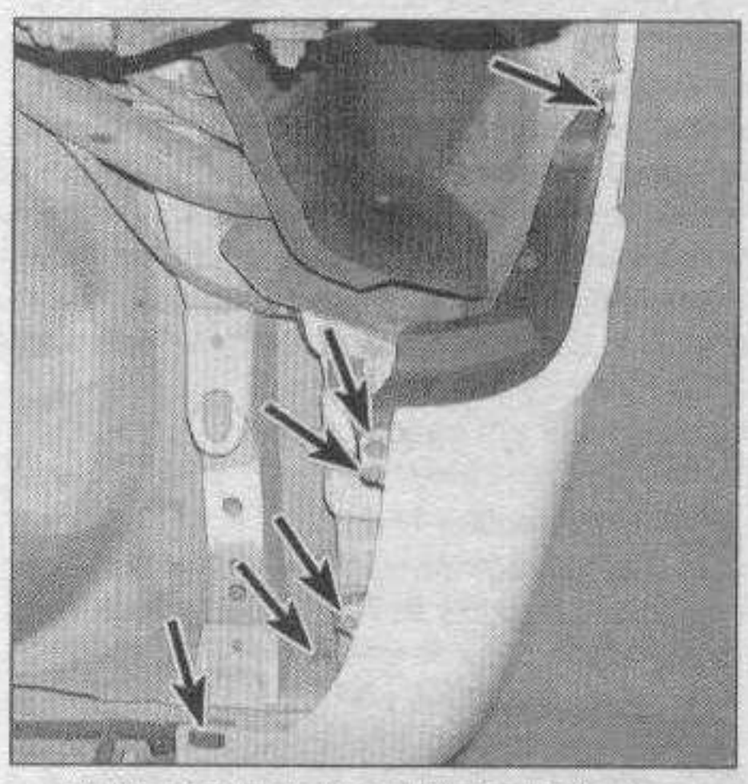
10 Remove the bumper cover bolts inside the rear compartment **(see illustration)**.

11 Remove the bumper retaining nuts inside the rear compartment, then pull the bumper and cover assembly out and away from the vehicle **(see illustration)**.

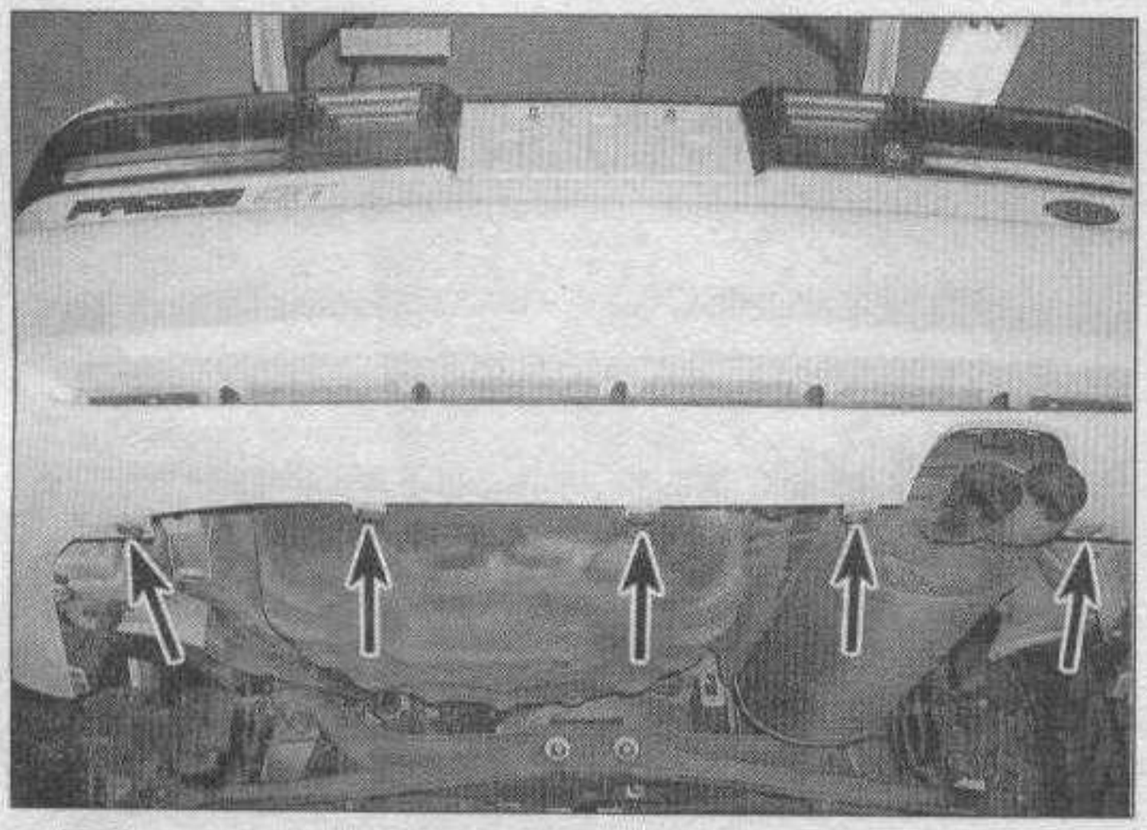
12 Installation is the reverse of removal.



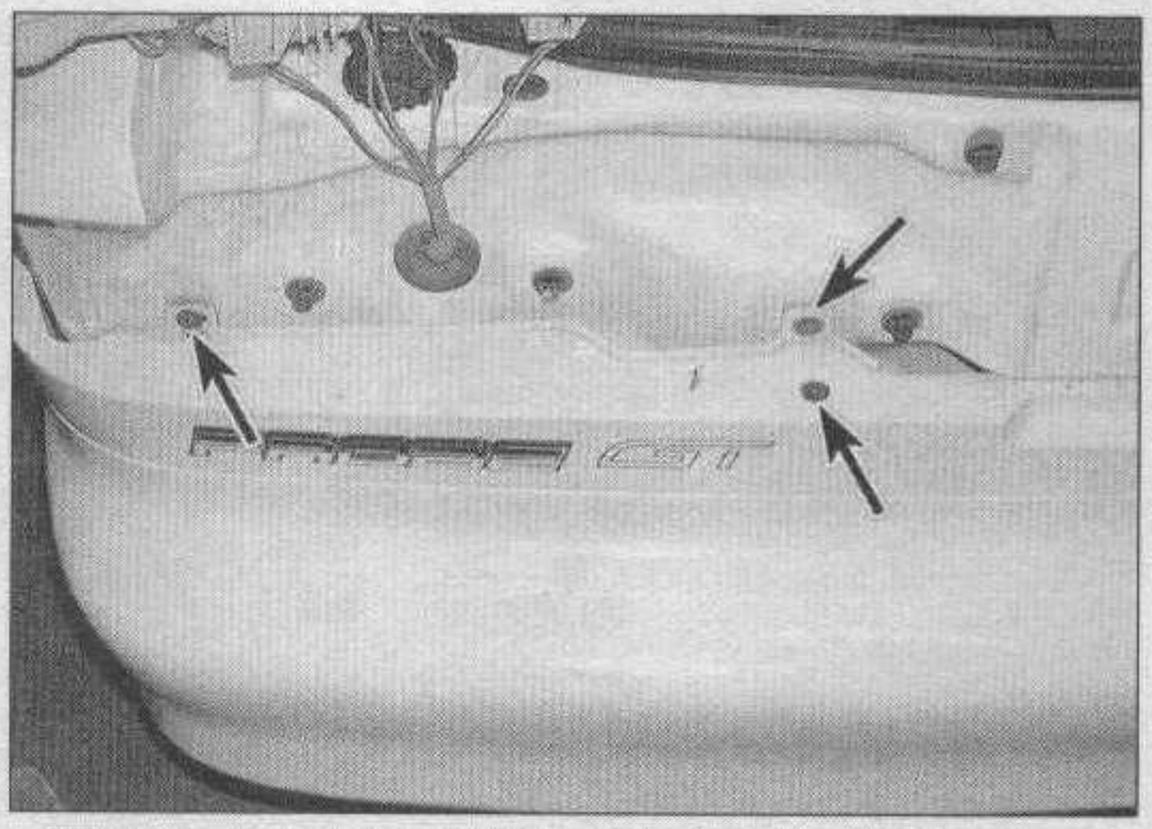
12.5 Remove the two nuts on each side (arrows) and detach the bumper



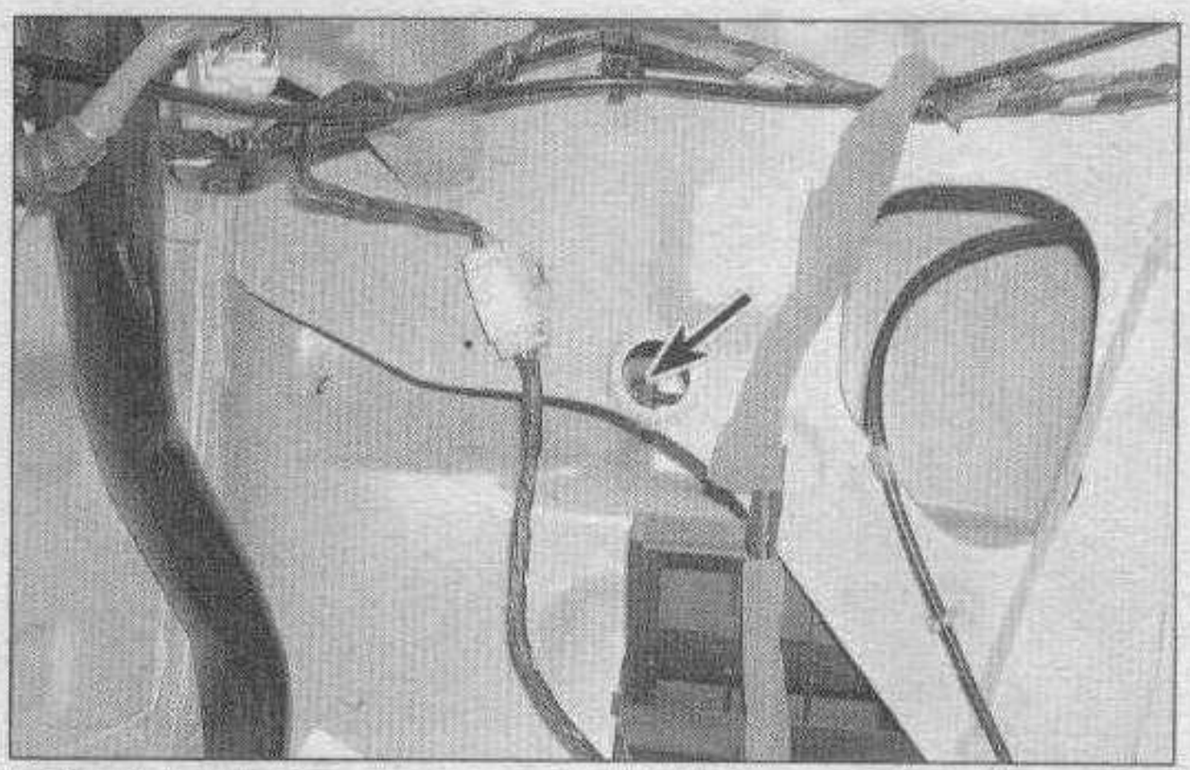
12.8a Remove the bolts in each rear fenderwell (arrows) . . .



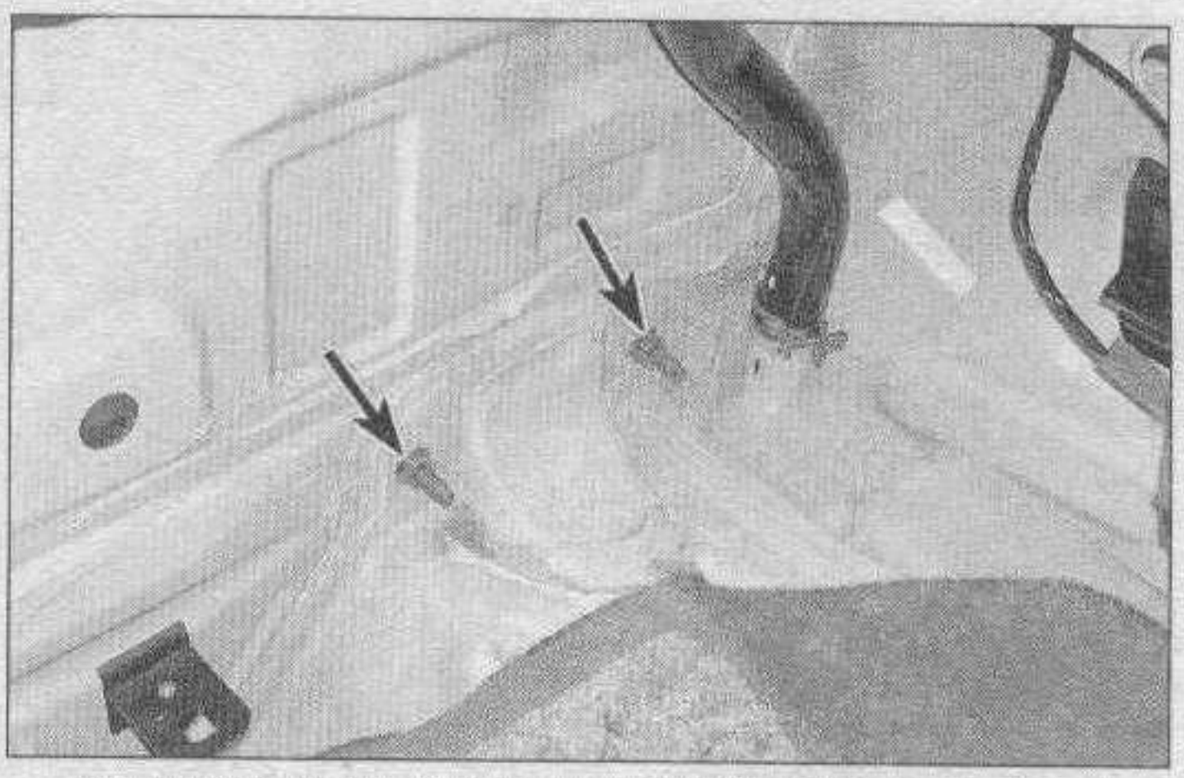
12.8b . . . and along the bottom of the bumper cover (arrows)



12.9 After removing the tail light housings, remove the screws retaining the upper edge of the bumper cover (arrows)



12.10 Inside the rear compartment, remove the bumper cover bolt (arrow) on each side



12.11 Remove the rear bumper retaining nuts (arrows) and detach the bumper/cover assembly

13 Front fender - removal and installation

Refer to illustrations 13.3, 13.4, 13.5a and 13.5b

1 Raise the vehicle, support it securely on jackstands and remove the front wheel.

2 Remove the front bumper cover (see Section 12).

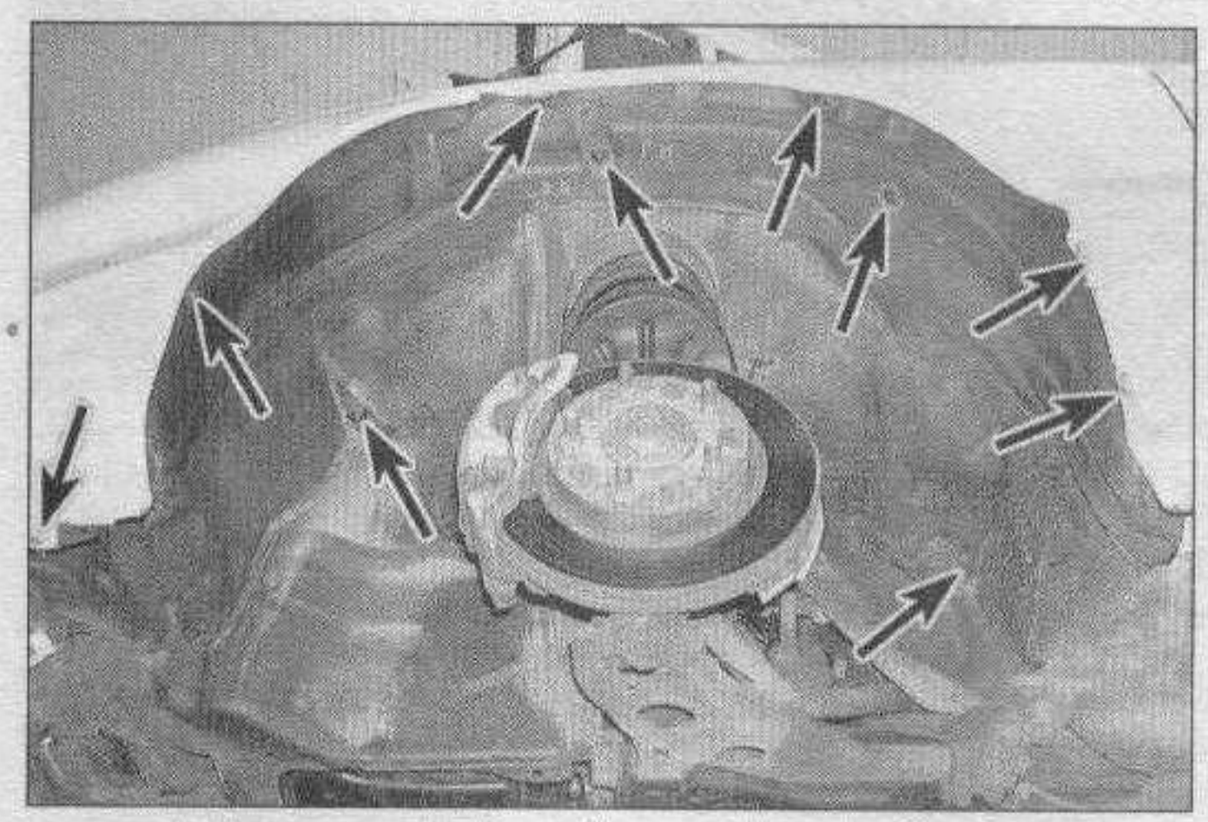
3 Detach the screws, then remove the inner fenderwell **(see illustration)**.

4 Open the hood and remove the upper fender-to-body bolts **(see illustration)**.

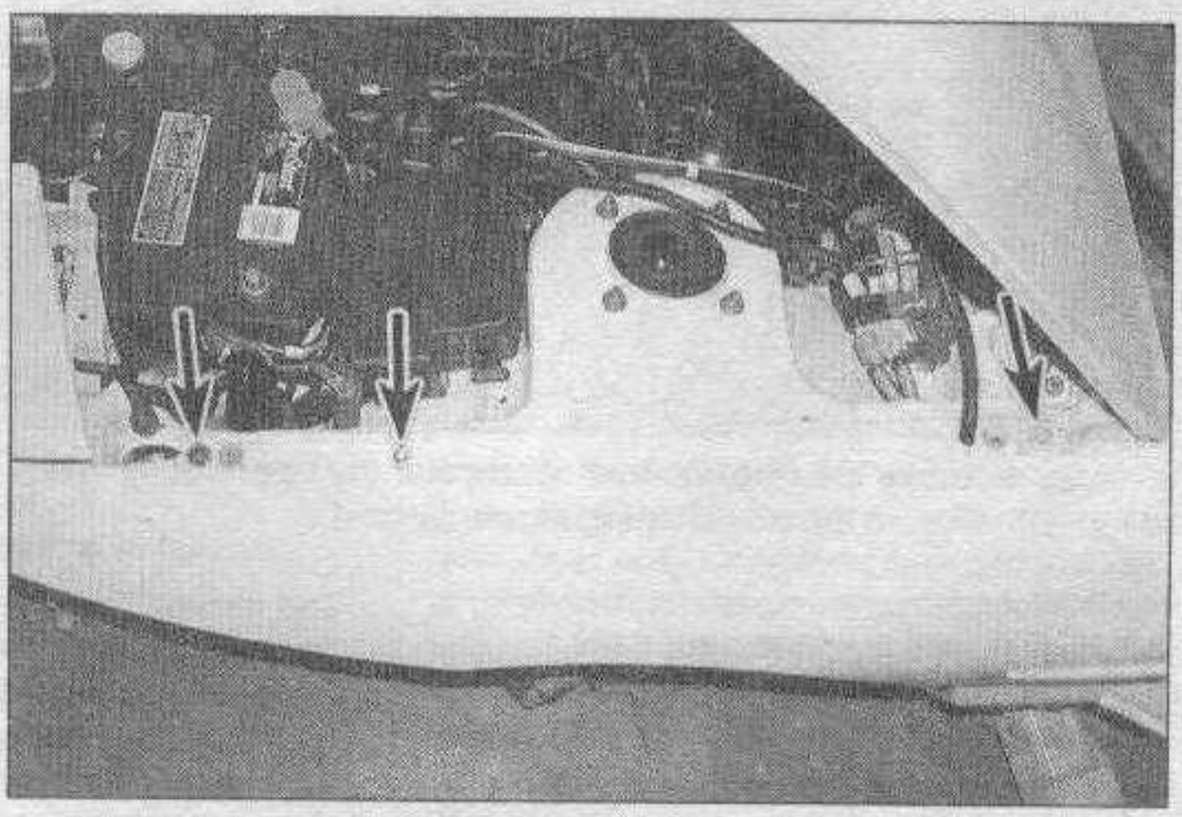
5 Remove the bolts along the bottom of the body and fender **(see illustrations)**.

6 Detach the fender. It's a good idea to have an assistant support the fender while it's being moved away from the vehicle to prevent damage to the surrounding body panels.

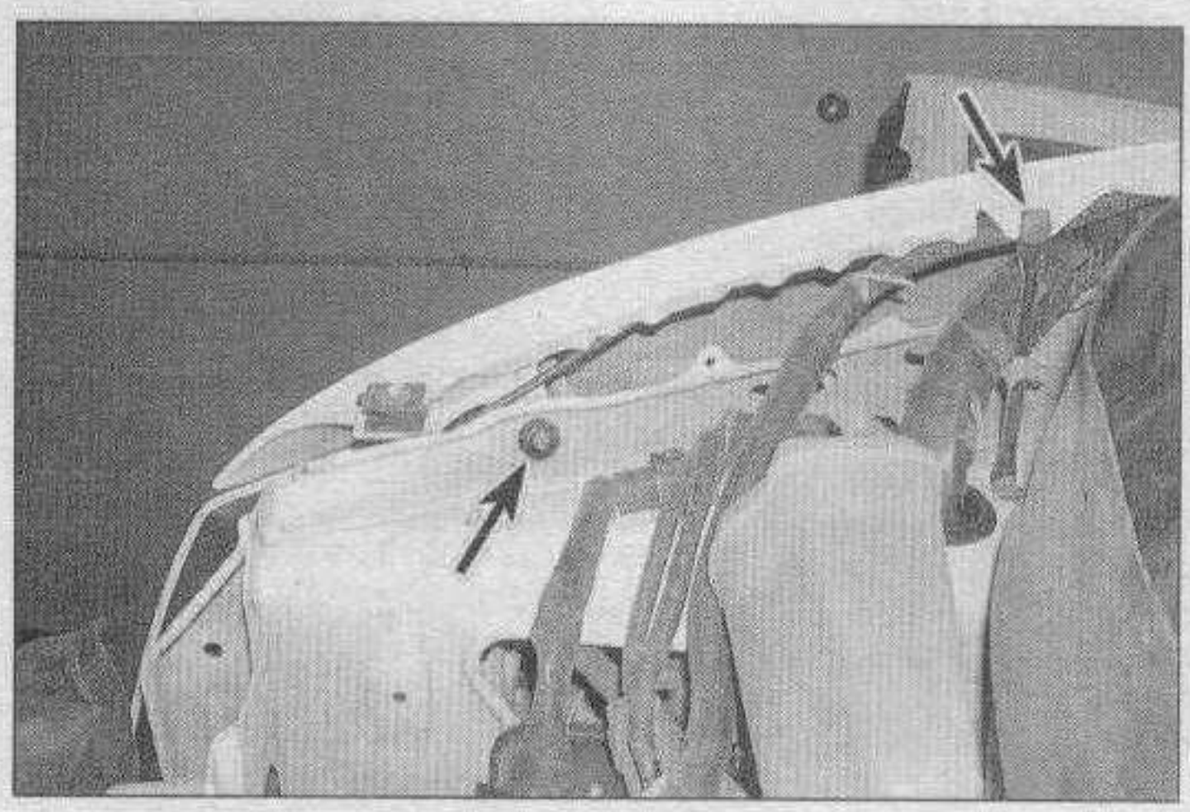
7 Installation is the reverse of removal.



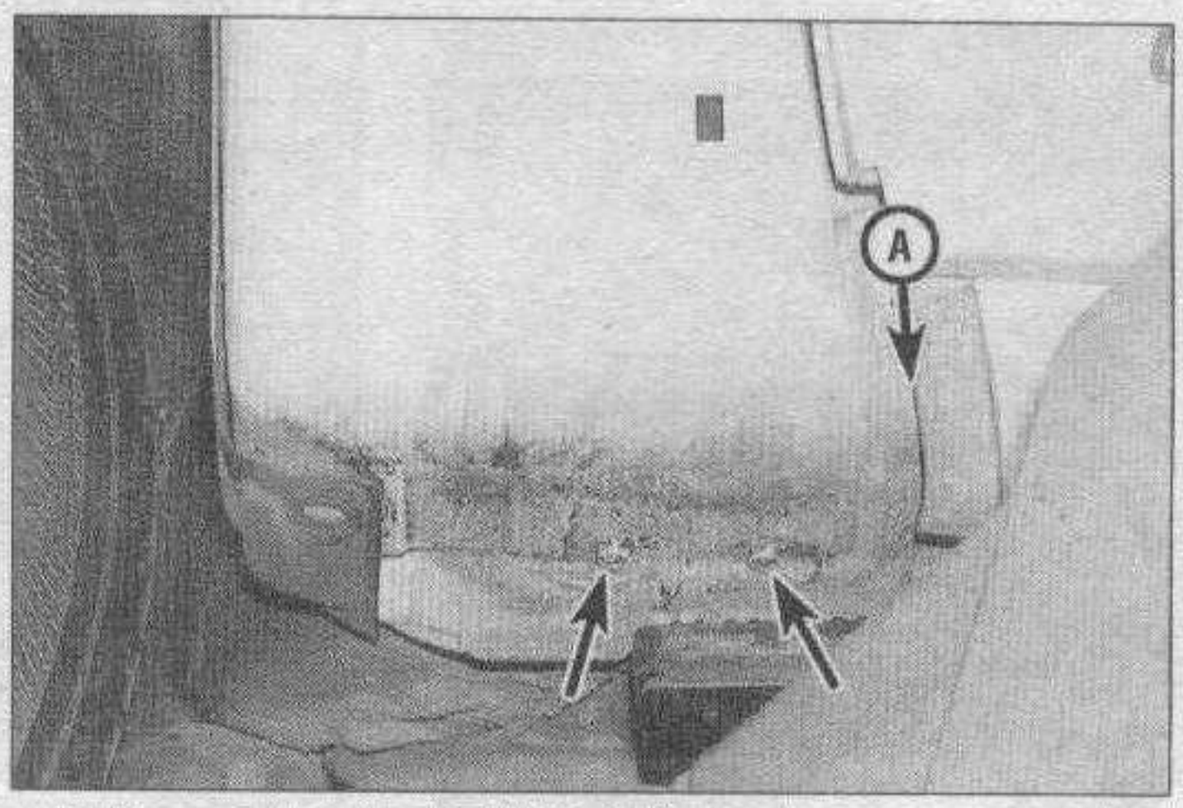
13.3 Remove the inner fenderwell screws (arrows)



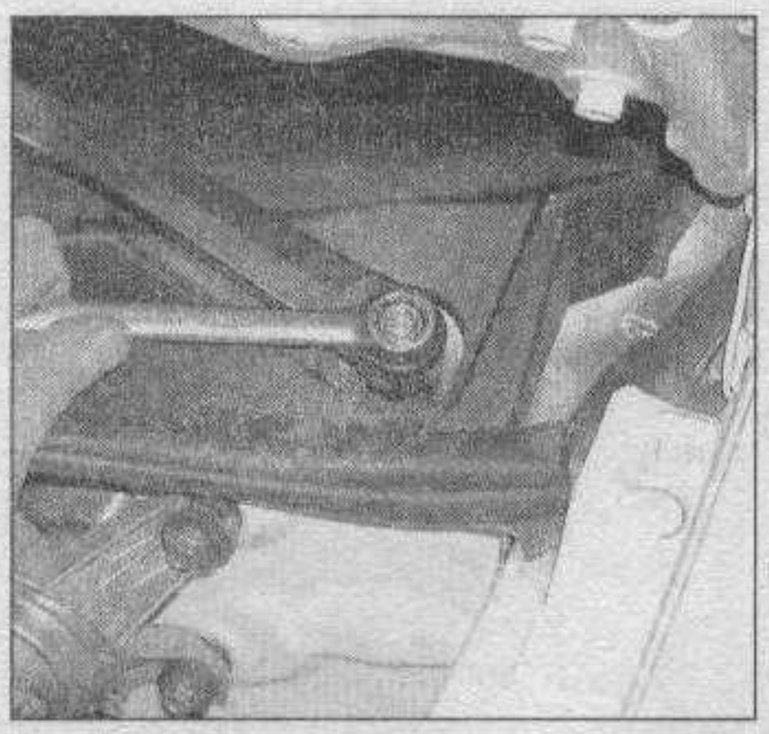
13.4 Remove the bolts along the top of the fender (arrows)



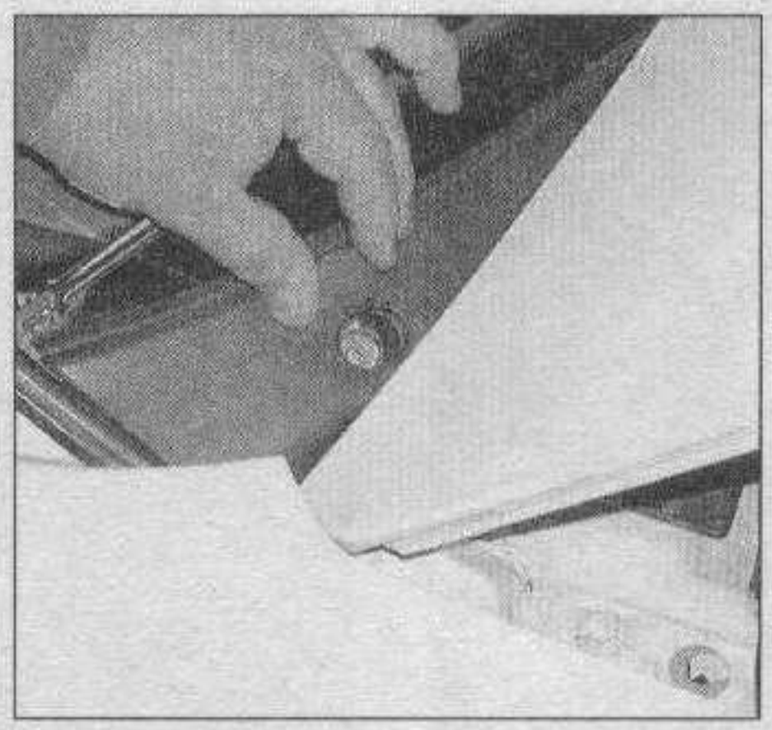
13.5a Remove the bolts (arrows) along the bottom of the fender . . .



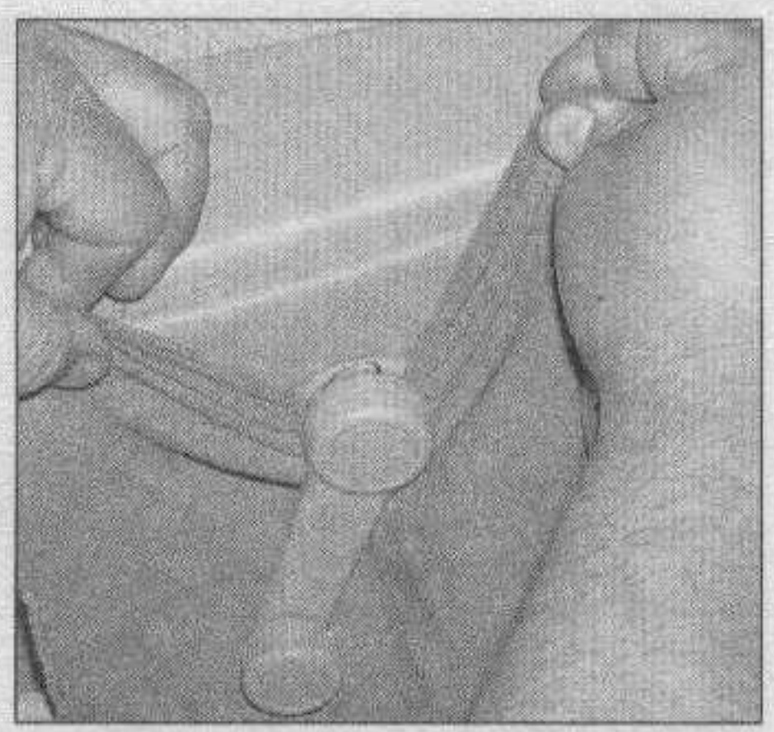
13.5b . . . and on the rocker panel (arrows) - on some models, it will be necessary to remove the screws and slide the plastic sill (A) back to access the bolts



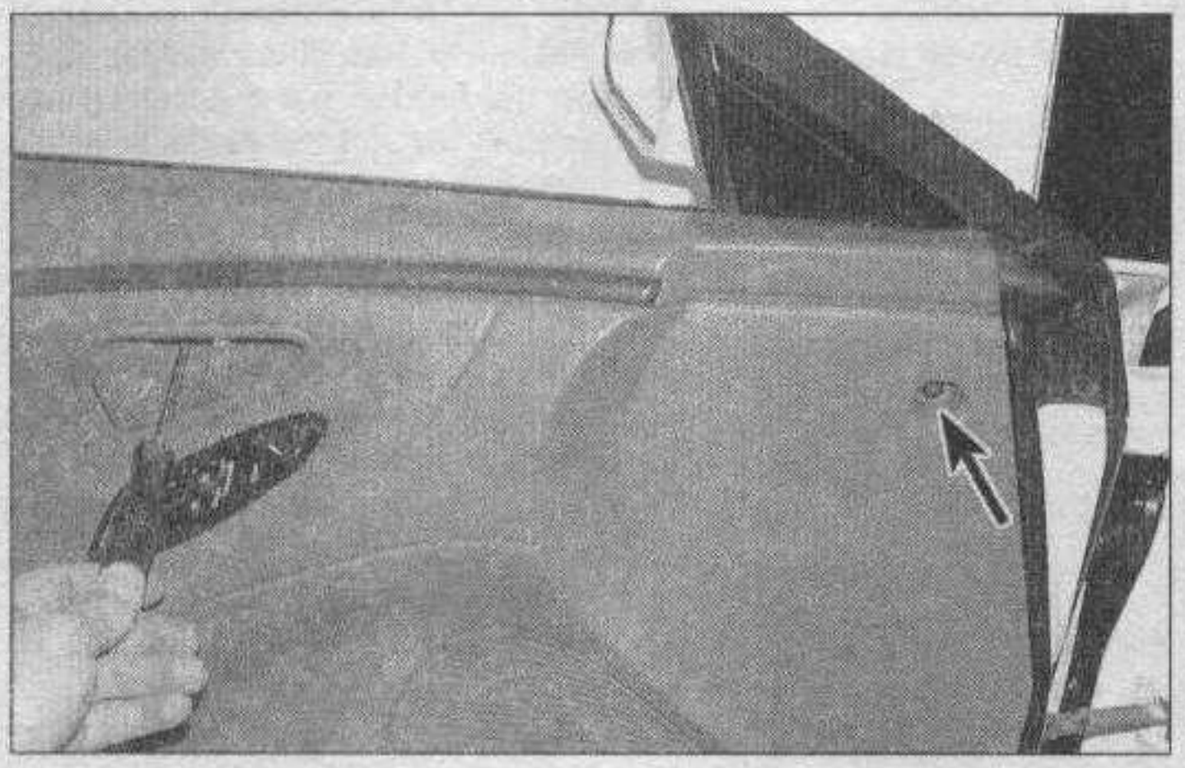
14.1 Remove the nuts and detach the wiper arms



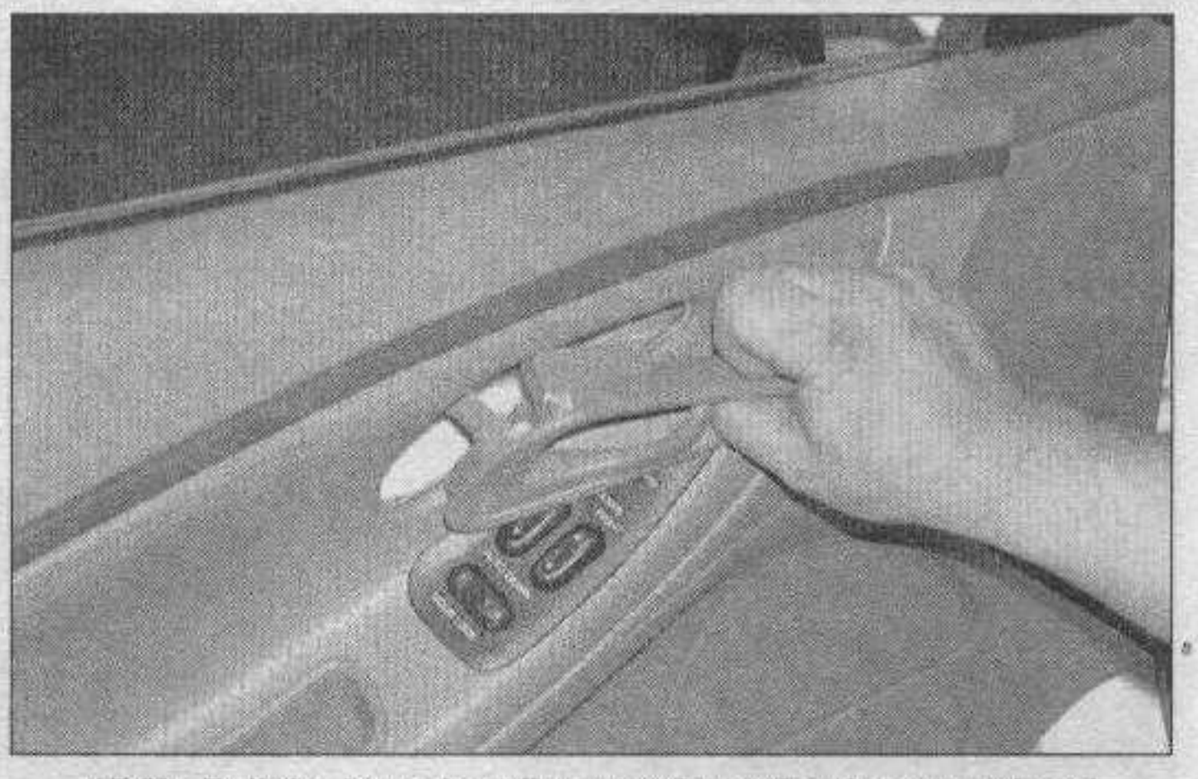
14.2 Detach the plastic covers for access to the cowl cover retainers



15.1 On models equipped with a manual window regulator, remove the window crank handle by removing this clip with a shop towel, as shown



15.3a Remove the door handle screw and the upper door trim panel retaining screw (arrow)



15.3b Pull the inner handle away from the door panel and disconnect the linkage rod

14 Cowl cover - removal and installation

Refer to illustrations 14.1 and 14.2

1 Remove the wiper arms **(see illustration)**.

2 Depending on model, detach the covers and remove the screws or pry out the plastic retainers securing the cowl cover to the vehicle **(see illustration)**.

3 Detach the cowl from the vehicle.

4 Installation is the reverse of removal.

15 Door trim panels - removal and installation

Refer to illustrations 15.1, 15.3a, 15.3b, 15.4, 15.5a and 15.5b

Caution: *Wear gloves when working inside the door openings to protect against cuts from sharp metal edges.*

Removal

1 On manual window regulator equipped models, remove the window crank handle **(see illustration)**. A shop towel worked up between the handle and door panel will usually dislodge the clip, but it can also be removed with a hooked tool.

2 Pull the door lock knob up, into the unlocked position.

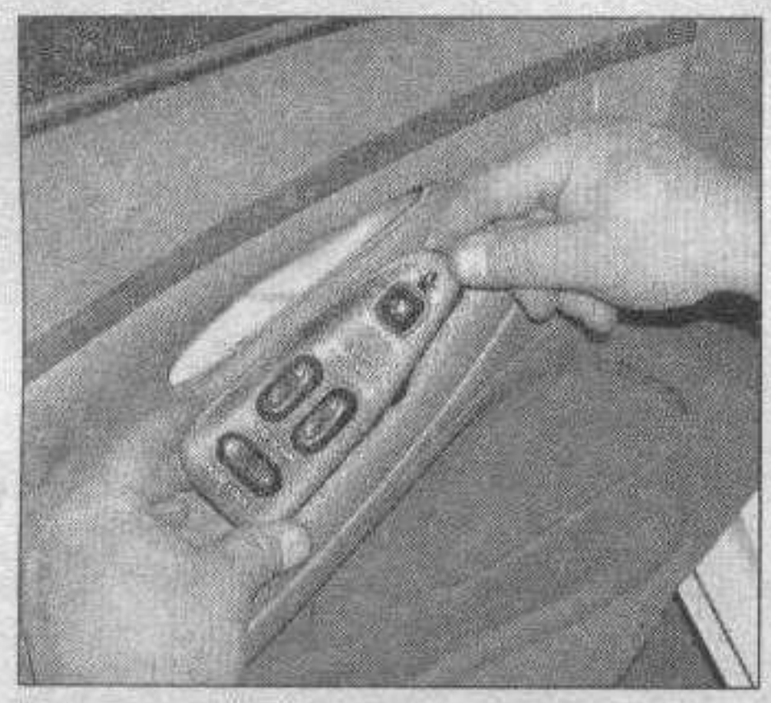
3 Remove the inside door handle mounting screw and the retaining screw at the front upper corner or the door **(see illustration)**. Pull the handle away from the door panel enough to disconnect the linkage rod **(see illustration)**.

4 Pry out the power window switch (if equipped) and unplug the electrical connector **(see illustration)**.

5 Remove the screw in the door pull and the remaining door trim panel retaining screws **(see illustrations)**, then carefully pull the panel out until the clips disengage. Work slowly and carefully around the outer edge of the trim panel until it's free.

6 Once all of the clips are disengaged, pull the trim panel up, unplug any wiring harness connectors and remove the panel.

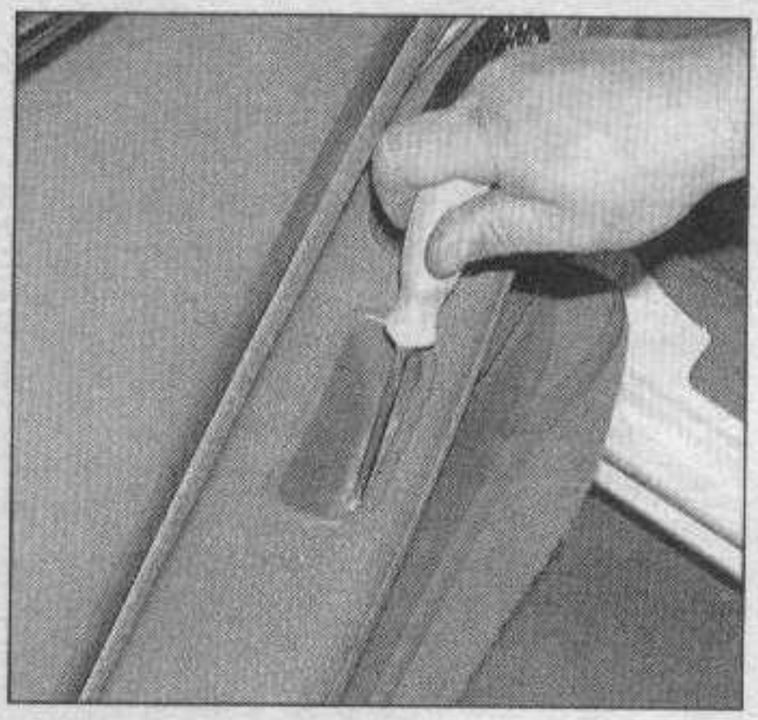
7 For access to the door outside handle or the door window regulator inside the door, raise the window fully, remove the power window control unit (if equipped), the door panel bracket and the speaker assembly (see Chapter 12), then carefully peel back the plastic watershield.



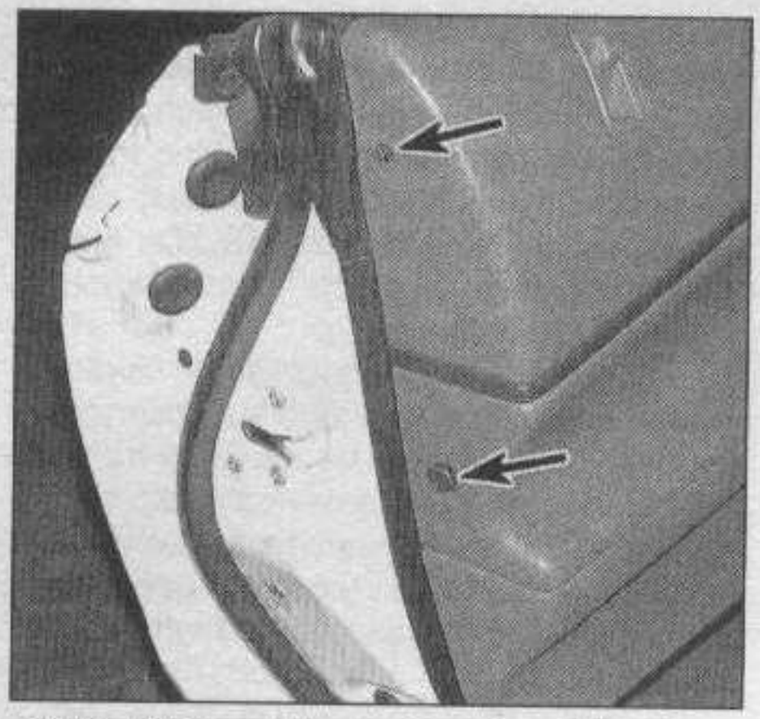
15.4 Carefully lift the switch assembly out of the trim panel and rotate it out far enough to disconnect the electrical connectors

Installation

8 Prior to installation of the door trim panel, be sure to reinstall any clips in the panel which may have come out when you removed the panel.



15.5a Remove the screw and lift out the door pull assembly



15.5b Remove the screws from the door end and lower front corner (arrows)

9 Plug in the wire harness connectors for the power door lock switch and the power window switch, if equipped, and place the panel in position in the door. Press the door panel into place until the clips are seated. Install the inner door handle and its screw. Install the power door lock switch assembly, if equipped, or the pull-pocket and its screw. Install the manual-regulator crank handle or power window switch assembly.

16 Door - removal, installation and adjustment

Note: *The door is heavy and somewhat awkward to remove and install - at least two people should perform this procedure.*
Caution: *Wear gloves when working inside the door openings to protect against cuts from sharp metal edges.*

Removal and installation

Refer to illustrations 16.6 and 16.8

1 Lower the window completely in the door and then disconnect the negative cable from the battery.
2 Open the door all the way and support it from the ground on jacks or blocks covered with rags to prevent damaging the paint.
3 Remove the door trim panel and water deflector as described in Section 15.
4 Disconnect all electrical connections, ground wires and harness retaining clips from the door. **Note:** *It is a good idea to label all connections to aid the reassembly process.*
5 From the door side, detach the rubber conduit between the body and the door. Then pull the wiring harness through conduit hole and remove from the door.
6 Remove the door stop strut pin by driving it out from the bottom **(see illustration)**.
7 Mark around the door hinges with a pen or a scribe to facilitate realignment during reassembly.
8 With an assistant holding the door, remove the hinge-to-door bolts **(see illustration)** and lift the door off. **Note:** *Draw a reference line around the hinges before removing the bolts.*
9 Installation is the reverse of removal.

Adjustment

Refer to illustration 16.13

10 Having proper door to body alignment is a critical part of a well-functioning door assembly. First check the door hinge pins for excessive play. Fully open the door and lift up and down on the door without lifting the body. If a door has 1/16-inch or more excessive play, the hinges should be replaced.
11 Door-to-body alignment adjustments are made by loosening the hinge-to-body bolts or hinge-to-door bolts and moving the door. Proper body alignment is achieved when the tops of the doors are parallel with the roof section, the front door is flush with the fender, the rear door is flush with the rear quarter panel and the bottom of the doors are aligned with the lower rocker panel. If these goals can't be reached by adjusting the hinge-to-body or hinge-to-door bolts, body alignment shims may have to be purchased and inserted behind the hinges to achieve correct alignment.
12 To adjust the door closed position, scribe a line or mark around the striker plate to provide a reference point, then check that the door latch is contacting the center of the latch striker. If not adjust the up and down position first.
13 Finally adjust the latch striker sideways position, so that the door panel is flush with the center pillar or rear quarter panel and provides positive engagement with the latch mechanism **(see illustration)**.

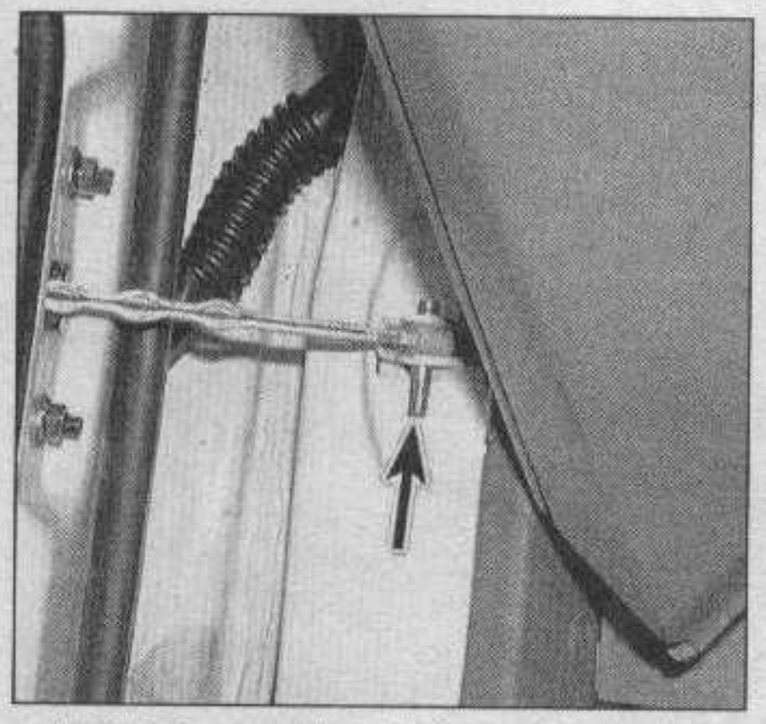
17 Door latch, lock cylinder and handle - removal and installation

Caution: *Wear gloves when working inside the door openings to protect against cuts from sharp metal edges.*

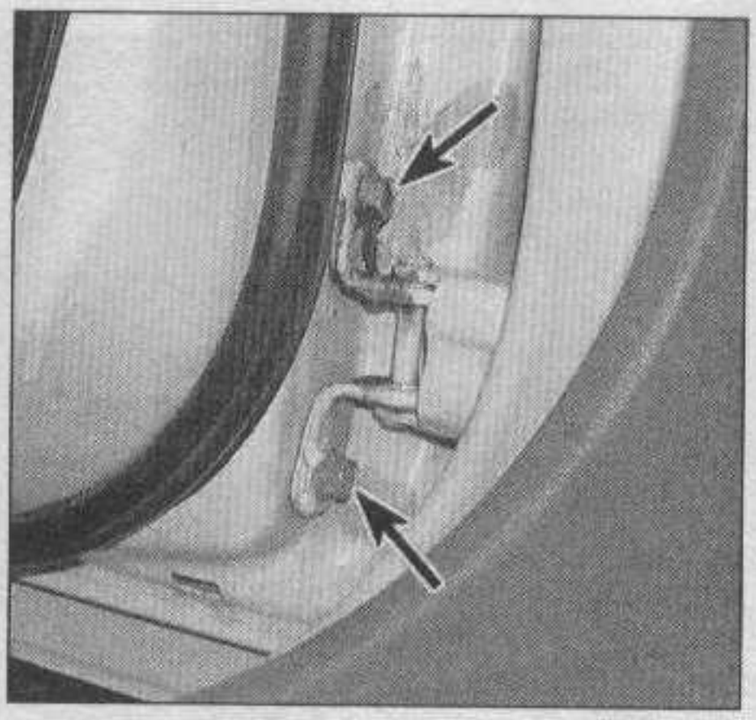
Door latch

Refer to illustration 17.4

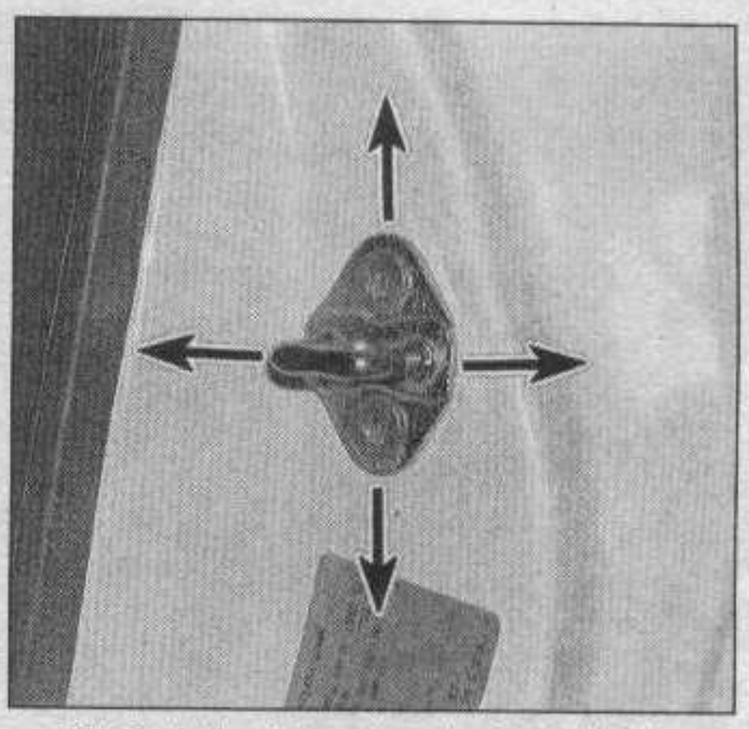
1 Raise the window, then remove the door trim panel and watershield (see Section 15).
2 Working through the access hole, disengage the outside door handle-to-latch rod, outside door lock-to-latch rod, the inside handle-to-latch rod, and the lock solenoid-to-latch rod.
3 All door lock rods are attached by plastic clips. The plastic clips can be removed by



16.6 Drive out the pin (arrow) retaining the door stop strut



16.8 Remove the door hinge bolts (arrows) with the door supported



16.13 Adjust the door lock striker by loosening the mounting screws and gently tapping the striker in the desired direction (arrows)

unsnapping the portion engaging the connecting rod and then pulling the rod out of its locating hole. On models with power door locks, disconnect the electrical connectors at the latch.

4 Remove the screws securing the latch to the door **(see illustration)**. Remove the latch assembly from the door.

5 Installation is the reverse of removal.

Outside handle and door lock cylinder

Refer to illustrations 17.7, 17.8a, 17.8b and 17.8c

6 To remove the outside handle and lock cylinder assembly, raise the window and remove the door trim panel and watershield (see Section 15). **Caution:** *Take care not to scratch the paint on the outside of the door. Wide masking tape applied around the handle opening before beginning the procedure can help avoid scratches.*

7 Working through the access hole, disengage the plastic clips that secure the outside handle-to-latch actuating rod, the outside door lock-to-latch actuating rod, and the clip holding the Ford Probe model lock cylinder switch to the lock cylinder **(see illustration)**.

8 On Ford Probe models, detach the rubber plugs in the door and, working through the access holes, remove the outside handle retaining nuts **(see illustration)**. On Mazda models remove the door handle retaining nuts **(see illustration)**.

9 Remove the handle/lock cylinder assembly from the vehicle. The lock cylinder on Mazda models can be removed from the handle assembly by removing a clip, or the electrical connector can be disconnected and the cylinder left on the handle assembly.

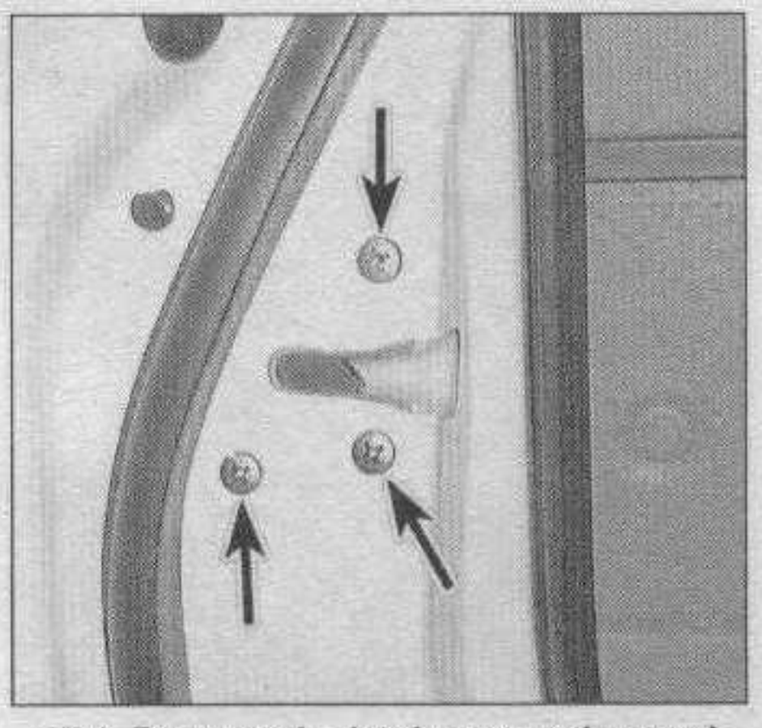
10 Installation is the reverse of removal.

18 Door window glass - removal and installation

Refer to illustrations 18.3 and 18.4

Caution: *Wear gloves when working inside the door openings to protect against cuts from sharp metal edges.*

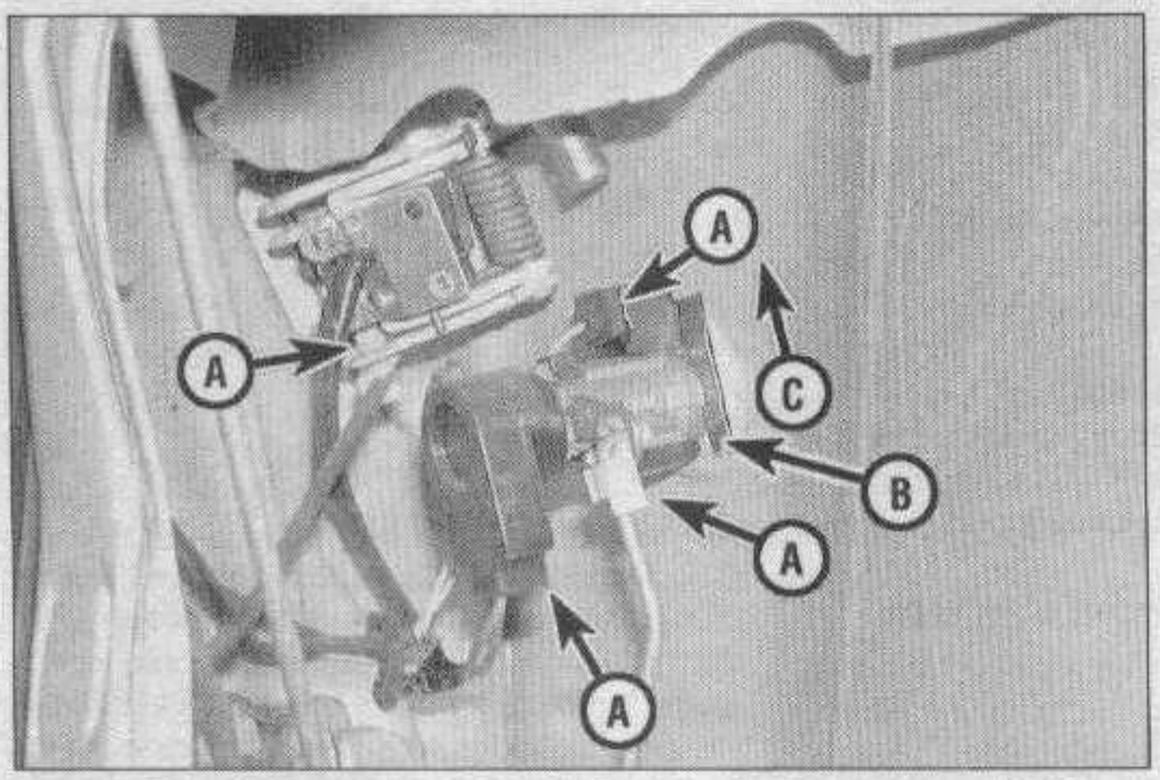
1 Remove the door trim panel and the plastic watershield (see Section 15).



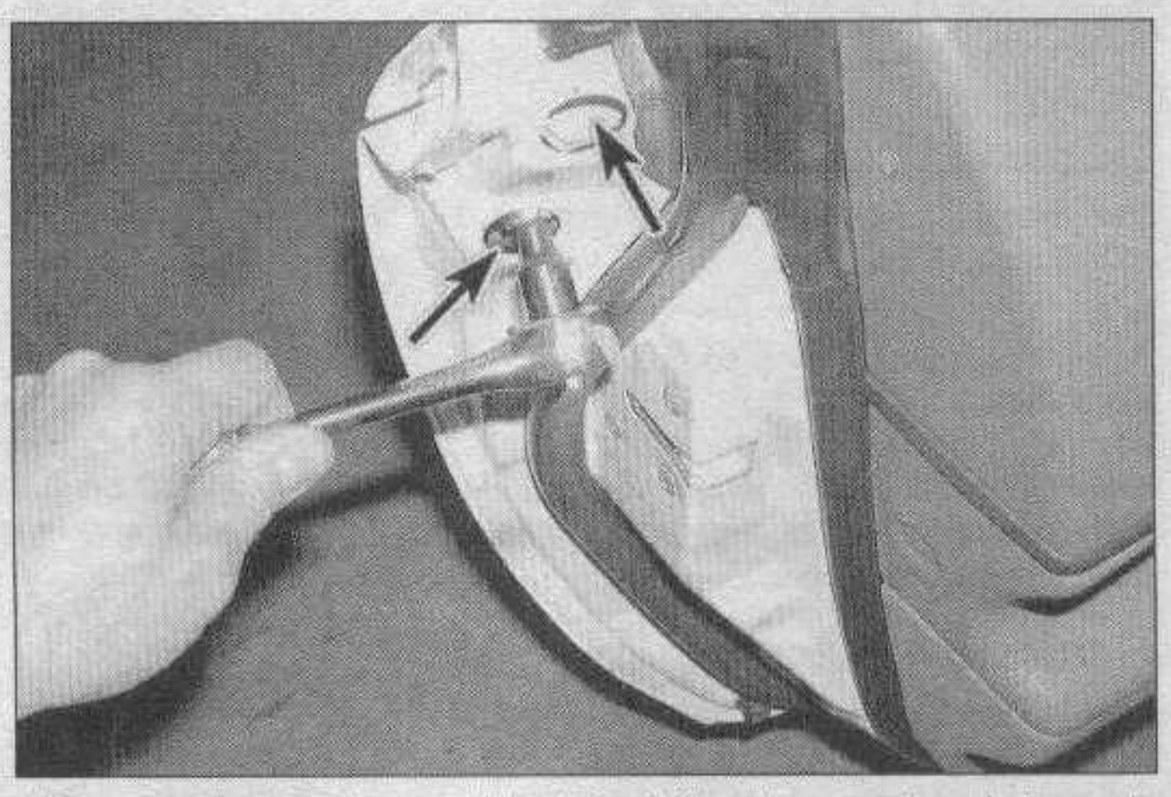
17.4 Remove the latch screws (arrows) from the end of the door and withdraw the latch assembly through the access hole

2 Lower the window glass all the way down into the door.

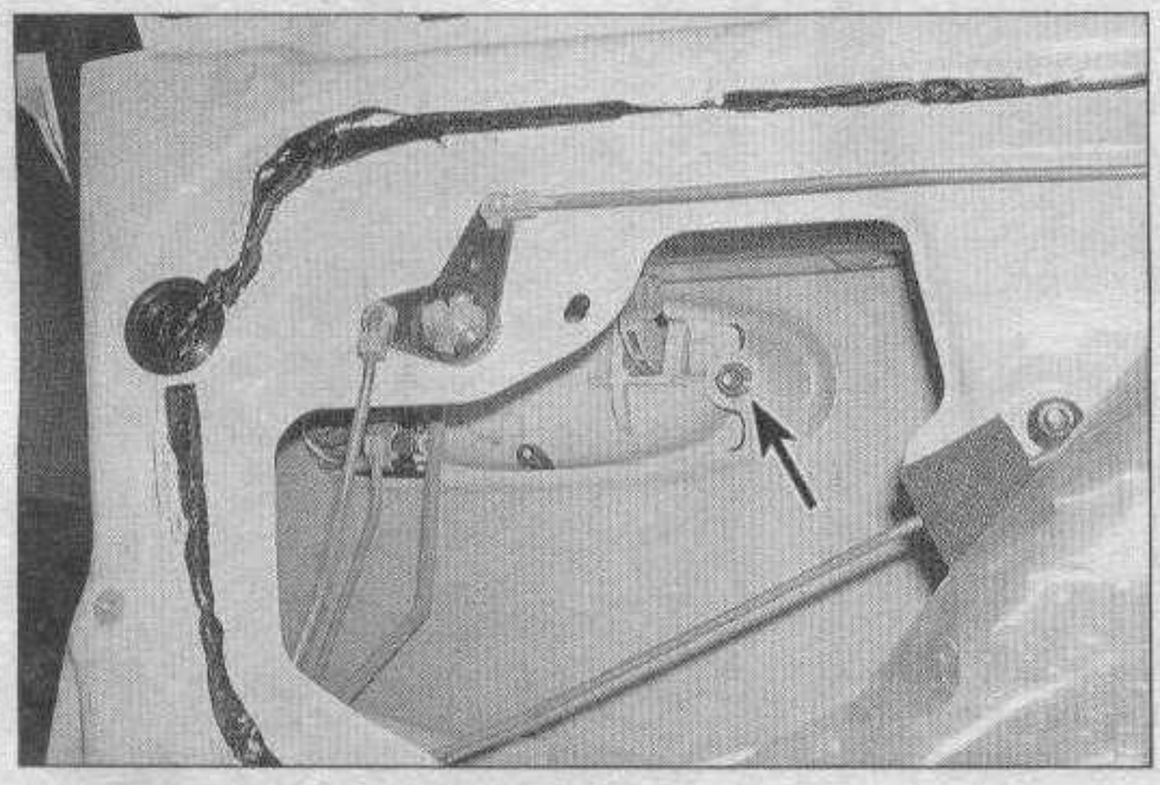
3 Raise the window just enough to access the window bracket retaining bolt through the hole in the door frame, then remove the bolt **(see illustration)**.



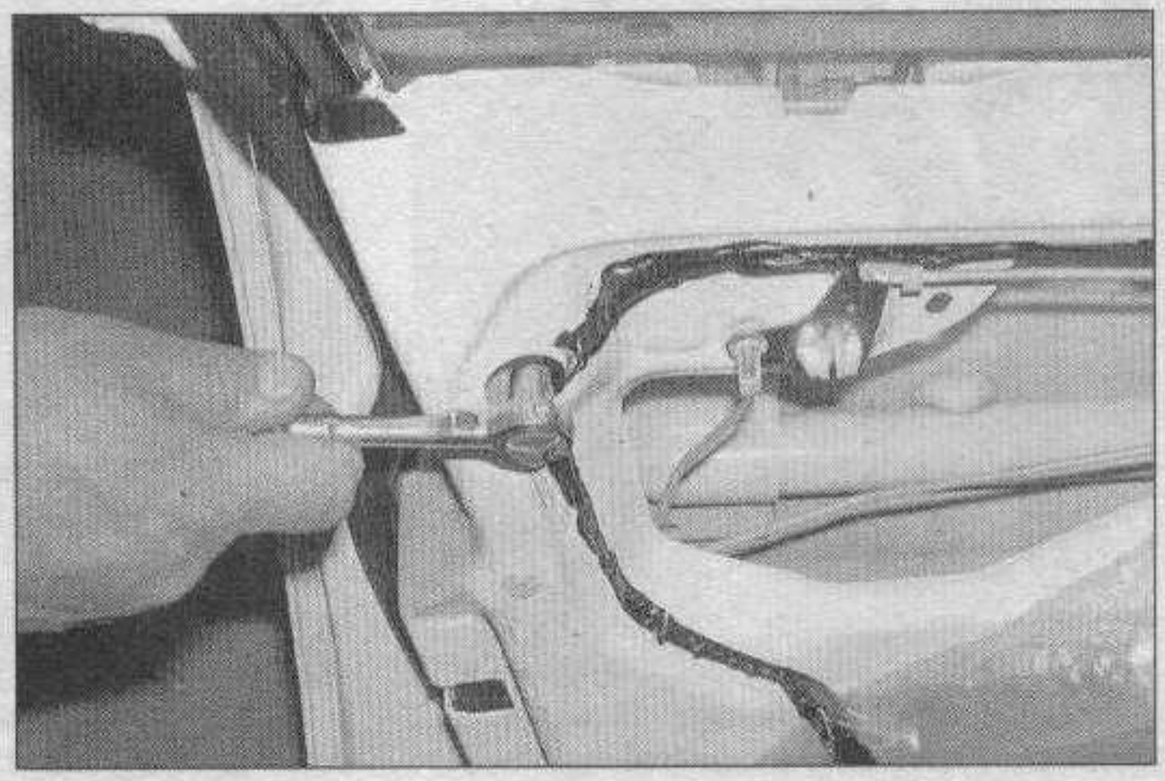
17.7 Detach the actuating rods and electrical connectors (A) from the door handle and lock cylinder, then remove the lock cylinder retaining clip (B) by pulling it up, in the direction of the arrow (C) (Ford Probe shown, Mazda models similar)



17.8a On Ford Probe models, detach the plugs and work through the two access holes to remove the outside door handle nuts



17.8b On Mazda models, work through the opening to remove one outside door handle nut (arrow), then . . .



17.8c . . . detach the rubber plug and work through the access hole to remove the other nut

4 Place a rag over the glass to help prevent scratching the glass and remove the two inner retaining bolts **(see illustration)**.
5 Remove the glass along with door opening weather stripping by pulling it up and out.
6 Installation is the reverse of removal.

19 Door window glass regulator - removal and installation

Caution: *Wear gloves when working inside the door openings to protect against cuts from sharp metal edges.*
Refer to illustration 19.4
1 Remove the door trim panel and the plastic watershield (see Section 15).
2 Remove the window glass assembly (see Section 18).
3 On power operated windows, disconnect the electrical connector from the window regulator motor.
4 Remove the regulator assembly mounting nuts **(see illustration)**.
5 Pull the regulator assembly through the service hole in the door frame to remove it.
6 Installation is the reverse of removal.

20 Mirrors - removal and installation

Outside mirrors

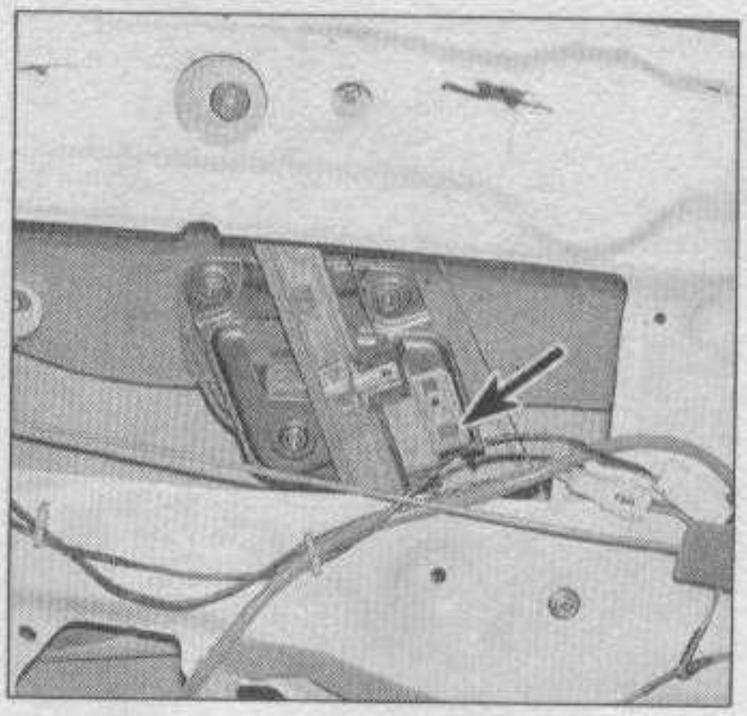
Refer to illustrations 20.2and 20.4
1 On power-mirror-equipped models, remove the door trim panel and the plastic watershield (see Section 15).
2 Pry off the mirror trim cover **(see illustration)**.
3 Disconnect the electrical connector from the mirror (if equipped).
4 Remove the three mirror retaining screws and detach the mirror from the vehicle **(see illustration)**.
5 Installation is the reverse of removal.

Inside mirror

Refer to illustration 20.6

1997 and earlier models

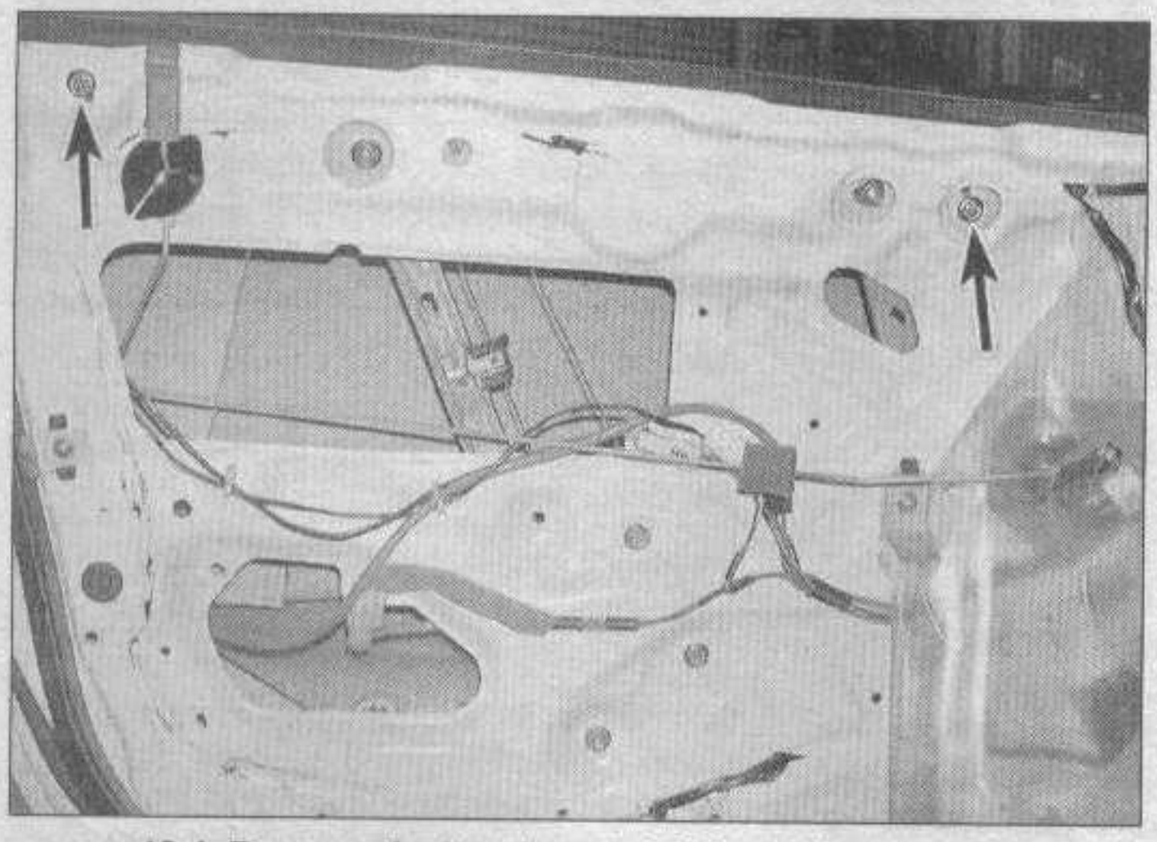
6 Grasp the mirror securely, loosen the Allen screw and lift the mirror from its mount **(see illustration)**.
7 Installation is the reverse of removal.



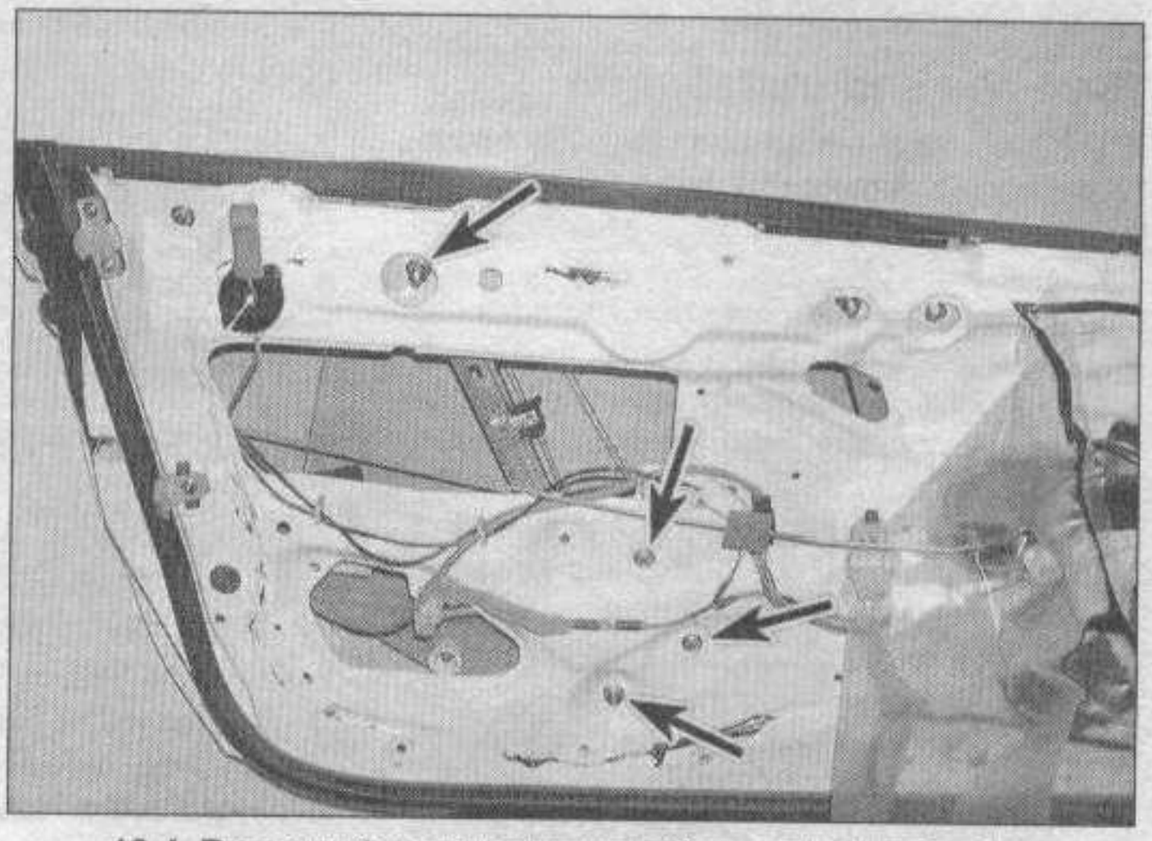
18.3 Remove the window bracket retaining bolt (arrow)

1998 and later models

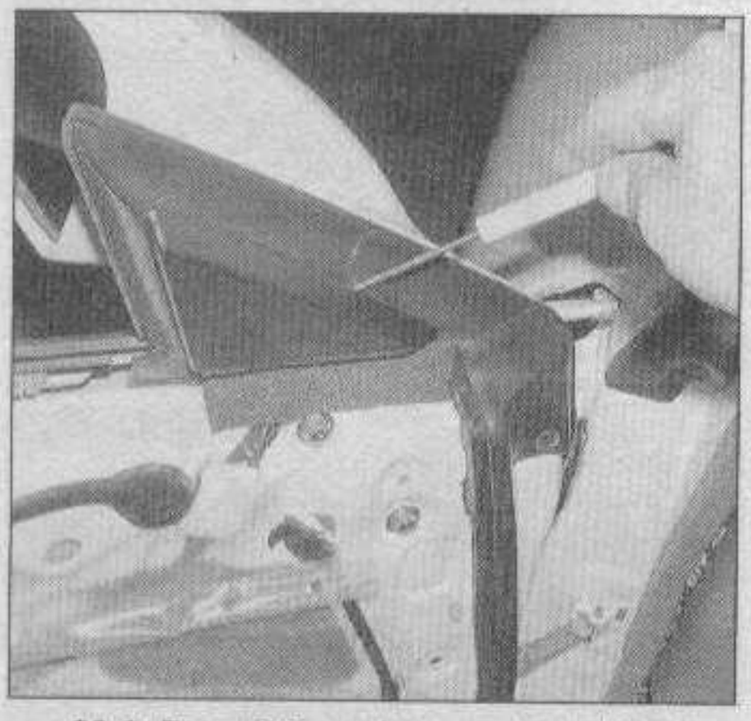
8 Insert a small flat-bladed screwdriver into the mirror mount parallel with the windshield to release the internal locking pin, then slide the mirror base off the mount.
9 Install by sliding the base into the mount until the locking pin clicks in place.



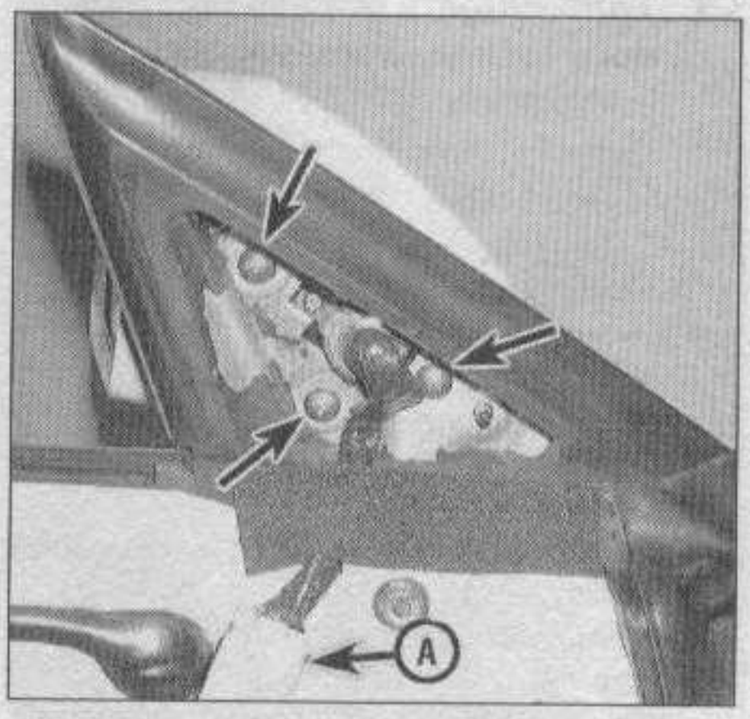
18.4 Remove the two inner retaining bolts (arrows)



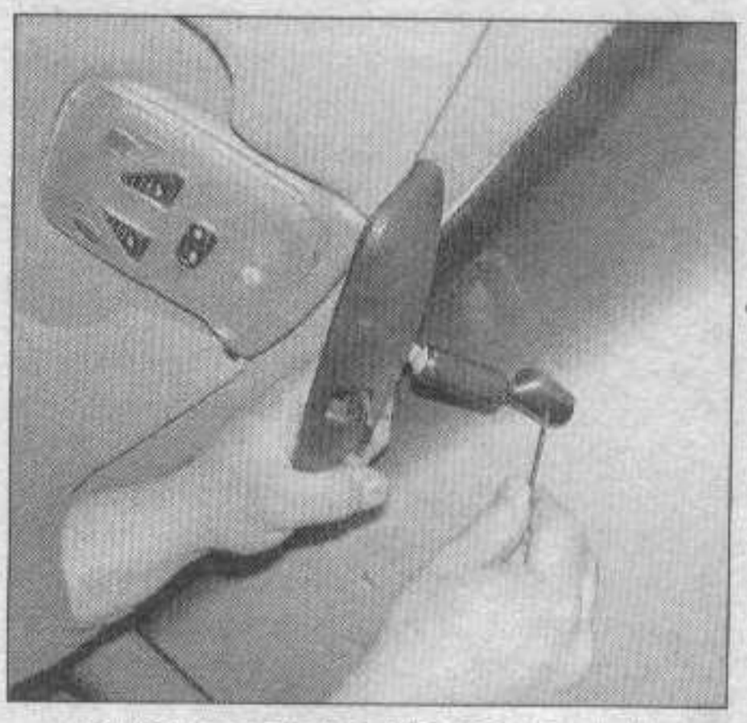
19.4 Remove the mounting nuts (arrows) retaining the regulator assembly to the door



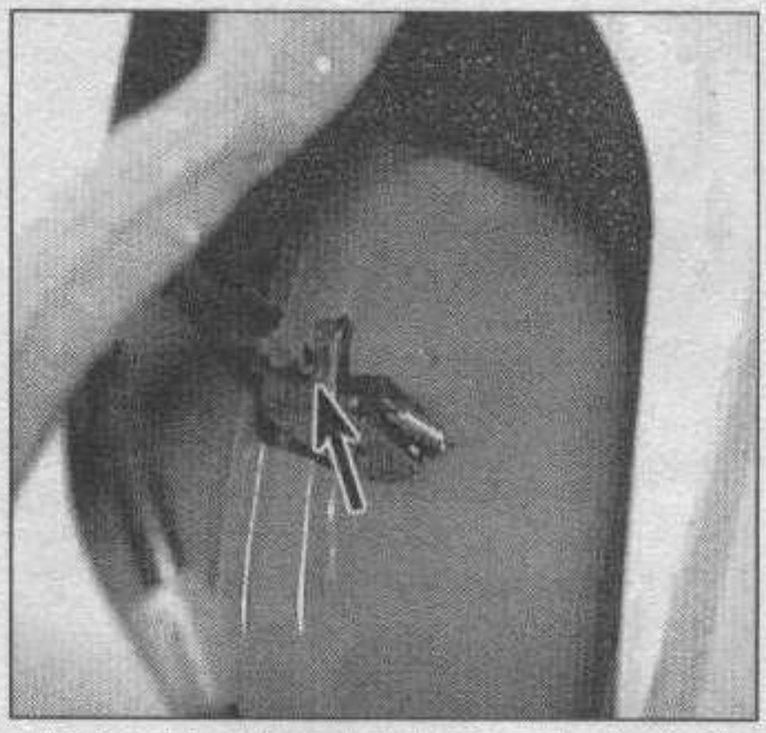
20.2 Pry off the mirror cover with a small screwdriver



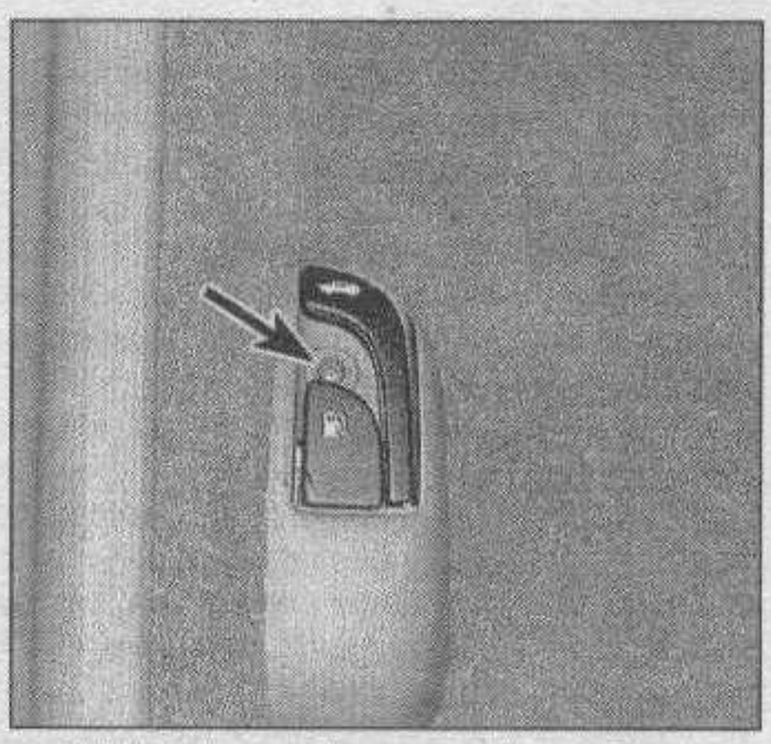
20.4 Disconnect the electrical connector (A), if equipped, then remove the three mirror mounting screws (arrows)



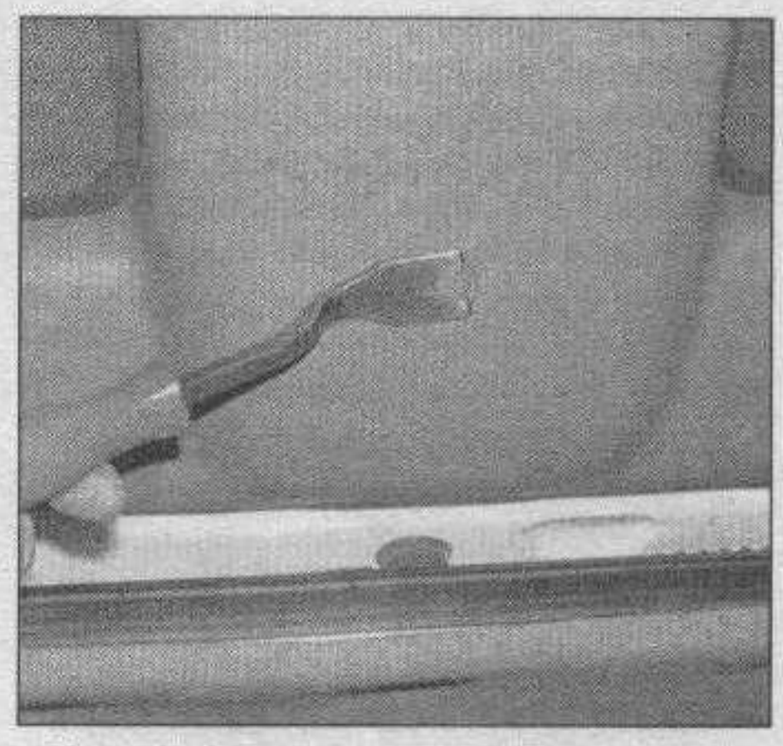
20.6 Loosen the Allen screw and lift the mirror off



23.2 Detach the fuel door cable (arrow) from the latch



23.4 Remove the screw (arrow) and detach the cover from the actuating lever housing



24.2a Using a trim removal tool, detach the clips and remove the upper window moulding . . .

21 Trunk lid (Mazda 626 and MX-6 models) - removal, installation and adjustment

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

Removal and installation

1 Open the trunk lid and cover the edges of the trunk compartment with pads or cloths to protect the painted surfaces when the lid is removed.

2 Unplug the electrical connectors for the license plate lights, brake lights, and trunk lock actuator, and remove the wire harness and actuator cable from the trunk lid (see Sections 22 and 23). Tie string or wire to the cables before withdrawing them from the trunk lid so they can be pulled back into the trunk lid when it's reinstalled.

3 Scribe or draw alignment marks around the trunk hinges on Mazda 626 models.

4 On MX-6 models, detach the support struts from the trunk lid (see Section 26).

5 Remove the hinge-to-trunk lid bolts/nuts from both sides and lift off the trunk lid.

6 Installation is the reverse of removal. Be sure to align the hinge flanges with the marks made on the trunk lid during removal.

Adjustment

7 After installation, close the lid and see if it's in proper alignment with the adjacent body surfaces. Fore-and-aft and side-to-side adjustments of the lid are controlled by the position of the hinge bolts in the slots. To adjust it, loosen the hinge bolts, reposition the lid and retighten the bolts.

8 The height of the rear of the lid in relation to the surrounding body panels when closed can be adjusted by loosening the lock striker bolts, moving the striker up/down or left/right, then re-tightening the bolts. **Note:** *Make a reference mark around the striker before making adjustments.*

22 Trunk lid latch and lock cylinder (Mazda 626 and MX-6) - removal and installation

Trunk lid latch

1 Open the trunk and scribe a line around the trunk lid latch assembly for a reference point to aid the installation procedure.

2 Disconnect the actuating rod (if equipped) and electrical connector.

3 Detach the two retaining bolts and remove the latch.

4 Remove the end of the latch release cable from the latch.

5 Installation is the reverse of removal.

Trunk lock cylinder

6 Remove the lock cylinder rod (if equipped) from its clip and remove the lock's mounting clip or bolt. On models so equipped, disconnect the electrical connector from the lock.

7 Remove the finish panel and remove the lock cylinder from the trunk lid.

8 Installation is the reverse of removal.

23 Trunk/liftgate release and fuel door cables - removal and installation

Refer to illustrations 23.2 and 23.4

1 Refer to Sections 22 and 25 for removal of the trunk latch and disengagement of the cable from the latch.

2 Inside the trunk, remove the trim panels for access to the trunk release and fuel door cables. Disconnect the fuel door release cable **(see illustration)**.

3 Detach all of the clips holding the cables to the body.

4 Remove the screw and detach the cover from the cable actuating lever housing next to the driver's seat **(see illustration)**. Remove the actuating lever housing and detach the cables from the lever.

5 Attach a piece of thin wire to the end of the cable.

6 Working in the trunk compartment, pull the cable assembly towards the rear of the vehicle until you can see the wire.

7 Attach the wire to the front of the new cable and fish it back through the body until it can be attached to the lever. The remainder of the installation is the reverse of removal.

24 Liftgate (Ford Probe models) - removal, adjustment and installation

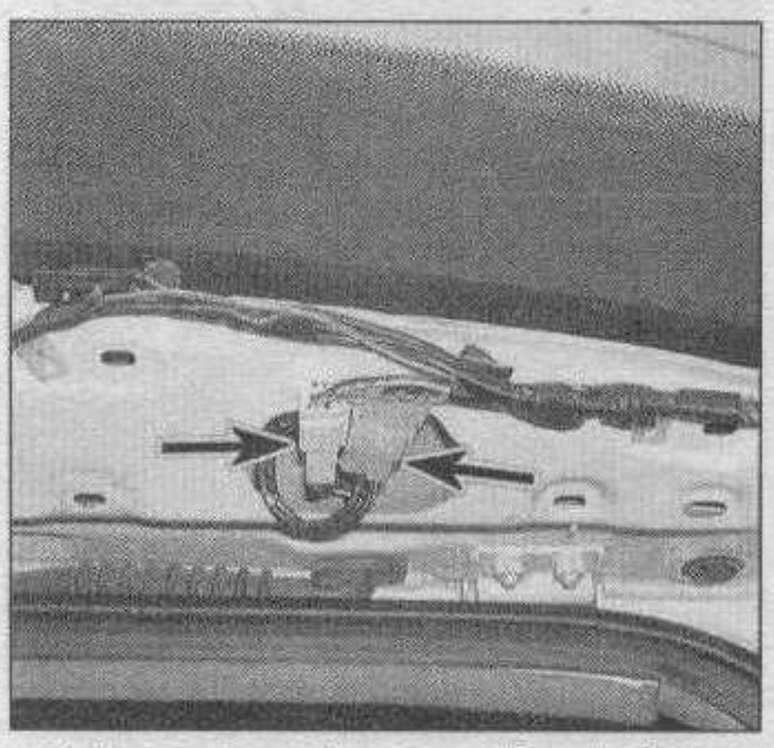
Refer to illustrations 24.2a, 24.2b and 24.5

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

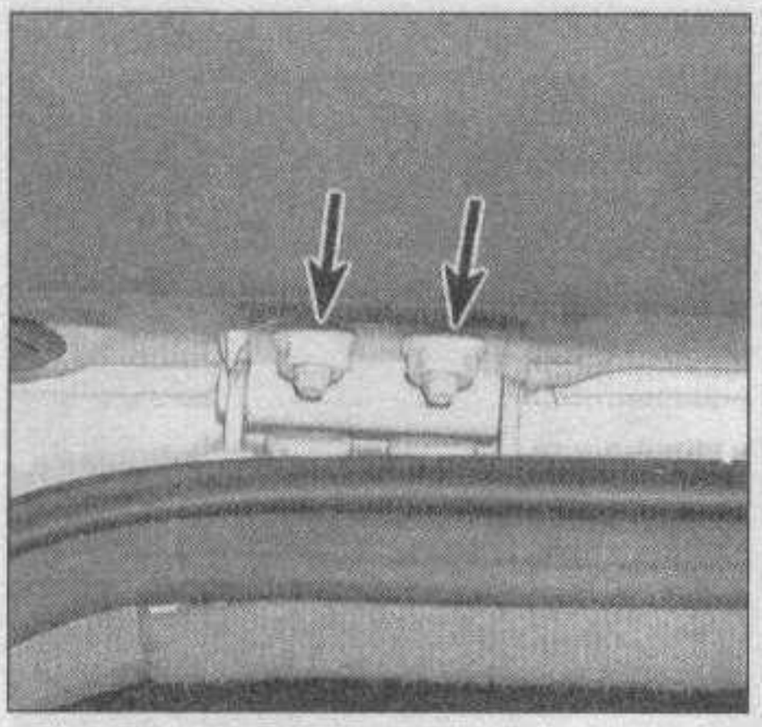
Removal and installation

1 Open the liftgate and support it securely.

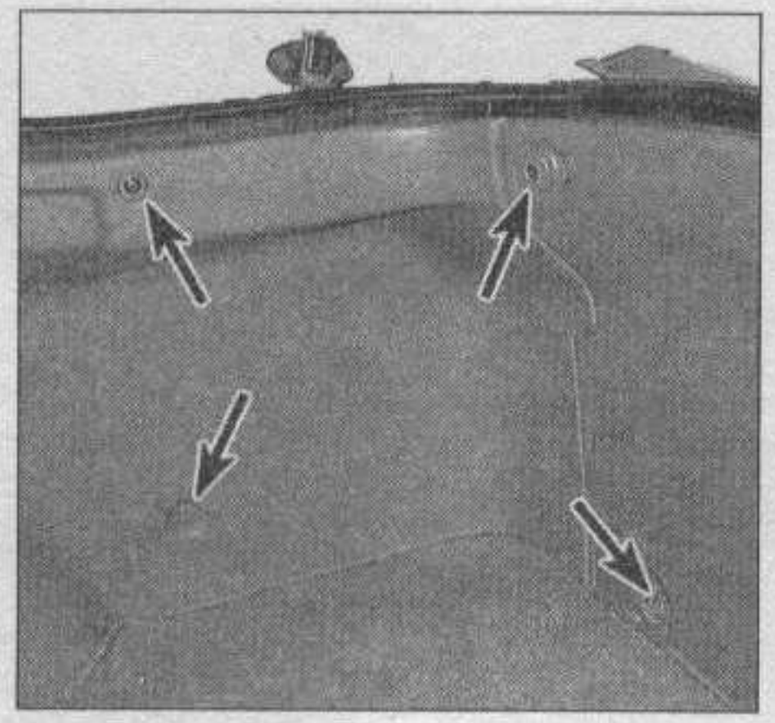
2 Remove the upper trim moulding from the lift gate opening and disconnect all wiring harness connectors leading to the liftgate **(see illustrations)**. On models equipped with a rear window washer, detach the roof headliner and disconnect the washer hose.



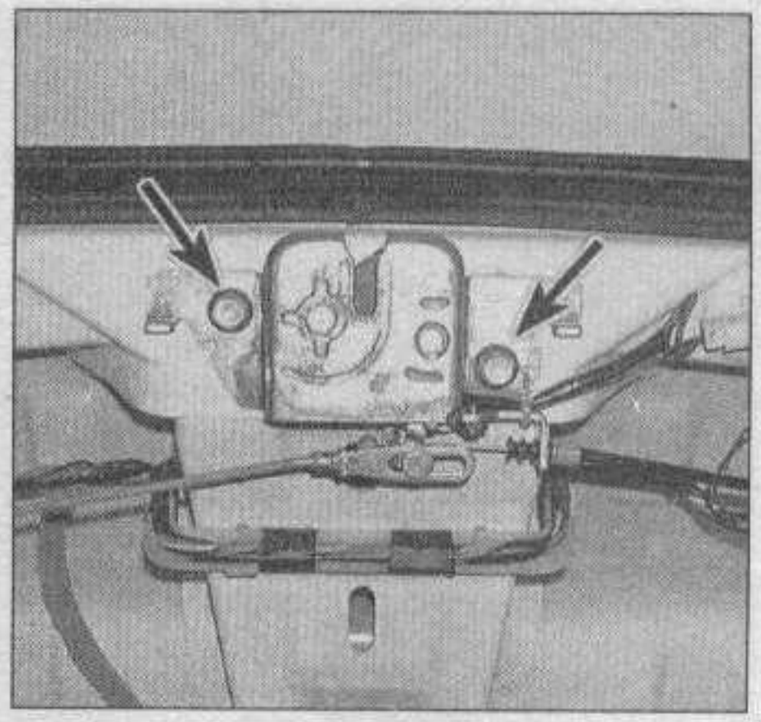
24.2b . . . then disconnect the electrical connectors (arrows)



24.5 Remove the retaining nuts (arrows) on each side of the liftgate



25.1 Remove the screws and clips (arrows) and detach the trim panels for access to the latch and lock cylinder



25.3 Remove the liftgate latch retaining bolts (arrows), then detach the actuating rods and cable

3 While an assistant supports the liftgate, detach the support struts (see Section 26).
4 Use a marking pen to mark the positions of the liftgate hinge plates to ensure proper alignment during installation.
5 Remove the hinge-to-liftgate nuts and remove the liftgate from the vehicle **(see illustration)**.
6 Installation is the reverse of removal.

Adjustment

7 The height of the liftgate in relation to the surrounding body panels when closed can be adjusted by loosening the liftgate latch bolts, moving the striker up or down, then re-tightening the bolts. **Note:** *Make a reference mark around the latch before making adjustments.*

25 Liftgate latch and lock cylinder (Ford Probe models) - removal and installation

Liftgate latch

Refer to illustrations 25.1 and 25.3

1 Open the liftgate and remove the rear compartment trim panels **(see illustration)**.
2 Scribe a line around the liftgate latch assembly for a reference point to aid the installation procedure.
3 Detach the two retaining bolts and remove the latch **(see illustration)**.
4 Installation is the reverse of removal.

Trunk lock cylinder

Refer to illustration 25.6

5 Remove the right side tail light housing assembly (see Chapter 12).
6 Remove the lock cylinder rod from its clip and remove the lock's mounting bolts **(see illustration)**.
7 Remove the lock cylinder.
8 Installation is the reverse of removal.

26 Trunk lid and liftgate support struts (Probe and MX-6 models) - removal and installation

Refer to illustrations 26.2 and 26.3

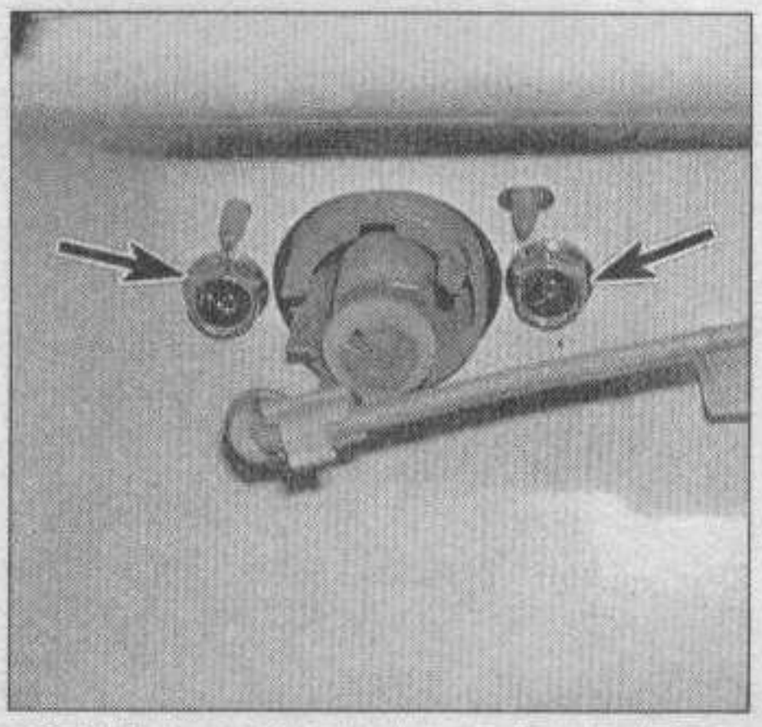
1 Open the liftgate and support it securely.
2 Use a wrench to unscrew the upper end of the support strut **(see illustration)**. Use this procedure for both ends of the support strut on MX-6 models.
3 On Probe models, remove the bolts and detach the strut from the vehicle **(see illustration)**.
4 Installation is the reverse of removal.

27 Center console - removal and installation

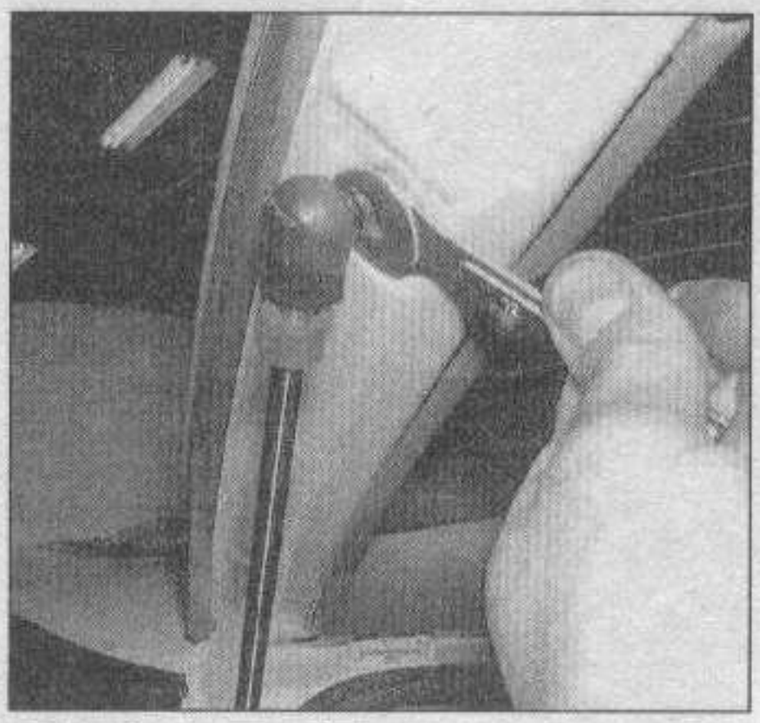
Refer to illustrations 27.2, 27.3, 27.4, 27.5, 27.6a, 27.6b, 27.7a and 27.7b

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

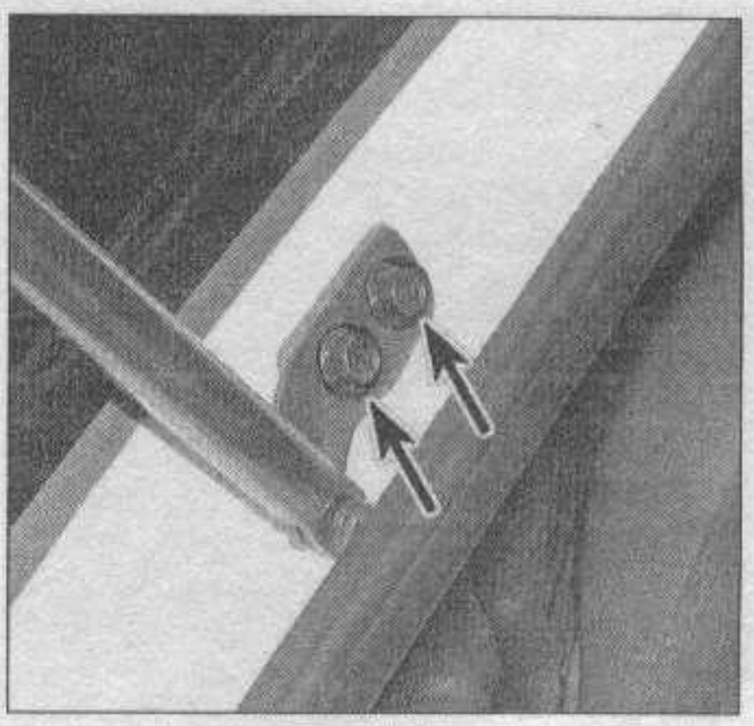
Caution: *The stereo in your vehicle is equipped with an anti-theft system. Make*



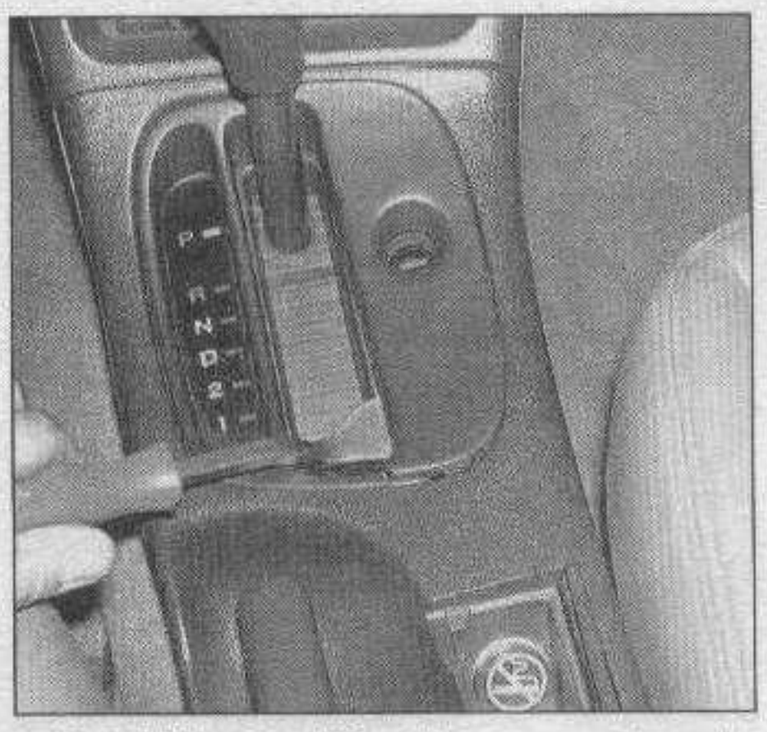
25.6 Remove the lock cylinder retaining bolts (arrows)



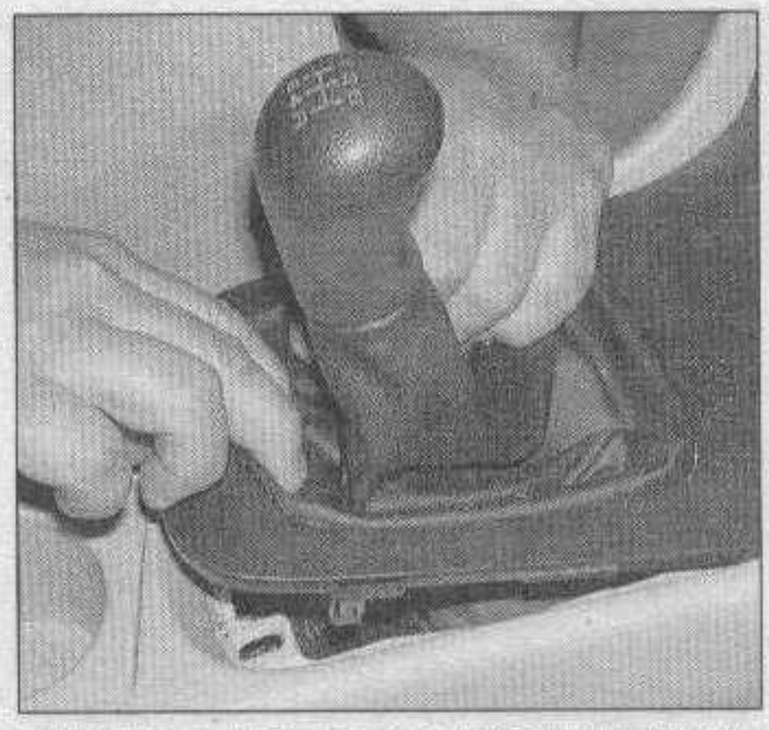
26.2 Use a wrench to remove the support strut from the liftgate or trunk lid



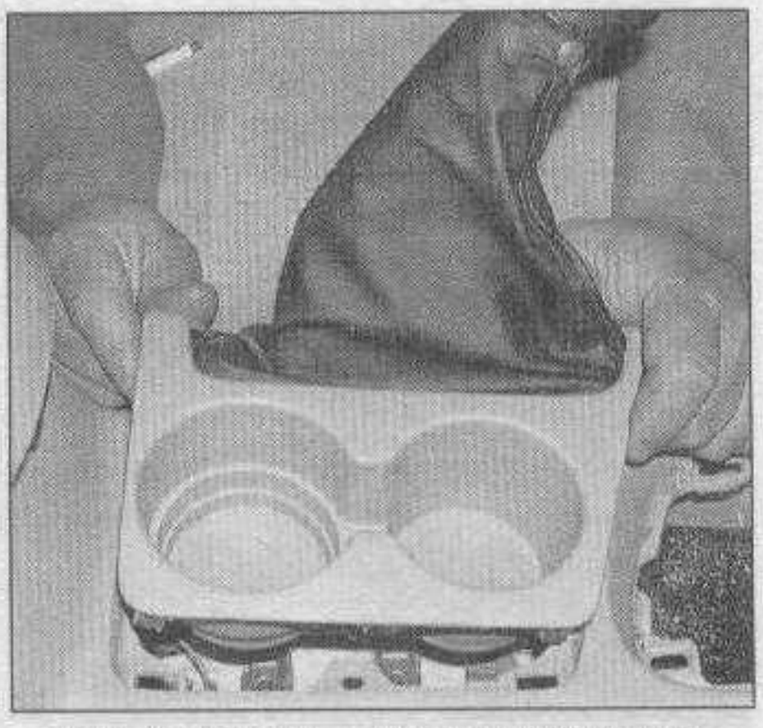
26.3 Remove the bolts (arrows) attaching the lower end of the strut



27.2 With a tool like this one or a taped screwdriver, pry out the shift bezel



27.3 Detach the manual shift lever/boot assembly and remove the shift knob



27.4 Detach the parking brake handle bezel and lift it up over the brake handle

sure you have the correct activation code before disconnecting the battery.

1 Disconnect the battery cables (see the **Warning** above).

2 Use a special tool or a screwdriver with the tip taped to prevent scratching panels, pry the console front cover off **(see illustration)**.

3 Pry out the gear selector trim bezel from the console. On manual-transaxle models, refer to Chapter 7 and remove the shift knob **(see illustration)**.

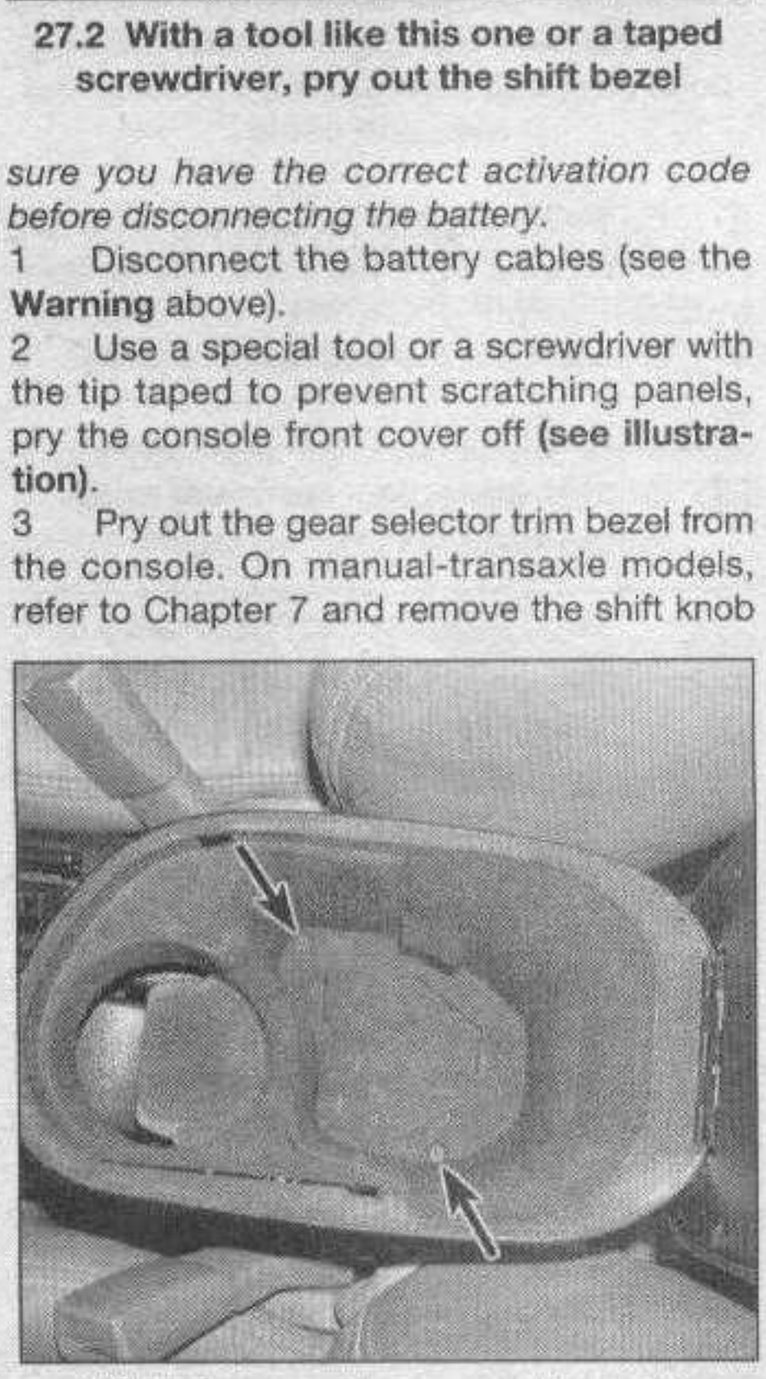
4 Detach the parking brake handle bezel and lift it up over the brake handle **(see illustration)**.

5 Lift up the armrest and (if equipped) remove the console glove compartment trim panel **(see illustration)**.

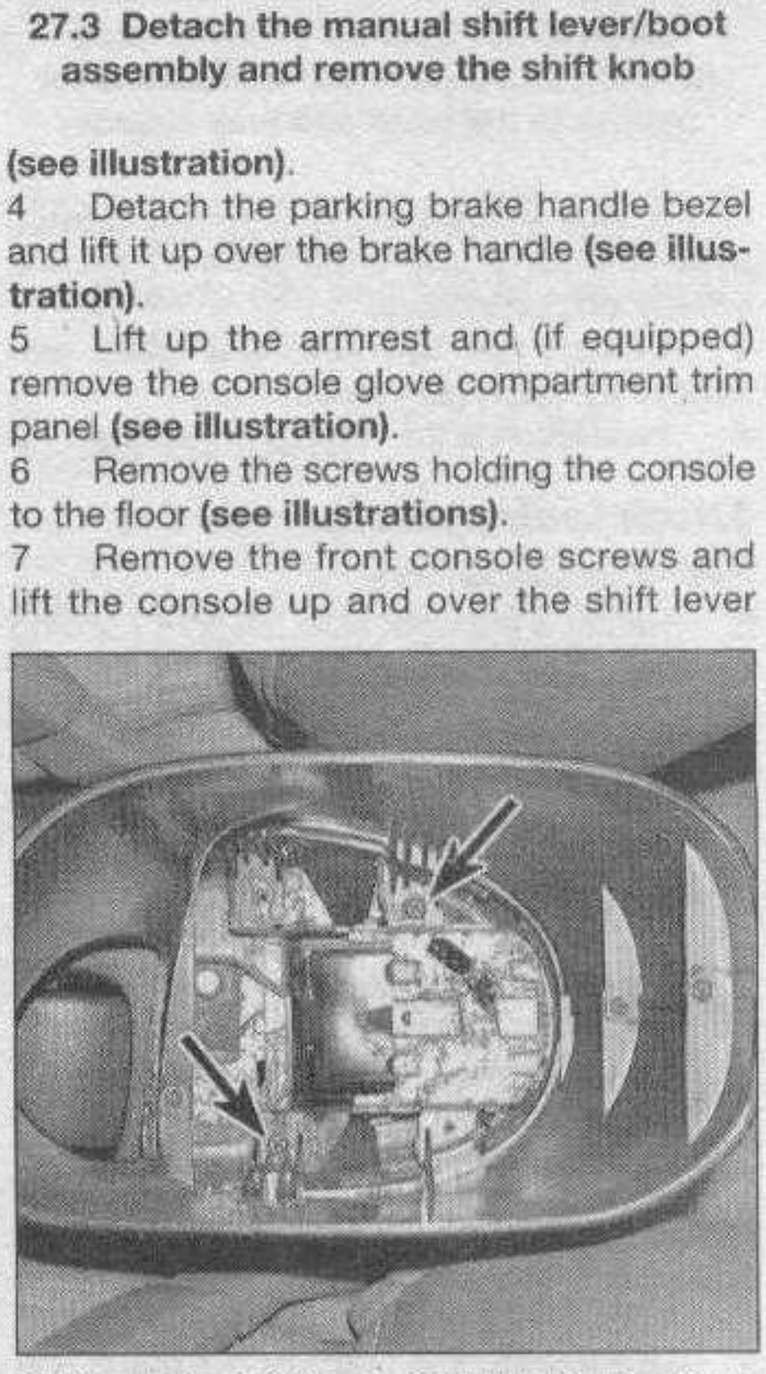
6 Remove the screws holding the console to the floor **(see illustrations)**.

7 Remove the front console screws and lift the console up and over the shift lever **(see illustrations)**. Disconnect any electrical connections and remove the console from the vehicle.

8 Installation is the reverse of removal.



27.5 Remove the screws (arrows) retaining the trim panel in the bottom of the rear console (Ford Probe)



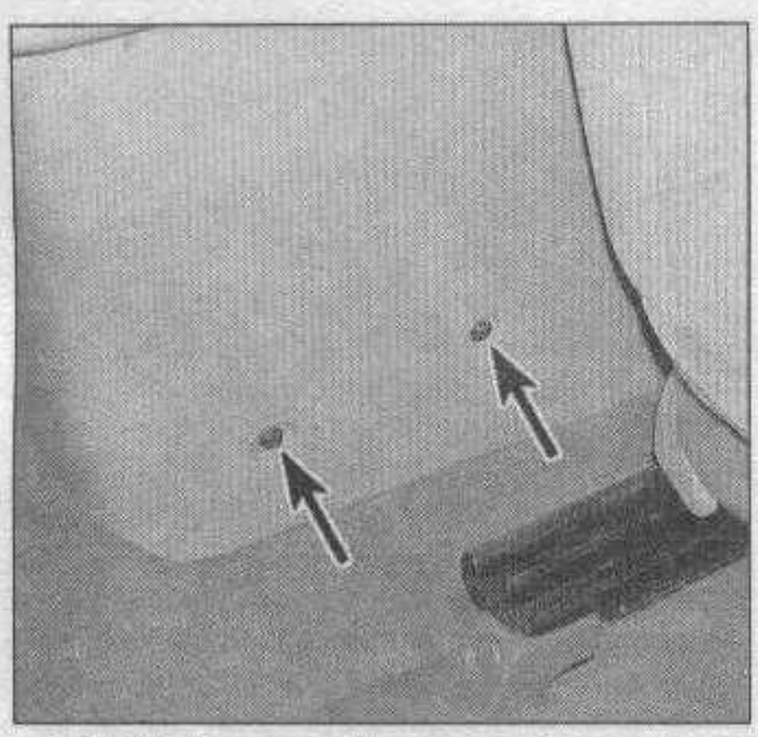
27.6a Remove the screws inside the rear console (arrows)

28 Dashboard trim panels - removal and installation

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

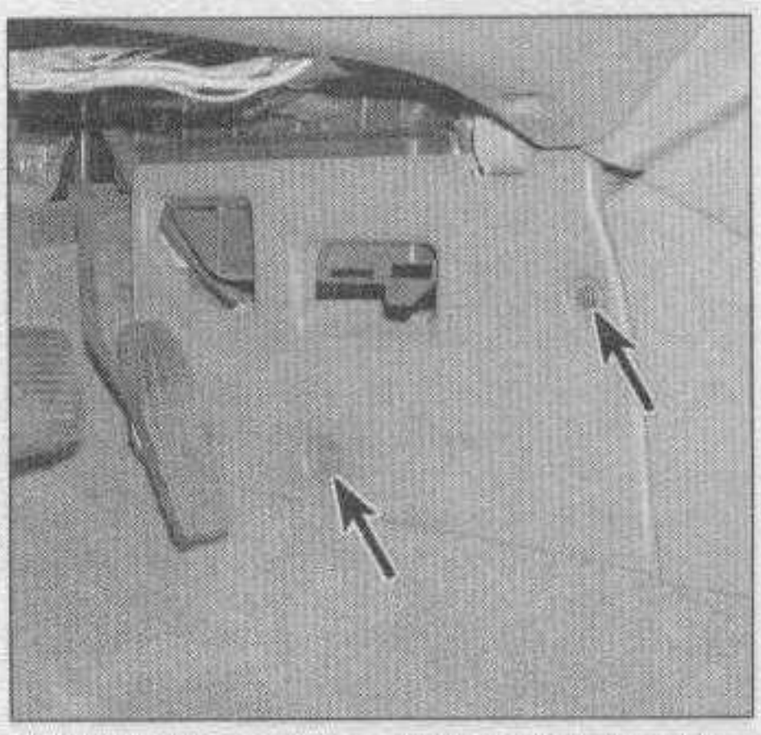
Caution: *If the stereo in your vehicle is equipped with an anti-theft system. Make sure you have the correct activation code before disconnecting the battery.*

1 Disconnect the negative battery cable, see **Warning** and **Caution** above.

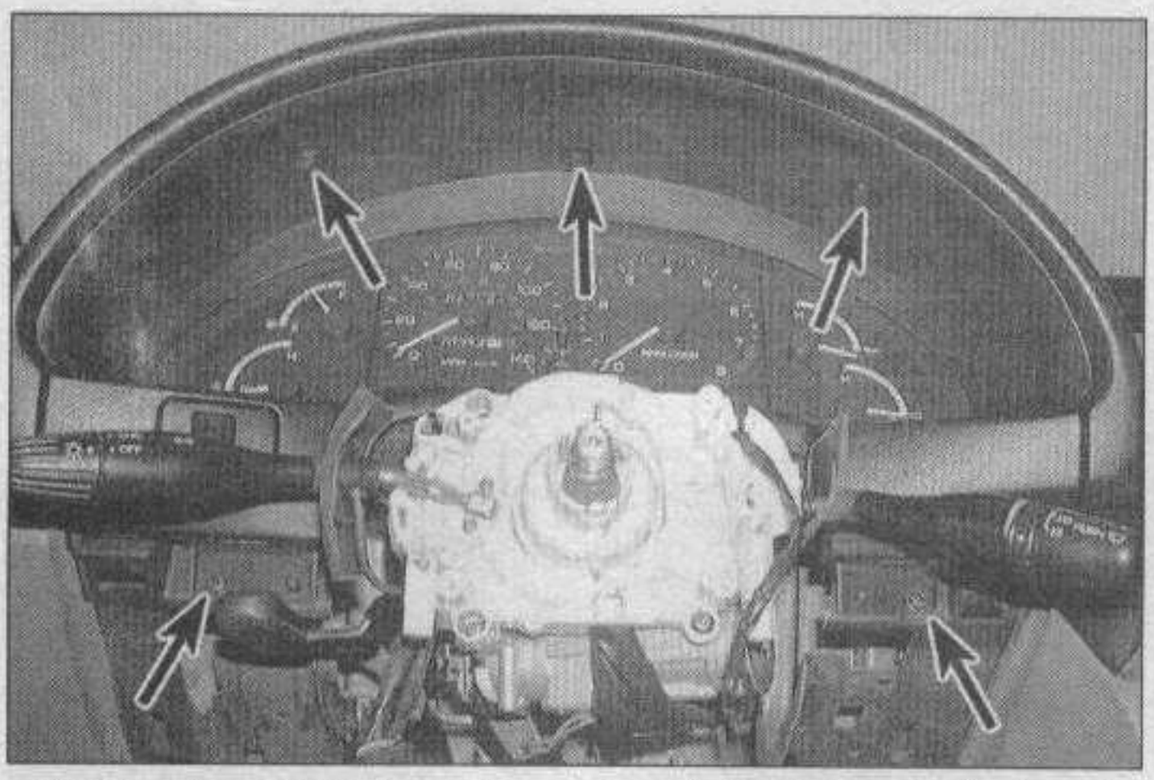


27.6b Remove the screws (arrows) retaining the rear console

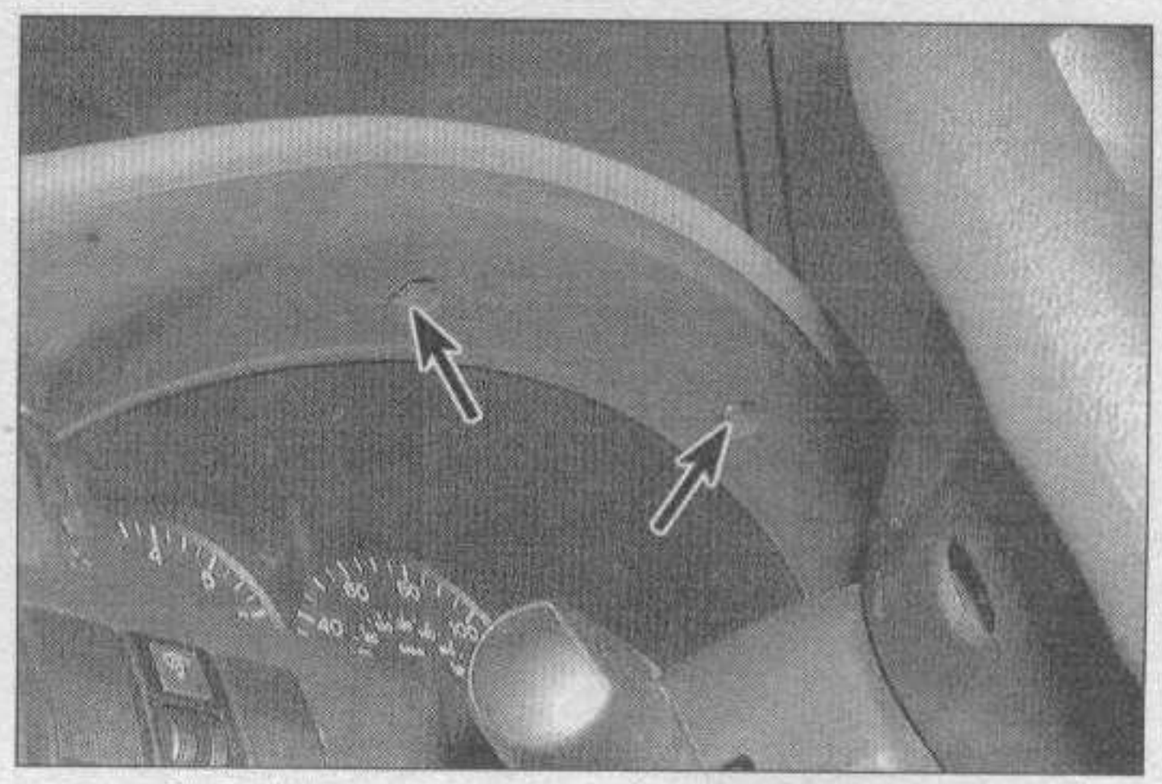
27.7a Remove the screws (arrows) at the front edge of the console



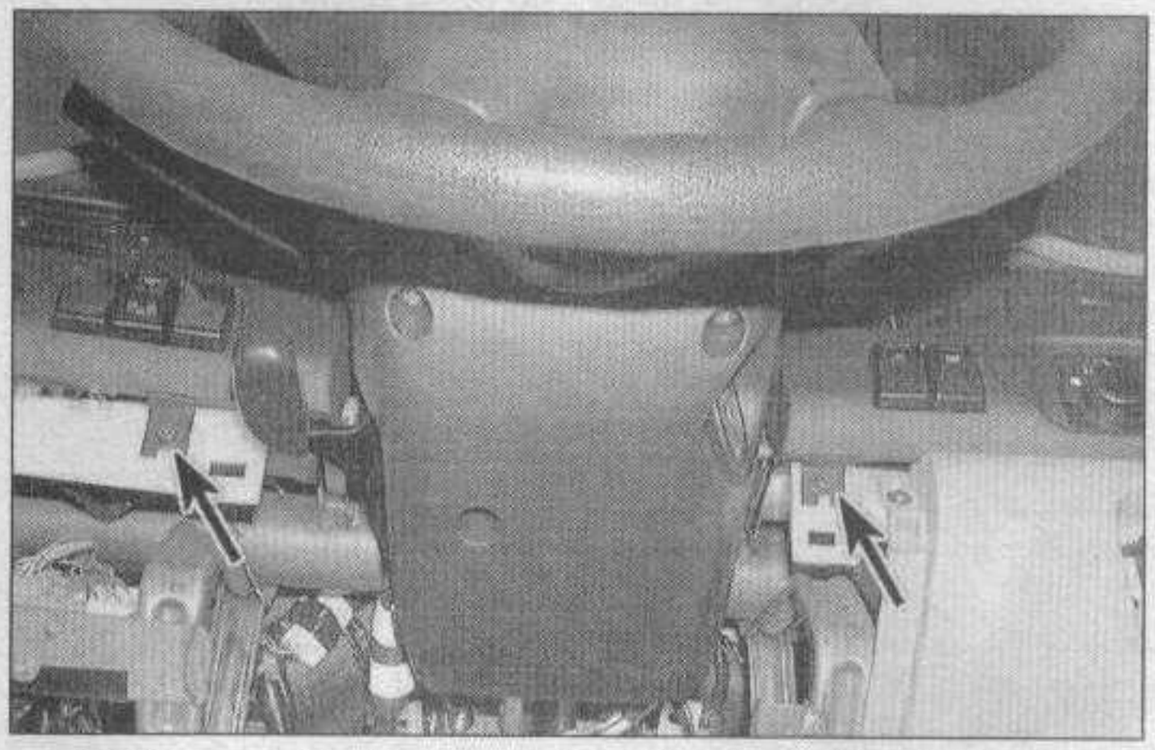
27.7b Remove the screws (arrows) on the front sides of the console



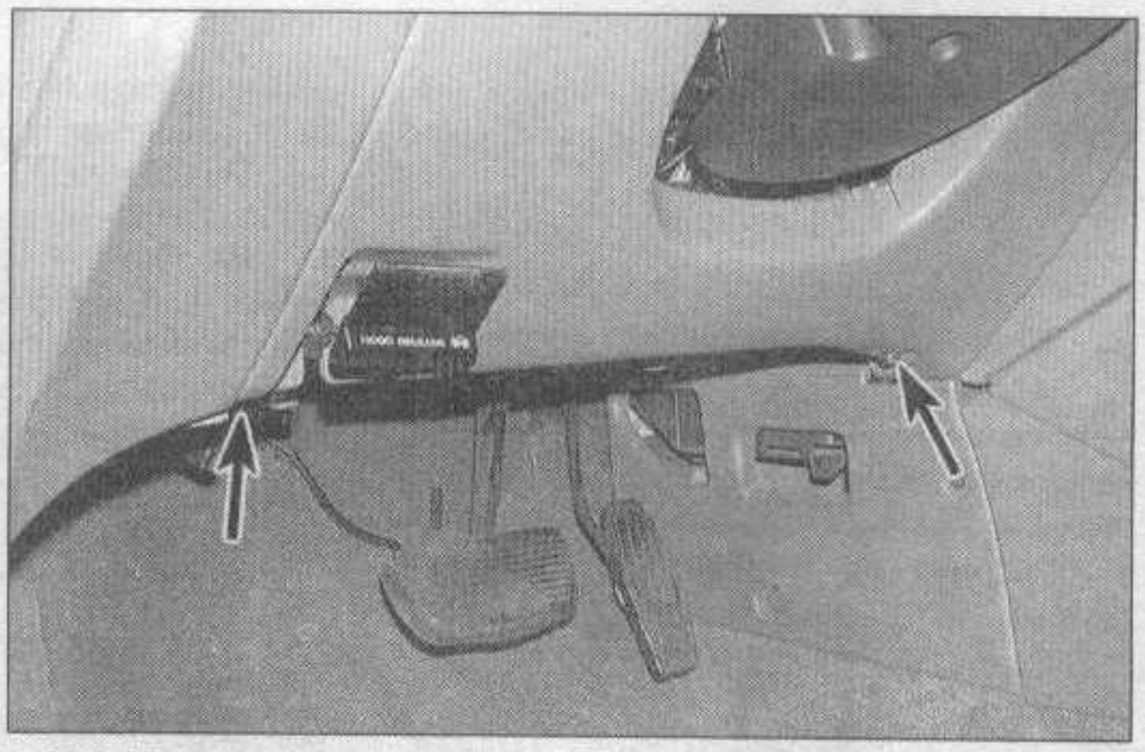
28.4 Remove the screws (arrows) and detach the cluster bezel (Ford Probe models) - steering wheel shown removed for clarity



28.5a Remove the screws (arrows) at the top . . .



28.5b . . . and bottom (arrows) of the cluster bezel (Mazda)



28.9 Remove the screws (arrows) and detach the knee bolster

Instrument cluster bezel

Refer to illustrations 28.4, 28.5a and 28.5b

2 If equipped with a tilt steering column, tilt the column all the way down.

3 Remove the knee bolster (see below).

4 On Ford Probe models, remove the five screws at the top and bottom of the instrument cluster bezel and detach it from the vehicle **(see illustration)**.

5 On Mazda models, remove the four bezel retaining screws **(see illustrations)**. Using a screwdriver with the tip taped with masking tape, carefully work around the outer edges of the bezel and pry it away from the instrument panel until the clips are released. Take care not to scratch the surrounding trim on the instrument panel.

6 Installation is the reverse of the removal procedure. Make sure any clips are engaged properly before pushing the bezel firmly into place.

Knee bolster

Refer to illustration 28.9

7 Refer to Section 27 and remove the console front cover.

8 Remove the hood release handle (see Section 11).

9 Remove the screws at the lower edge of the knee bolster and pry the bolster away to release the remaining clips **(see illustration)**.

10 Installation is the reverse of removal.

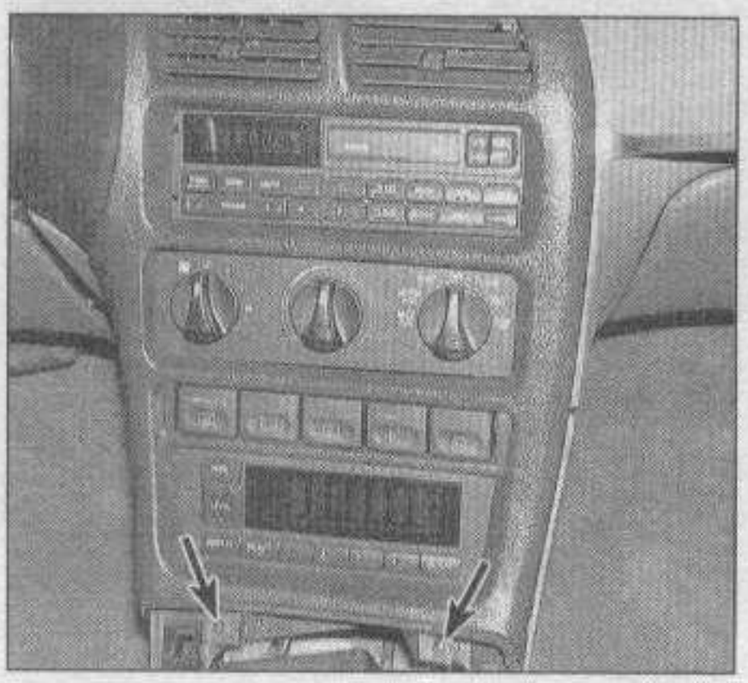
Center trim panel

Refer to illustration 28.12

11 Remove the center console (see Section 27).

12 Remove the screws at the bottom edge, pry carefully on the panel until the clips are disengaged and detach the panel from the center instrument panel **(see illustration)**.

13 Installation is the reverse of removal.

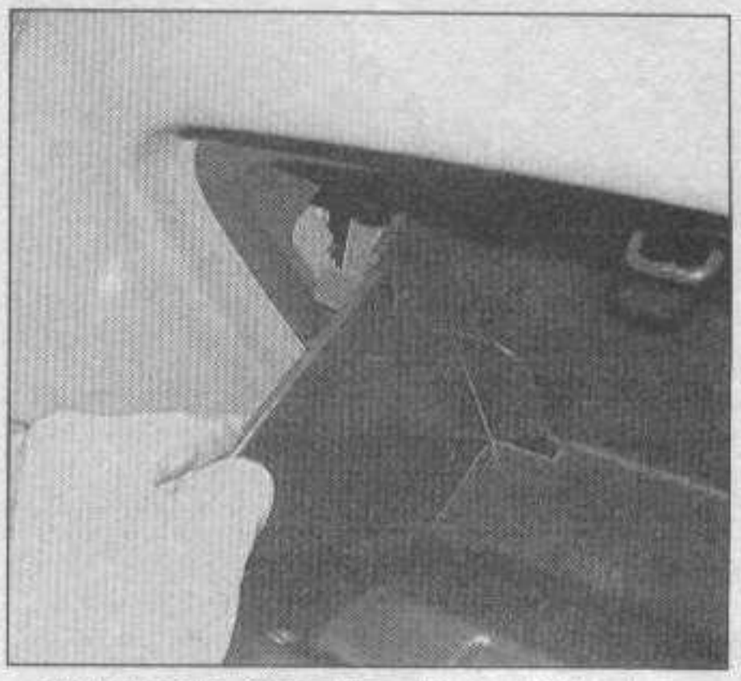


28.12 Remove the screws (arrows) and pry the center instrument panel free of the instrument panel

Glove box

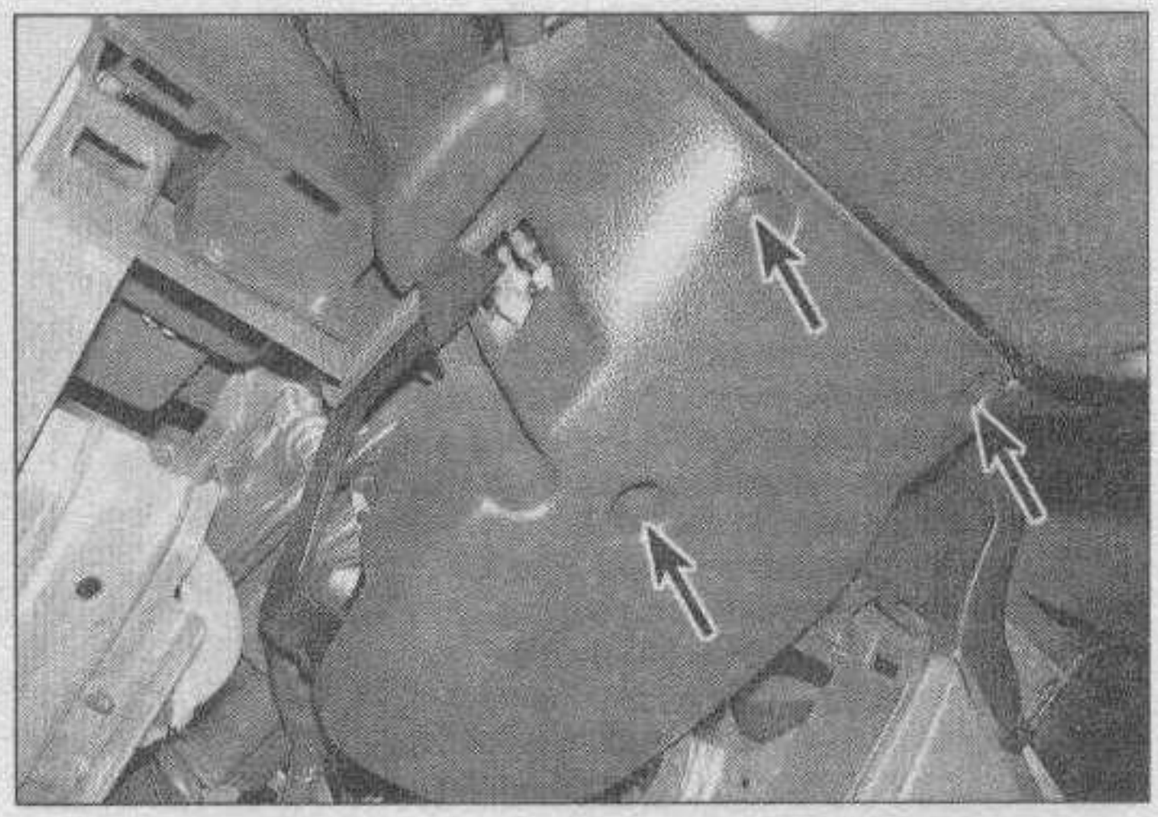
Refer to illustrations 28.14 and 28.15

14 Open the glovebox door, squeeze the sides in and lower it for access to the retaining screws **(see illustration)**.



28.14 Push in on the sides of the glove box and lower it

28.15 Remove the glove box hinge screws (arrows)



29.2 Remove the screws (arrows) at the lower column cover, then remove the upper and lower covers

15 Remove the screws and remove the glove box from the instrument panel **(see illustration)**.

16 Installation is the reverse of removal.

29 Steering column cover - removal and installation

Refer to illustration 29.2

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

Caution: *If the stereo in your vehicle is equipped with an anti-theft system. Make sure you have the correct activation code before disconnecting the battery.*

1 On tilt steering columns, move the column to the lowest position.

2 Remove the screws, then separate the halves and remove the upper and lower steering column covers **(see illustration)**.

3 Installation is the reverse of the removal procedure.

30 Instrument panel - removal and installation

Refer to illustrations 30.6, 30.8a and 30.8b

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

Caution: *The stereo in your vehicle is equipped with an anti-theft system. Make sure you have the correct activation code before disconnecting the battery.*

1 Disconnect the negative battery cable see the **Warning** and **Caution** above.

2 Remove the dashboard trim panels (see Section 28) and the center floor console (see Section 27).

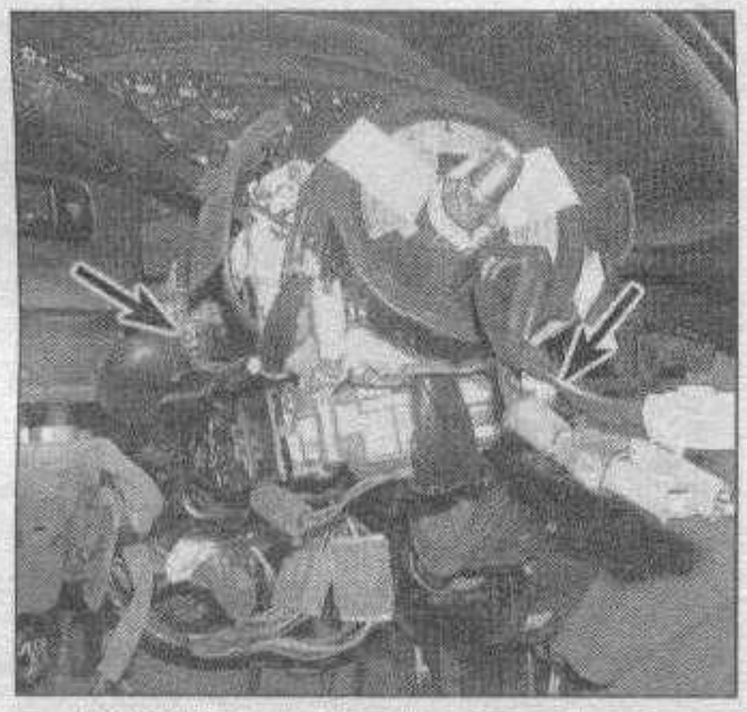
3 Remove the instrument cluster (see Chapter 12) and the glove box (see Section 28).

4 Disconnect the passenger's side air bag (if equipped) and remove it (see Chapter 12).

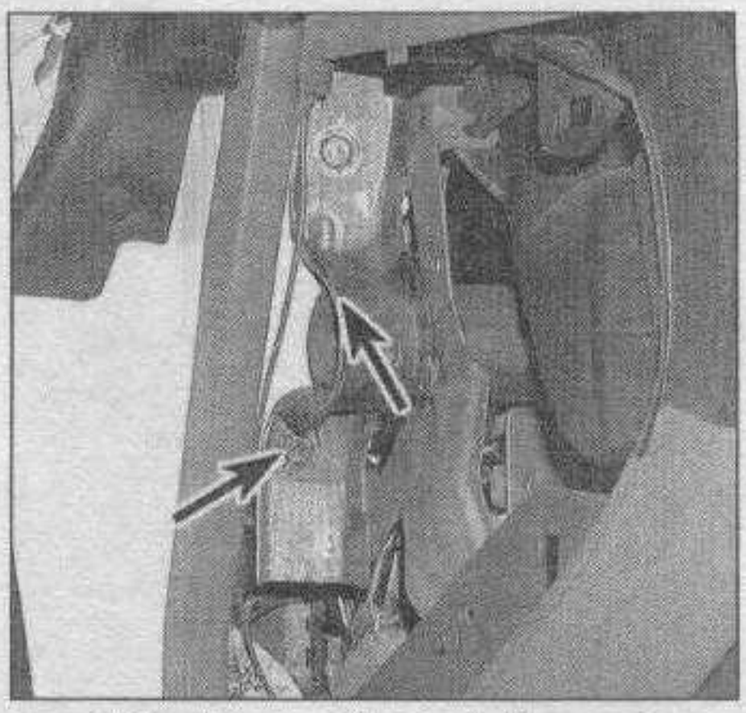
5 Remove the audio unit from the center of the dashboard (see Chapter 12).

6 Remove the driver's knee bolster (see Section 28). Then detach the bolts securing the steering column and lower it away from the instrument panel **(see illustration)**.

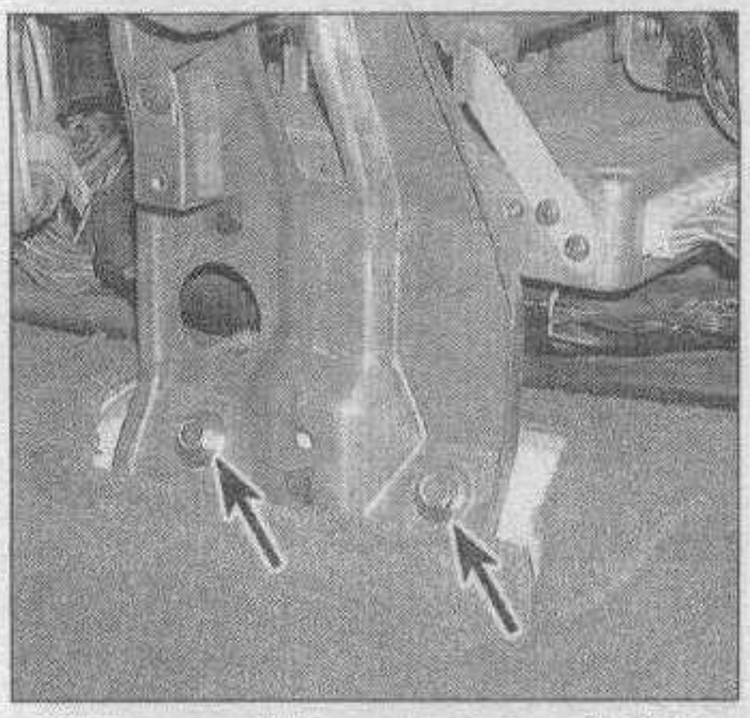
7 A number of electrical connectors must be disconnected in order to remove the instrument panel. Most are designed so that they will only fit on one matching connector (male or female), but if there is any doubt,



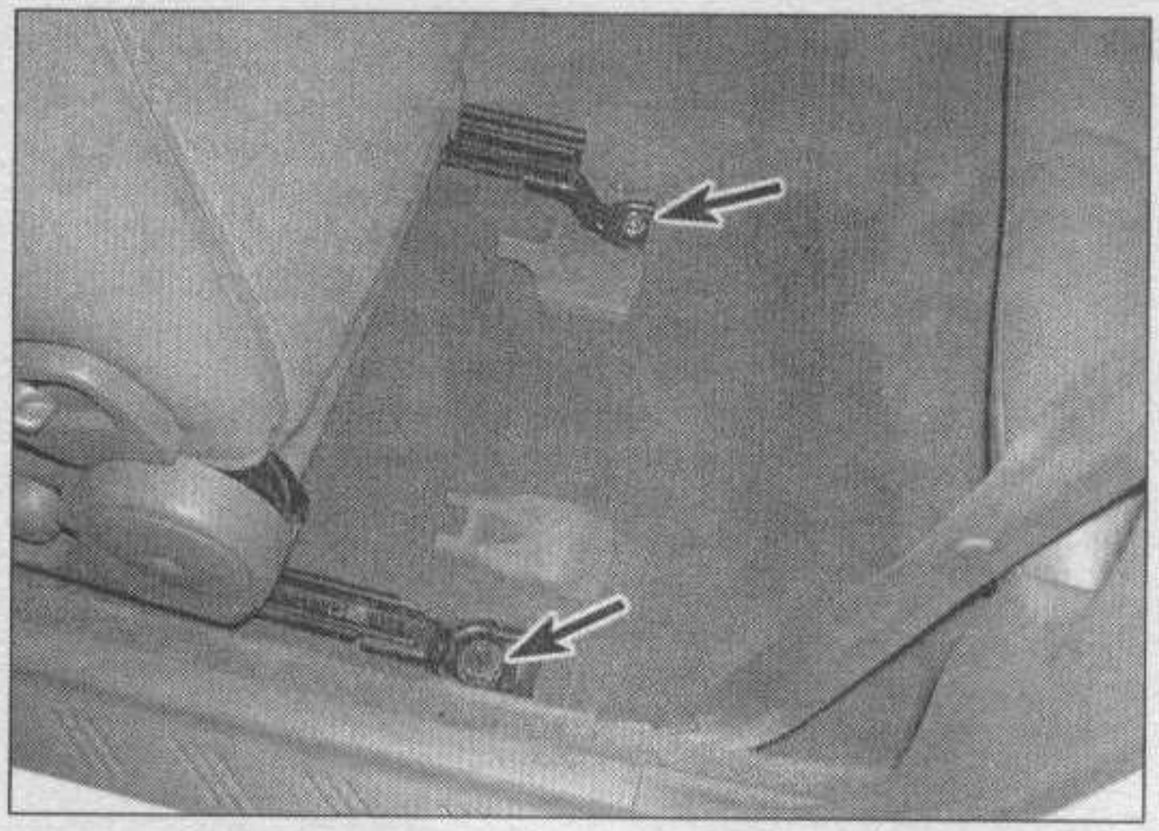
30.6 Remove the steering column retaining bolts (arrows) and lower it away from the instrument panel



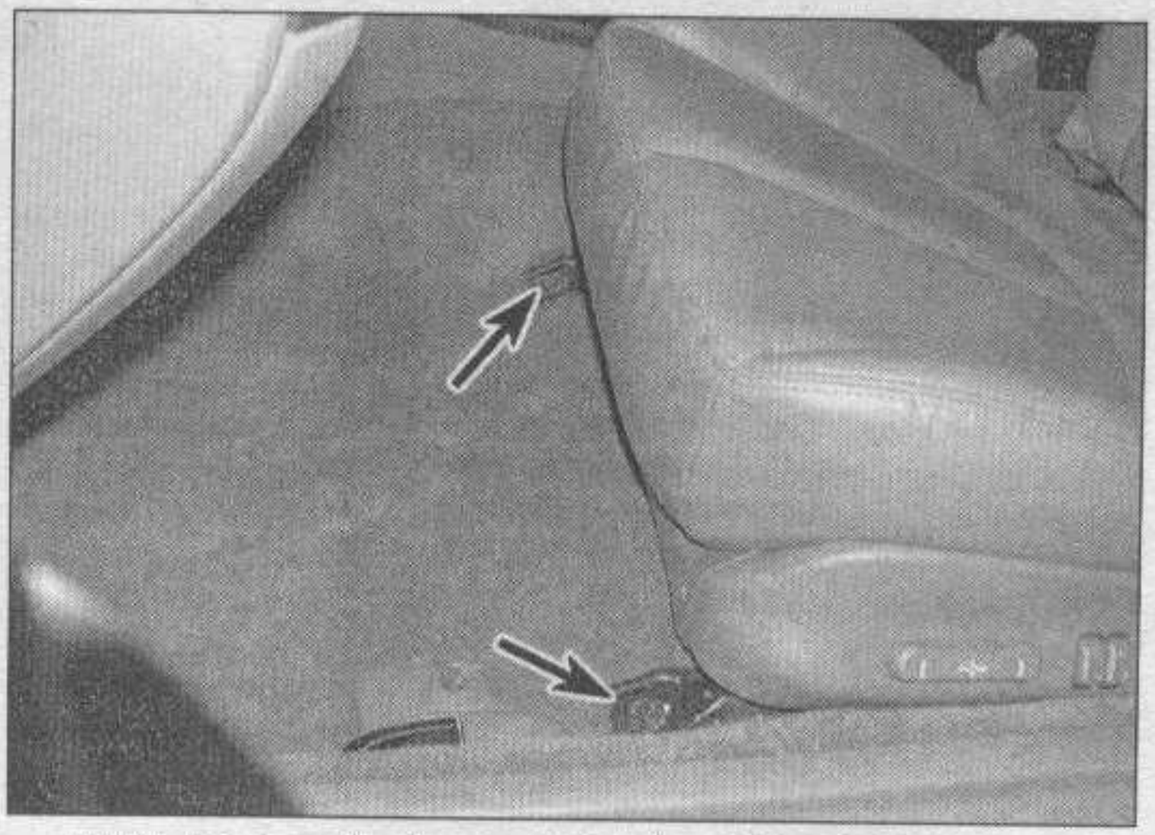
30.8a Remove the bolts (arrows) retaining the ends . . .



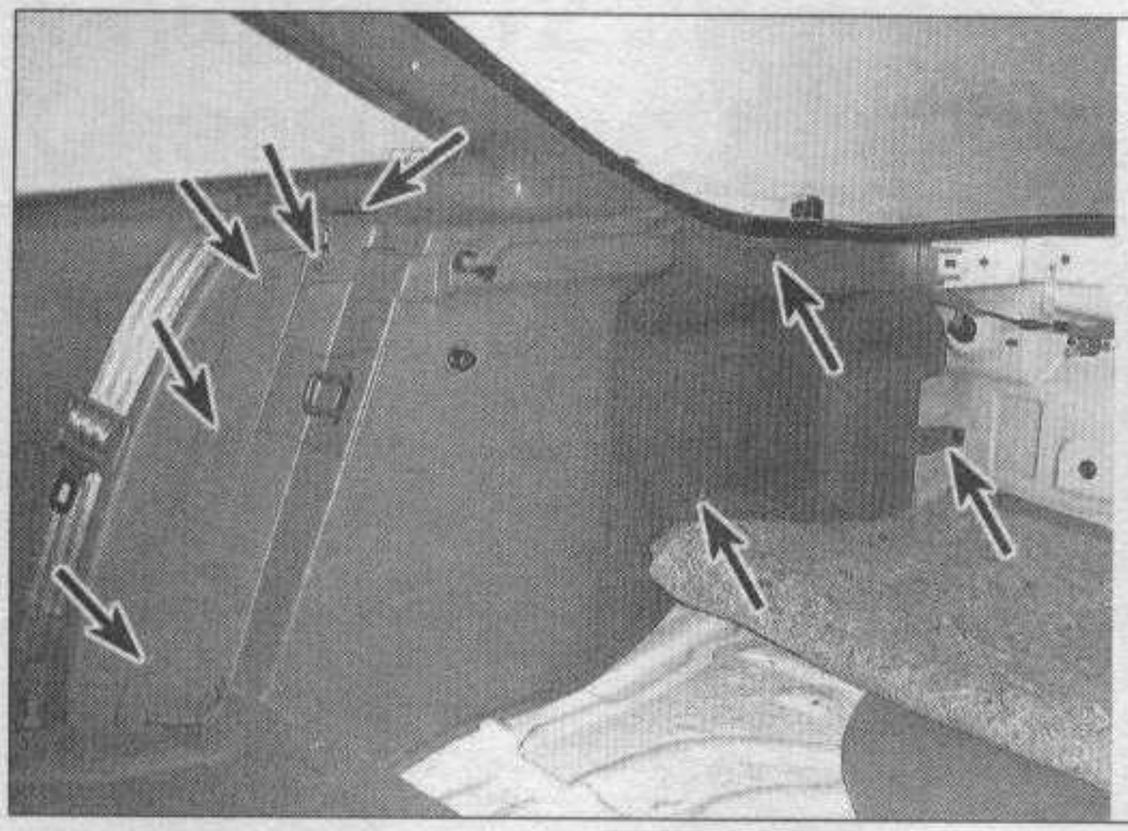
30.8b . . . and the center (arrows) of the instrument panel



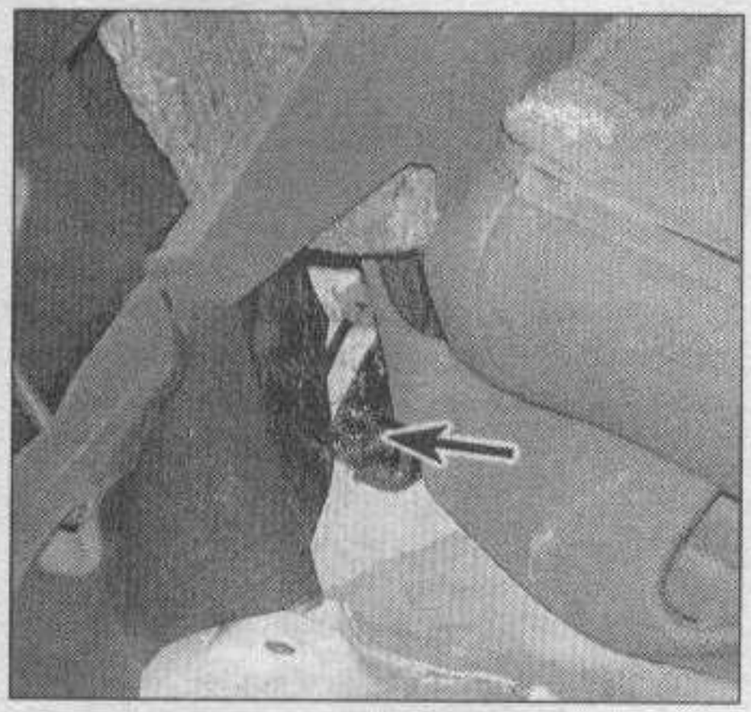
31.2a Remove the rear retaining nuts/bolts for the front seats (arrows)



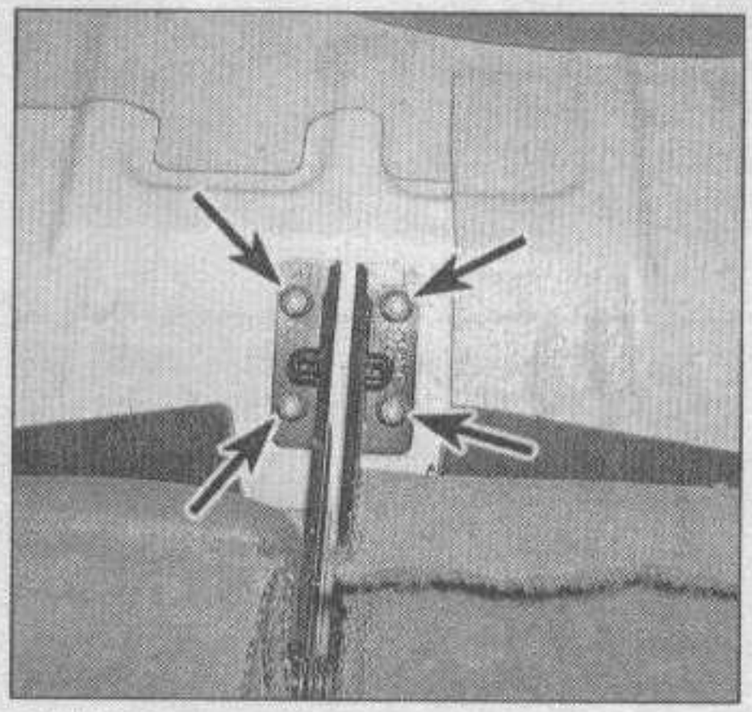
31.2b Remove the front seat track retaining bolts (arrows)



31.5a With the seat back folded down, remove the plastic retainers (arrows) and detach the trim panels, then . . .



31.5b . . . pull the seatbelt out of the way to expose the seat back retaining bolt (arrow)



31.6 Remove the rear seat back center retaining bolts (arrows)

mark the connectors with masking tape and a marking pen before disconnecting them.

8 Remove all of the bolts holding the instrument panel to the body **(see illustrations)**. Once all are removed, lift the panel up (it is held to the body by three plastic pins behind it) then pull it away from the windshield and take it out through the driver's door opening.

9 Installation is the reverse of removal.

31 Seats - removal and installation

Front seat

Refer to illustrations 31.2a and 31.2b

1 Position the seat all the way forward or all the way to the rear to access the front seat retaining bolts.

2 Detach any bolt trim covers and remove the retaining nuts/bolts **(see illustrations)**.

3 Tilt the seat upward to access the underside, then disconnect any electrical connectors and lift the seat from the vehicle.

4 Installation is the reverse of removal.

Rear seat

Refer to illustrations 31.5a, 31.5b and 31.6

5 Flip the rear seat back panel down, remove the screws and plastic retainers and detach the trim panels, then pry the seat belt strap away for access and remove the seat cushion retaining bolt on each side **(see illustrations)**.

6 Lift up the cardboard strip and remove the seat back center retaining bolts **(see illustration)**.

7 Installation is the reverse of removal.

Chapter 12
Chassis electrical system

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1 General information

The electrical system is a 12-volt, negative ground type. Power for the lights and all electrical accessories is supplied by a lead/acid-type battery which is charged by the alternator.

This Chapter covers repair and service procedures for the various electrical components not associated with the engine. Information on the battery, alternator, distributor and starter motor can be found in Chapter 5. It should be noted that when portions of the electrical system are serviced, the negative battery cable should be disconnected from the battery to prevent electrical shorts and/or fires. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

2 Electrical troubleshooting - general information

Refer to illustration 2.15

A typical electrical circuit consists of an electrical component, any switches, relays, motors, fuses, fusible links or circuit breakers related to that component and the wiring and connectors that link the component to both the battery and the chassis. To help you pinpoint an electrical circuit problem, wiring diagrams are included at the end of this Chapter.

Before tackling any troublesome electrical circuit, first study the appropriate wiring diagrams to get a complete understanding of what makes up that individual circuit. Trouble spots, for instance, can often be narrowed down by noting if other components related to the circuit are operating properly. If several components or circuits fail at one time, chances are the problem is in a fuse or ground connection, because several circuits are often routed through the same fuse and ground connections.

Electrical problems usually stem from simple causes, such as loose or corroded connections, a blown fuse, a melted fusible link or a failed relay. Visually inspect the condition of all fuses, wires and connections in a problem circuit before troubleshooting the circuit.

If test equipment and instruments are going to be utilized, use the diagrams to plan ahead of time where you will make the necessary connections in order to accurately pinpoint the trouble spot.

The basic tools needed for electrical troubleshooting include a circuit tester or volt/ohmmeter (a 12-volt bulb with a set of

test leads can also be used), a continuity tester, which includes a bulb, battery and set of test leads, and a jumper wire, preferably with a circuit breaker incorporated, which can be used to bypass electrical components. Before attempting to locate a problem with test instruments, use the wiring diagram(s) to decide where to make the connections.

Voltage checks

Voltage checks should be performed if a circuit is not functioning properly. Connect one lead of a circuit tester to either the negative battery terminal or a known good ground. Connect the other lead to a connector in the circuit being tested, preferably nearest to the battery or fuse. If the bulb of the tester lights, voltage is present, which means that the part of the circuit between the connector and the battery is problem free. Continue checking the rest of the circuit in the same fashion. When you reach a point at which no voltage is present, the problem lies between that point and the last test point with voltage. Most of the time the problem can be traced to a loose connection. **Note:** *Keep in mind that some circuits receive voltage only when the ignition key is in the Accessory or Run position.*

Finding a short

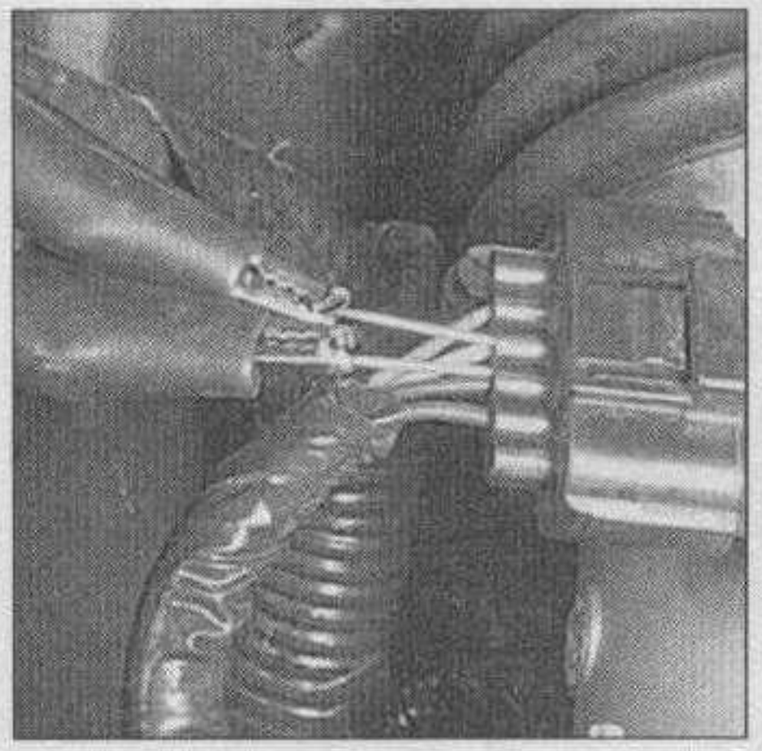
One method of finding shorts in a circuit is to remove the fuse and connect a test light or voltmeter in place of the fuse terminals. There should be no voltage present in the circuit. Move the wiring harness from side-to-side while watching the test light. If the bulb goes on, there is a short to ground somewhere in that area, probably where the insulation has rubbed through. The same test can be performed on each component in the circuit, even a switch.

Ground check

Perform a ground test to check whether a component is properly grounded. Disconnect the battery and connect one lead of a self-powered test light, known as a continuity tester, to a known good ground. Connect the other lead to the wire or ground connection being tested. If the bulb goes on, the ground is good. If the bulb does not go on, the ground is not good.

Continuity check

A continuity check is done to determine if there are any breaks in a circuit - if it is passing electricity properly. With the circuit off (no power in the circuit), a self-powered continuity tester can be used to check the circuit. Connect the test leads to both ends of the circuit (or to the "power" end and a good ground), and if the test light comes on the circuit is passing current properly. If the light doesn't come on, there is a break somewhere in the circuit. The same procedure can be used to test a switch, by connecting the continuity tester to the switch terminals. With the switch turned On, the test light should come on.



2.15 To backprobe a connector, insert a small, sharp probe (such as a straight-pin) into the back of the connector alongside the desired wire until it contacts the metal terminal inside; connect your meter leads to the probes - this allows you to test a functioning circuit

Finding an open circuit

When diagnosing for possible open circuits, it is often difficult to locate them by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may correct the open circuit condition. Remember this when an open circuit is indicated when troubleshooting a circuit. Intermittent problems may also be caused by oxidized or loose connections.

Electrical troubleshooting is simple if you keep in mind that all electrical circuits are basically electricity running from the battery, through the wires, switches, relays, fuses and fusible links to each electrical component (light bulb, motor, etc.) and to ground, from which it is passed back to the battery. Any electrical problem is an interruption in the flow of electricity to and from the battery.

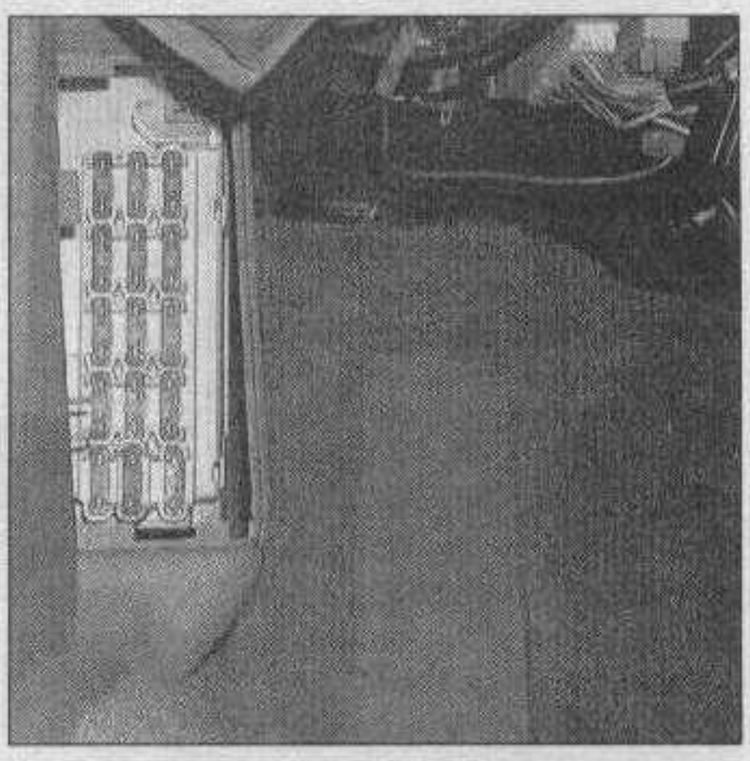
Connectors

Most electrical connections on these vehicles are made with multi-wire plastic connectors. The mating halves of many connectors are secured with locking clips molded into the plastic connector shells. The mating halves of large connectors, such as some of those under the instrument panel, are held together by a bolt through the center of the connector.

To separate a connector with locking clips, use a small screwdriver to pry the clips apart carefully, then separate the connector halves. Pull only on the shell, never pull on the wiring harness as you may damage the individual wires and terminals inside the connectors. Look at the connector closely before trying to separate the halves. Often the locking clips are engaged in a way that is not immediately clear. Additionally, many connectors have more than one set of clips.

Each pair of connector terminals has a male half and a female half. When you look at the end view of a connector in a diagram, be sure to understand whether the view shows the harness side or the component side of the connector. Connector halves are mirror images of each other, and a terminal shown on the right side end view of one half will be on the left side end view of the other half. When inserting a test probe into a female terminal, be careful not to distort the terminal opening. Doing so can lead to a poor connection and corrosion at that terminal later.

It is often necessary to take circuit voltage measurements with a connector connected. Whenever possible, carefully insert a straight pin into the rear of the connector shell to contact the terminal inside, then attach your meter lead to the pin. Shoving the meter's probe into the connector may spread or damage the connector. This kind of connection is called "backprobing" **(see illustration)**.



3.1a Remove the plastic cover to access the interior fuse block located in the driver's side kick panel - it contains 15 miniaturized fuses

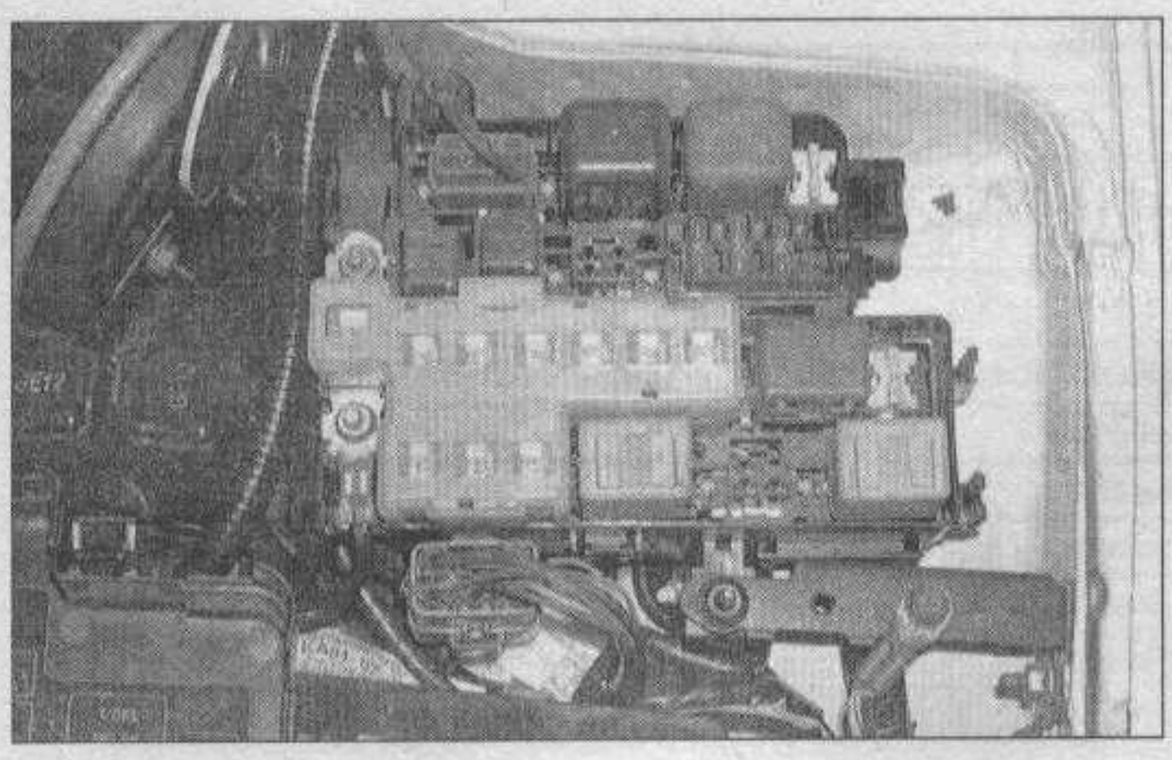
3 Fuses - general information

Refer to illustrations 3.1a, 3.1b and 3.3

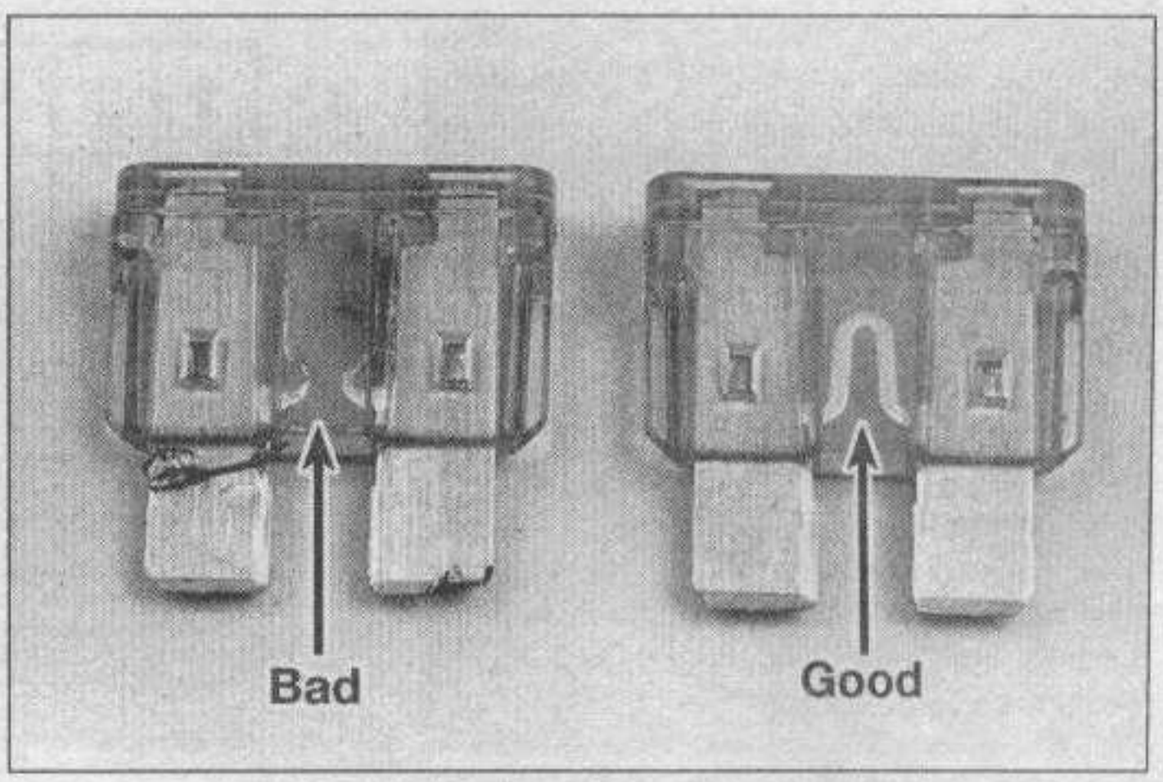
1 The electrical circuits of the vehicle are protected by a combination of fuses and circuit breakers. The two fuse blocks are located under the instrument panel and on the left side of the engine compartment **(see illustrations)**.

2 Each of the fuses is designed to protect a specific circuit (or circuits), and the various circuits are identified on the fuse panel itself.

3 Miniaturized fuses are employed in the fuse block. These compact fuses, with blade terminal design, allow fingertip removal and replacement. If an electrical component fails, always check the fuse first. To check the fuses, turn the ignition key to the On position and, using a test light, probe each exposed terminal of each fuse. If the test light glows on both terminals of a fuse, the fuse is good. If power is available on one side of the fuse but not the other, the fuse is blown. When



3.1b The power distribution box is located in the engine compartment adjacent to the battery - it contains cartridge type fusible links, miniaturized fuses, and relays



3.3 The fuses can easily be checked visually to see if they are blown (the fuse on the left is blown)

removed, a blown fuse is easily identified through the clear plastic body. Visually inspect the element for evidence of damage **(see illustration)**.

4 Be sure to replace blown fuses with the correct type. Fuses of different ratings are physically interchangeable, but only fuses of the proper rating should be used. Replacing a fuse with one of a higher or lower value than specified is not recommended. Each electrical circuit needs a specific amount of protection. The amperage value of each fuse is molded into the fuse body.

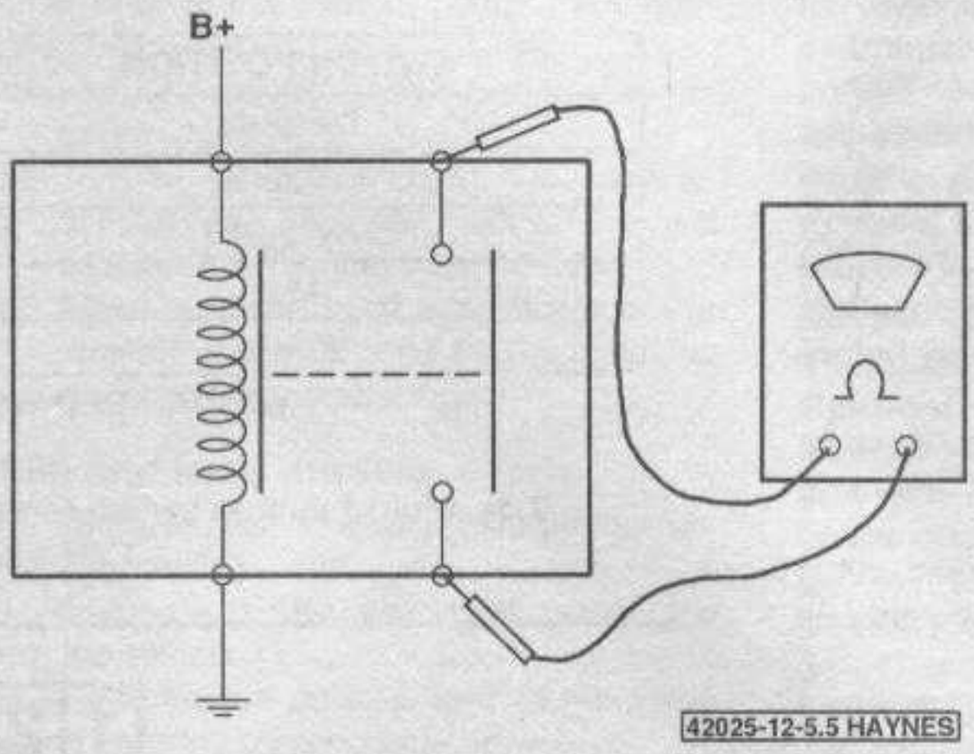
5 If the replacement fuse immediately fails, don't replace it again until the cause of the problem is isolated and corrected. In most cases, the cause will be a short circuit in the wiring caused by a broken or deteriorated wire.

6 All models are equipped with a 100-amp main fuse which protects all the circuits coming from the battery. If these circuits are overloaded, the main fuse blows, preventing damage to the main wiring harness. The main fuse consists of a metal strip which will be visibly melted when overloaded. Always disconnect the battery before replacing a main fuse (available from your dealer). **Caution:** *The stereo in your vehicle is equipped with an anti-theft system. Refer to the information at the front of this manual before detaching the battery cables.* The main fuse is located in the engine compartment fuse box. It's very similar in appearance to standard fuses and is replaced in the same way. If you have to replace a main fuse, make sure you install a replacement unit that's equivalent to the old fuse. In other words, if the old main fuse is an 80A unit, replace it with an 80A fuse; if it's a 100A unit, replace it with a 100A fuse. Don't switch amperage ratings on the main fuse!

4 Circuit breakers - general information

Circuit breakers protect components such as moonroof motors, power window motors and airbag inflator resistors.

On some models the circuit breaker resets itself automatically, so an electrical overload in a circuit-breaker-protected system will cause the circuit to fail momentarily, then come back on. If the circuit does not come back on, check it immediately. Once the condition is corrected, the circuit breaker will resume its normal function. Some circuit breakers must be reset manually.



5.4 To test a typical four-terminal normally open relay, connect an ohmmeter to the two terminals of the power circuit - the meter will indicate no continuity until battery power and ground are connected to the two terminals of the control circuit, then the relay will click and continuity will be indicated on the meter

5 Relays - general information and testing

General information

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

Testing

Refer to illustration 5.5

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

3 Some relays may be marked as an aid to help you determine which terminals are the control circuit and which are the power circuit. If the relay is not marked, refer to the wiring diagrams at the end of this Chapter to determine the proper hook-ups for the relay you're testing.

4 To test a relay connect an ohmmeter across the two terminals of the power circuit, continuity should not be indicated **(see illustration)**. Now connect a fused jumper wire between one of the two control circuit terminals and the positive battery terminal. Connect another jumper wire between the other control circuit terminal and ground. When the connections are made, the relay should click and continuity should be indicated on the meter. On some relays, polarity may be criti-

cal, so, if the relay doesn't click, try swapping the jumper wires on the control circuit terminals.

5 If the relay fails the above test, replace it.

6 Turn signal/hazard flasher - check and replacement

1 The turn signal and hazard flashers are controlled from a single electronic flasher unit which is mounted behind the left side of the dashboard, just above the driver's courtesy light socket on the knee bolster. It can be located by listening for the clicks when the signals are on.

2 When the flasher unit is functioning properly, an audible click can be heard during its operation. If the turn signals fail on one side or the other and the flasher unit does not make its characteristic clicking sound, a faulty turn signal bulb is indicated.

3 If both turn signals fail to blink, the problem may be due to a blown fuse, a faulty flasher unit, a broken switch or a loose or open connection. If a quick check of the fuse box indicates that the turn signal fuse has blown, check the wiring for a short before installing a new fuse.

4 To replace the flasher, unplug it from its connector an remove it from its mounting bracket behind the dashboard.

5 Make sure that the replacement unit is identical to the original. Compare the old one to the new one before installing it.

6 Installation is the reverse of removal.

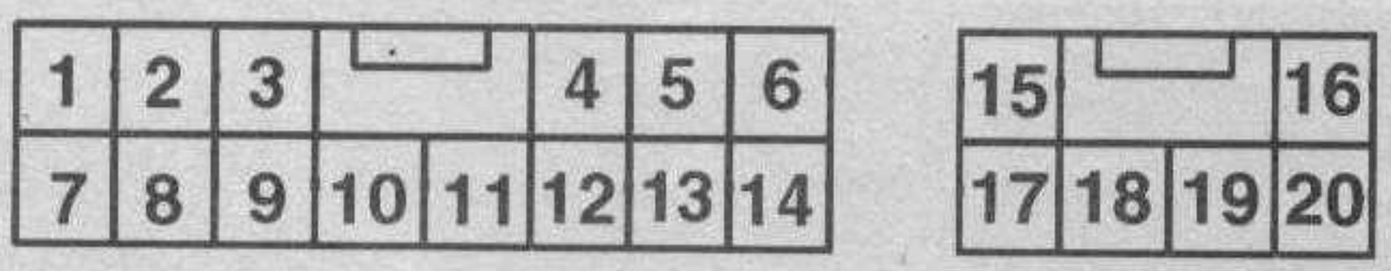
7 Steering column switches - check and replacement

Warning: *The models covered by this manual are equipped with Supplemental Restraint systems (SRS), more commonly known as airbags. Always disable the airbag system before working in the vicinity of the airbag system components to avoid the possibility of accidental deployment of the airbag, which could cause personal injury* (see Section28).

Check

Refer to illustrations 7.3a, 7.3b and 7.3c

1 The multi-function switch is located on the top of the steering column. It incorporates the turn signal, hazard and headlight dimmer functions into the stalk on the left side of the column, and the windshield wipers and washer into the stalk on the right side of the column. On 1997 and earlier models, the two stalks are incorporated into a one-piece switch assembly. On 1993 and 1994 models the airbag system clockspring can be removed from the switch. On 1995 and 1996 models, the airbag system clockspring is part of the switch assembly and must be replaced with the switch. On 1998 and later models, the switches are two separate units and can be replaced individually.



SWITCH POSITION	CONTINUITY BETWEEN
Headlights	3 and 8
Parking lights	2 and 3
Low beams	15 and 19
High beams	19 and 17
Flash-to-pass	17 and 18
Left turn signal	9 and 16
Right turn signal	9 and 20
Hazard warning lights	6 and 14

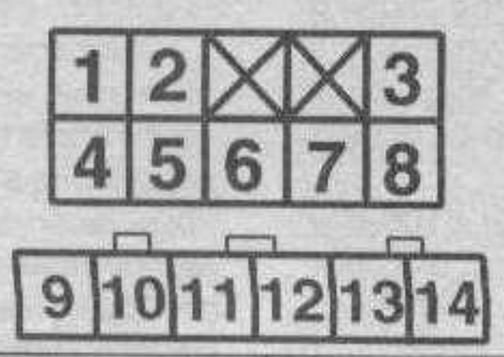
COMBINATION LIGHT SWITCH

SWITCH POSITION	CONTINUITY BETWEEN
Off (park)	4 and 13
Low speed	11 and 13
High speed	11 and 12
Mist	11 and 12
Washer	5 and 11

WINDSHIELD WIPER/WASHER SWITCH

61042-12-7.3a HAYNES

7.3a Multi-function switch terminal identification and continuity chart - 1997 and earlier models



SWITCH POSITION	CONTINUITY BETWEEN
Headlights	9, 10 and 11
Parking lights	10 and 11
Low beams	2 and 6; 7 and 8
High beams	2 and 5; 3 and 7
Flash-to-pass	9 and 11
Left turn signal	12 and 14
Right turn signal	12 and 13

61042-12-7.3b HAYNES

7.3b Combination light switch terminal identification and continuity chart - 1998 and later models

2 On 1997 and earlier models, remove the lower steering column cover and disconnect the 6-pin and 14-pin connectors at the base of the steering column; perform the tests at these connectors. On 1998 and later models, remove the individual switch for testing.

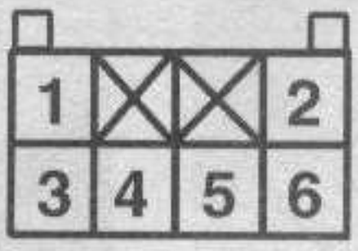
3 Using an ohmmeter or self-powered test light and the accompanying diagrams, check for continuity between the indicated switch terminals with the switch in each of the indicated positions **(see illustrations)**. If the continuity isn't as specified, replace the switch.

Replacement

1997 and earlier models

Refer to illustration 7.8

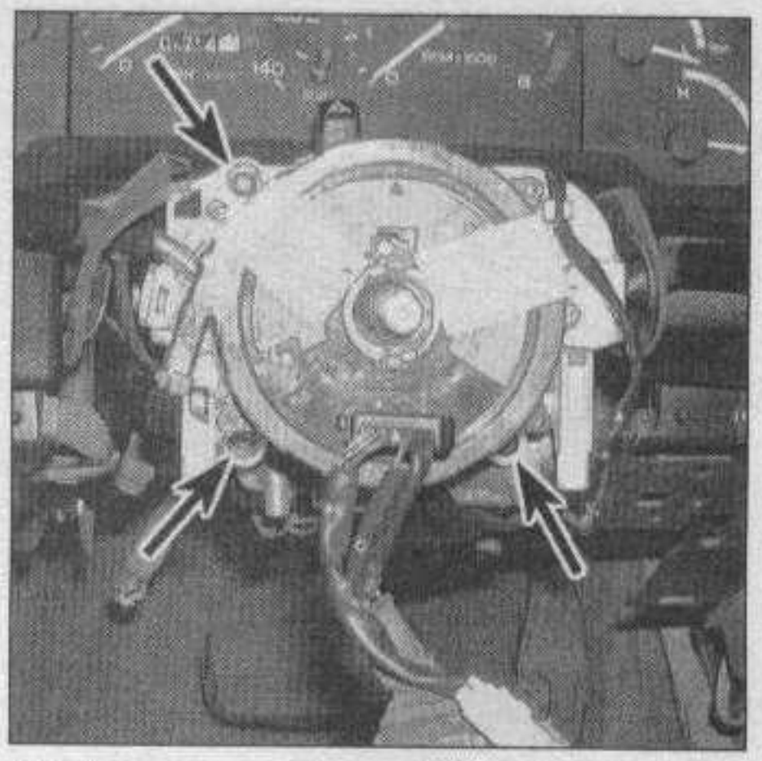
4 Disconnect the negative battery cable. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make*



SWITCH POSITION	CONTINUITY BETWEEN
Off (park)	3 and 5
Low speed	3 and 6
High speed	4 and 6
Mist	4 and 6
Washer	1 and 6

61042-12-7.3c HAYNES

7.3c Windshield wiper/washer switch terminal identification and continuity chart - 1998 and later models



7.8 To remove the multi-function switch, remove the three screws (arrows)

sure you have the correct activation code before disconnecting the battery.

5 Position the front wheels and the steering wheel in the straight ahead position. Remove the steering wheel (see Chapter 10). Remove the knee bolster and steering column covers (see Chapter 11).

6 On 1993 and 1994 models, apply two small pieces of tape across the airbag clockspring center hub and outer housing to retain the clockspring in the centered position. Remove the three screws retaining the clockspring to the multi-function switch. Disconnect the electrical connector and ground wire and remove the clockspring.

7 On 1995 through 1997 models, the clockspring is part of the multi-function switch assembly - DO NOT attempt to remove the clockspring separately. The clockspring is shipped in the centered position on new multi-function/clockspring assemblies.

8 Remove the switch retaining screws, disconnect the electrical connectors, then detach the multi-function switch from the steering column **(see illustration)**.

9 Installation is the reverse of removal. If the clockspring is accidentally moved off center prior to installation, center the clockspring before installing it as follows:

a) Lightly turn the center hub clockwise until it stops.

b) Turn the center hub counterclockwise 2-3/4 turn and align the mark on the hub with the mark on the outer housing.

c) Make sure the front wheels are in the straight ahead position before installing the centered clockspring.

1998 and later models

10 Remove the steering column covers (see Chapter 11).

11 Disconnect the electrical connector from the switch.

12 Remove the screws and remove the switch from the steering column.

13 Installation is the reverse of removal.

8 Ignition switch and key lock cylinder - check and replacement

Warning: *The models covered by this manual are equipped with Supplemental Restraint systems (SRS), more commonly known as airbags. Always disable the airbag system before working in the vicinity of the airbag system components to avoid the possibility of accidental deployment of the airbag, which could cause personal injury* (see Section 28).

Check

Refer to illustrations 8.3 and 8.4

1 Disconnect the negative battery cable.

Caution: *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

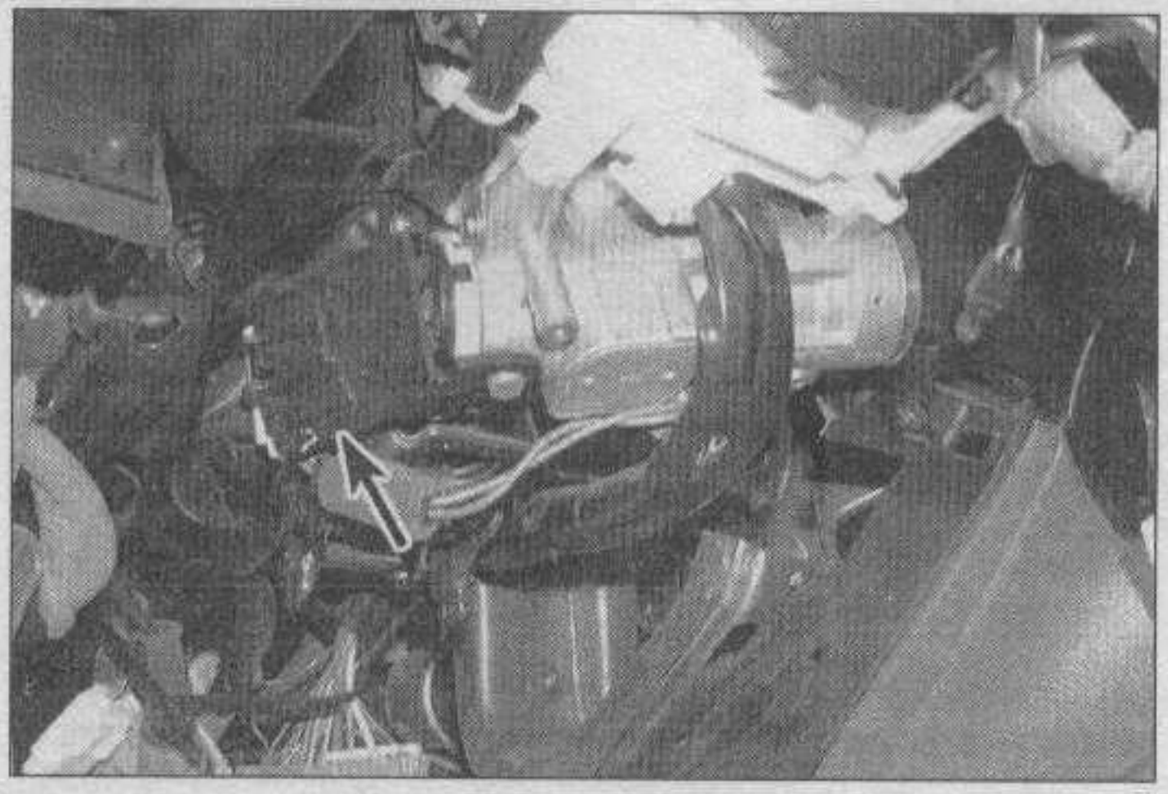
2 Remove the steering column covers (see Chapter 11).

3 Disconnect the electrical connector from the ignition switch **(see illustration)**.

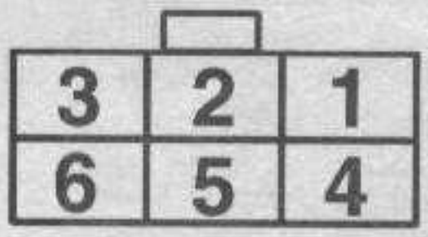
4 Check the connector for continuity between the indicated terminals with the key in each position **(see illustration)**. **Note:** *There should be no continuity between any of the terminals with the key in the Lock position.*

5 If the continuity is not as specified, replace the switch.

6 Check the lock cylinder in each position to make sure it isn't worn or loose and that the key position corresponds to the markings



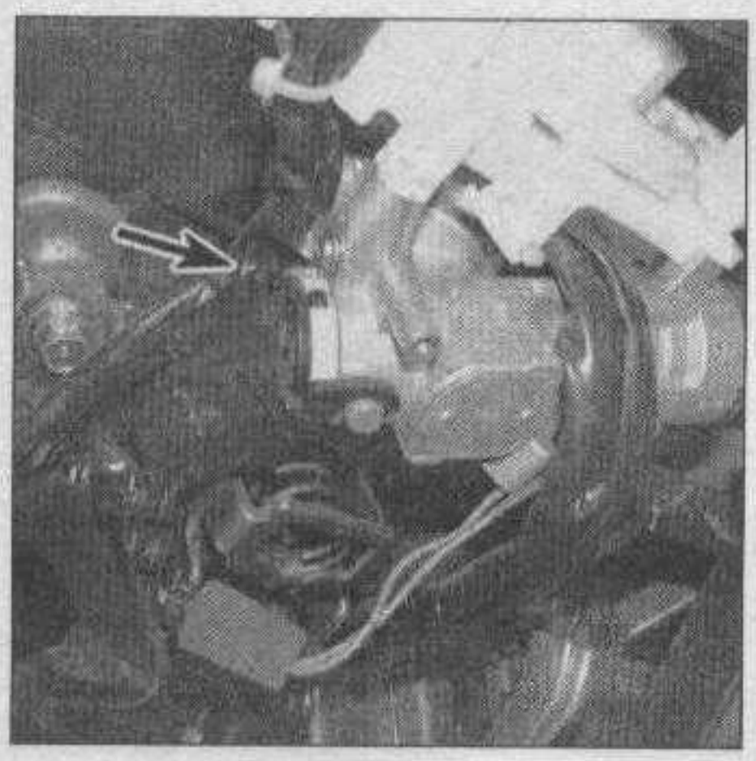
8.3 Disconnect the ignition switch electrical connector (arrow) from the switch



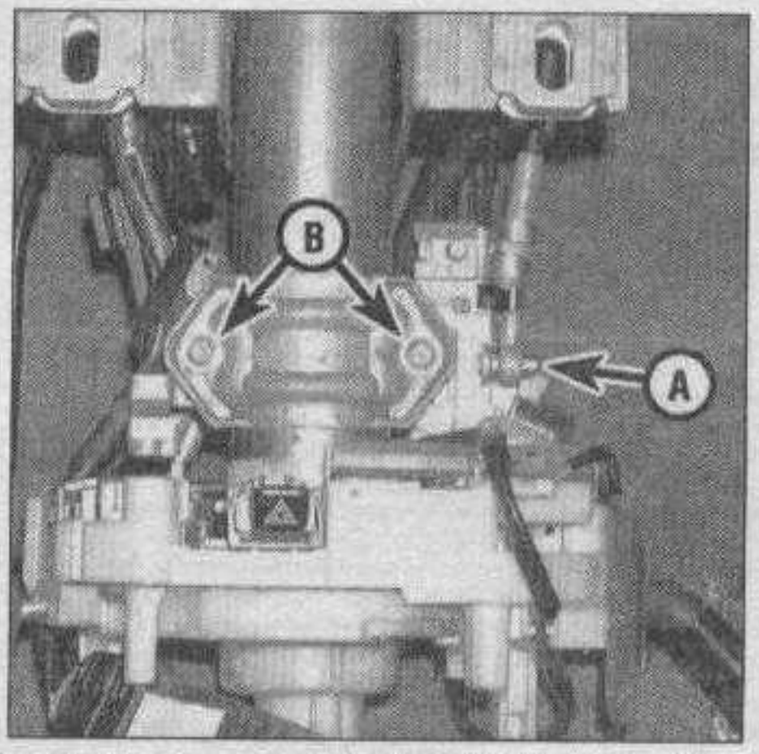
KEY POSITION	CONTINUITY BETWEEN TERMINALS
Acc	2 and 6
On	2,4 and 6 1 and 5
Start	2 and 4 3 and 5

61042-12-8.4 HAYNES

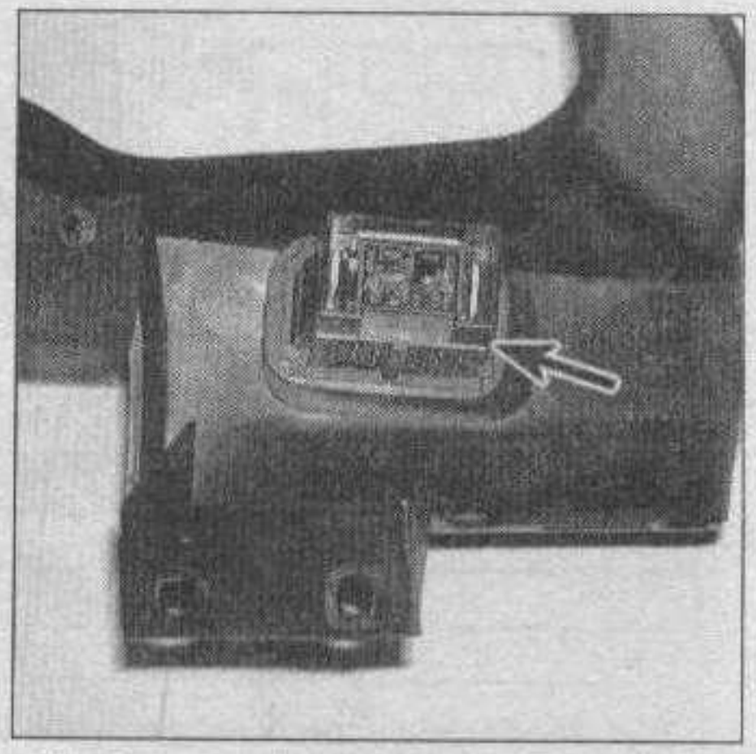
8.4 Check the ignition switch terminals for continuity in each of the indicated positions



8.10 Remove the ignition switch mounting screw (arrow)



8.13 Disconnect the interlock cable (A), drill the heads off the bolts (B) and remove the bracket



9.3 Release the clips on the back of the instrument bezel to remove the dashboard light control (arrow) from the bezel

on the housing. If the lock cylinder is faulty, the entire steering column lock assembly will have to be replaced.

Replacement

Ignition switch

Refer to illustration 8.10

7 Disconnect the negative battery cable. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

8 Remove the steering column covers (see Chapter 11).

9 Disconnect the electrical connector from the ignition switch **(see illustration 8.3)**.

10 Remove the screw retaining the switch to the steering column **(see illustration)**.

Lock cylinder

Refer to illustration 8.13

11 Remove the steering column covers and the lower instrument panel cover (see Chapter 11).

12 Refer to Chapter 10 and lower the steering column.

13 Disconnect the shift interlock cable from the ignition lock housing **(see illustration)**.

14 The lock assembly is clamped to the steering column by two shear-head bolts **(see illustration 8.13)**. Drill the heads off each bolt and remove the bracket.

15 Remove the steering column lock assembly from the steering column.

16 Mount the lock assembly in a vise and drill out the four pins holding the lock cylinder to the housing.

17 Place the new cylinder in position without the key inserted and drive in four new pins.

18 Mount the lock assembly on the steering column, install the bracket and two new shear-head bolts. Tighten the shear head bolts securely, but don't break the heads off at this time.

19 Insert the key and check the lock cylinder and steering column lock for proper operation. When your satisfied the lock cylinder and steering column lock is operating properly, tighten the shear-head bolts until the heads break off.

20 The remainder of installation is the reverse of removal.

9 Instrument panel switches - check and replacement

Warning: *The models covered by this manual are equipped with Supplemental Restraint systems (SRS), more commonly known as airbags. Always disable the airbag system before working in the vicinity of the airbag system components to avoid the possibility of accidental deployment of the airbag, which could cause personal injury* (see Section 28).

Dashboard light control

Check

1 The dashboard light control is mounted on the left side of the instrument panel, near the steering wheel. Within the control unit is circuitry that varies the voltage to the instrument panel bulbs as the thumbwheel is turned.

2 Remove the light control and reconnect the electrical connector, turn on the headlights (ignition key Off). Backprobe the terminal for the orange or red wire; there should be battery voltage. If so, backprobe the terminals for the green/yellow (Probe) or gray (Mazda) wire with a 12-volt test light connected to a good chassis ground. The illumination brightness of the test light should vary as the thumbwheel is turned. If not, replace the light control switch. Before replacing the switch, disconnect the connector and check for continuity to chassis ground at the black wire terminal.

Replacement

Refer to illustration 9.3

3 Refer to Chapter 11 and remove the instrument cluster bezel. Release the clips on the back of the panel to remove the light control unit **(see illustration)**.

Hazard warning switch (Mazda models)

Check

Refer to illustration 9.5

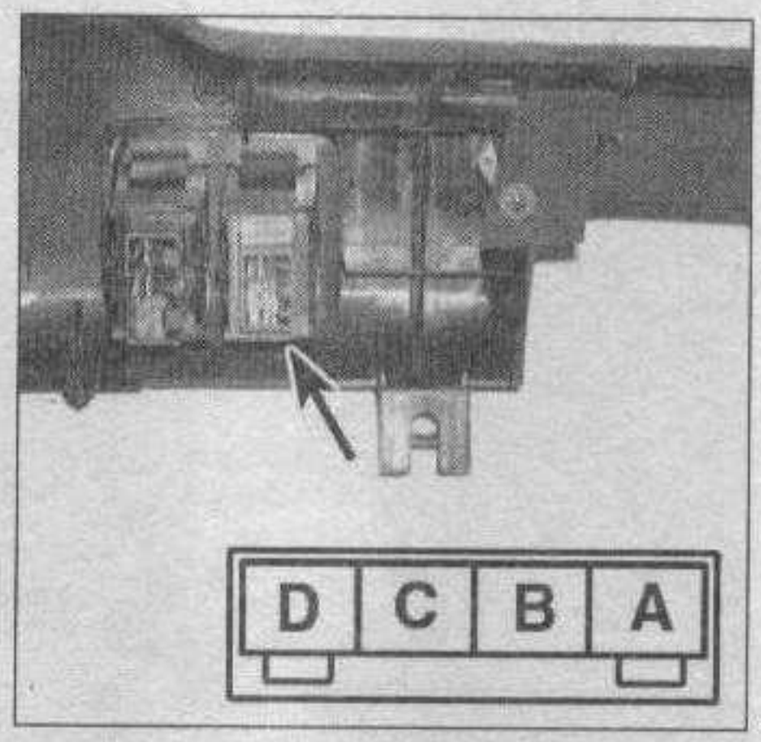
4 On Probe models, the hazard switch function is part of the multi-function switch (see Section 7 for check and replacement procedures). On Mazda models the hazard switch is located in the instrument panel. To check the switch it must first be removed (see below).

5 Test for continuity between the terminals of the switch **(see illustration)**. If the switch fails the test, replace it.

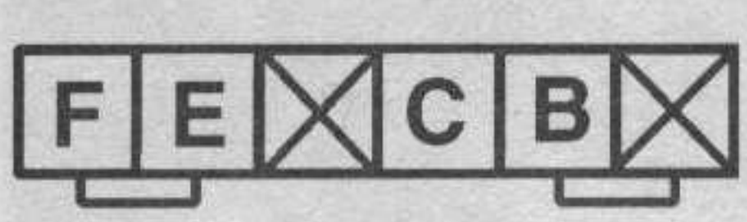
Replacement

6 Refer to Chapter 11 for removal of the instrument panel bezel.

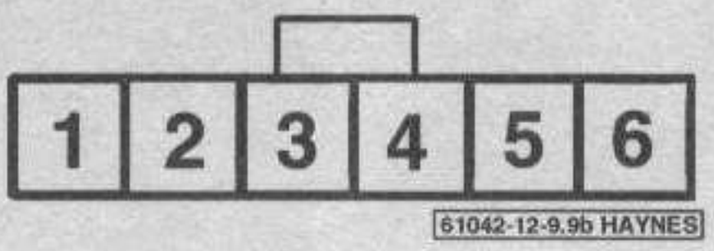
7 The hazard switch is located above the radio on 1997 and earlier models, and just to the right of the steering wheel on 1998 and later models. Disconnect the electrical connector, squeeze the clips on the back of the switch and remove the switch from the bezel.



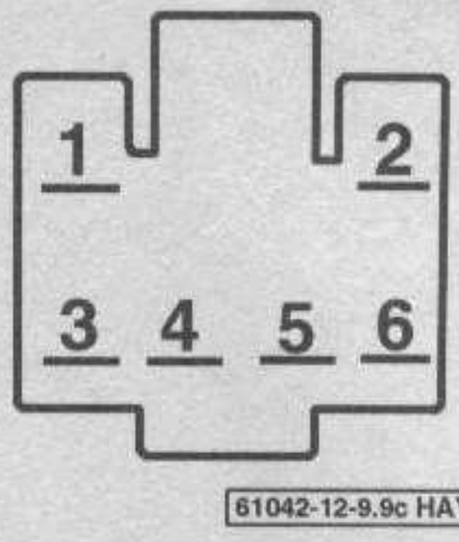
9.5 Hazard warning switch terminal identification (Mazda models) - there should be continuity between A and B with the switch On and no continuity with the switch Off



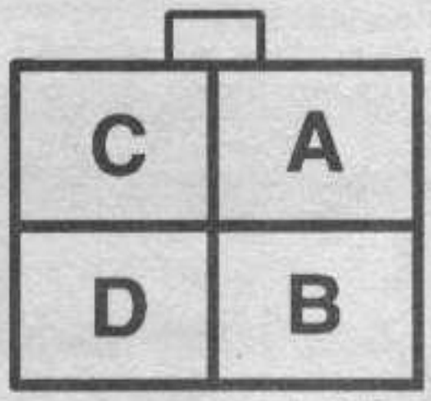
9.9a Mazda rear window defogger switch terminal identification - there should be continuity between B and C with the switch On and no continuity with the switch Off



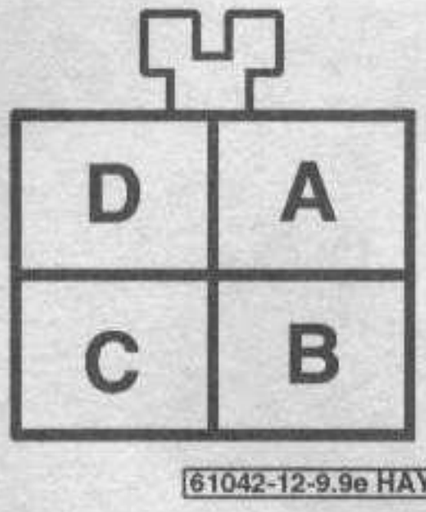
9.9b Probe rear window defogger switch terminal identification - apply battery power to terminal 3 and ground to terminal 5, there should be battery voltage at terminal 4 when the switch is pushed (voltage should shut off after 15 to 20 minutes due to timer action)



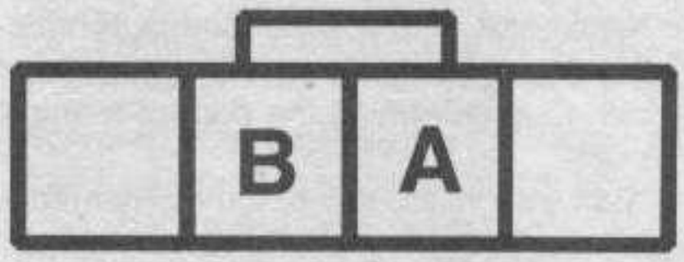
9.9c Probe fog light switch terminal identification - there should be continuity between terminals 4 and 5 with the switch On and no continuity with the switch Off



9.9d Mazda fog light switch terminal identification - there should be continuity between terminals B and D with the switch On and no continuity with the switch Off



9.9e Probe rear window wiper switch terminal identification - there should be continuity between terminals A and B with the switch On and no continuity with the switch Off



9.9f Probe rear window washer switch terminal identification - there should be continuity between terminals A and B with the switch On and no continuity with the switch Off

Rear window defogger, fog light, rear wiper/washer and headlight retractor switches

Check

Refer to illustrations 9.9a through 9.9g

8 The rear window defogger switch, fog light switch (if equipped) and rear window wiper/washer switches and are all mounted on the instrument panel bezel on Mazda models. On Probe models, the switches are mounted on the center dashboard trim panel (1993 Probe models are also equipped with a headlight retractor switch).

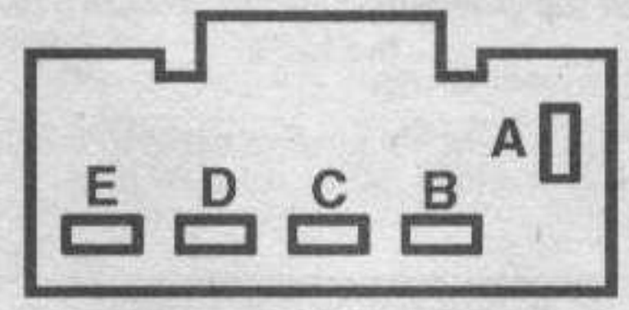
9 Remove the switch for testing (see below) and check for continuity **(see illustrations)**. If the test results aren't as specified, replace the switch. **Note:** *Before testing any switch or circuit, always check the fuses for that circuit first.*

Replacement

Refer to illustration 9.11

10 Refer to Chapter 11 for removal of the instrument cluster bezel (Mazda models) or center dash bezel (Probe models).

11 All of the switches are mounted to the bezel with clips. From behind the bezel, disconnect the electrical connector for the switch you are testing or replacing, release the clips and push the switch out the front side of the bezel **(see illustration)**.



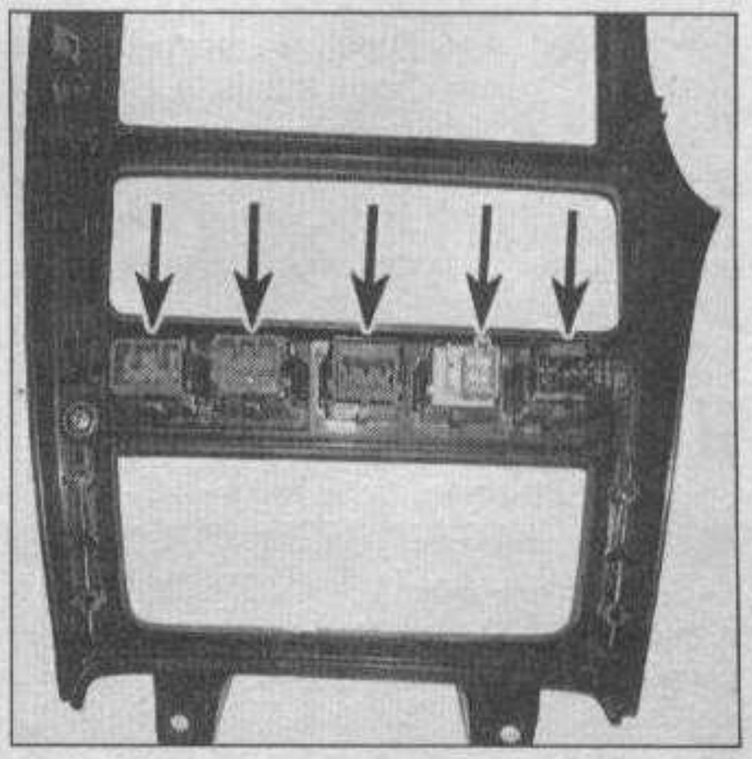
9.9g Headlight retractor switch terminal identification (1993 Probe models) - there should be continuity between terminals C and D with the switch On and continuity between C and E with the switch Off

10 Instrument panel gauges - check

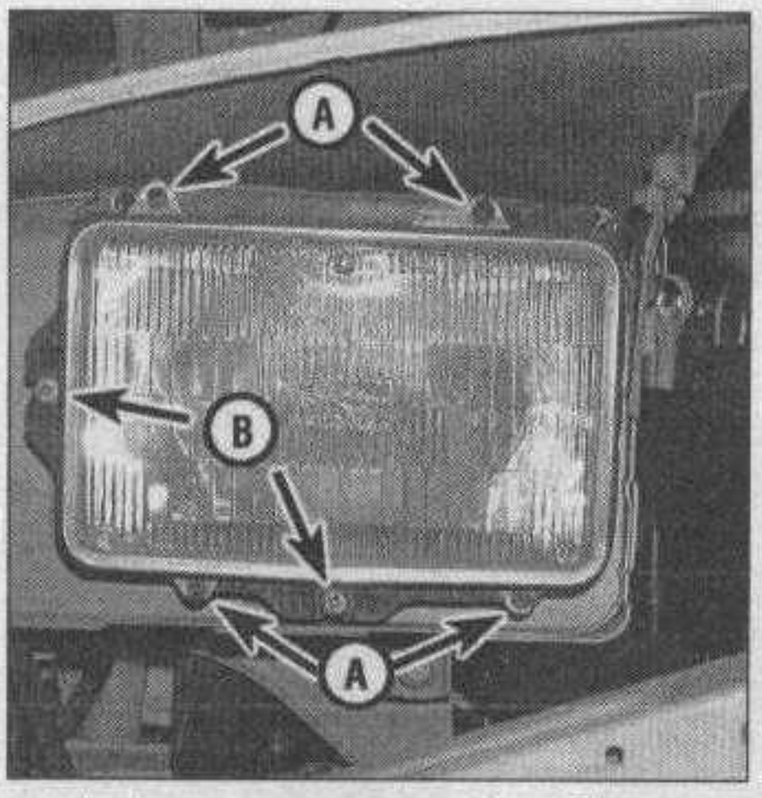
Note: *This procedure applies to conventional analog type gauges (NON-digital) only.*

1 This procedure can be used as a general operational check for the temperature gauge, fuel gauge and oil pressure gauge. The voltage gauge circuitry is contained within the instrument panel and cannot be checked using this procedure.

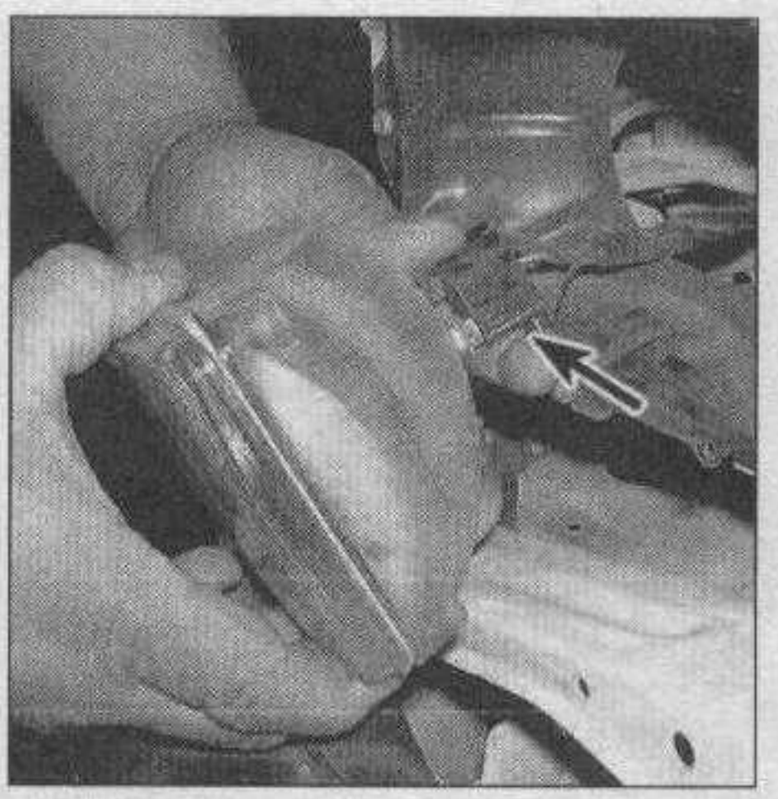
2 If the gauge pointer does not move from the empty or cold positions, check the fuse. If the fuse is OK, locate the particular sending unit for the circuit you're working on (see Chapter 4 for fuel sending unit location, Chapter 3 for the temperature gauge sending unit location or Chapter 2C for the oil pressure gauge sending unit location). Disconnect the electrical connector to the sending unit and using a jumper wire, connect the terminal in the harness connector to a good chassis



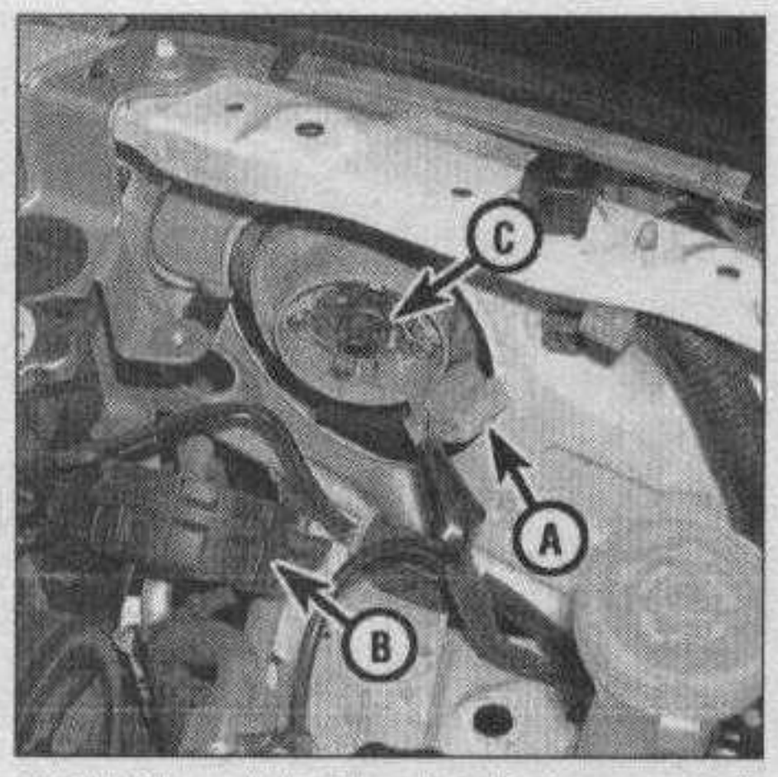
9.11 The instrument panel switches are attached to the back of the bezel with clips - Probe model switches (shown) include, from left-to-right: headlight retractor switch, fog light switch, rear window washer switch, rear window wiper switch and rear window defogger switch



14.4 Remove the screws (A) and remove the retaining ring - (B) indicates the two headlight aiming screws



14.5 disconnect the electrical connector (arrow) from the back of the headlight bulb



14.7 Disconnect the electrical connector (A), remove the rubber ring (B), then squeeze the wire clip (B) to extract the halogen bulb (Mazda models)

4 Remove the screws and the bulb-retaining ring **(see illustration)**.

5 Pull the headlight out far enough to disconnect the electrical connector **(see illustration)**.

6 Installation is the reverse of the removal procedure.

Mazda models

Refer to illustration 14.7

7 From behind the headlight assembly, disconnect the electrical connector, then pull off the large rubber protective ring from the back of the headlight **(see illustration)**.

8 Release the spring-wire clip, then withdraw the halogen bulb from the headlight housing.

9 Without touching the glass with your bare fingers, insert the new bulb into the socket assembly and then lock the bulb holder into the place by installing the spring-wire clip **(see illustration 14.7)**.

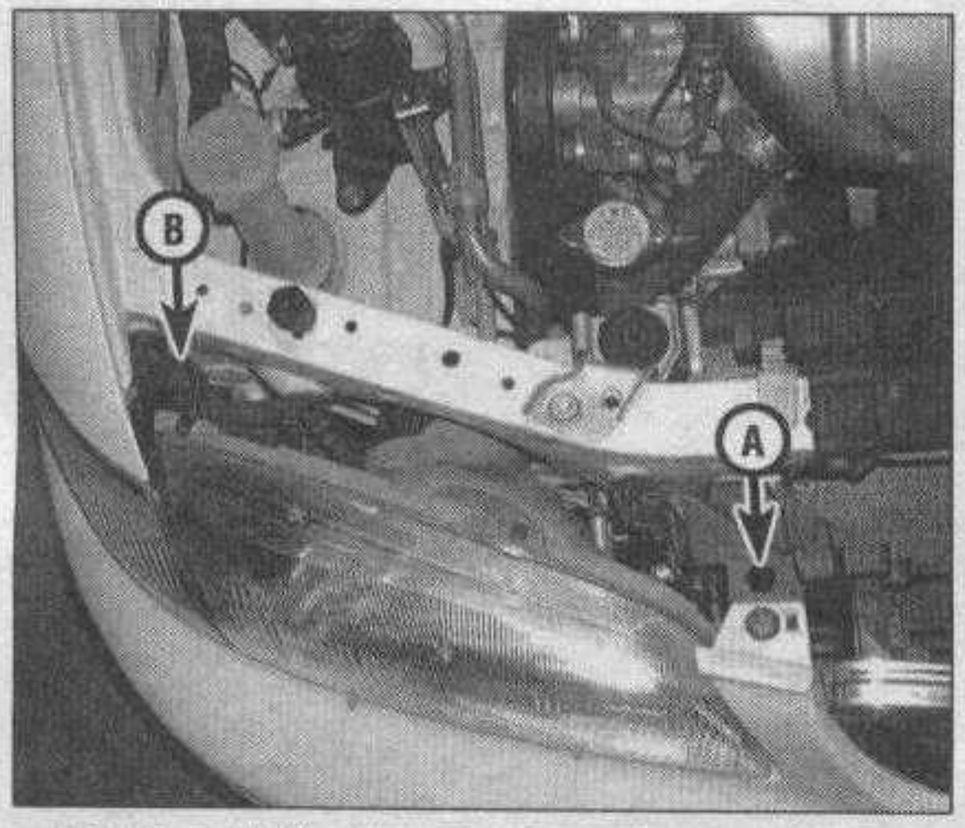
10 Reinstall the electrical connector and test the headlight operation.

15 Headlights - adjustment

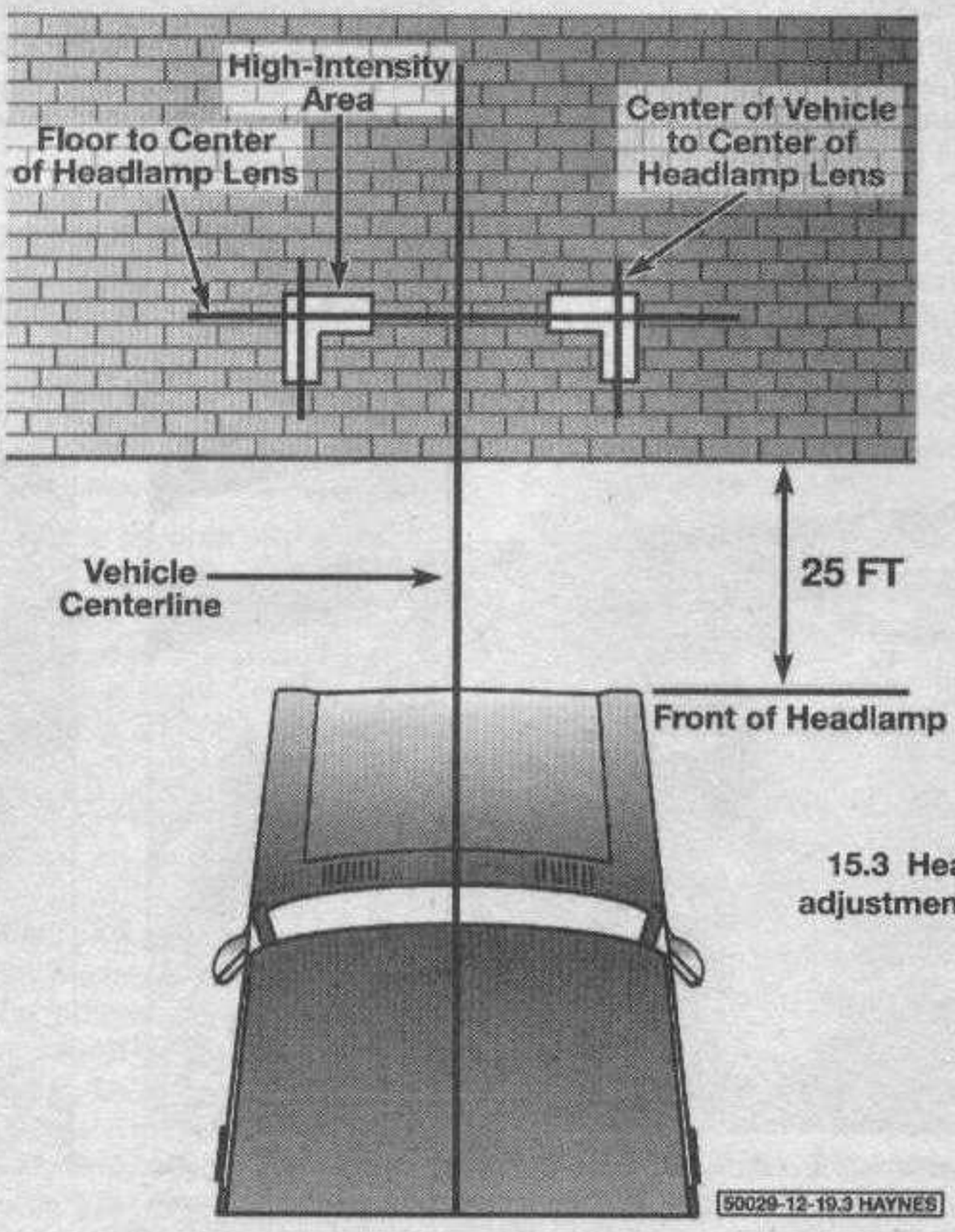
Refer to illustrations 15.1 and 15.3

Note: *The headlights must be aimed correctly. If adjusted incorrectly they could blind the driver of an oncoming vehicle and cause a serious accident or seriously reduce your ability to see the road. The headlights should be checked for proper aim every 12 months and any time a new headlight is installed or front end body work is performed. It should be emphasized that the following procedure is only an interim step which will provide temporary adjustment until the headlights can be adjusted by a properly equipped shop.*

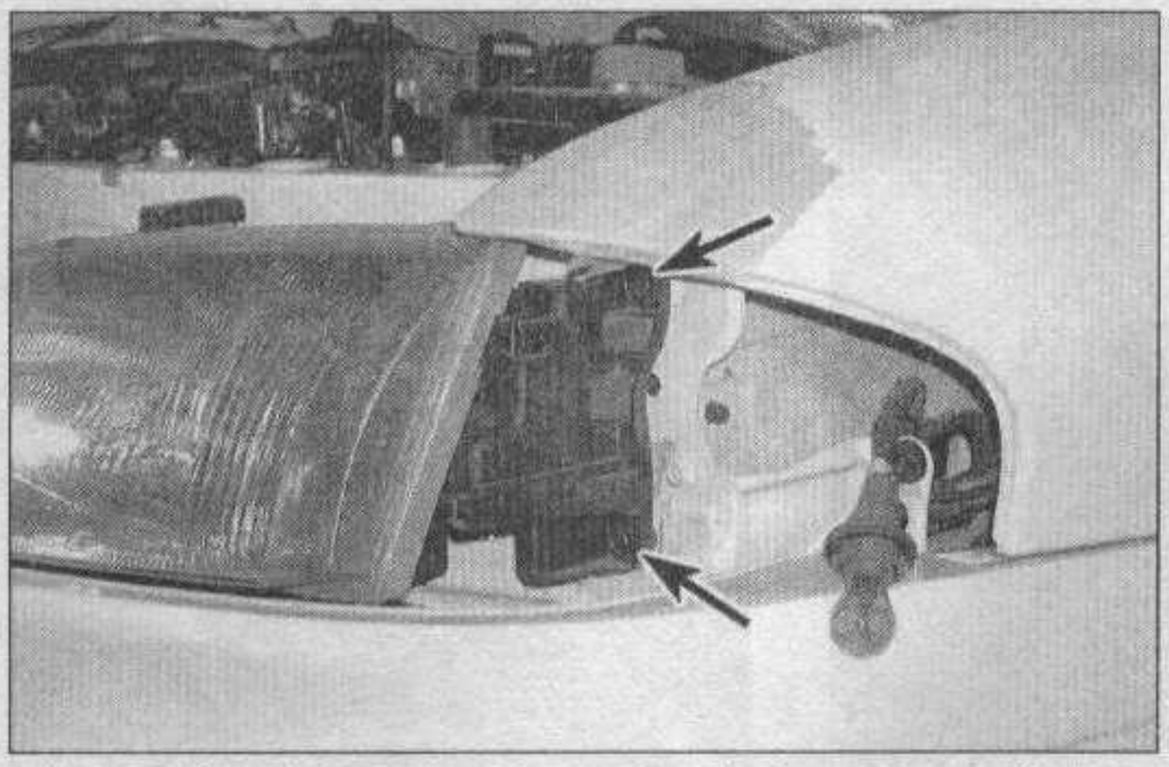
1 The headlights have two adjusting screws each. On Probe models, the two screws are accessible only after removing the outer headlight bezel **(see illustration 14.4)**. On Mazda MX-6 models, one adjuster screw is accessible from the rear of the headlight assembly and one from the front. On Mazda 626 models, the two screws are accessible



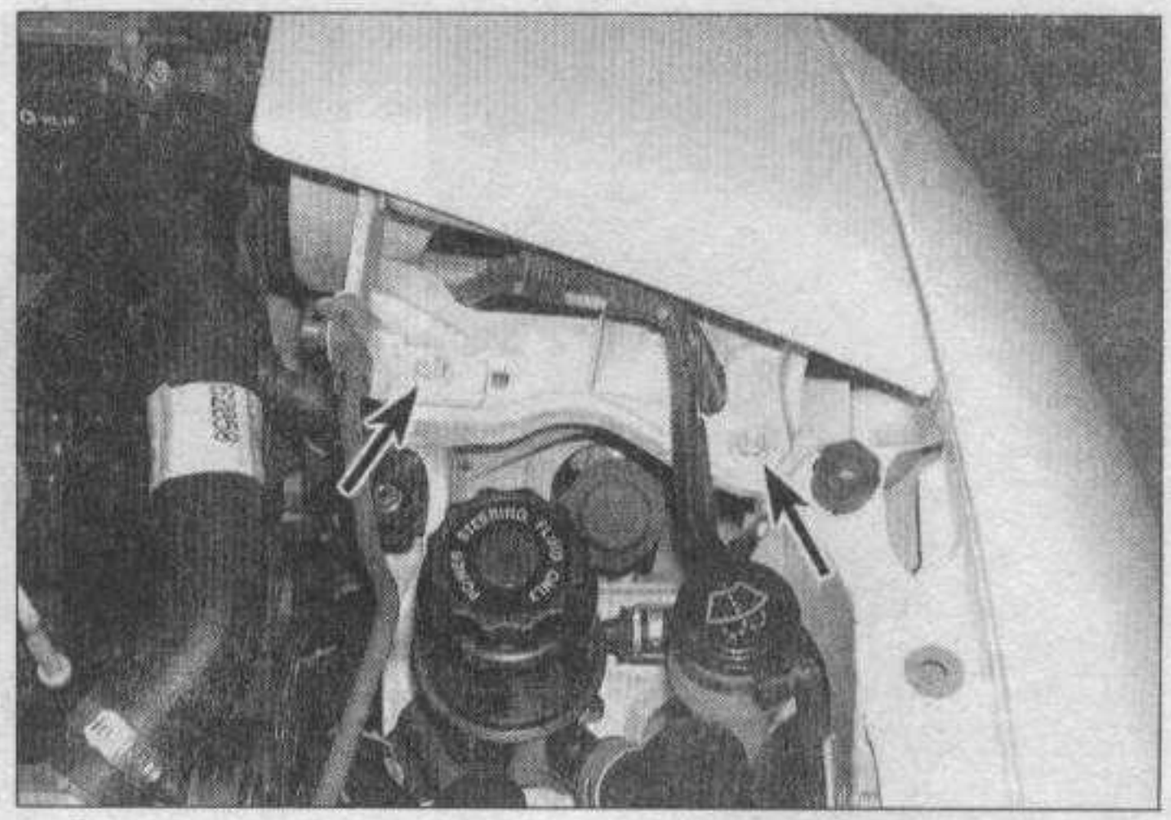
15.1 Headlight adjustment is made with a Phillips screwdriver at the horizontal adjuster (A) and the vertical adjuster (B) - Mazda 626 model shown



15.3 Headlight adjustment details



16.3 On Mazda models with separate front combination lights, remove the single bolt on top of the headlight housing holding the combination light, then remove the outer headlight bolts (arrows) - note that the front of the fender is taped to prevent scratches



16.9a Remove the two nuts (arrows) at the rear (shown with the headlight down for clarity, headlight should be up), then . . .

from the top **(see illustration)**. All adjusters are turned using a Phillips screwdriver.

2 Mazda 626 models are equipped with bubble-level gauges for headlight aiming. If the headlights still don't aim properly after adjusting the vertical and horizontal adjusters until the indicators show level, there may be body damage in the headlight area. Proceed to the following Steps for adjustment.

3 The following adjustment method requires a level area and a blank wall. Position the vehicle with the headlights aimed squarely at the wall. Place masking tape vertically on the wall in reference to the vehicle centerline and the centerlines of both headlights **(see illustration)**.

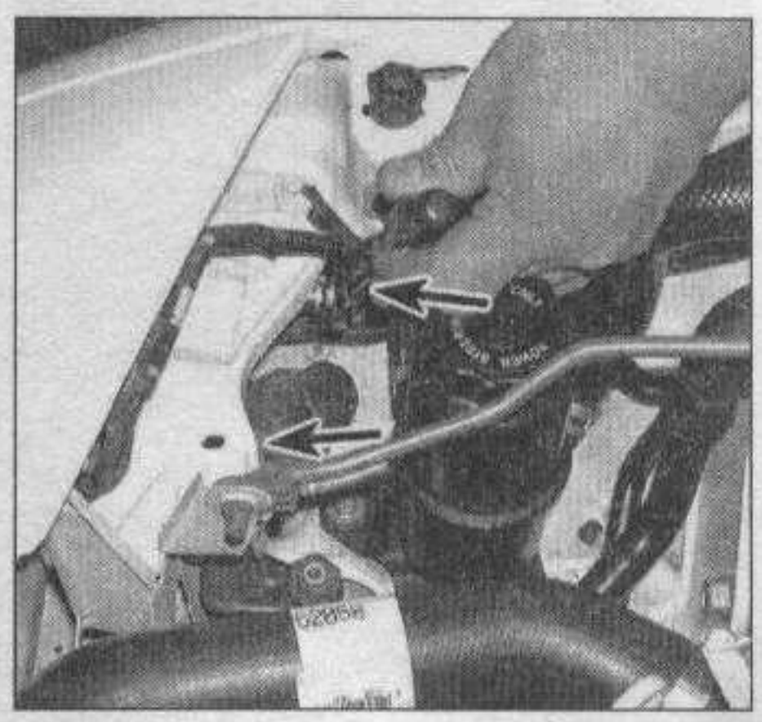
4 Position a horizontal tape line in reference to the centerline of all the headlights. **Note:** *It may be easier to position the tape on the wall with the vehicle parked only a few inches away.*

5 Adjustment should be made with the vehicle parked 25 feet from the wall, sitting level, the gas tank half-full and no unusually heavy load in the vehicle.

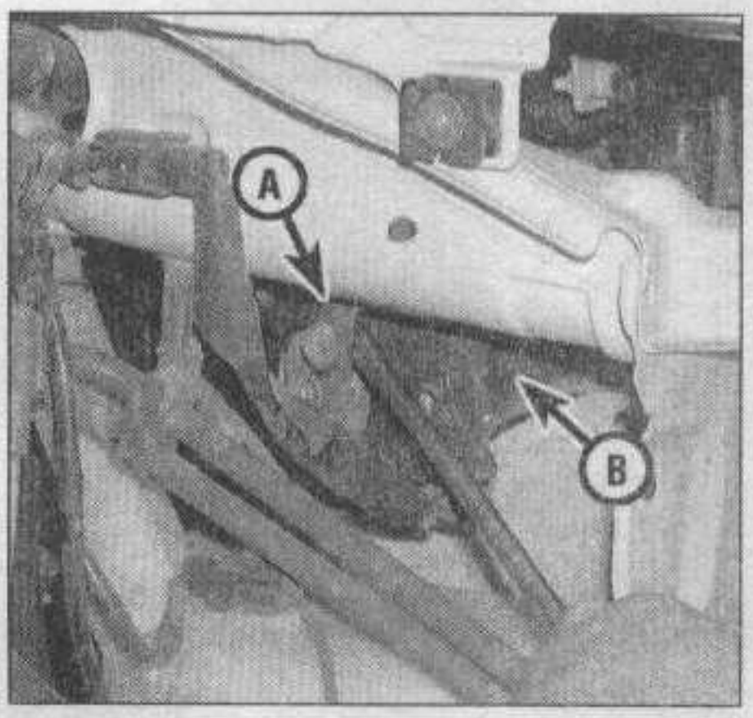
6 Starting with the low beam adjustment, position the high intensity zone so it is two inches below the horizontal line and two inches to the right of the headlight vertical line. Adjustment is made by turning the top adjusting screw clockwise to raise the beam and counterclockwise to lower the beam. The adjusting screw on the side should be used in the same manner to move the beam left or right.

7 With the high beams on, the high intensity zone should be vertically centered with the exact center just below the horizontal line: **Note:** *It may not be possible to position the headlight aim exactly for both high and low beams. If a compromise must be made, keep in mind that the low beams are the most used and have the greatest effect on safety.*

8 Have the headlights adjusted by a properly equipped headlight aiming facility at the earliest opportunity.



16.9b . . . remove the two bolts (arrows indicate the approximate location) below the bracket



16.10 Insert a large screwdriver under the link arm (A) and pry the arm from the mechanism - (B) indicates the motor mounting bracket

16 Headlight housing - replacement

Mazda models

Refer to illustration 16.3

1 Unplug the electrical connectors, and remove the halogen bulbs (see Section 14).

2 Remove the grille on models so equipped (see Chapter 11).

3 On some Mazda models, the front combination (park and turn signal) light is incorporated into the headlight housing, while on other models the headlight housing is a separate unit. On models with separate combination lights, remove the combination light (see Section 18) for access to the outer headlight housing bolts **(see illustration)**. On models with a radiator grille, remove the grille for access to the inner headlight housing bolts (see Chapter 11 for grille removal).

4 Remove the headlight housing mounting bolts and remove the housing. **Note:** *Protect the paint by placing masking tape over the front edge of the fender while replacing the headlight housing.*

5 Installation is the reverse of removal. After you're done, adjust the headlights (see Section 14).

Probe models

Refer to illustrations 16.9a, 16.9b and 16.10

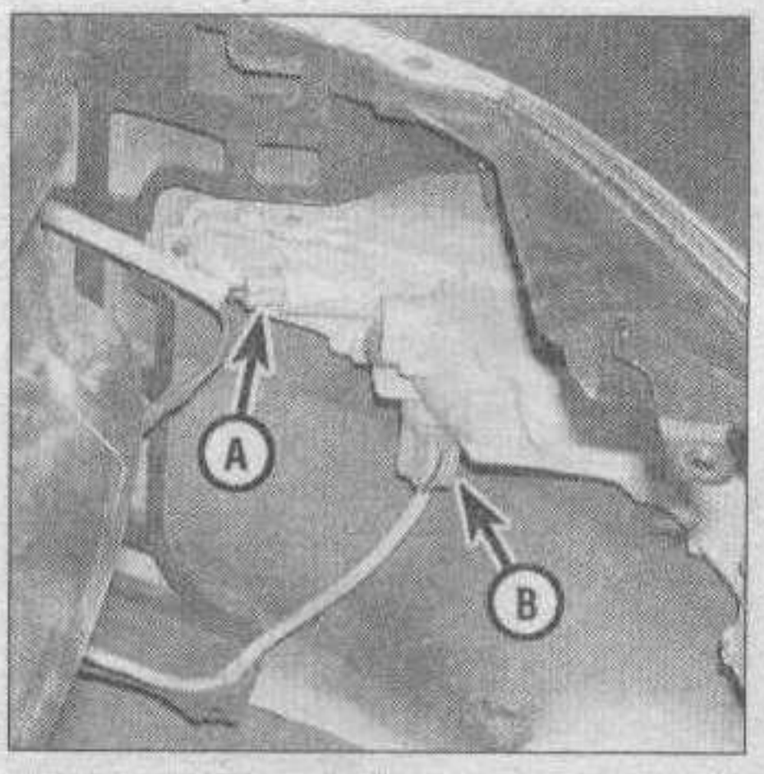
6 The retractable headlight housings on Probe models may be removed for replacement or servicing of the headlight housing motors.

7 Switch the headlights On and raise the headlight housings. Disconnect the negative battery cable (see Chapter 1). **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, refer to the information at the front of this manual before detaching the battery cables.*

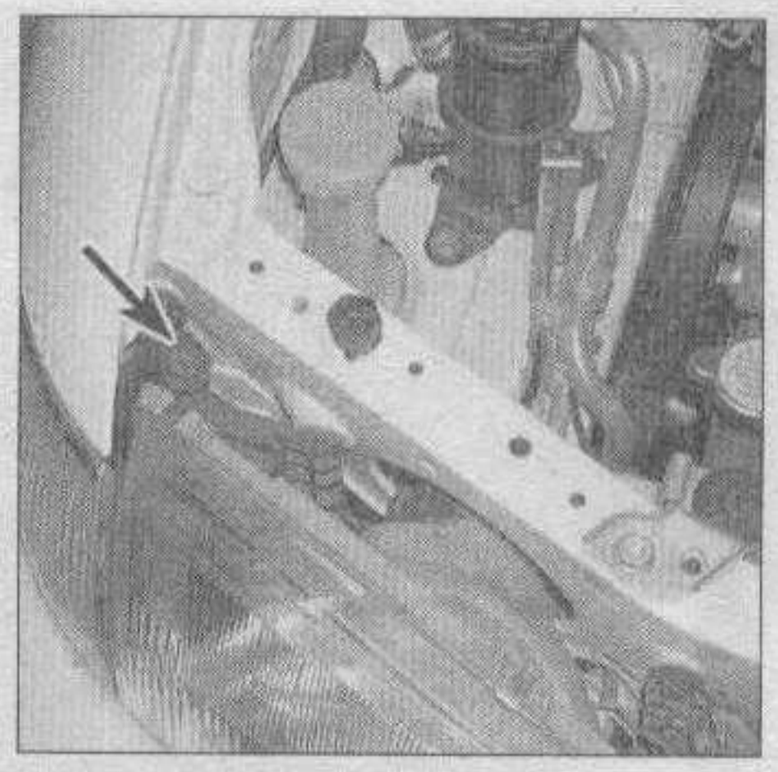
8 If you are replacing the driver's-side headlight housing, remove the battery (see Chapter 5).

9 Remove the housing mounting screws or nuts at the rear of the assembly **(see illustrations)**. **Caution:** *Once the bracket mounting bolts are removed, the headlight housing will require some kind of support to remain in the up position.*

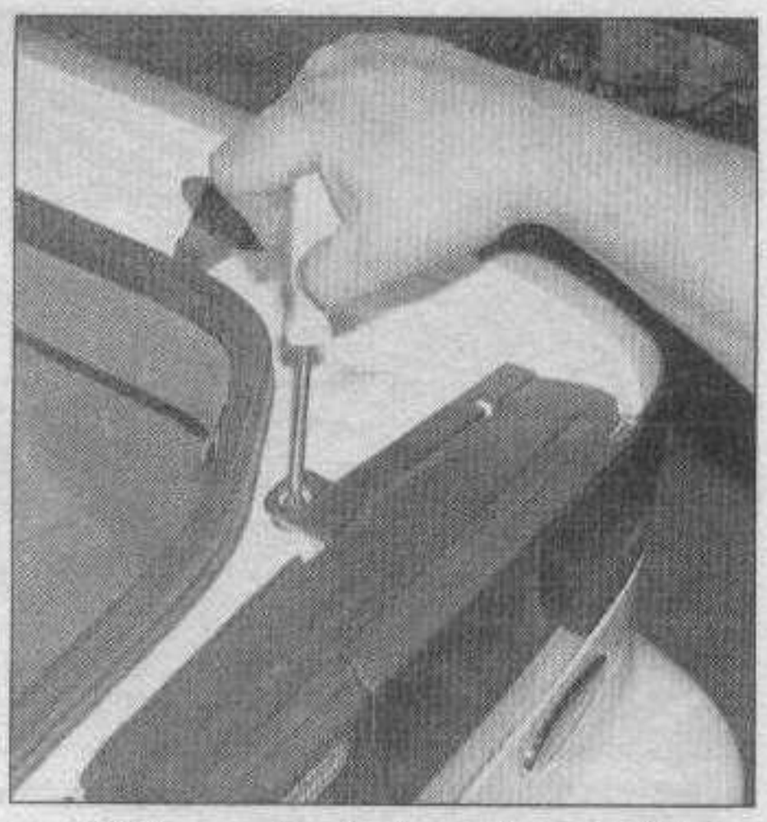
10 Disconnect the electrical connector at



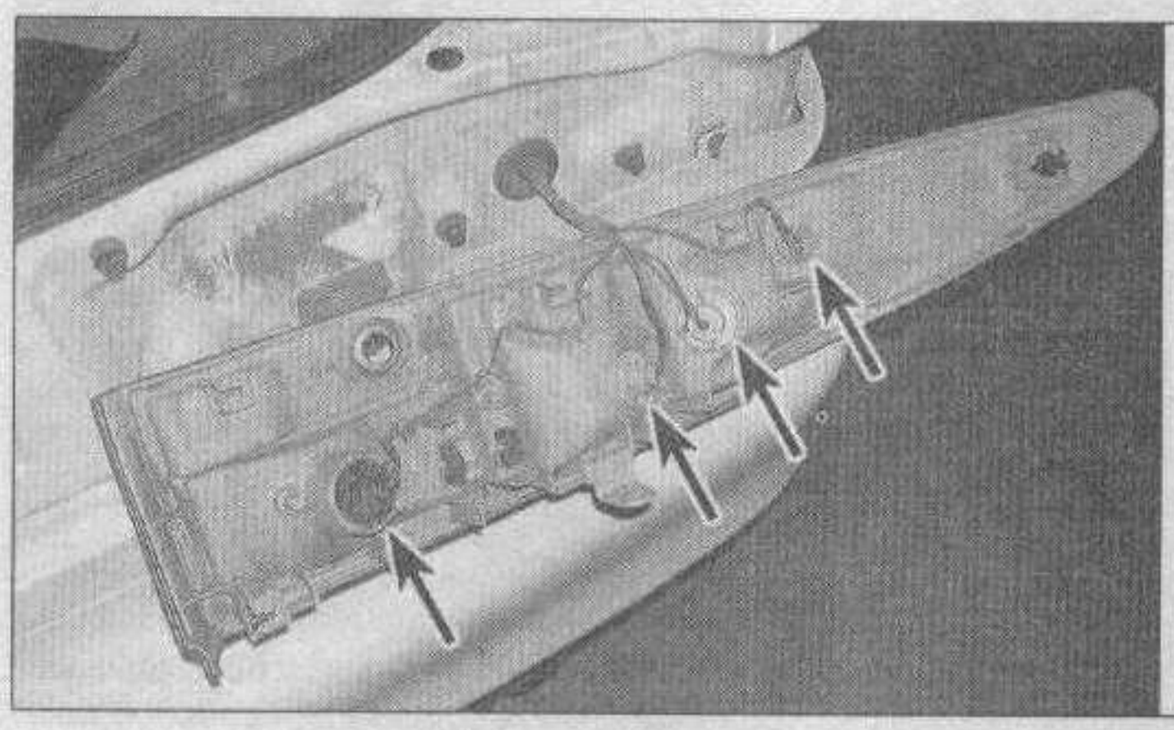
18.2a On Probe models, twist and remove the front turn signal (A) and parking light (B) sockets (bumper cover removed for clarity only)



18.2b On Mazda models with a separate combination light housing, remove the bolt (arrow) at the headlight housing, then rotate the combination housing forward and out (the rear is retained by a prong that fits into a grommet in the body)



18.6a Remove the screw on Probe models to release the taillight cover and housing . . .



18.6b . . . then twist and pull the housing free of the tabs on the body - remove the bulb holders (arrows)

the headlight housing and separate the housing's link from the raising mechanism **(see illustration)**. Remove the housing.

11 Installation is the reverse of the removal. Refer to Section 15 and adjust the headlight aiming whenever the headlight housing has been removed.

17 Headlight door actuators (Probe only) - check and replacement

Check

1 If the headlights do not raise, either when turning the headlight switch On or pushing the headlight retractor switch on 1993 models, check the 20-amp cartridge fusible link in the engine compartment fuse/relay box (see Section 3).

2 Disconnect the electrical connector at the headlight actuator motor.

3 Using a voltmeter or test light, check for battery power at the red/white wire terminal of the actuator motor harness connector. Using an ohmmeter or self-powered test light, check for continuity to chassis ground at the black wire terminal. If power and ground are not available, repair the wiring harness.

4 With the headlight switch (and retractor switch on 1993 models) Off, check for battery power at the orange/black wire terminal of the actuator harness connector. The red wire terminal should have no power with the switch Off. Turn the headlight switch On (and the retractor switch on 1993 models), battery power should now be present at the red wire terminal and no power at the orange/black wire terminal. If the control circuit did not operate as described, there is a problem with the control module controlling the retractors. Have the system checked by a dealer service department or other properly equipped repair facility.

5 If the power and ground circuits are good and the control circuits operate as described, but the retractor does not operate when connected, replace the retractor motor assembly.

Replacement

6 Refer to Section 16 and remove the headlight housings.

7 Remove the three bolts holding the headlight actuator motor bracket to the body **(see illustration 16.10)**.

8 Disconnect the electrical connector at the headlight actuator motor and remove the motor with the bracket. If the motor is to be replaced, remove the three bolts holding the motor to the bracket.

9 Installation is the reverse of the removal procedure.

18 Bulb replacement

Warning: *Bulbs remain hot for up to twenty minutes after they're turned off. Be sure bulbs are off and cool before you touch them.*

Exterior lights

Front turn signal/park light

Refer to illustrations 18.2a and 18.2b

1 On Probe models, remove the screws and pull down the front portion of the inner fender liner (refer to Chapter 11), this provides just enough room for your hand to reach in and access the two bulb holders.

2 Turn the bulb holder counterclockwise and pull it out of the housing **(see illustrations)**. **Note:** *On some Mazda models/years, the headlight and combination light are one-piece. Refer to Section 16 for headlight housing removal for access to the combination light bulbs.*

3 Pull the bulb out of the holder.

4 Installation is the reverse of removal.

Rear turn signal, brake light and taillight bulbs

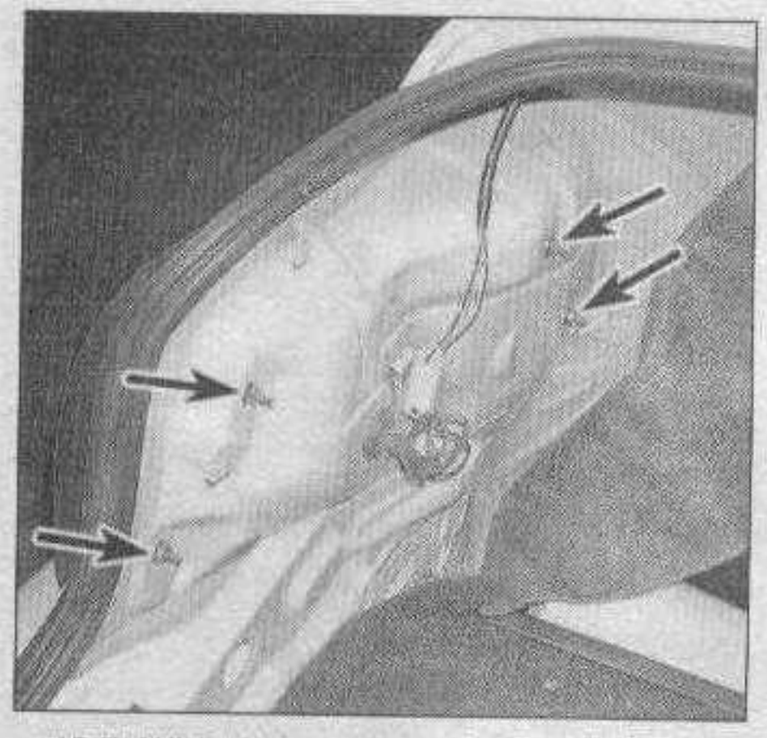
Refer to illustrations 18.6a, 18.6b and 18.7

5 Open the trunk/liftgate.

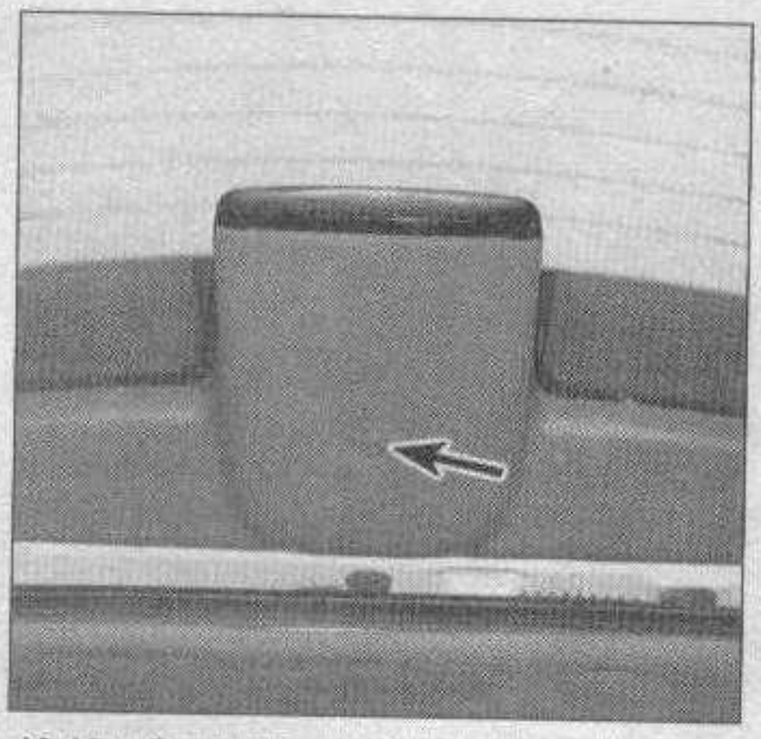
6 On Probe models, remove the top screw holding the taillight housing cover and housing to the body, then rotate the housing down to access the bulbs **(see illustrations)**.

7 On Mazda models, pull back the trunk liner to expose the four nuts retaining the housing that contains the bulbs for the brake, tail, turn and backup lights **(see illustration)**.

8 To replace any rear bulb, rotate the bulb holder 1/8-turn counterclockwise and pull it

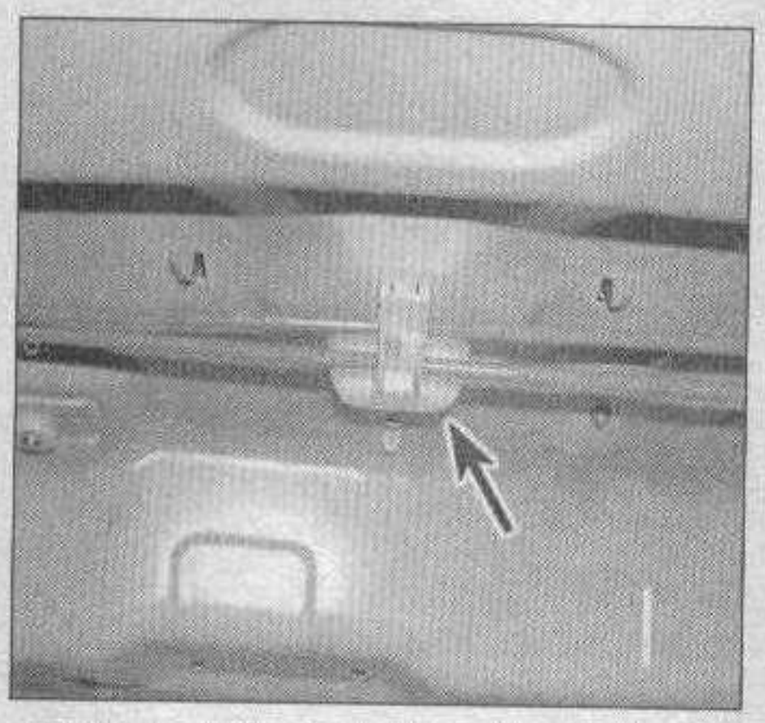


18.7 With the trunk panel pulled back, remove the four nuts (arrows) and pull the light housing away from the body to access the bulb holders

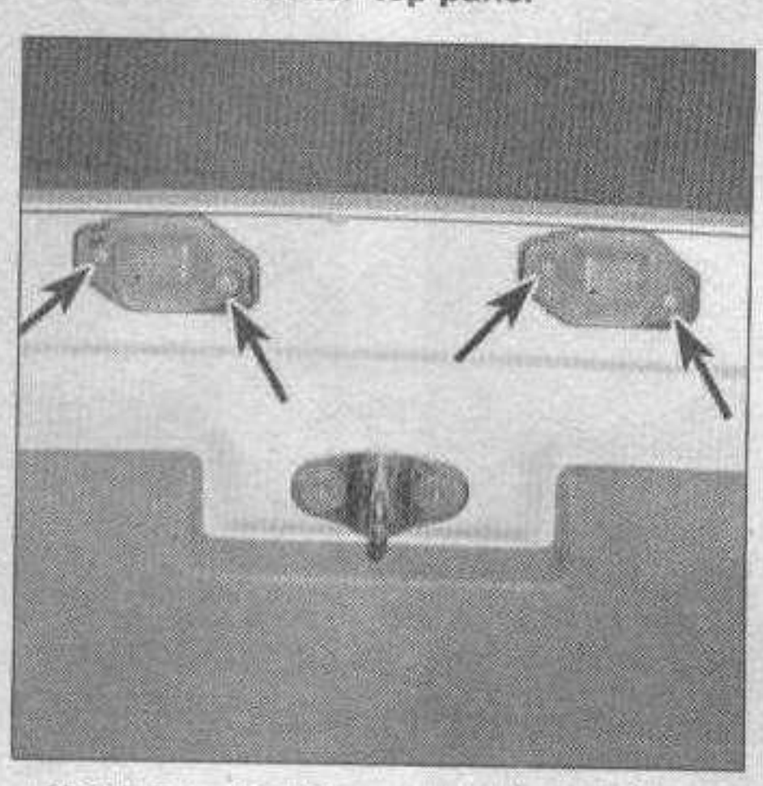


18.12a On Probe models, remove the two side trim panels on the liftgate, then remove the plastic pin (arrow) and the center-top panel

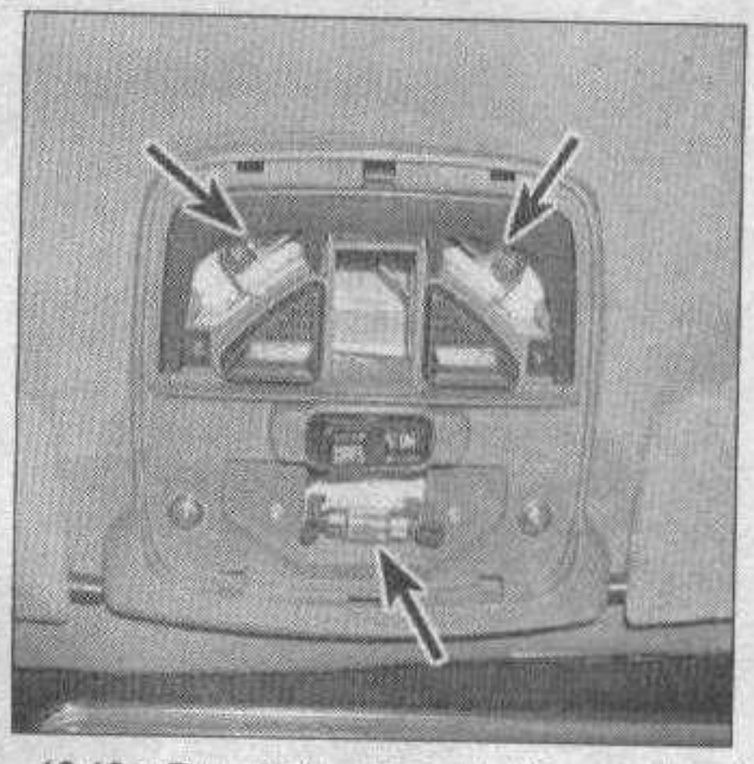
18.12b The two bulb holders (arrows) on Probe models are accessed once the trim panel is removed



18.12c On Mazda models, the package-shelf-mounted high-mount brake light's cover is released by pressing this plastic tab (arrow) inside the trunk, under the package shelf



18.15 Remove the screws (arrows) and the two license plate light housings to access the bulbs (Probe shown, Mazda similar)



18.18a Pry off the clear plastic cover to access the dome light bulbs (arrows) - Probe model shown

out of the housing, then pull the bulb out.

9 Installation is the reverse of removal.

High-mounted brake light

Refer to illustrations 18.12a, 18.12b and 18.12c

10 Open the trunk/liftgate.

11 On Probe models the high-mounted brake light is mounted to the underside of the liftgate glass at the top, while on Mazda models the light is mounted on the rear package shelf.

12 Remove the cover from the high-mount brake light to access the bulb **(see illustrations)**.

13 Twist the bulb holder counterclockwise to remove it, then pull the bulb straight out of the holder.

14 Installation is the reverse of removal.

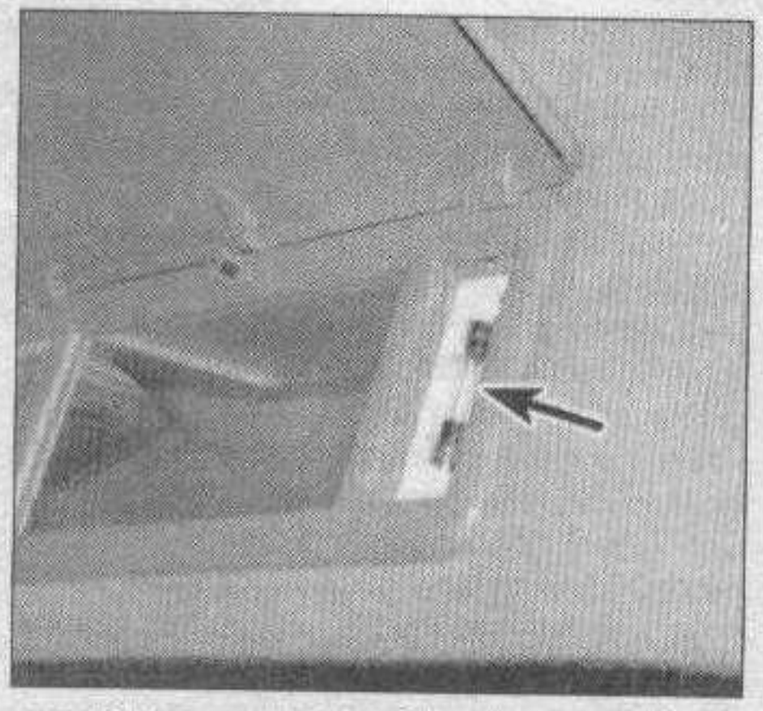
License plate lights

Refer to illustration 18.15

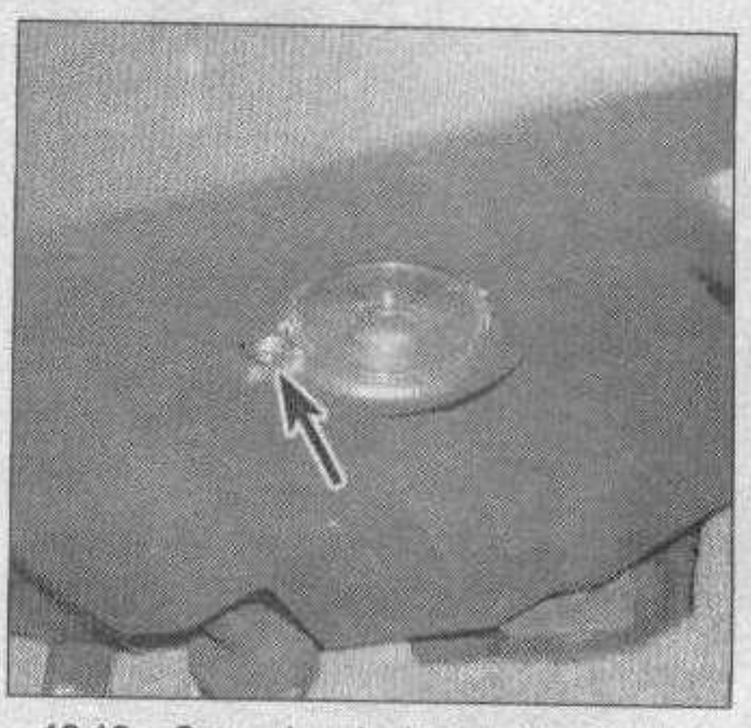
15 Unbolt the two license plate housings from the trunk lid/liftgate **(see illustration)**.

16 Pull the bulb straight out of the holder.

17 Installation is the reverse of removal.



18.18b Remove the cover to access the bulb (arrow) for the vanity mirror light



18.18c On under-dash courtesy lights, remove the screw (arrow) to access the bulb

Interior lights

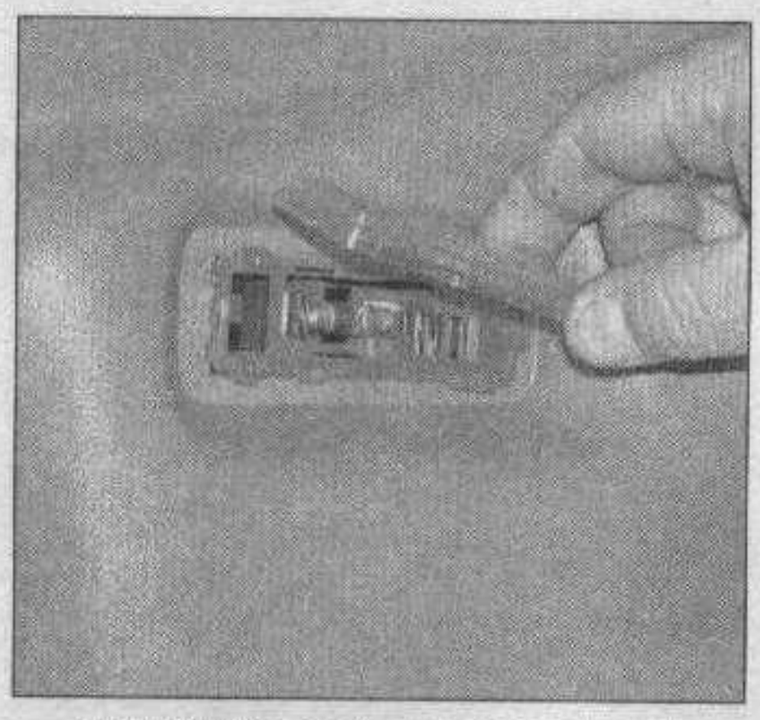
Dome/interior lights

Refer to illustrations 18.18a, 18.18b, 18.18c and 18.18d

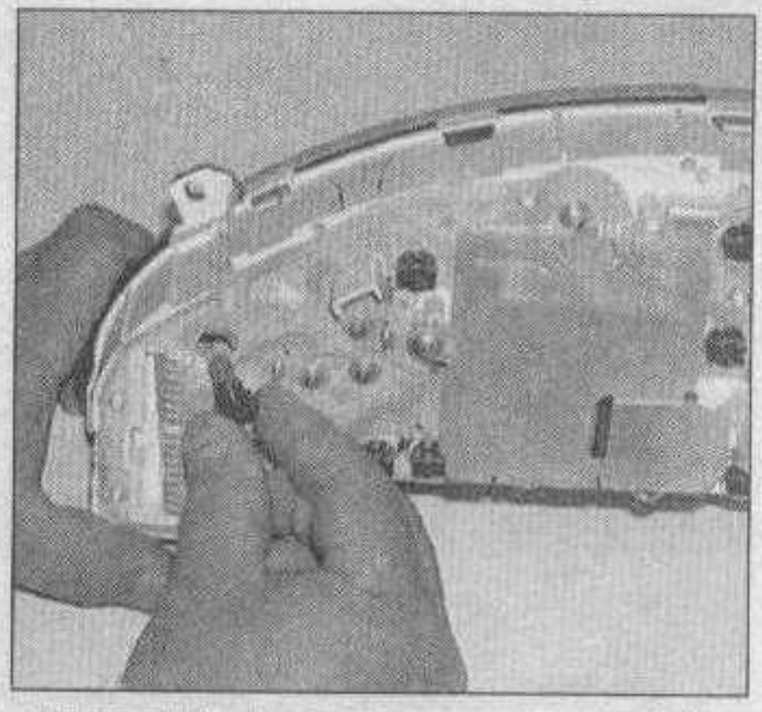
18 Interior lights are accessed by removing their covers and extracting the bulb(s) **(see illustrations)**. **Note:** *When replacing interior light bulbs, the battery should be disconnected or the doors kept shut while replacing the bulbs, since these bulbs will be illuminated (and hot) when the door is open.*

19 When handling the prong-type interior

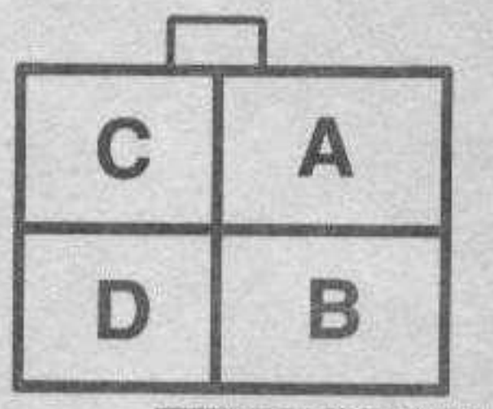
12



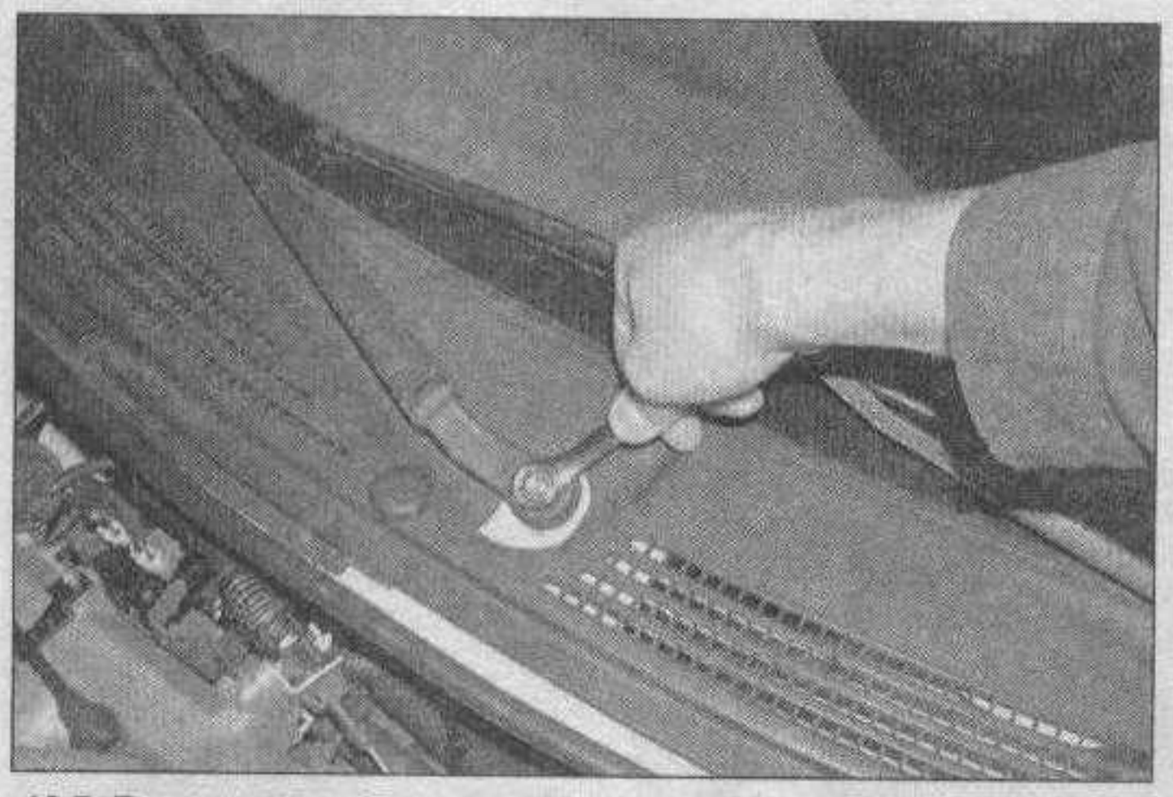
18.18d Where trunk compartment courtesy lights are used, pry off the plastic cover to access the bulb



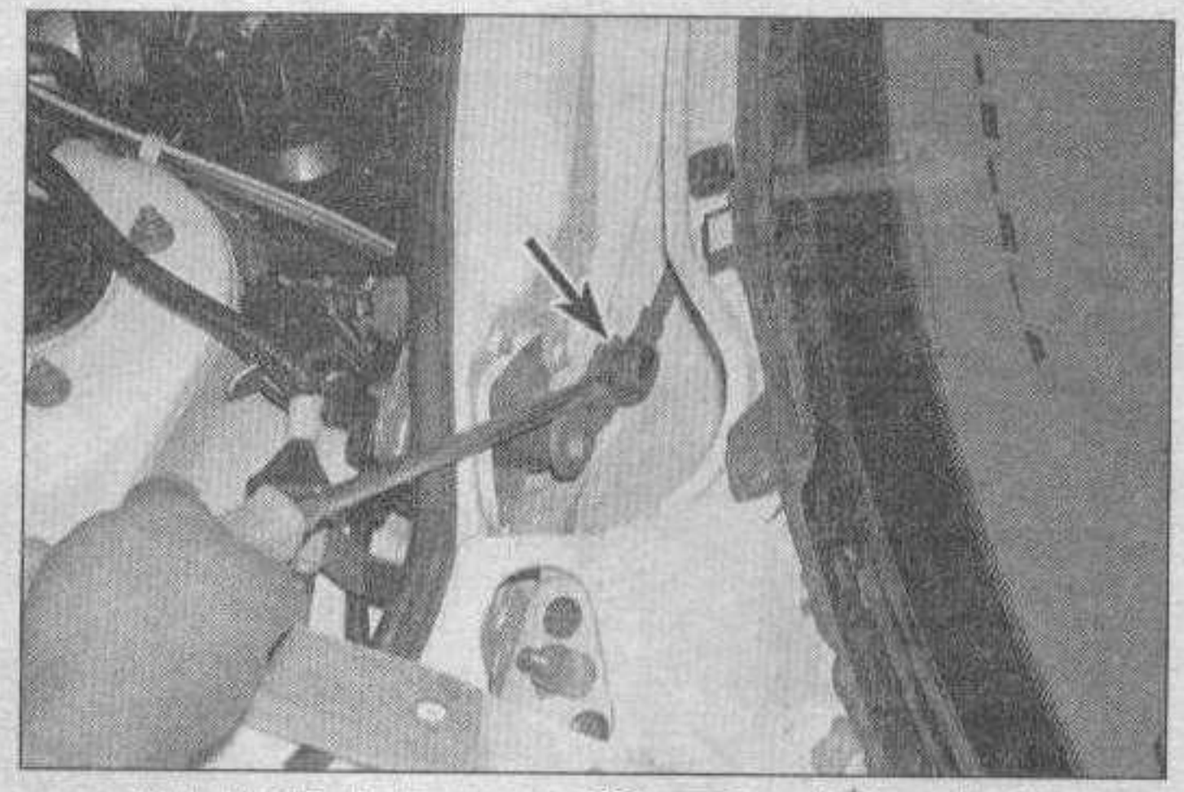
18.21 Twist the instrument cluster bulb holders to remove them from the cluster for bulb replacement



19.4 Wiper motor terminal identification - the motor should run at low speed with battery voltage applied to terminal C and high speed with battery voltage applied to terminal A



19.7 Remove the wiper arm nut, then pull the arm off carefully to avoid scratching the hood



19.9 Pry the linkage arm off the wiper pin(arrow) with a large screwdriver

bulbs (the type with contacts at each end that fit into spring clips), use gloves or a cotton cloth to hold them. Acid from your fingers could damage the glass of these hot-running bulbs.

Instrument panel lights

Refer to illustration 18.21

20 To gain access to the instrument panel lights, the instrument cluster will have to be removed first (see Section 11).

21 Rotate the bulb counterclockwise and remove it from the instrument cluster **(see illustration)**.

22 Pull the bulb straight out of the holder.

23 Installation is the reverse of removal.

Note: *Make sure you replace the bulb with the same wattage as the original bulb. The gauge bulbs have higher wattage than the indicator bulbs.*

19 Wiper motor - check and replacement

Check

Refer to illustration 19.4

1 If the wipers fail to operate when activated, check the 20-amp Wiper fuse. If the fuse is OK, disconnect the wiper motor connector and check for battery voltage at the blue wire terminal with the ignition switch On. If battery power is not available, check for an open circuit from the fuse box to the wiper motor.

2 Turn the wiper switch on low speed and check for battery power at the blue/white wire terminal. Turn the wiper switch to the high speed position and check for battery power at the red or blue/red wire terminal. If the results are not as described, check the multi-function switch (see Section 7)

3 Check for continuity between the wiper motor housing and chassis ground. If the motor is not grounded, repair the ground connection.

4 If the wiper switch, power and ground circuits are good, disconnect the wiper motor connector and using a fused jumper wire, apply battery voltage to the low and high speed terminals at the wiper motor **(see illustration)**. If the motor doesn't operate at the desired speed, replace it.

5 If the interval (delay) function is inoperative, check the continuity of all the wiring between the switch and wiper motor. If the wiring is OK, the switch is probably defective (see Section 7).

6 If the wipers stop at the position they're in when the switch is turned off (fail to park), check for a defective switch, an open circuit between the wiper motor and the switch or a defective motor. If the wipers won't shut off unless the ignition is Off, check for a defective switch or a short to battery power in the blue/white or blue/red wires from the switch to the motor.

Replacement

Refer to illustrations 19.7, 19.9, 19.10a and 19.10b

7 Remove the windshield wiper arms **(see illustrations)**.

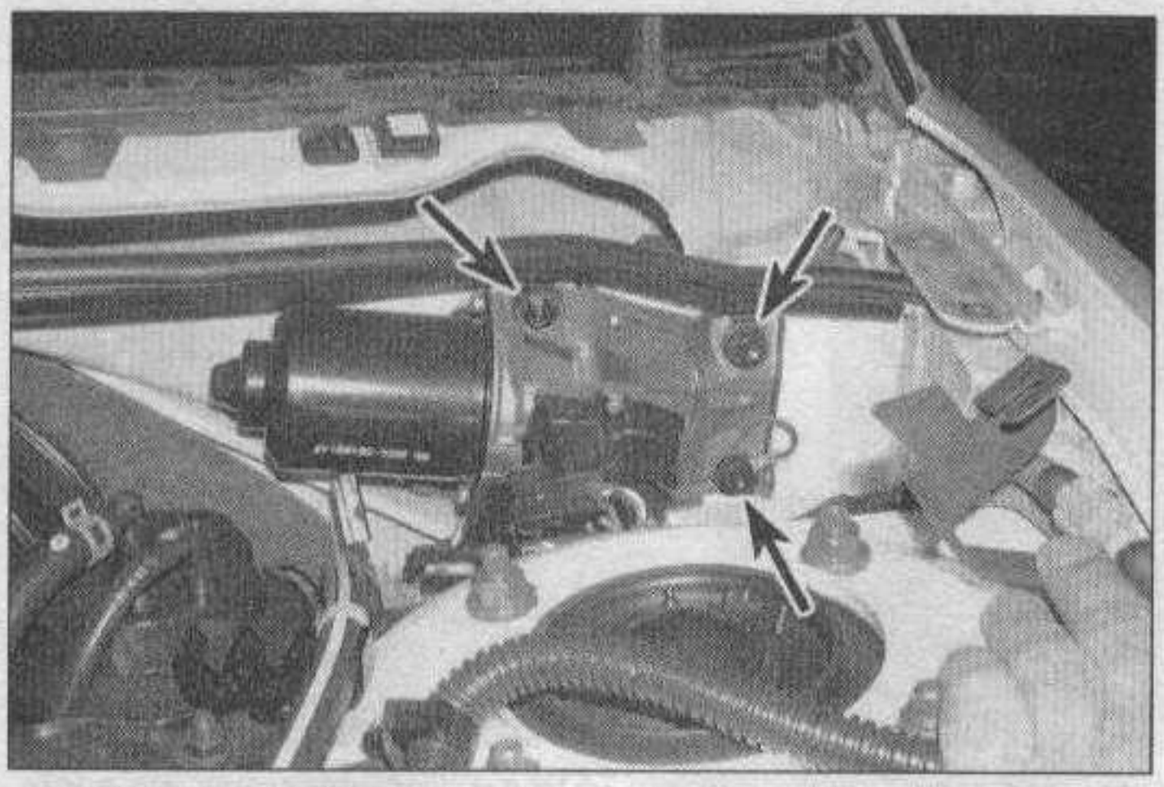
8 Remove the cowl cover (see Chapter 11).

9 Disconnect the wiper motor/linkage from the motor **(see illustration)**.

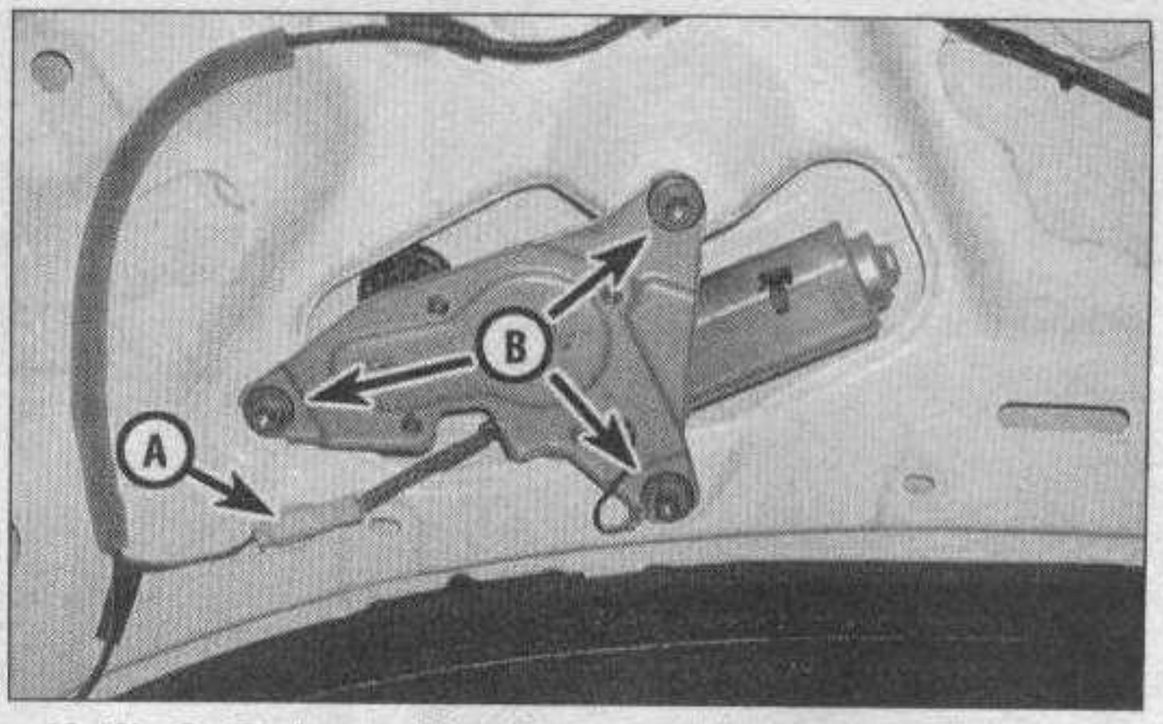
10 Remove the wiper motor retaining bolts **(see illustrations)**. **Note:** *On Probe models, refer to Chapter 11 for removal of the liftgate trim for access to the rear wiper motor.*

11 Disconnect the electrical connector from the wiper motor and remove the motor.

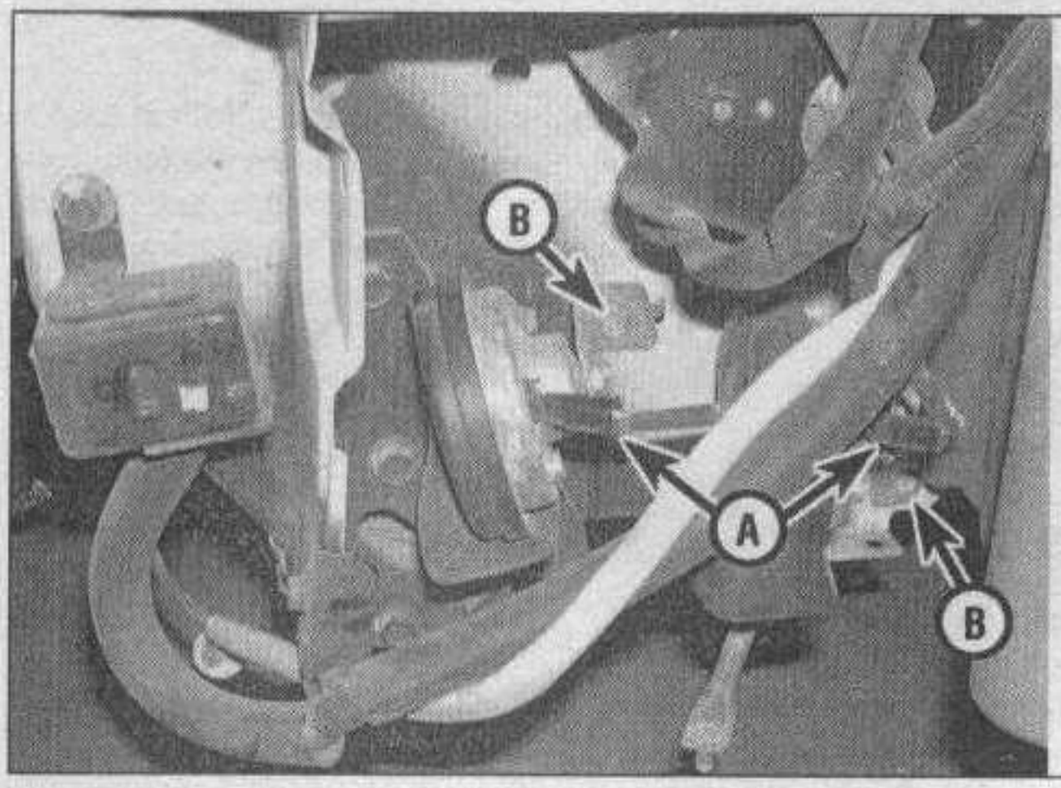
12 Installation is the reverse of removal.



19.10a Remove the bolts (arrows) and remove the wiper motor



19.10b On Probe models with rear window wipers, disconnect the electrical connector (A), then remove the motor mounting bolts (B)



20.1 Horn electrical connectors (A) and mounting bolts (B)

20 Horn - check and replacement

Check

Refer to illustration 20.1

Note: *Check the fuses before beginning electrical diagnosis.*

1 Disconnect the electrical connector from the horn **(see illustration)**.

2 To test the horns, connect battery voltage to the horn terminals with a pair of jumper wires. If either horn doesn't sound, replace it.

3 If the horn does sound, check for voltage at the horn connector when the horn switch is depressed. If there's voltage at the connector, check for a bad ground at the horn.

4 If there's no voltage at the horn, check the relay (see Section 5).

5 If the relay is OK, check for voltage to the relay power and control circuits. If either of the circuits is not receiving voltage, inspect the wiring between the relay and the fuse panel.

6 If both relay circuits are receiving voltage, depress the horn switch and check the circuit from the relay to the horn switch for continuity to ground. If there's no continuity, check the circuit for an open. If there's no open circuit, replace the horn switch.

7 If there's continuity to ground through the horn switch, check for an open or short in the circuit from the relay to the switch.

Replacement

8 To access the horns, the left front inner fenderwell must first be removed (see Chapter 11).

9 Disconnect the electrical connectors and remove the bracket bolts **(see illustration 20.1)**.

10 Installation is the reverse of removal.

21 Daytime Running Lights (DRL) - general information

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

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

22 Rear window defogger - check and repair

1 The rear window defogger consists of a number of horizontal heating elements baked onto the inside surface of the glass. Power is supplied through a large fuse from the power distribution box in the engine compartment. The heater is controlled by the instrument panel switch.

2 Small breaks in the element can be repaired without removing the rear window.

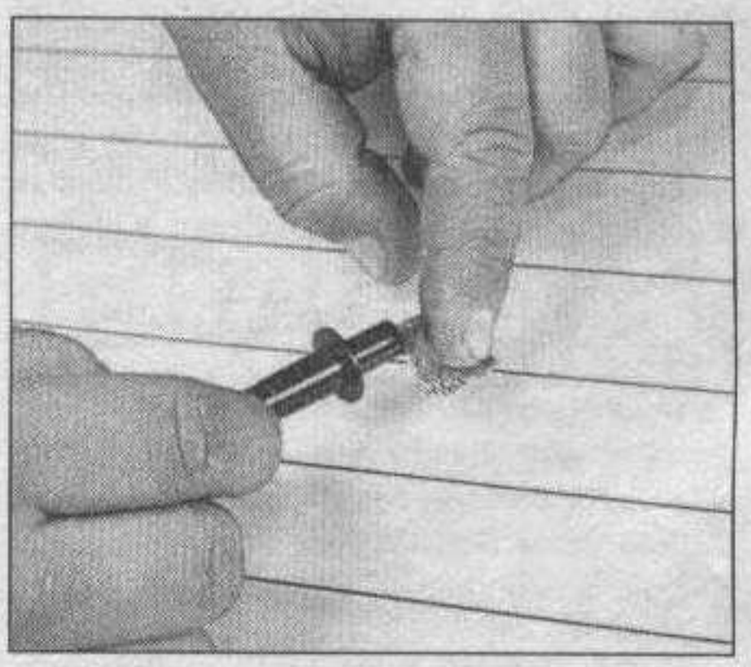
Check

Refer to illustrations 22.5, 22.6 and 22.8

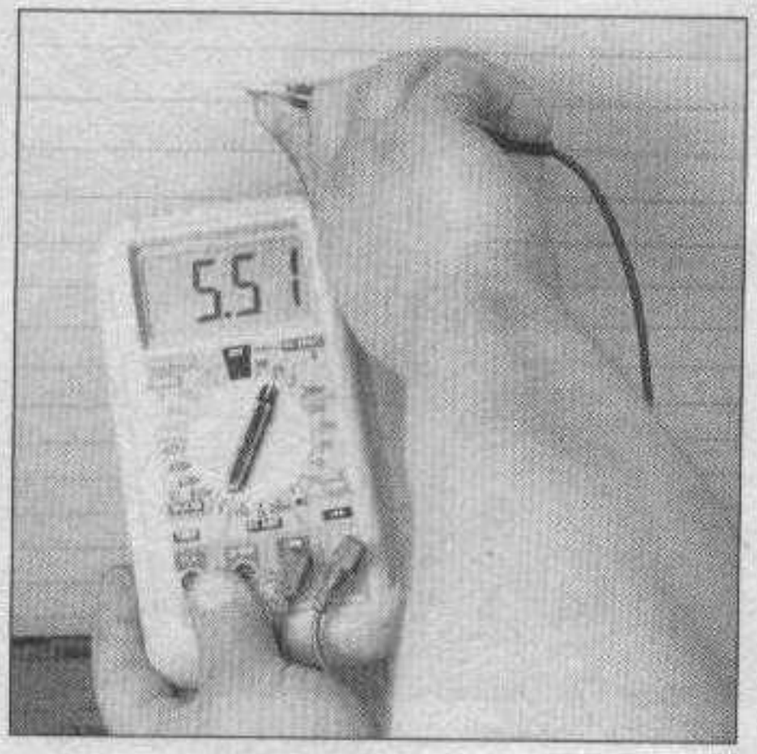
3 Turn the ignition switch and defogger switches to the On position.

4 Using a voltmeter, place the positive probe against the defogger grid positive terminal and the negative probe against the ground terminal. If battery voltage is not indicated, check the fuse, defogger switch, defogger relay and related wiring. If voltage is indicated, but all or part of the defogger doesn't heat, proceed with the following tests.

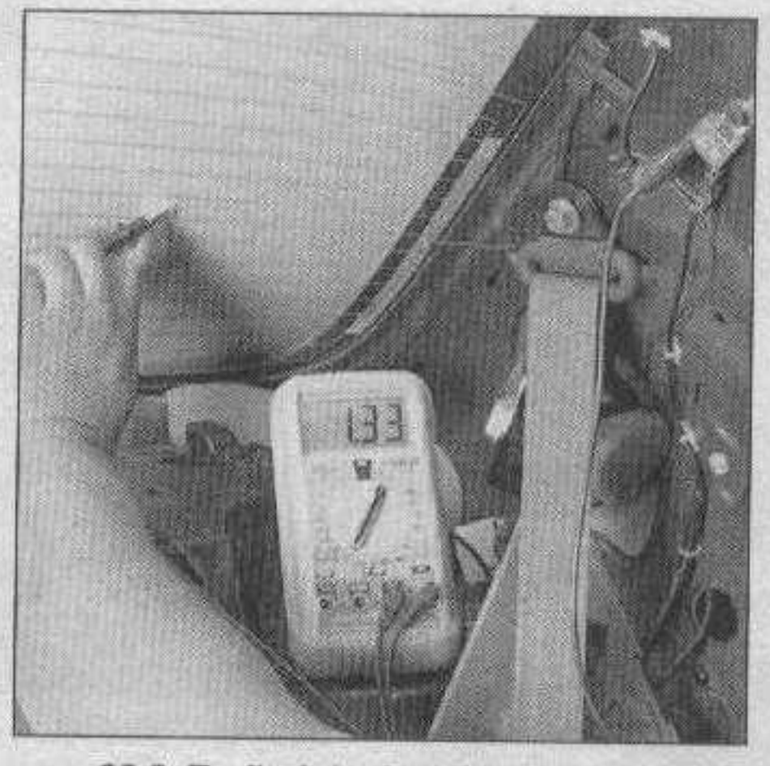
5 When measuring voltage during the next two tests, wrap a piece of aluminum foil



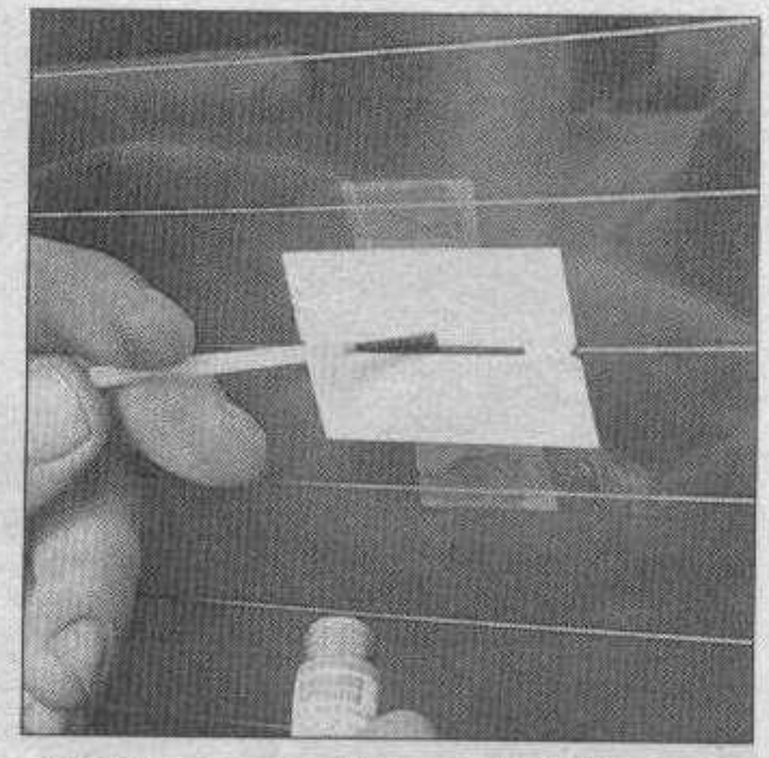
22.5 When measuring the voltage at the rear window defogger grid, wrap a piece of aluminum foil around the positive probe of the voltmeter and press the foil against the wire with your finger



22.6 To determine if a wire has broken, check the voltage at the center of each wire. If the voltage is 5 to 6 volts, the wire is unbroken; if the voltage is 10 to 12 volts, the wire is broken between the center of the wire and the ground side; if the voltage is 0 volts, the wire is broken between the center of the wire and the power side



22.8 To find the break, place the voltmeter negative lead against the defogger ground terminal, place the voltmeter positive lead with the foil strip against the heat wire at the positive terminal end and slide it toward the negative terminal end - the point at which the voltmeter deflects from several volts to zero volts is the point at which the wire is broken



22.14 To use a defogger repair kit, apply masking to the inside of the window at the damaged area, then brush on the special conductive coating

around the tip of the voltmeter positive probe and press the foil against the heating element with your finger **(see illustration)**. Place the negative probe on the defogger grid ground terminal.

6 Check the voltage at the center of each heating element **(see illustration)**. If the voltage is 5 to 6 volts, the element is okay (there is no break). If the voltage is 0 volts, the element is broken between the center of the element and the positive end. If the voltage is 10 to 12 volts the element is broken between the center of the element and the ground side. Check each heating element.

7 If none of the elements are broken, connect the negative probe to a good chassis ground. The voltage reading should stay the same, if it doesn't the ground connection is bad.

8 To find the break, place the voltmeter negative probe against the defogger ground terminal. Place the voltmeter positive probe with the foil strip against the heating element at the positive side and slide it toward the negative side. The point at which the voltmeter deflects from several volts to zero is the point where the heating element is broken **(see illustration)**.

Repair

Refer to illustration 22.14

9 Repair the break in the element using a repair kit specifically for this purpose, such as Dupont paste No. 4817 (or equivalent). The kit includes conductive plastic epoxy.

10 Before repairing a break, turn off the system and allow it to cool for a few minutes.

11 Lightly buff the element area with fine steel wool; then clean it thoroughly with rubbing alcohol.

12 Use masking tape to mask off the area being repaired.

13 Thoroughly mix the epoxy, following the kit instructions.

14 Apply the epoxy material to the slit in the masking tape, overlapping the undamaged area about 3/4-inch on either end **(see illustration)**.

15 Allow the repair to cure for 24 hours before removing the tape and using the system.

23 Cruise control system - description, check and cable adjustment

Refer to illustration 23.5

1 The cruise control system maintains vehicle speed with a servo motor located in the engine compartment on the driver's side fenderwell. This servo is connected to the throttle linkage by a cable. The system consists of the servo motor, brake switch (clutch switch on manual transmission models), control switches, speed sensors and relays. Some features of the system require special testers and diagnostic procedures which are beyond the scope of this manual. Listed below are some general procedures that may be used to locate common problems.

2 Locate and check the fuse (see Section 3).

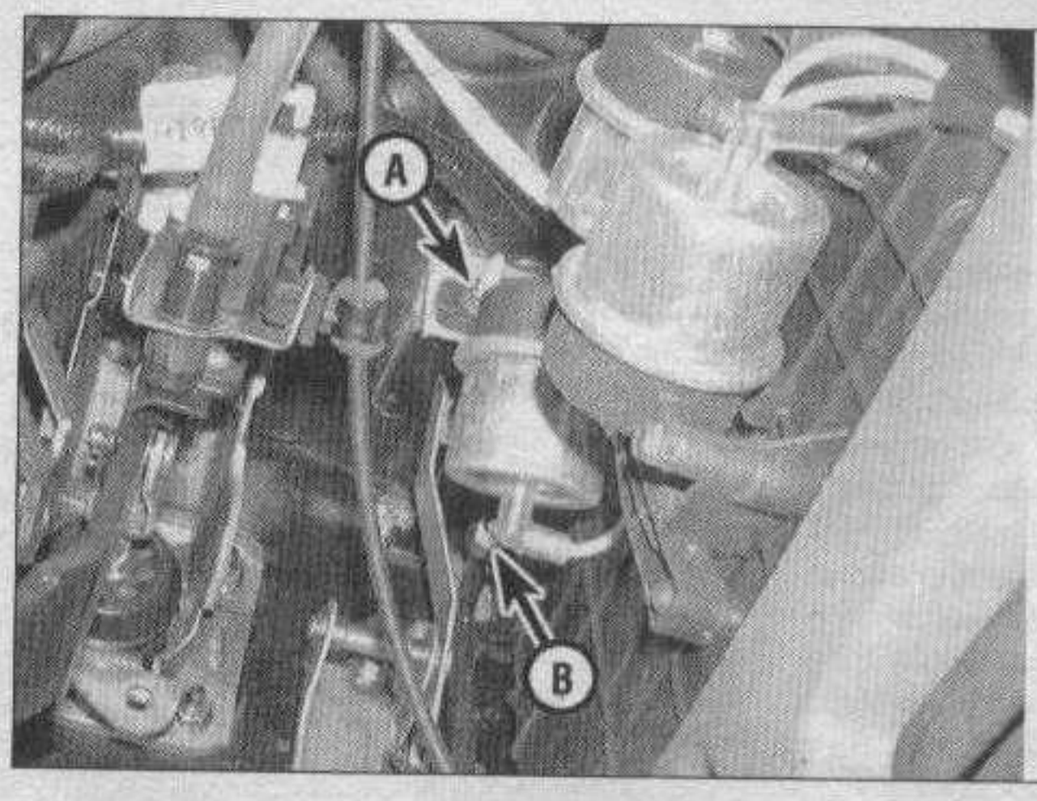
3 The brake light switch deactivates the cruise control system. Have an assistant press the brake pedal while you check the brake light operation.

4 If the brake lights do not operate properly, correct the problem and retest the cruise control.

5 Check the control cable between the cruise control servo/amplifier and the throttle linkage and adjust/replace as necessary **(see illustration)**.

6 The cruise control system uses a speed sensing device. The speed sensor is located in the transmission. To test the speed sensor, see Chapter 6.

7 Test drive the vehicle to determine if the cruise control is now working. If it isn't, take it to a dealer service department or an automotive electrical specialist for further diagnosis.

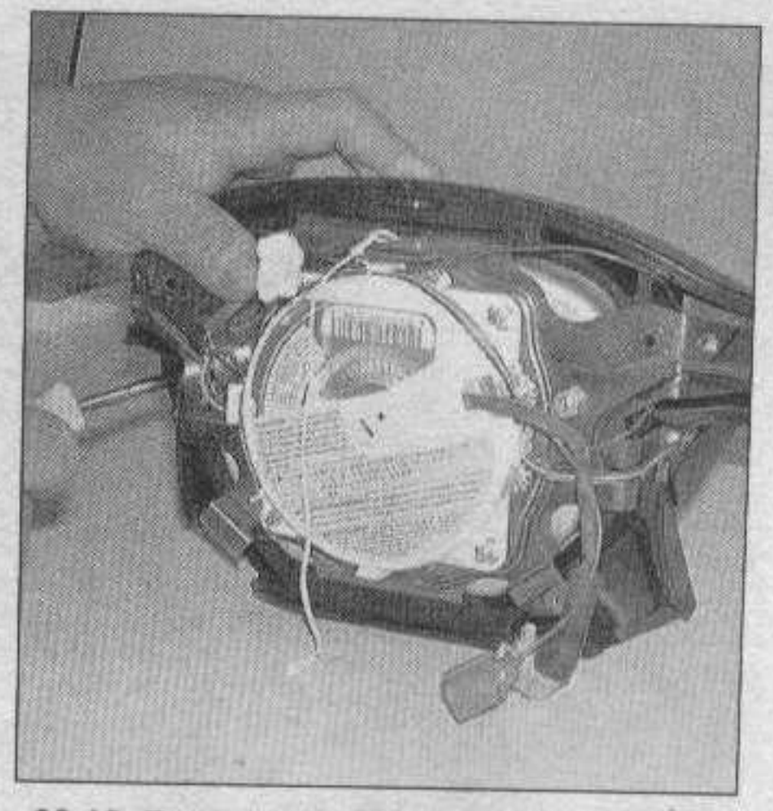


23.5 Make sure the cruise control (A) and accelerator linkage (B) mounted on the throttle pedal assembly are not damaged and that they operate smoothly together when the throttle is opened

SWITCH POSITION	RESISTANCE (ohms)
On	10,000 +
Off	Less than 5
Set/Acc	@ 680
Coast	@ 120
Resume	@ 2200

61042-12-23.10 HAYNES

23.10 Terminal identification and resistance tests (between terminals 2 and 3) at the cruise control switch connector - Probe models



23.13 Remove the screws at the back of the airbag module to remove the cruise control switch

CODE	POSSIBLE CAUSE
1	Defective wiring Defective actuator Defective brake switch
5	Defective fuse (Stop 20a)
7	Defective brake switch (two switches on at once)
11	Defective cruise switch
15	Defective cruise control module

61042-12-23.18 HAYNES

23.18 Diagnostic trouble codes for the Mazda cruise control system - codes are flashed on the indicator light

Cruise control switches

Probe models

Refer to illustrations 23.10 and 23.13

Check

8 On Probe models, the Set/Resume and On/Off switches are mounted on the steering wheel.

9 Refer to the Steps below for switch removal.

10 Using an ohmmeter and the accompanying diagram, check for continuity in each of the switch positions indicated **(see illustration)**. If the resistance isn't as specified, replace the switch. If the switches check OK, but the functions aren't correct when the switch is installed, check the harness from the switch to the control unit under the dash. **Note:** *The are two types of cruise control used on the covered vehicles, vacuum-operated and electronically-operated.*

Replacement

11 Disable the airbag system (see Section 28).

12 Remove the driver's side airbag module from the steering wheel (see Chapter 10).

13 Detach the switch-retaining screws **(see illustration)**. Then disconnect the electrical connections and remove the switches from the steering wheel.

14 Installation is the reverse of removal.

Mazda models

Refer to illustrations 23.18 and 23.21

Check

15 On Mazda models, the cruise control switches are mounted on the steering wheel, but the main cruise on/off switch is located on the instrument panel.

16 The cruise control system has a self-test function to troubleshoot problems with all aspects except the Resume/Accel switch. If this switch is bad, take your vehicle to the dealer for diagnosis.

17 To initiate the test mode, turn the ignition key On (engine not running) and press the dash-mounted main cruise switch. Press and hold the Resume/Accel switch for three seconds.

18 The cruise indicator light on the dashboard will stay on for three seconds, go off for two seconds, and then blink a trouble code if any is present **(see illustration)**. Count the number of flashes. If more than one code is present, the system will only display the higher priority code. Once that code-identified problem has been fixed, any other codes will be displayed on subsequent tests.

19 The test mode can be ended by either turning off the main cruise control switch on the dashboard or turning the ignition key to Lock.

20 To check the main switch, it must first be removed (see below).

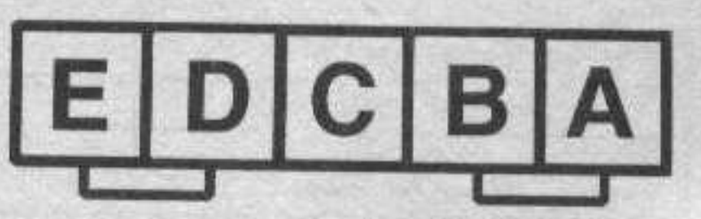
21 Using an ohmmeter or self-powered test light and the accompanying diagrams, check for continuity between the indicated switch terminals with the switch in each of the indicated positions **(see illustration)**. If the continuity isn't as specified, replace the switch.

Replacement

22 Refer to Steps 11 through 16 to replace the steering wheel mounted switch. To replace the cruise control On/Off switch, pry it from the instrument panel with a screwdriver. **Note:** *Tape the tip of the screwdriver to avoid damaging the instrument panel covering.*

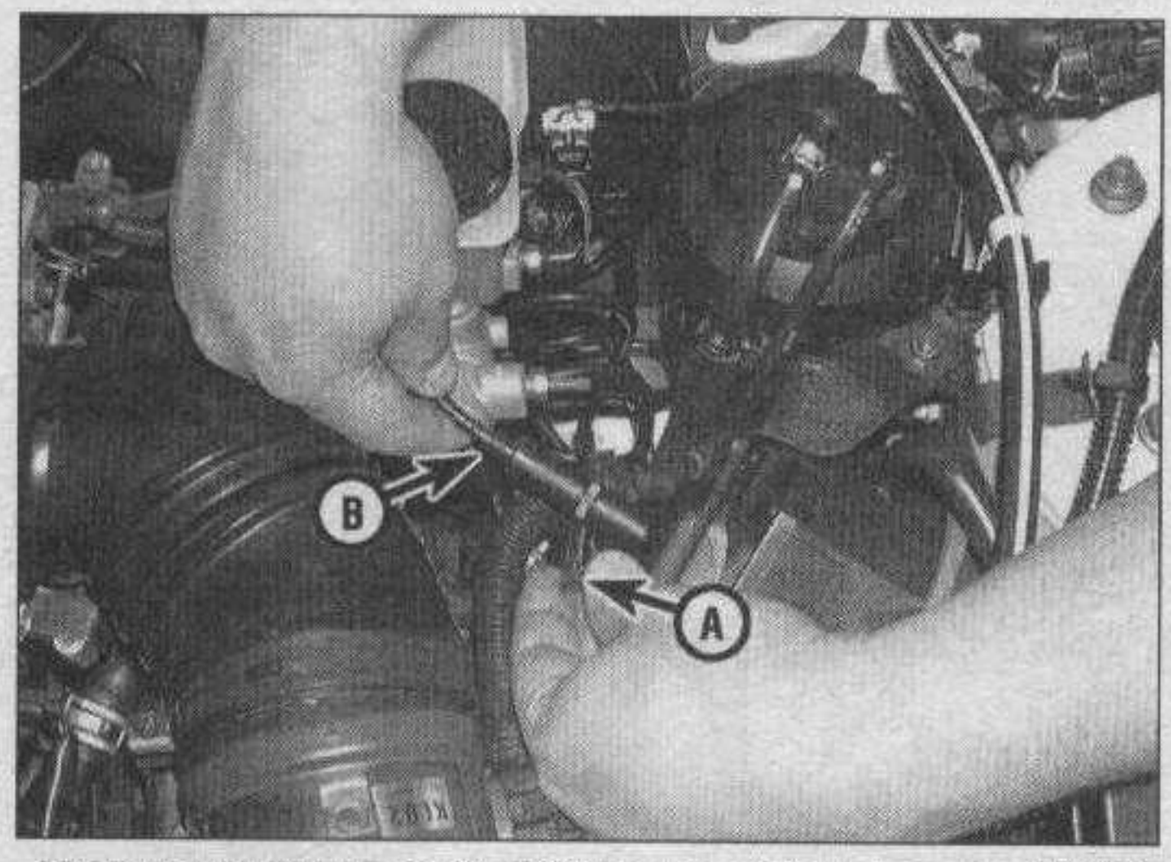
23 Disconnect the electrical connector and remove the switch from the vehicle.

24 Installation is the reverse of removal.

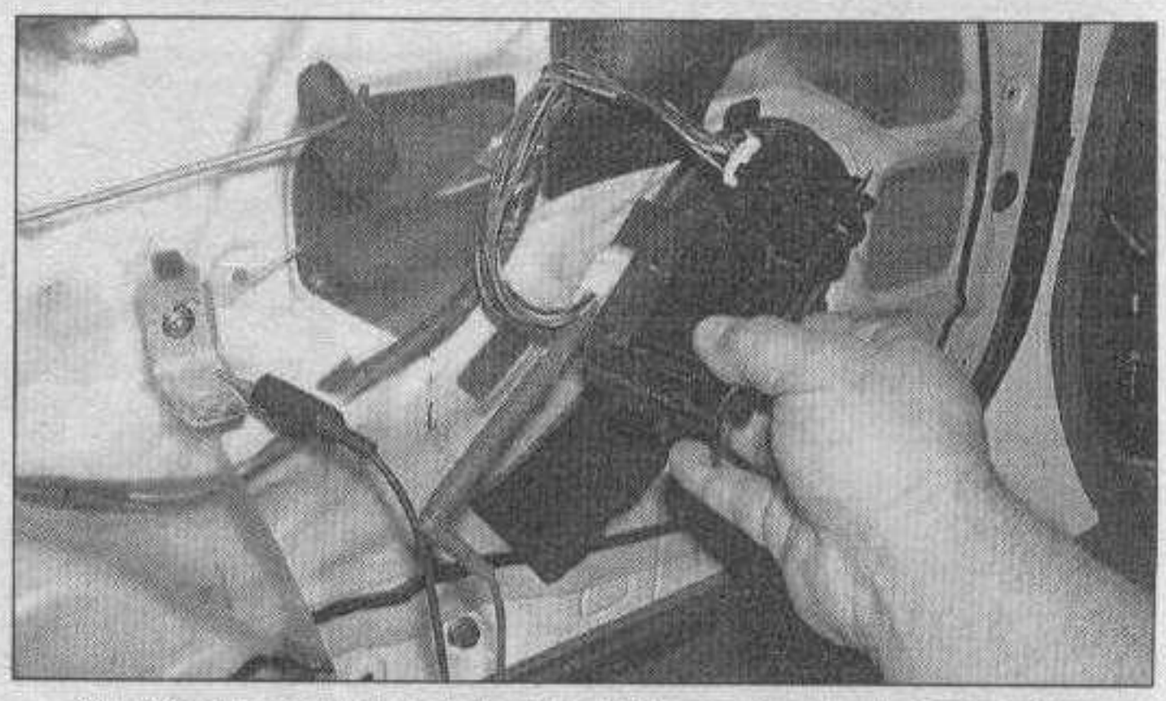


61042-12-23.21 HAYNES

23.21 Mazda Cruise control On/Off switch terminal identification - there should be continuity between terminals C and D with the switch On and no continuity with the switch Off



23.25 Remove the clip (A), obtain 3 mm of clearance at point (B) and reinsert the clip



24.12a On probe models, the drivers power window switch contains solid state circuitry - DO NOT use and ohmmeter to check for continuity, instead backprobe the connector with a voltmeter or test light and check for power at the wire terminals indicated in the accompanying chart with the switch in the indicated positions

Cable adjustment

Refer to illustration 23.25

25 Use pliers to remove the clip from the cable at the actuator end, in the engine compartment **(see illustration)**.

26 Pull the cable toward the actuator while observing the throttle linkage at the throttle body. Pull until any slack is just removed. Allow the cable to come back toward the actuator until there is 3 mm (0.120-inch) freeplay, then insert the clip.

24 Power window system - description and check

Refer to illustrations 24.12a, 24.12b, 24.12c and 24.12d

1 The power window system operates electric motors, mounted in the doors, which lower and raise the windows. The system consists of the control switches, the motors, regulators, glass mechanisms and associated wiring.

2 The power windows can be lowered and raised from the master control switch by the driver or by remote switches located at the individual windows. Each window has a separate motor which is reversible. The position of the control switch determines the polarity and therefore the direction of operation.

3 The circuit is protected by a fuse and a circuit breaker. Each motor is also equipped with an internal circuit breaker; this prevents one stuck window from disabling the whole system.

4 The power window system will only operate when the ignition switch is On. In addition, many models have a window lockout switch at the master control switch which, when activated, disables the switches at the rear windows and, sometimes, the switch at the passenger's window also. Always check these items before troubleshooting a window problem.

5 These procedures are general in nature, so if you can't find the problem using them, take the vehicle to a dealer service department or other properly equipped repair facility.

6 If the power windows won't operate, always check the fuse and circuit breaker first.

7 If only the rear windows are inoperative, or if the windows only operate from the master control switch, check the rear window lockout switch for continuity in the unlocked position. Replace it if it doesn't have continuity.

8 Check the wiring between the switches and fuse panel for continuity. Repair the wiring, if necessary.

9 If only one window is inoperative from the master control switch, try the other control switch at the window. **Note:** *This doesn't apply to the drivers door window.*

10 If the same window works from one switch, but not the other, check the switch for continuity.

11 If the switch tests OK, check for a short or open in the circuit between the affected switch and the window motor.

12 If one window is inoperative from both switches, remove the trim panel from the affected door and check for voltage at the

SWITCH POSITION	VOLTAGE AT TERMINAL
Left switch, Up	Green/blue wire
Left switch, Down	Red/blue wire
Left switch, One-touch, Down	Red/blue wire
Right switch, Up	Green/white wire
Right switch, Down	Red/white wire
Right switch, One-touch, Down	Red/white wire

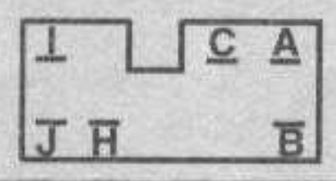
61042-12-24.12b HAYNES

24.12b Main power window switch tests - Probe models

SWITCH POSITION	CONTINUITY BETWEEN
Driver's, Down	A and J, H and L
Driver's, Up	A and L, H and J
Passenger's, Down	A and B, D and H
Passenger's, Up	A and D, B and H
Left rear, Down	A and I, K and H
Left rear, Up	A and K, I and H
Right rear, Down	A and C, E and H
Right rear, Up	A and E, C and H

61042-12-24.12c HAYNES

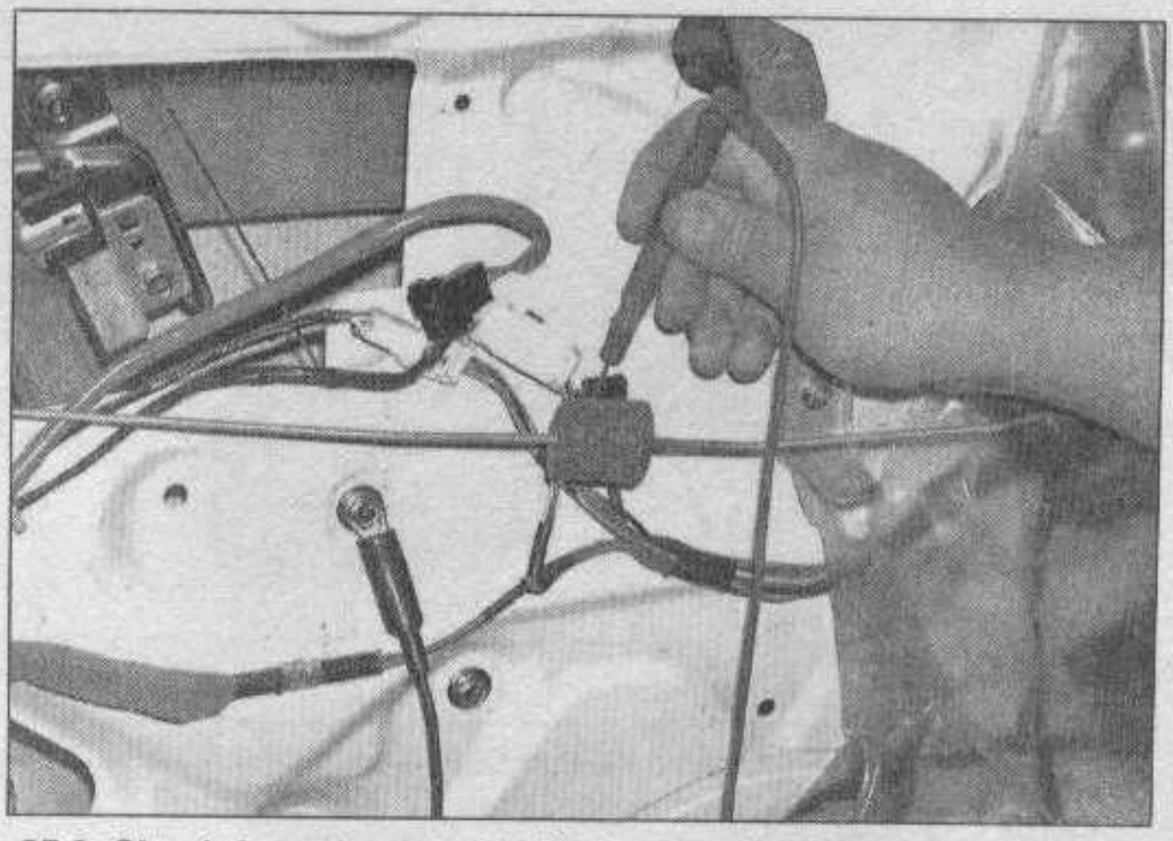
24.12c Main power window switch terminal identification and continuity table - 1997 and earlier Mazda 626 models (remove the switch and check for continuity in the various switch positions)



SWITCH POSITION	CONTINUITY BETWEEN
Driver's, Down	A and J, B and C
Driver's, Up	A and C, B and J
Passenger's, Down	C and H, I and J
Passenger's, Up	C and I, H and J
One-touch, Down	A and J, B and C
Driver's, Off	A, B and C
Passenger's, Off	C, H and I

61042-12-24.12d HAYNES

24.12d Main power window switch terminal identification and continuity table - Mazda MX-6 models (remove the switch and check for continuity in the various switch positions)



25.9 Check for voltage at the lock solenoid while the lock switch is operated

motor while the switch is operated. If a defective switch is suspected, check the switch as indicated **(see illustrations)**.

13 If voltage is reaching the motor, disconnect the glass from the regulator (see Chapter 11). Move the window up and down by hand while checking for binding and damage. Also check for binding and damage to the regulator. If the regulator is not damaged and the window moves up and down smoothly, replace the motor. If there's binding or damage, lubricate, repair or replace parts, as necessary.

14 If voltage isn't reaching the motor, check the wiring in the circuit for continuity between the switches and motors. You'll need to consult the wiring diagram for the vehicle. If the circuit is equipped with a relay, check that the relay is grounded properly and receiving voltage.

15 Test the windows after you are done to confirm proper repairs.

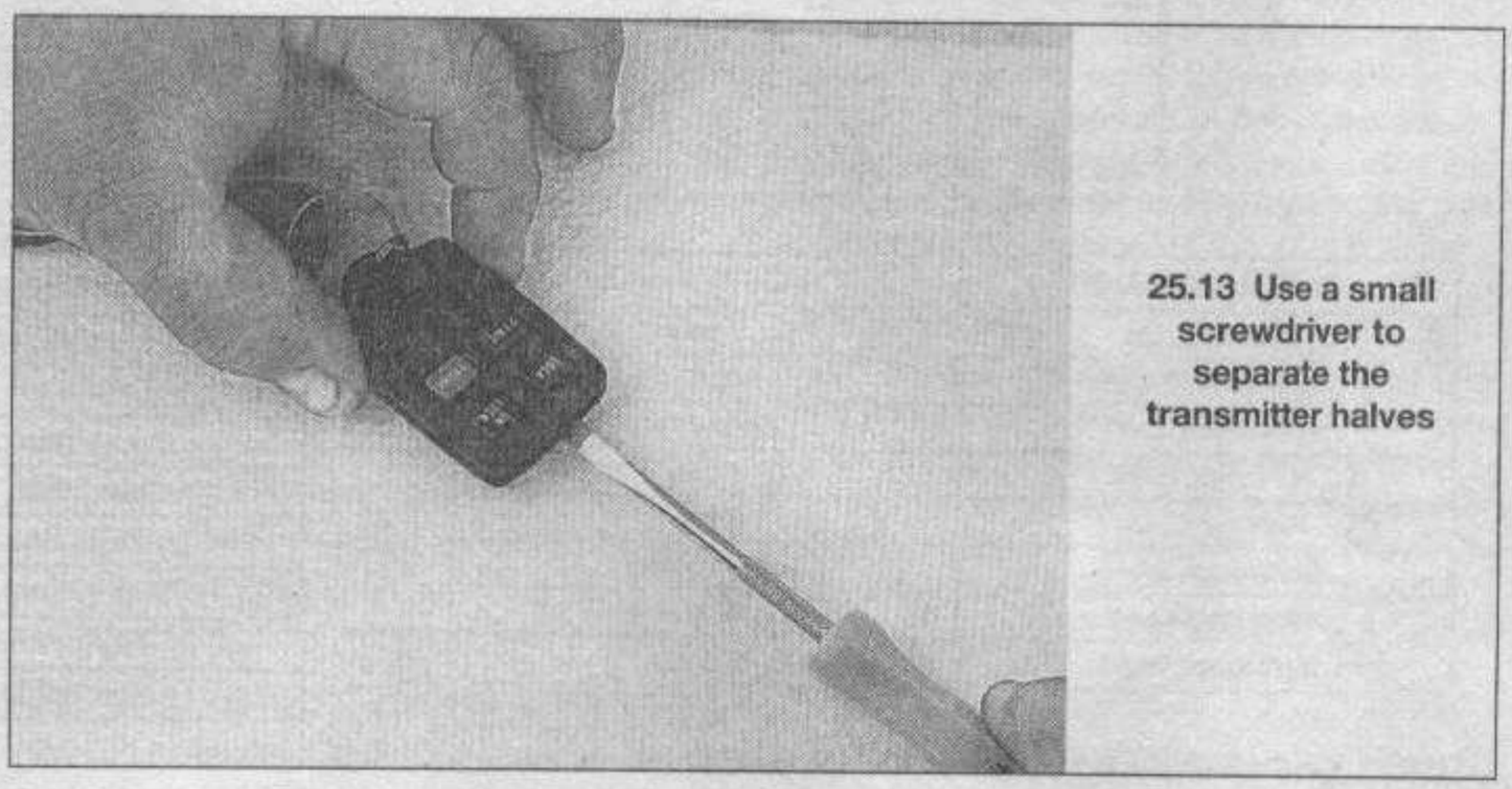
25 Power door lock and keyless entry system - description and check

Power door lock system

Refer to illustration 25.9

1 The power door lock system operates the door lock actuators mounted in each door. The system consists of the switches, actuators, and associated wiring. Diagnosis can usually be limited to simple checks of the wiring connections and actuators for minor faults which can be easily repaired.

2 Power door lock systems are operated by bi-directional solenoids or motors located in the doors. The lock switches have two operating positions: Lock and Unlock. On later models with keyless entry the switches activate a module which in turn connects voltage to the door lock solenoids or motors. Depending on which way the switch is activated, it reverses polarity, allowing the two sides of the circuit to be used alternately as the feed (positive) and ground side. On earlier models without keyless entry, the switches directly activate the door lock solenoids or motors.



25.13 Use a small screwdriver to separate the transmitter halves

3 If you are unable to locate the trouble using the following general steps, consult your dealer service department.

4 Always check the circuit protection first. On Probe models the battery voltage passes through fuses 3, 2 and 11 in the drivers side interior fuse block. On Mazda models, check the 30-amp Door Lock fuse and Room 15-amp fuse.

5 Operate the door lock switches in both directions (Lock and Unlock) with the engine off. Listen for the faint click of the door lock relay operating.

6 If there's no click, check for voltage at the switches. If no voltage is present, check the wiring between the fuse block and the switches for shorts and opens.

7 If voltage is present but no click is heard, test the switch for continuity. Replace it if there's no continuity in both switch positions.

8 If the switch has continuity but the solenoid or motor doesn't click, check the wiring between the switch and solenoid for continuity. Repair the wiring if there's not continuity.

9 If all but one lock solenoids operate, remove the trim panel from the affected door (see Chapter 11) and check for voltage at the solenoid while the lock switch is operated **(see illustration)**. One of the wires should have voltage in the Lock position; the other should have voltage in the unlock position.

10 If the inoperative solenoid is receiving voltage, replace the solenoid. **Note:** *It's common for wires to break in the portion of the harness between the body and door (opening and closing the door fatigues and eventually breaks the wires).*

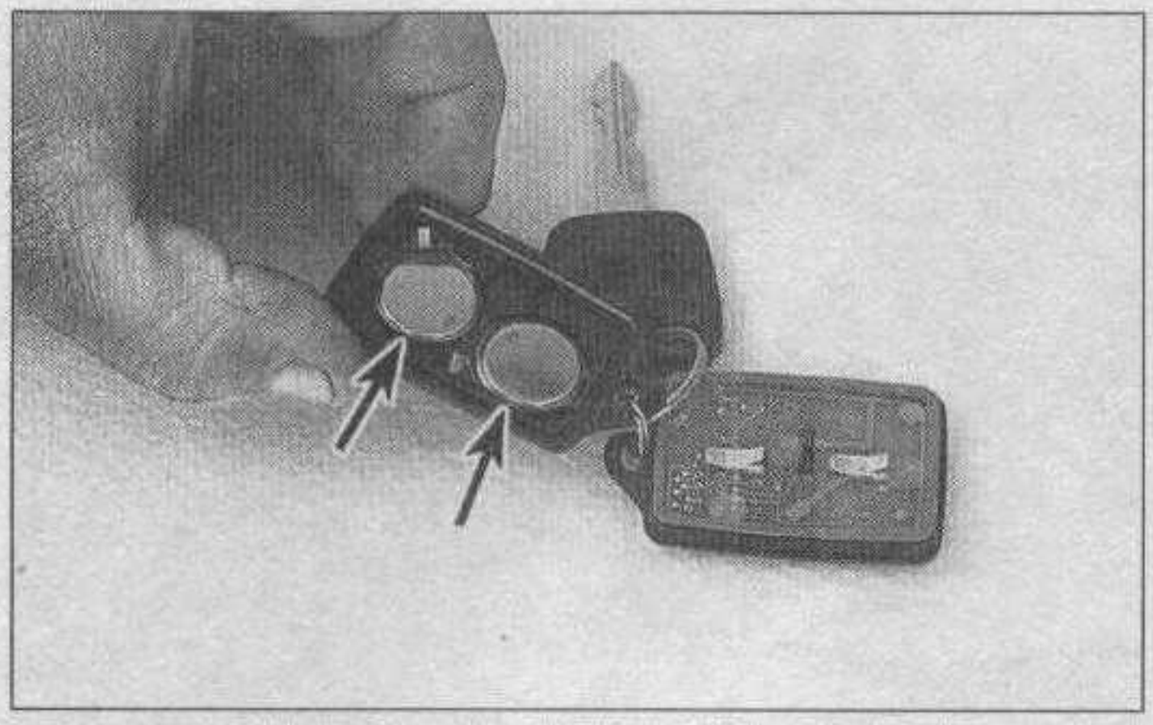
Keyless entry system

Refer to illustrations 25.13 and 25.14

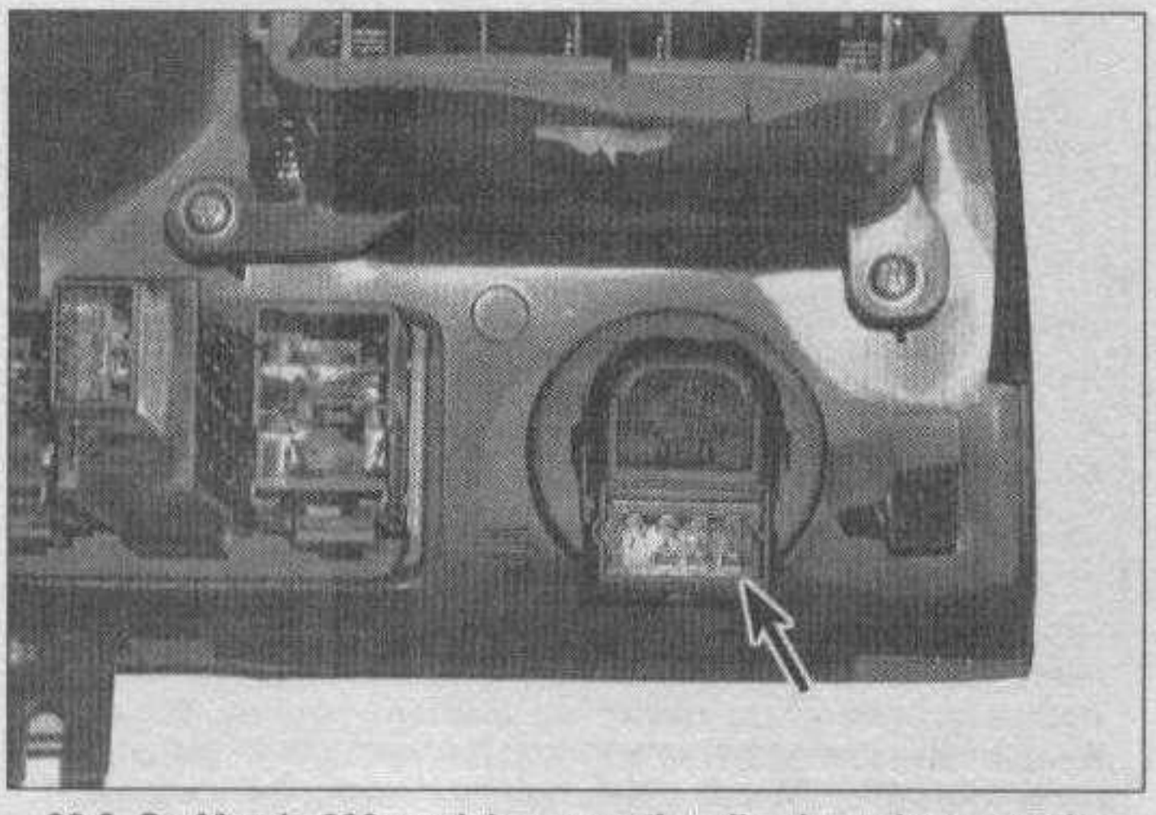
11 The keyless entry system consists of a remote control transmitter that sends a coded infrared signal to a receiver which then operates the door lock system.

12 Replace the transmitter batteries when the red LED light on the side of the case doesn't light when the button is pushed.

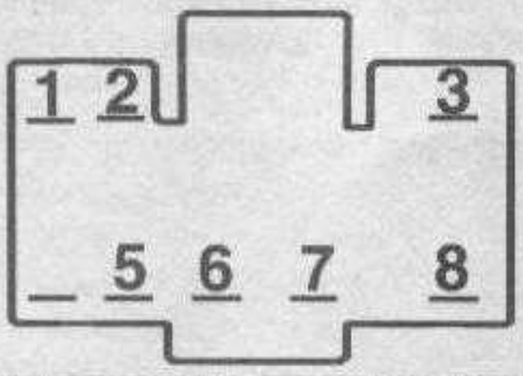
13 Use a small screwdriver to carefully separate the case halves **(see illustration)**.



25.14 Replace the lithium batteries (arrows)



26.6 On Mazda 626 models, press the clips in and remove the switch (arrow) from the instrument panel bezel



SWITCH POSITION	VOLTAGE AT
Left mirror, Up	7 only
Left mirror, Down	1 and 2 only
Left mirror, Left	2 and 7 only
Left mirror, Right	1 only
Right mirror, Up	7 only
Right mirror, Down	5 and 6 only
Right mirror, Left	7 and 6 only
Right mirror, Right	5 only

61042-12-26.7b HAYNES

26.7a On Probe models, backprobe the power mirror switch connector (without disconnecting the connector) with a voltmeter or test light and check for battery power at the indicated terminals with the switch in each position

SWITCH POSITION	CONTINUITY BETWEEN
Left mirror, Up	I and J; C, I and J
Left mirror, Down	I and C; L and J
Left mirror, Left	I and C; H and J
Left mirror, Right	I and H; C, L and J
Right mirror, Up	I and L; A, F and J
Right mirror, Down	L and J; A and I
Right mirror, Left	I and A; F and J
Right mirror, Right	I and F; A, L and J

61042-12-26.7b HAYNES

26.7b Power mirror switch terminal identification and continuity table - 1997 and earlier Mazda 626 models

14 Replace the CR2025 lithium battery **(see illustration)**.

15 Snap the case halves together.

26 Electric side view mirrors - description and check

Refer to illustrations 26.6, 26.7a and 26.7b

1 Most electric rear view mirrors use two motors to move the glass; one for up-and-down adjustments and one for left-to-right adjustments. In addition, some mirrors have electrically heated glass defroster circuits, which are usually powered through the rear window defogger relay.

2 The control switch usually has a selector portion which sends voltage to the left or right side mirror. With the ignition On but the engine Off, roll down the windows and operate the mirror control switch through all functions (left-right and up-down) for both the left and right side mirrors.

3 Listen carefully for the sound of the electric motors running in the mirrors.

4 If the motors can be heard but the mirror glass doesn't move, there's probably a problem with the drive mechanism inside the mirror. Remove and disassemble the mirror to locate the problem.

5 If the mirrors don't operate and no sound comes from the mirrors, check the 15-amp Radio fuse in the interior fuse panel (see Section 3).

6 If the fuse is OK, remove the mirror control switch from its mounting without disconnecting the wires attached to it. On Probe and Mazda MX-6 models, the switch is mounted in the driver's door panel, and on Mazda 626 models, it is mounted on the left side if the dashboard **(see illustration)**. Turn the ignition On and check for voltage at the switch. There should be voltage at one terminal. If there's no voltage at the switch, check for an open or short in the wiring between the fuse panel and the switch.

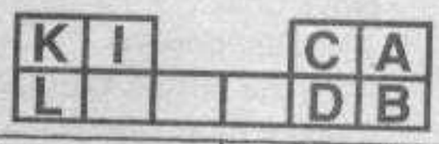
7 If there's voltage at the switch, disconnect it. Check the switch for continuity in all its operating positions **(see illustrations)**. If the switch does not have the designated continuity, replace it.

8 Reconnect the switch. Locate the wire going from the switch to ground. Leaving the switch connected, connect a jumper wire between this wire and ground. If the mirror works normally with this wire in place, repair the faulty ground connection.

9 If the mirror still doesn't work, remove the cover and check the wires at the mirror for voltage with a test light. Check with ignition On and the mirror selector switch on the appropriate side. Operate the mirror switch in all its positions. There should be voltage at one of the switch-to-mirror wires in each switch position (except the neutral "off" position).

10 If there's no voltage in any switch position, check the wiring between the mirror and control switch for opens and shorts.

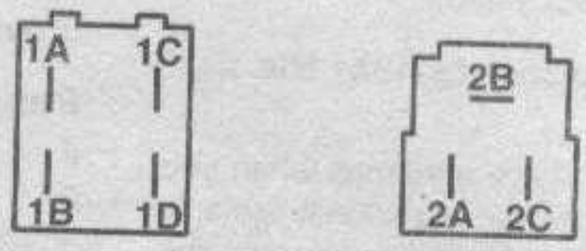
11 If there's voltage, remove the mirror and test it off the vehicle with jumper wires.



SWITCH, POSITION	CONTINUITY BETWEEN
Left mirror, Up	A and L; I and K
Left mirror, Down	I and A; K and L
Left mirror, Left	I and A; D and L
Left mirror, Right	A and L; D and I
Right mirror, Up	C and L; K and I
Right mirror, Down	C and I; K and L
Right mirror, Left	I and C; B and L
Right mirror, Right	I and B; L and C

61042-12-26.7c HAYNES

26.7c Power mirror switch terminal identification and continuity table - Mazda MX-6 models



SWITCH POSITION	CONTINUITY BETWEEN
Released	2A and 2C; 2A and 2B
Close	1A and 2A; 2B and 2C
Open	1A and 2C; 1B and 2A

61042-12-27.7 HAYNES

27.7 Power moonroof switch terminal identification and continuity table

Replace the mirror if it fails this test (see Chapter 11).

27 Electric moonroof - description and check

Refer to illustration 27.7

1 The electric moonroof is powered by a single motor located in the roof behind the overhead console. The power circuit is protected by a circuit breaker. When sunlight isn't desired, an interior sliding panel can be closed.

2 The control switches (tilt and slide) send a ground signal to the moonroof motor when the switches are pressed. Power is supplied to the motor from the moonroof relay. With the ignition On but the engine Off, operate the moonroof control switch through the tilt and slide functions.

3 Listen carefully for the sound of the moonroof motor running in the roof.

4 If the motors can be heard but the moonroof glass doesn't move, there's probably a problem with the drive mechanism or drive cables.

5 If the moonroof does not operate and no sound comes from the motor, check the fuse (15-amp fuse number 5 in the Probe interior fuse panel, Sunroof fuse on Mazda models).

6 If the fuse is OK, remove the control switches in the overhead interior light panel. Disconnect the wires attached to it. Turn the ignition On and check for voltage at the switch. There should be voltage at four terminals. If there's no voltage at the switch, check for power and ground at the motor. If power and ground exist at the motor and there's still no voltage at the switch replace the motor. If there's no voltage at the motor, check the ignition relay or an open or short in the wiring between the ignition relay and the motor.

7 If there's voltage at the switch, disconnect it. Check the switch for continuity in all its operating positions **(see illustration)**. If the switch does not have continuity, replace it.

8 If the switch has continuity re-connect the switch. Locate the wire going from the switch to ground. Leaving the switch connected, connect a jumper wire between this wire and ground. If the motor works normally with this wire in place, repair the faulty ground connection.

9 The moonroof can be closed manually by inserting an Allen wrench into the motor shaft and rotating it clockwise.

28 Airbag system - general information, removal and installation

General information

Refer to illustration 28.2

1 All models are equipped with a Supplemental Restraint System (SRS), more commonly known as an airbag. There are two airbags, one for the driver and one for the front seat passenger. The SRS system is designed to protect the driver (and on later models, the passenger as well) from serious injury in the event of a head-on or frontal collision.

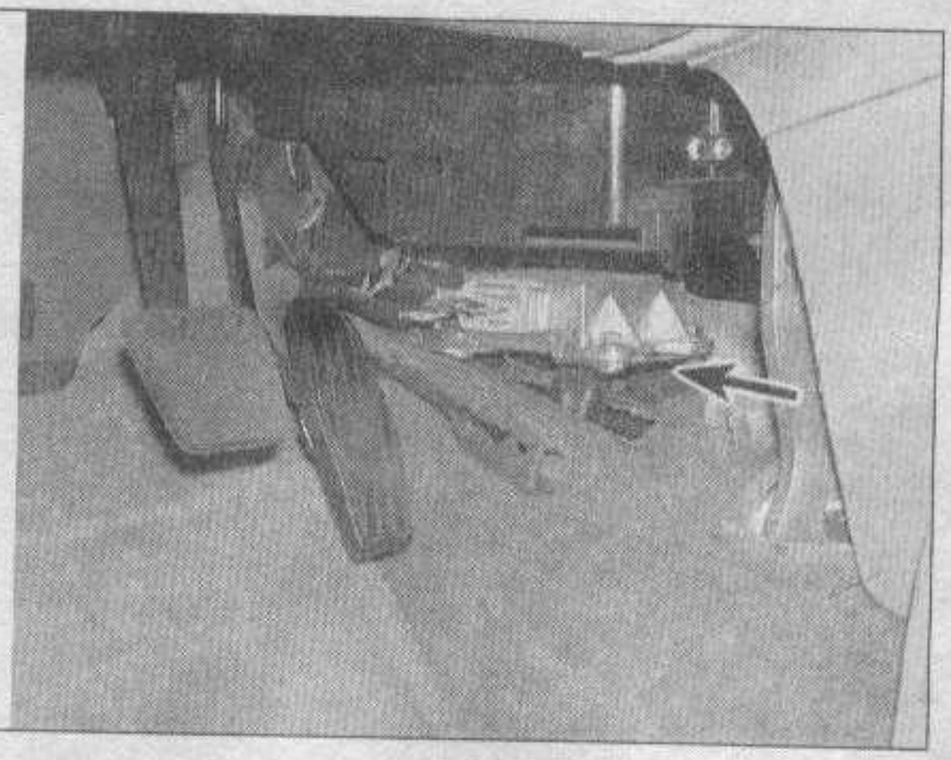
2 The SRS system consists of an SRS unit - which contains a safing sensor, self-diagnosis circuit and a back-up power circuit - located under the dash **(see illustration)**, two impact sensors, an airbag assembly in the center of the steering wheel and a second airbag assembly for the front seat passenger, located in the top of the dashboard right above the glove box.

Operation

3 For the airbag(s) to deploy, one or both impact sensors and the safing sensor must be activated. When this condition occurs, the circuit to the airbag inflator is closed and the airbag inflates. If the battery is destroyed by the impact, or is too low to power the inflator, a back-up power unit inside the SRS unit provides power.

Self-diagnosis system

4 A self-diagnosis circuit in the SRS unit displays a light when the ignition switch is turned to the On position. If the system is operating normally, the light should go out after about six seconds. If the light doesn't come on, or doesn't go out after six seconds, or if it comes on while you're driving the vehicle, there's a malfunction in the SRS system. Have it inspected and repaired as soon as possible. Do not attempt to troubleshoot or service the SRS system yourself. Even a



28.2 The airbag diagnostic module (arrow) is mounted on top of the transmission tunnel ahead of the console front cover on 1995 and later models - on earlier models, the module is mounted under the left side of the dashboard

small mistake could cause the SRS system to malfunction when you need it.

Servicing components near the SRS system

5 Nevertheless, there are times when you need to remove the steering wheel, radio or service other components on or near the dashboard. At these times, you'll be working around components and wire harnesses for the SRS system. The SRS wiring harnesses are easy to identify: They're all bright yellow. Do not unplug the connectors for these wires. And do not use electrical test equipment on yellow wires; it could cause the airbag(s) to deploy. ***ALWAYS DISABLE THE SRS SYSTEM BEFORE WORKING NEAR THE SRS SYSTEM COMPONENTS OR RELATED WIRING.***

Disabling the SRS system

Warning: *Any time you are working in the vicinity of airbag wiring or components, DISABLE THE SRS SYSTEM.*

6 Disconnect the battery negative cable, then disconnect the positive cable and wait two minutes. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

Driver's side airbag

7 Remove the access panel below the steering column and disconnect the electrical connector leading up the column to the driver's airbag.

Passenger's side airbag

8 Remove the glove box (see Chapter 11).

9 Disconnect the passenger's side airbag electrical connector.

Enabling the SRS system

10 After you've disabled the airbag and performed the necessary service, reconnect the electrical connectors to the airbags. Reinstall the lower panel and the glove box.

11 Turn the ignition switch to the Off position.

12 Reattach the positive battery cable first and then the negative cable.

Removal and installation

Driver's side airbag

13 Refer to Chapter 10 for removal and installation of the driver's side airbag.

Passenger side airbag

14 Disconnect the battery negative cable, then disconnect the positive cable and wait two minutes. **Caution:** *If the stereo in your vehicle is equipped with an anti-theft system, make sure you have the correct activation code before disconnecting the battery.*

15 Refer to Chapter 11 and remove the glove box.

16 Disconnect the electrical connectors from the airbag module. Remove the airbag module mounting bolts from underneath and gently push the airbag module up and out of the dashboard from below. **Warning:** *Be extremely careful when pushing under the airbag. Too much force could cause the airbag to deploy.*

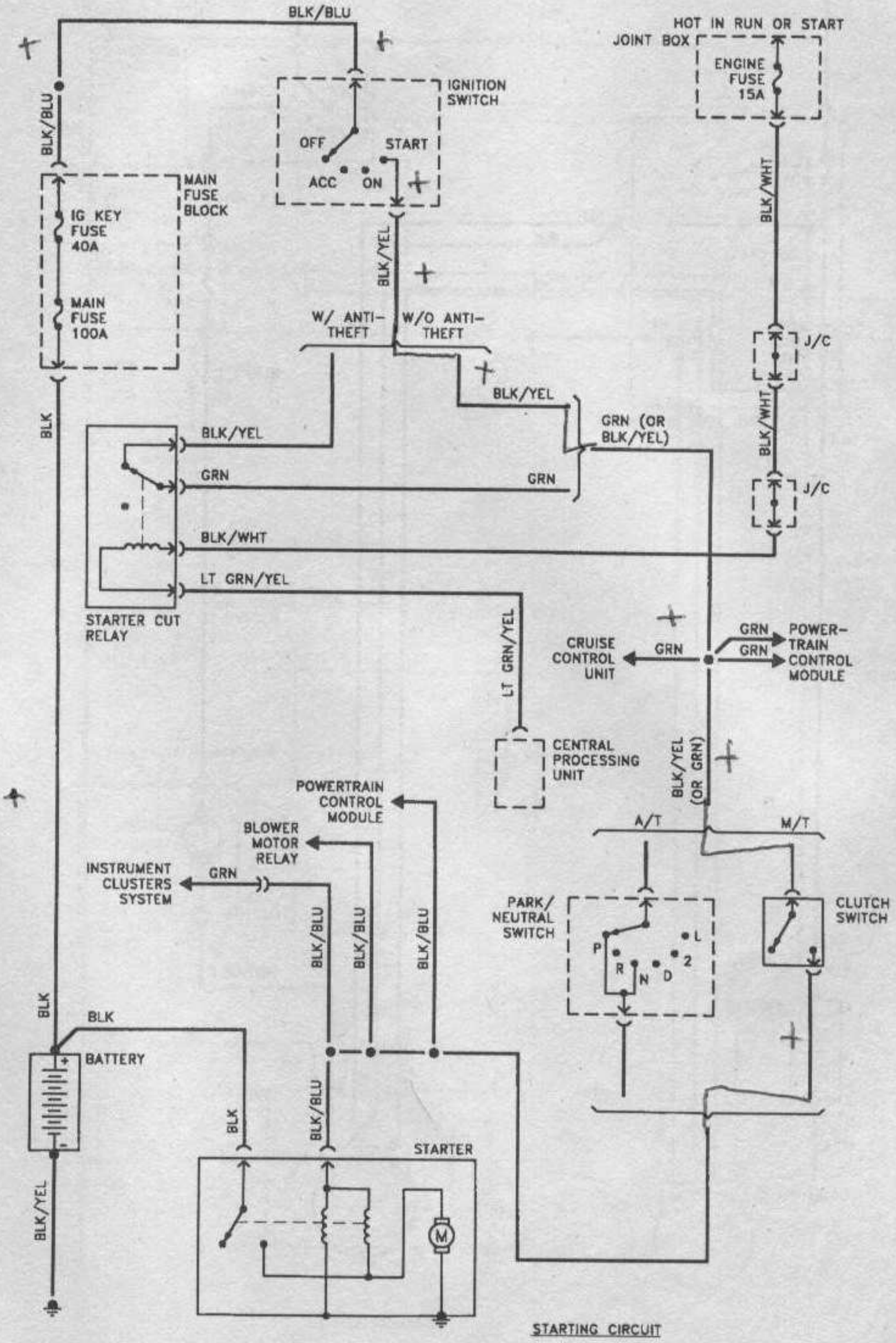
17 Installation is the reverse of the removal procedure.

29 Wiring diagrams - general information

Since it isn't possible to include all wiring diagrams for every year and model covered by this manual, the following diagrams are those that are typical and most commonly needed.

Prior to troubleshooting any circuits, check the fuse and circuit breakers (if equipped) to make sure they're in good condition. Make sure the battery is properly charged and check the cable connections (see Chapter 1).

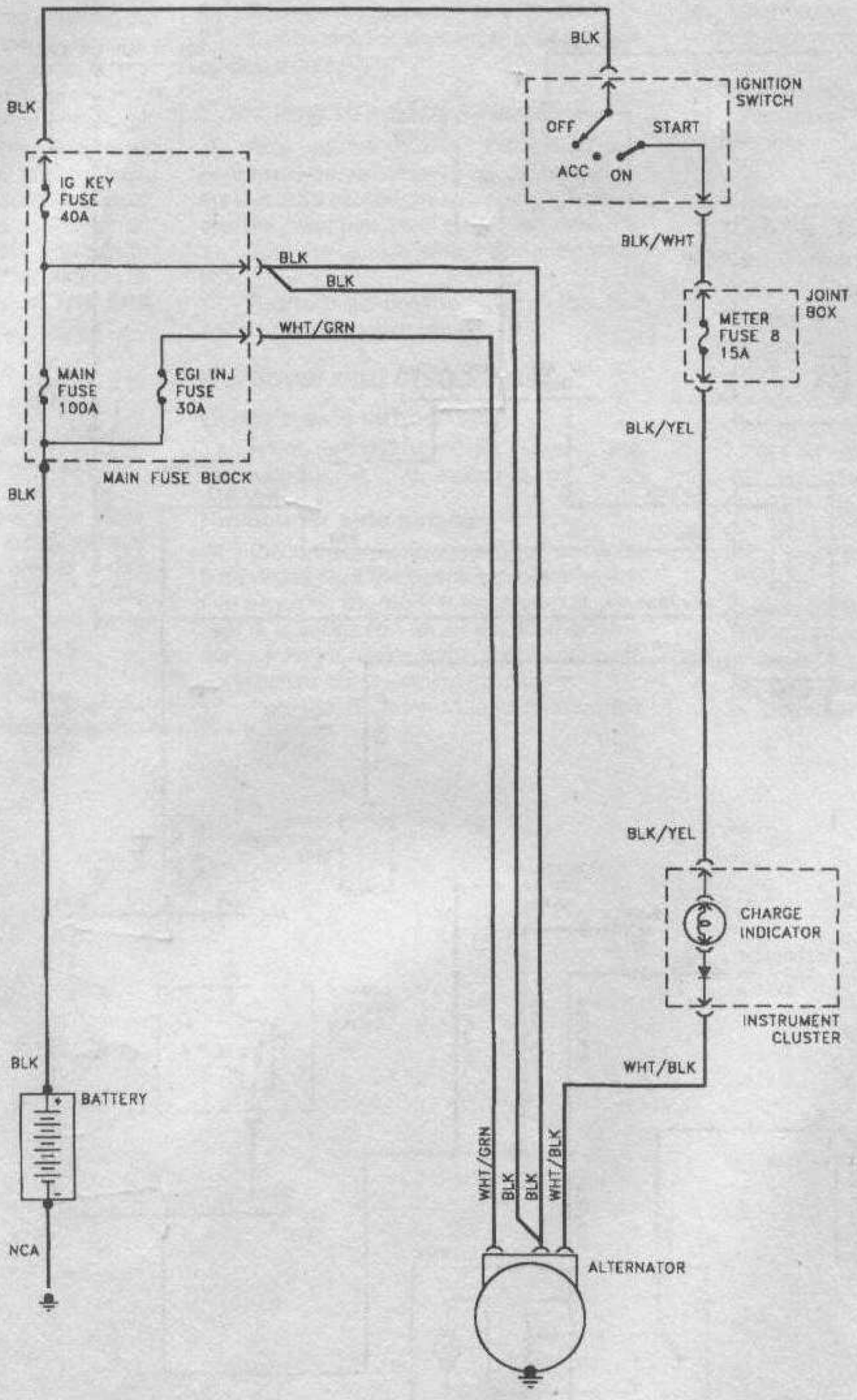
When checking a circuit, make sure that all connectors are clean, with no broken or loose terminals. When unplugging a connector, do not pull on the wires. Pull only on the connector housings themselves.



STARTING CIRCUIT

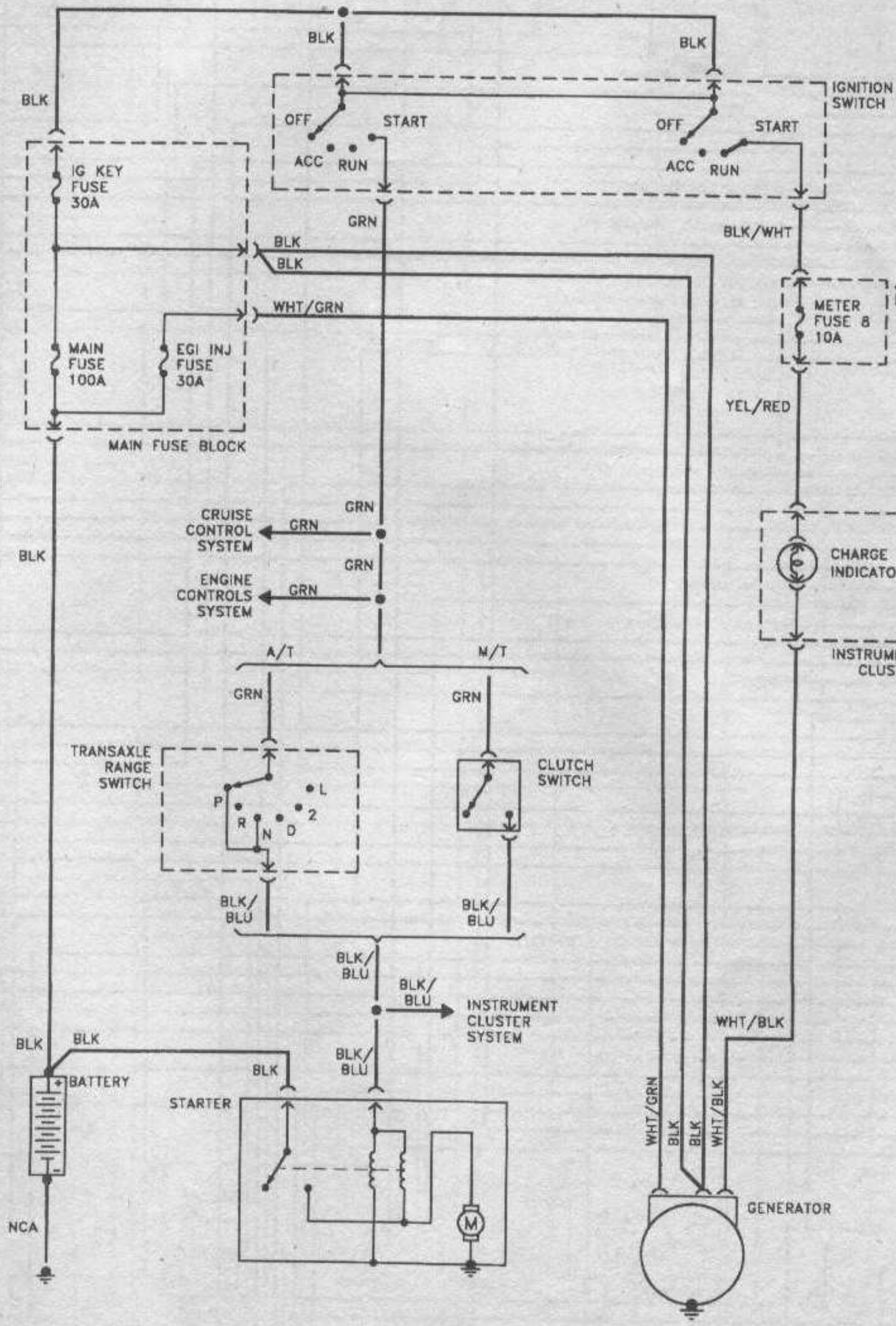
Starting and charging systems - 1993 through 1997 models (1 of 2)

12

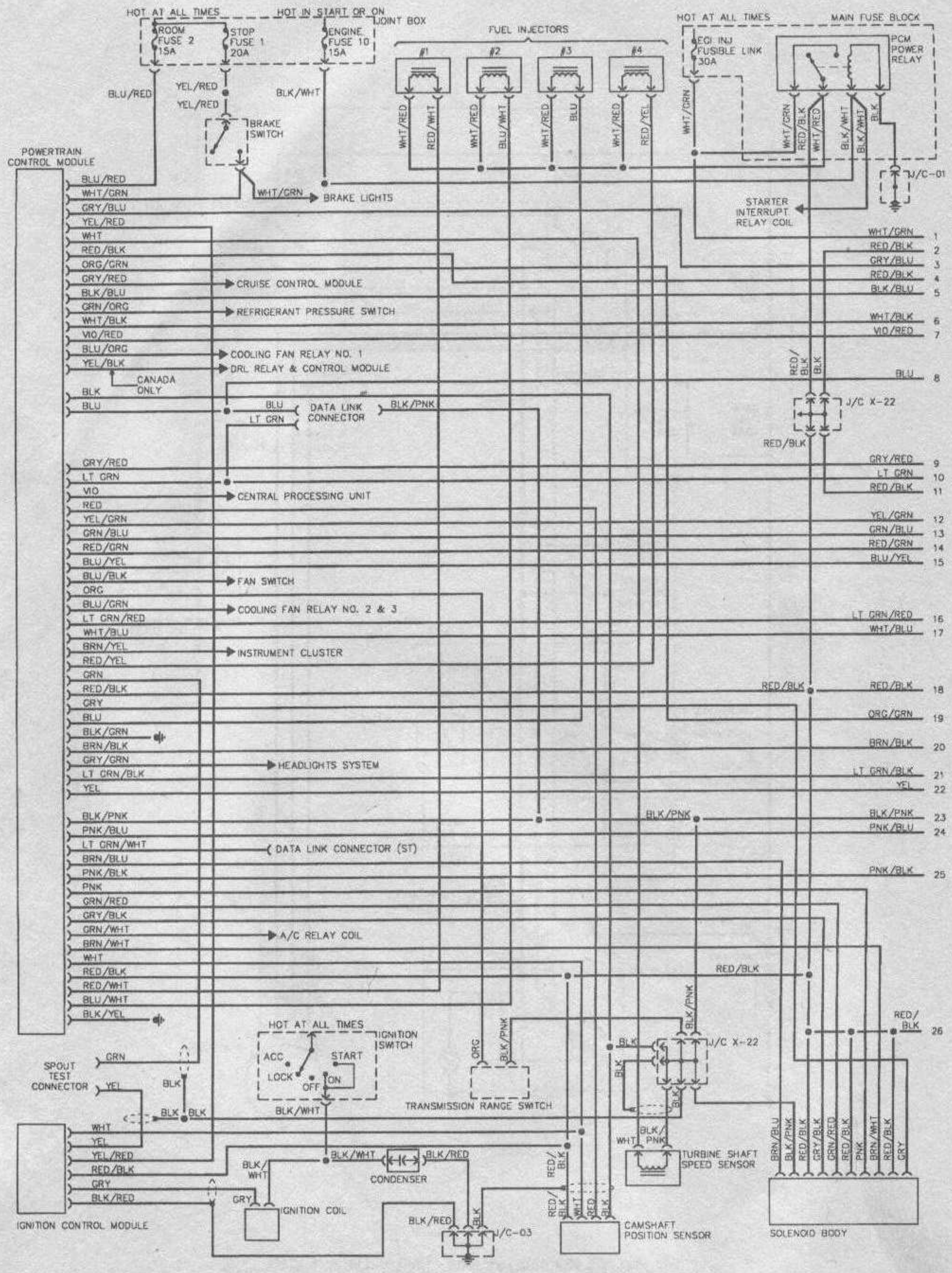


CHARGING CIRCUIT

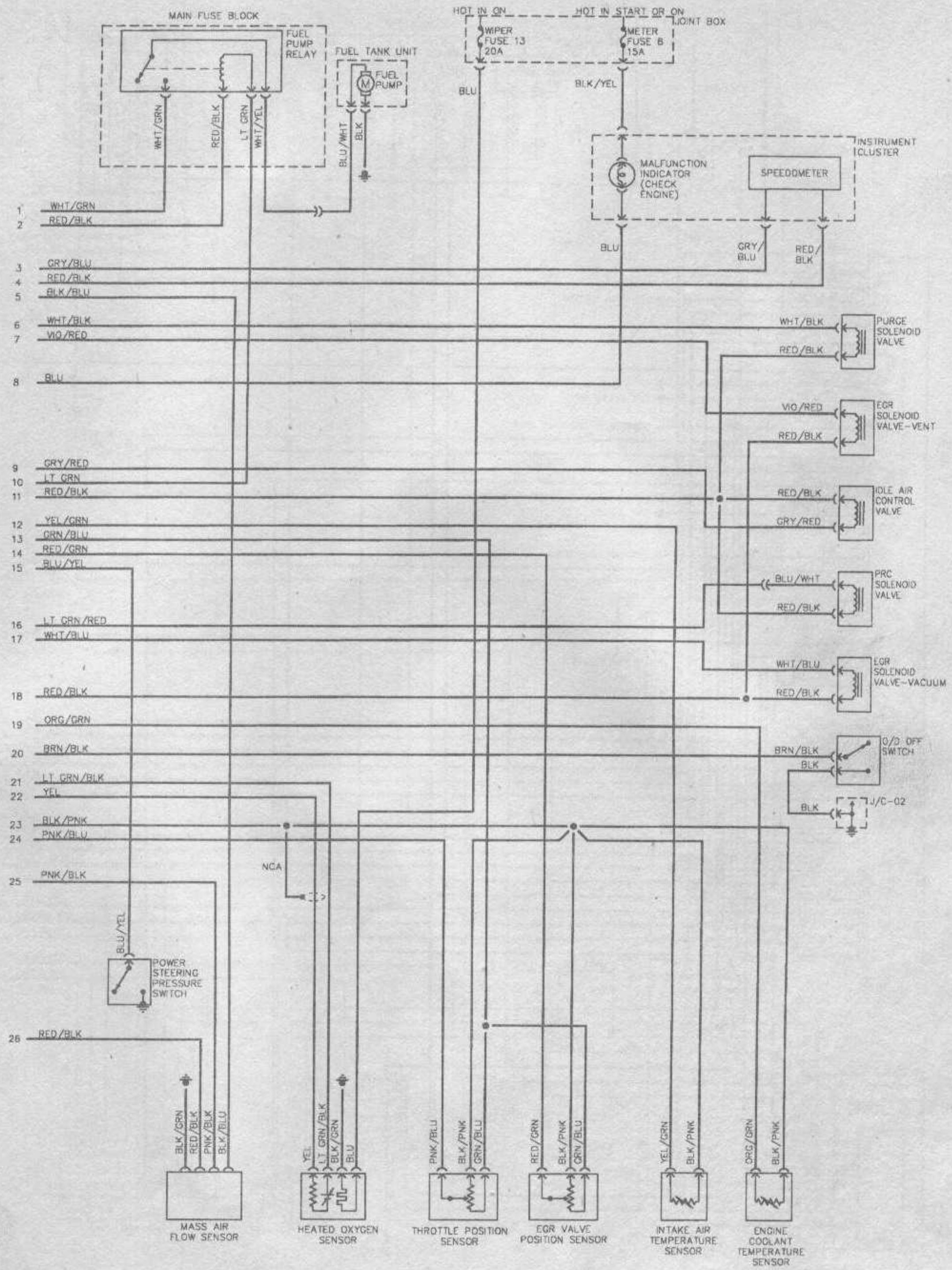
Starting and charging systems - 1993 through 1997 models (2 of 2)



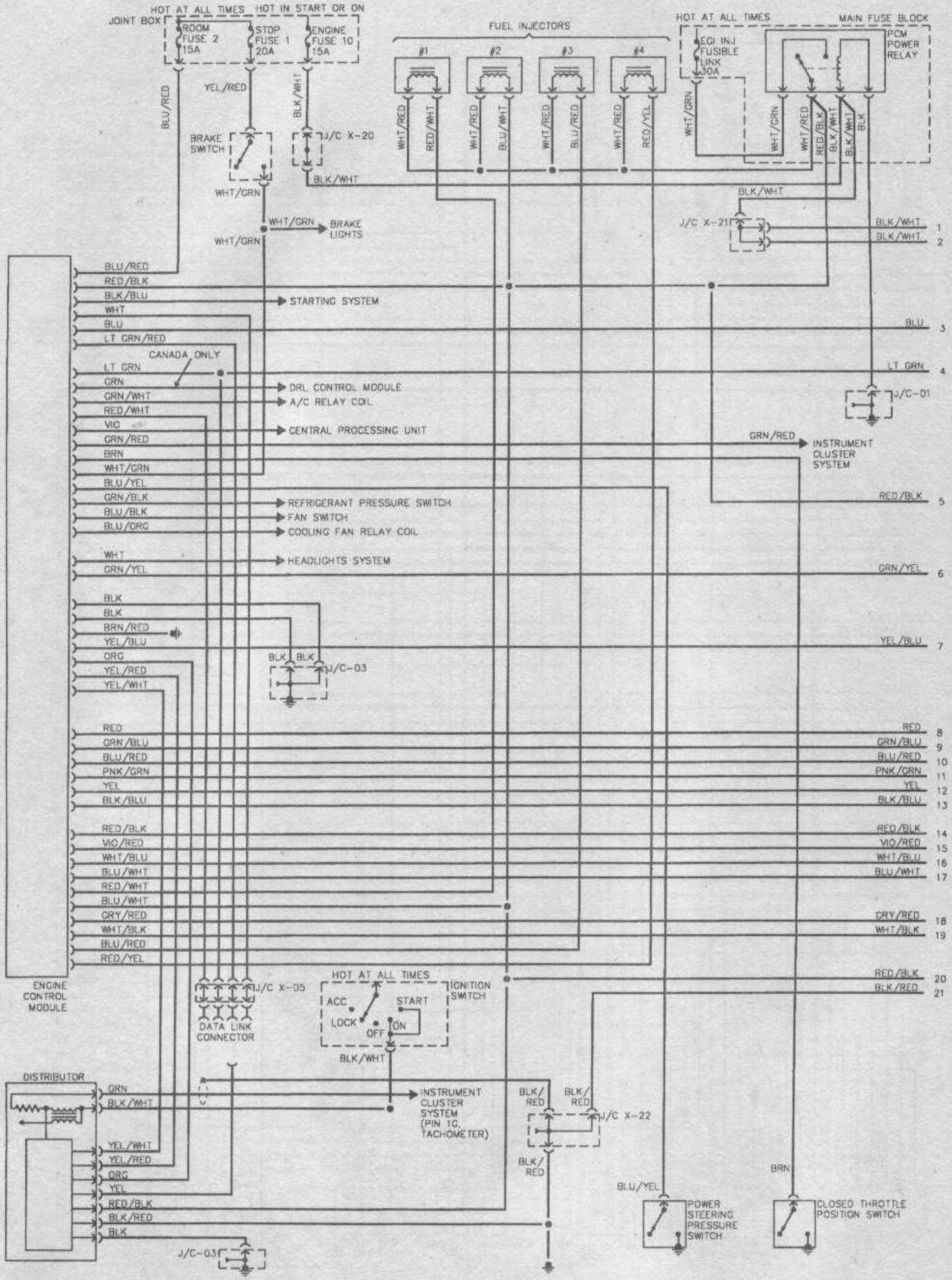
Starting and charging systems - 1998 and later models



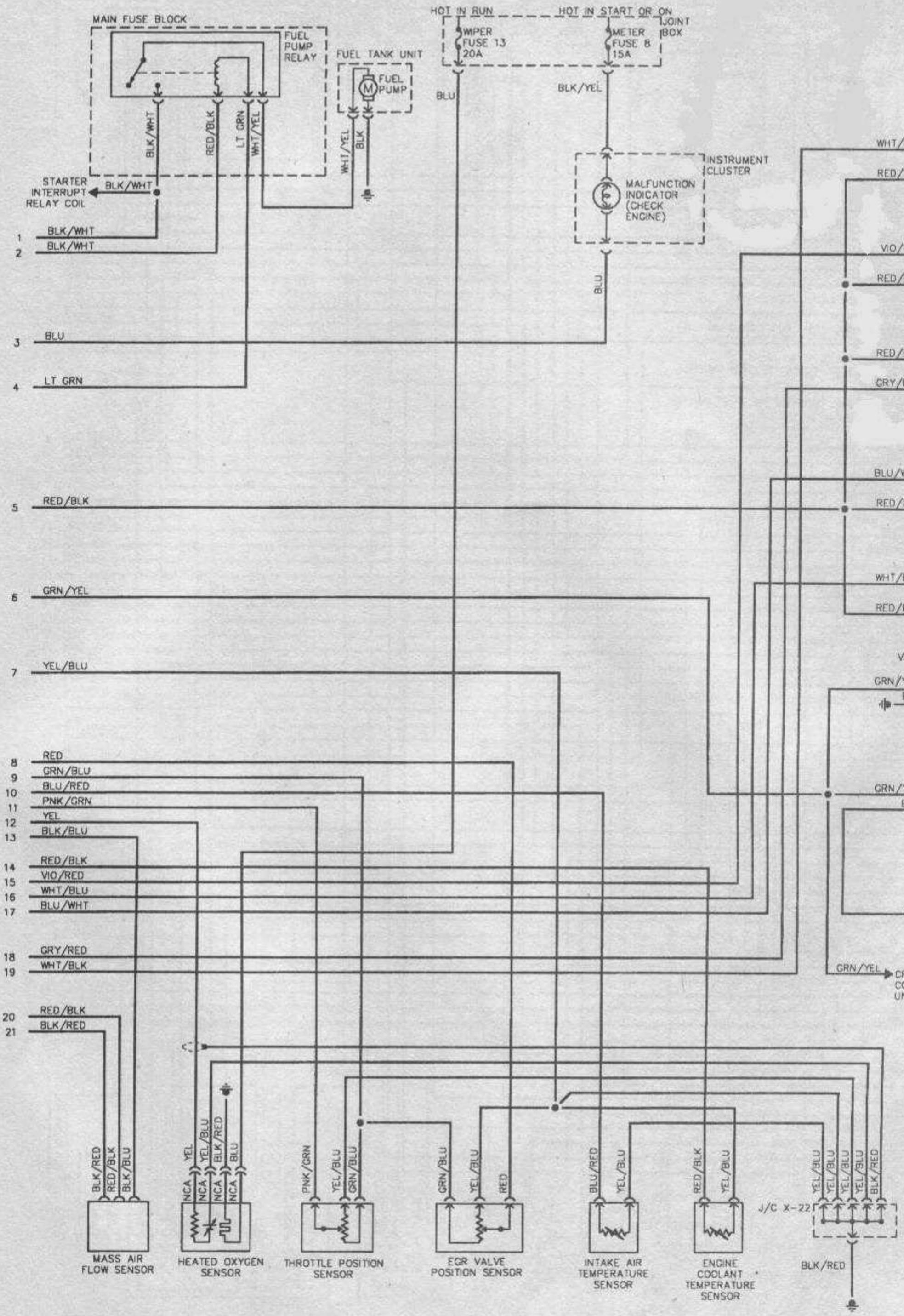
Engine control system - 1993 through 1995 four-cylinder models with automatic transaxle (1 of 2)



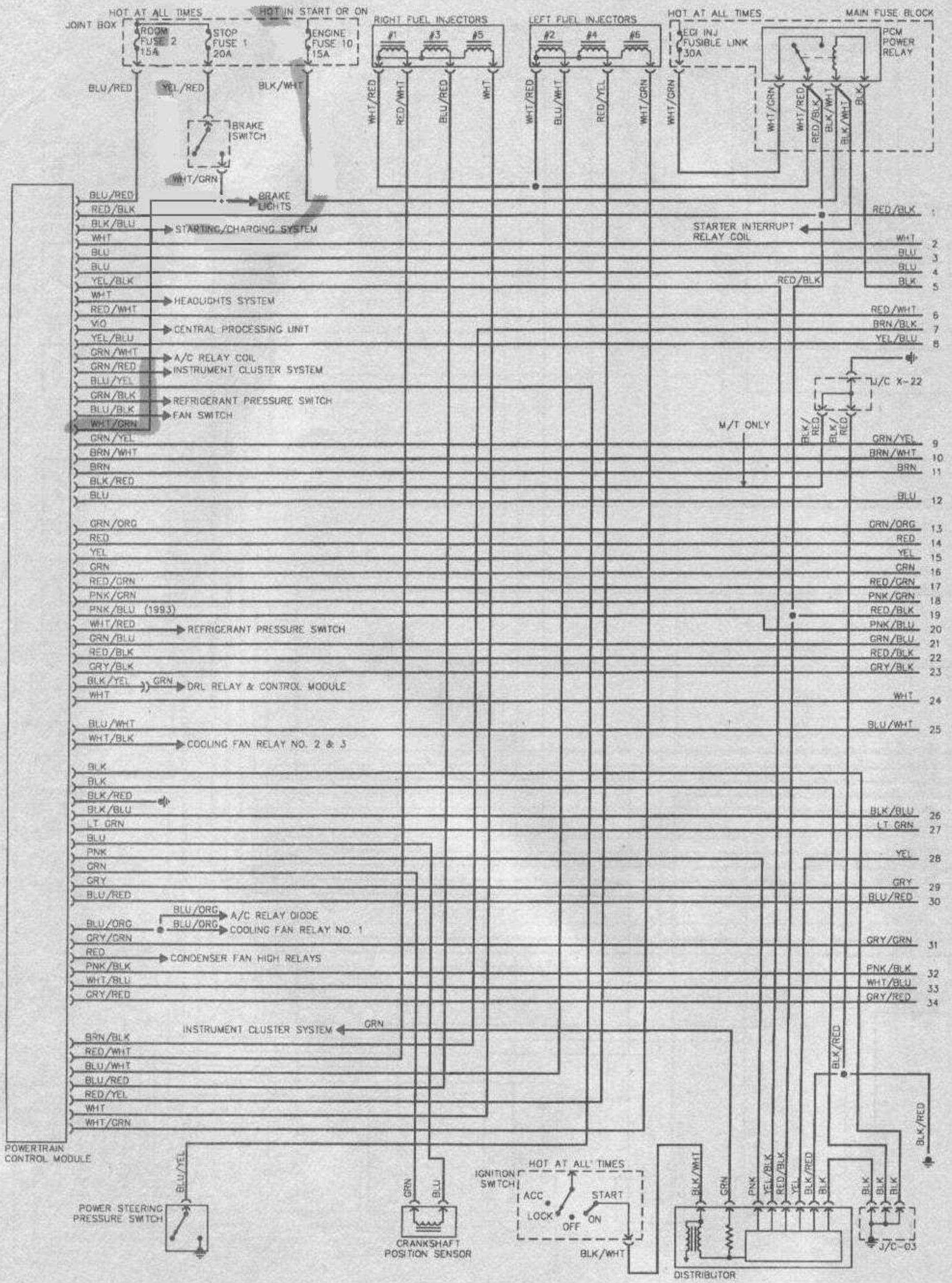
Engine control system - 1993 through 1995 four-cylinder models with automatic transaxle (2 of 2)



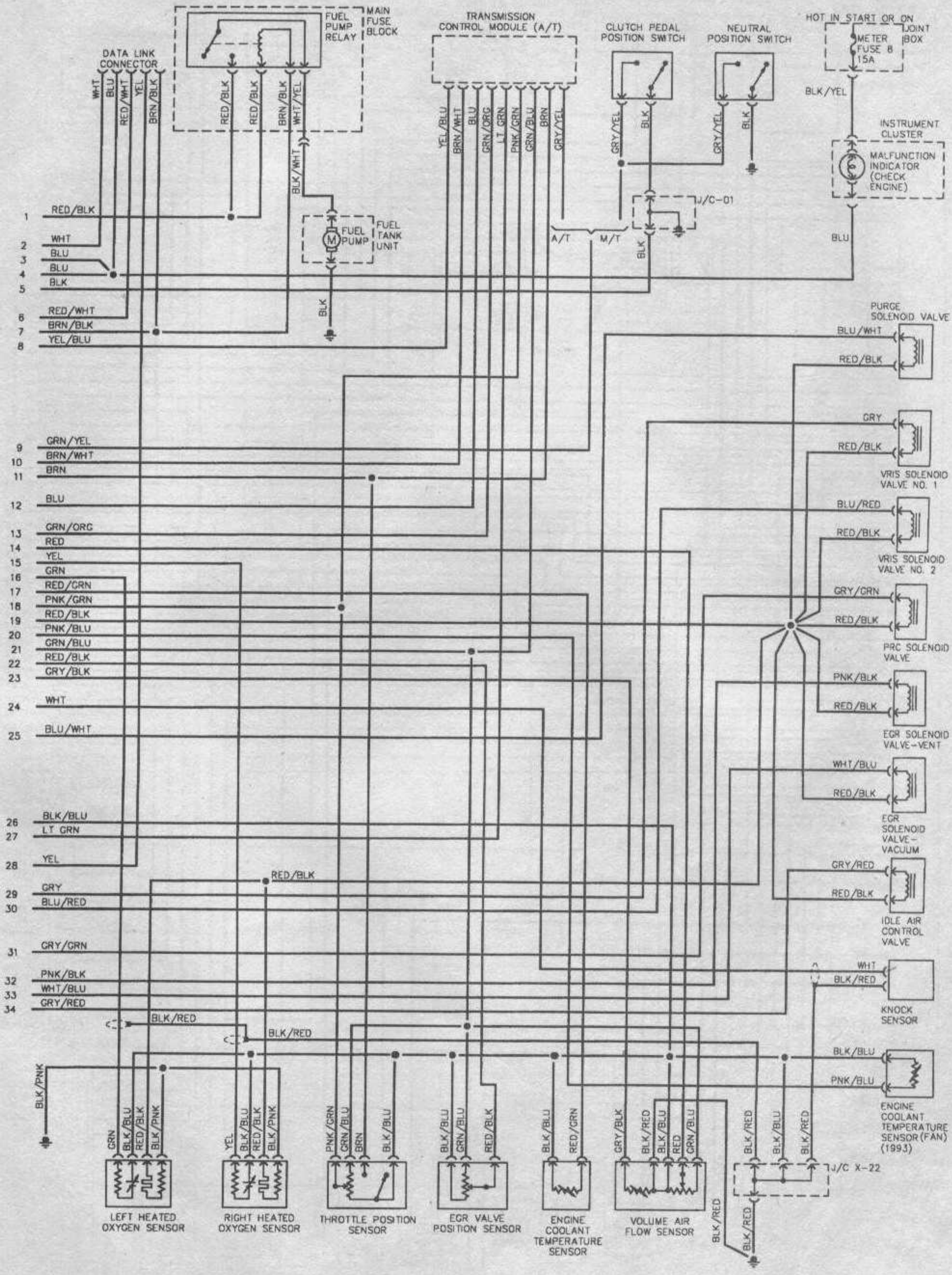
Engine control system - 1993 through 1995 four-cylinder models with manual transaxle (1 of 2)



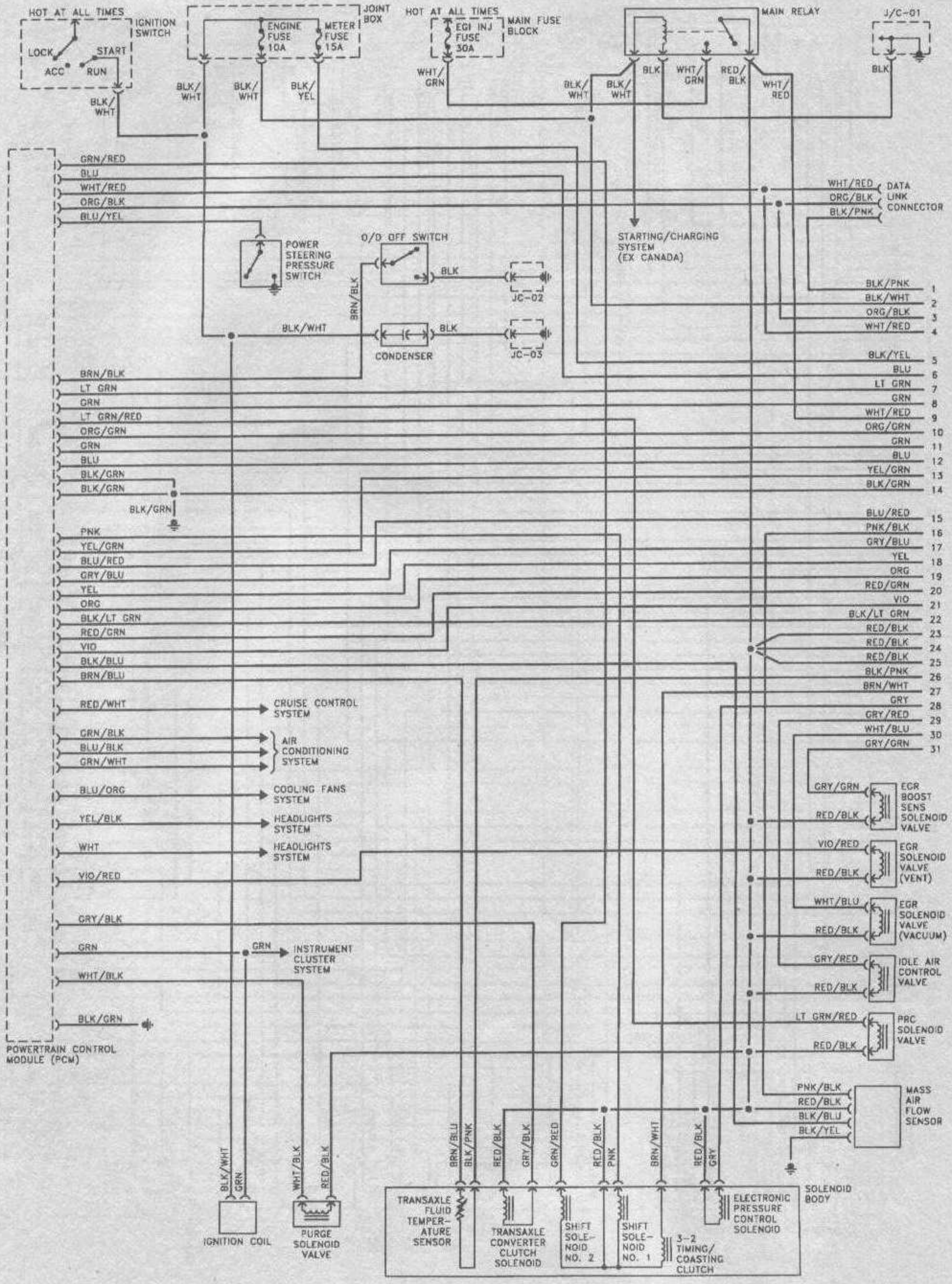
Engine control system - 1993 through 1995 four-cylinder models with manual transaxle (2 of 2)



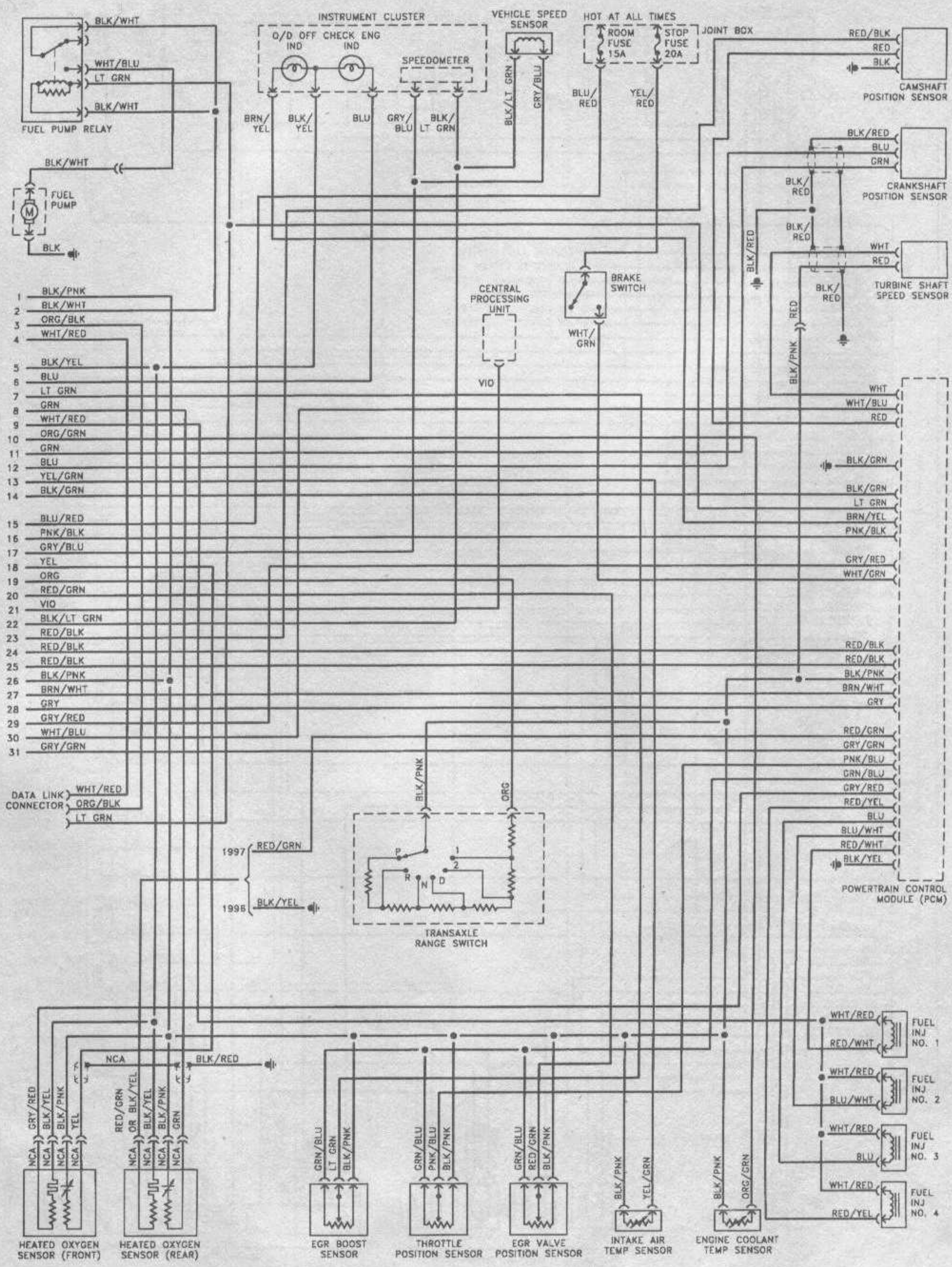
Engine control system - 1993 through 1995 V6 models (1 of 2)



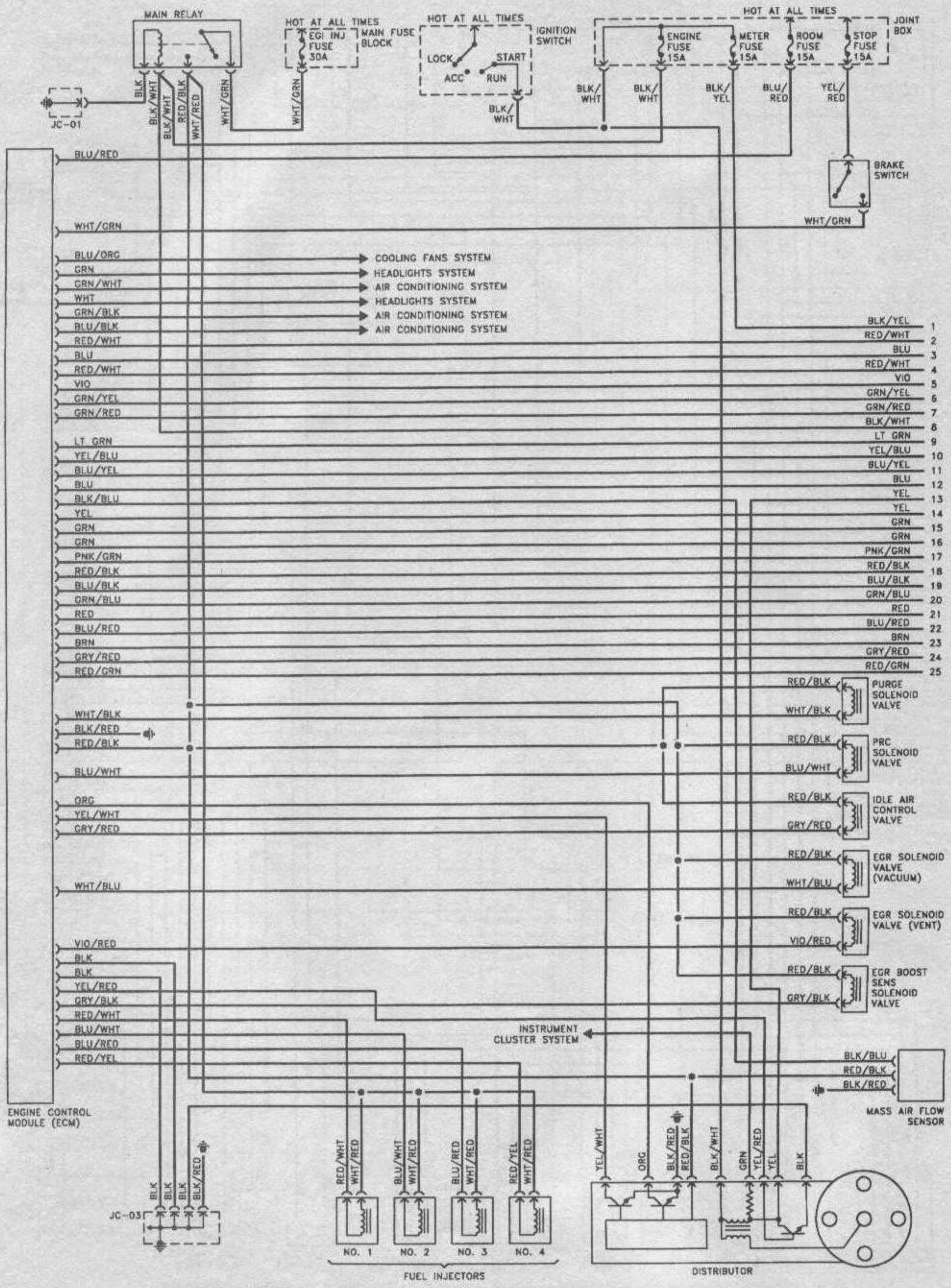
Engine control system - 1993 through 1995 V6 models (2 of 2)



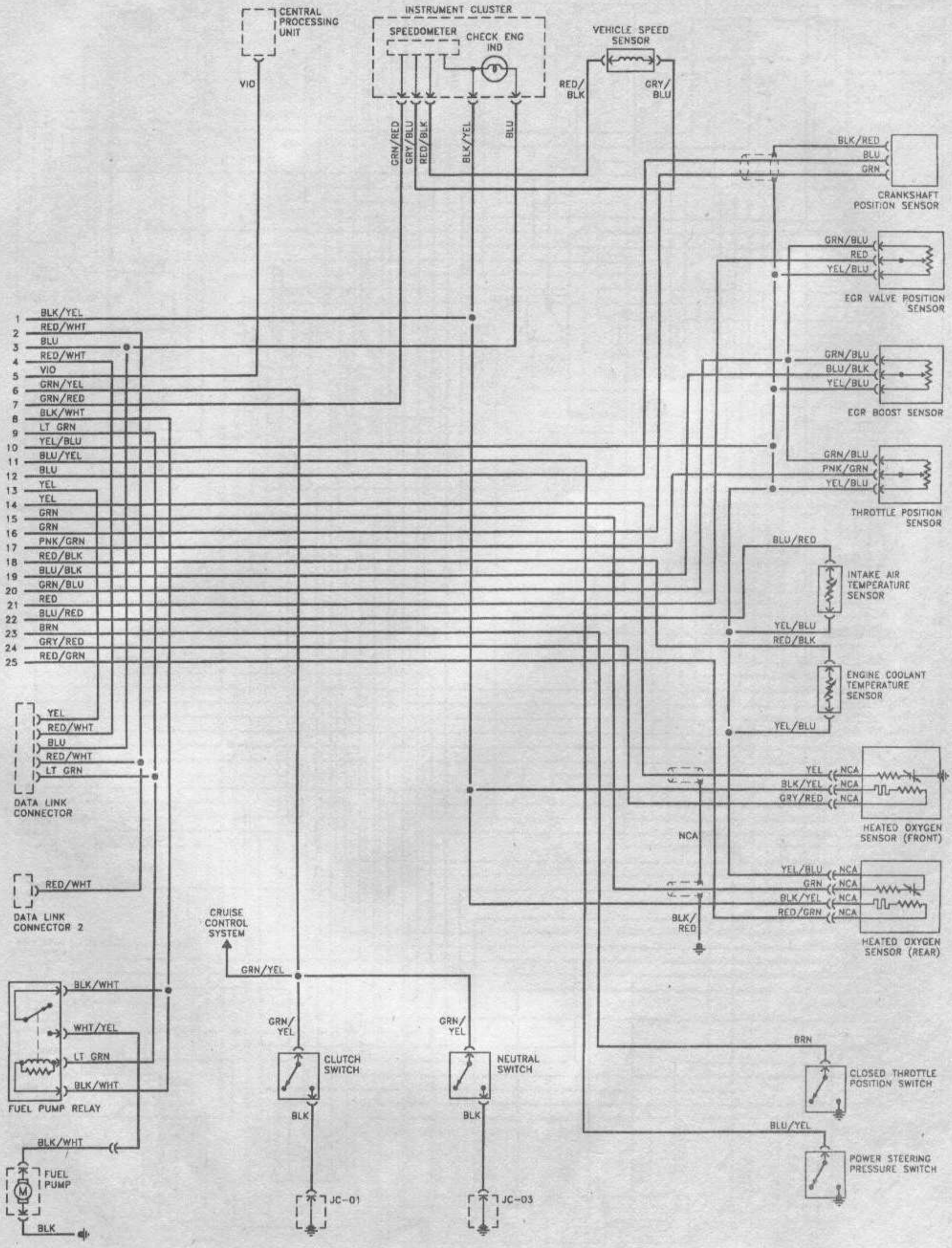
Engine control system - 1996 and 1997 four-cylinder models with automatic transaxle (1 of 2)



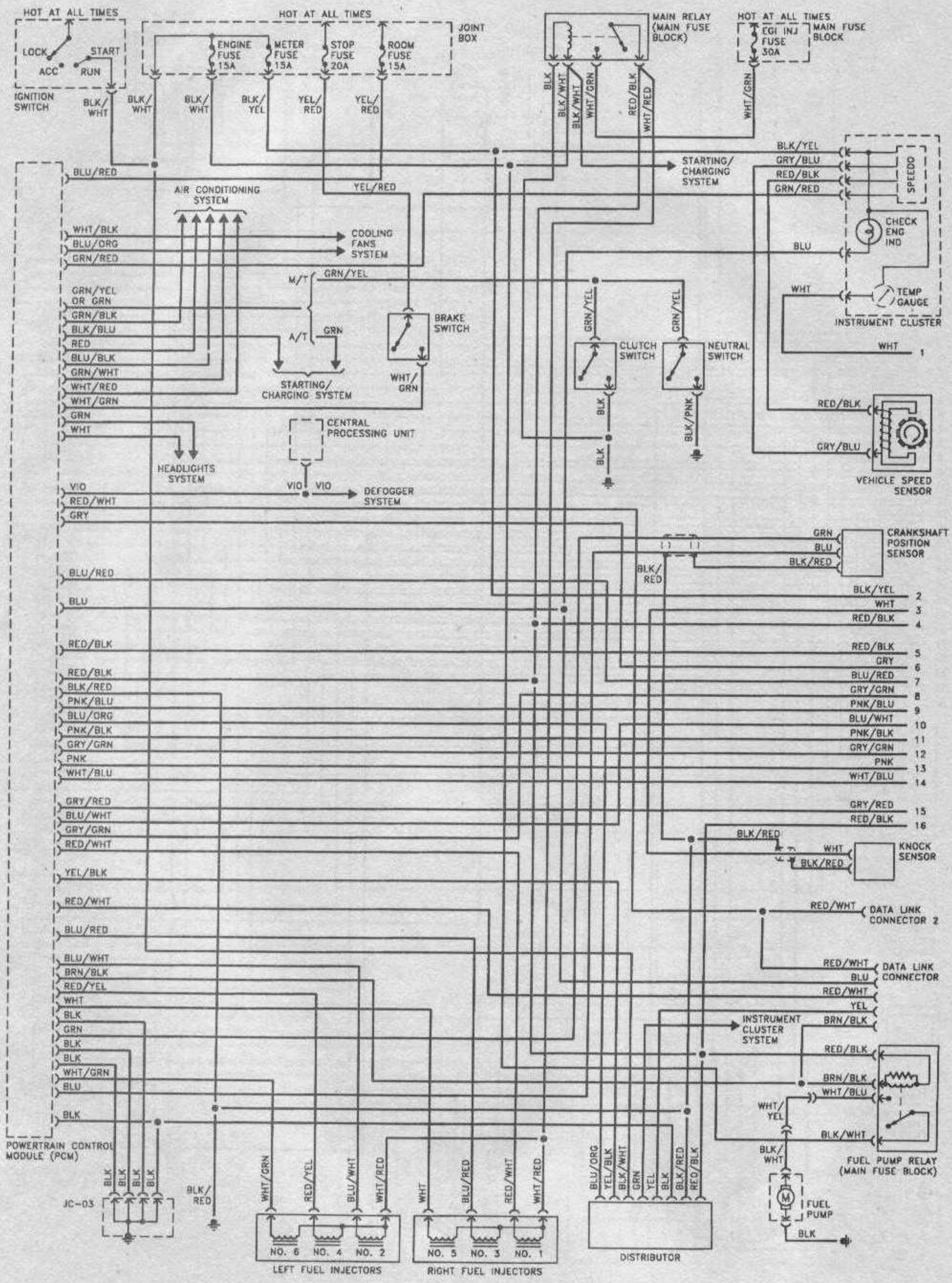
Engine control system - 1996 and 1997 four-cylinder models with automatic transaxle (2 of 2)



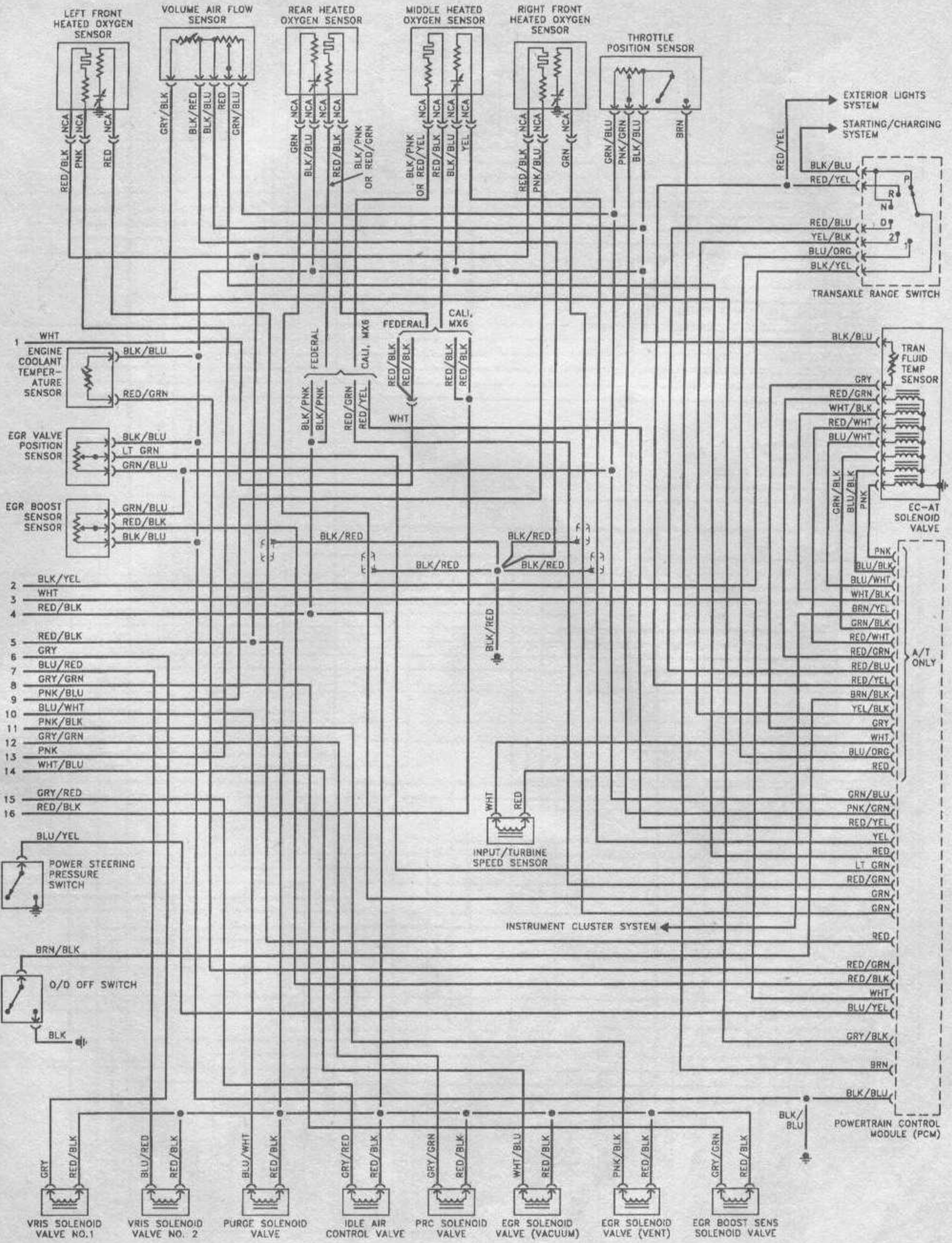
Engine control system - 1996 and 1997 four-cylinder models with manual transaxle (part 1 of 2)



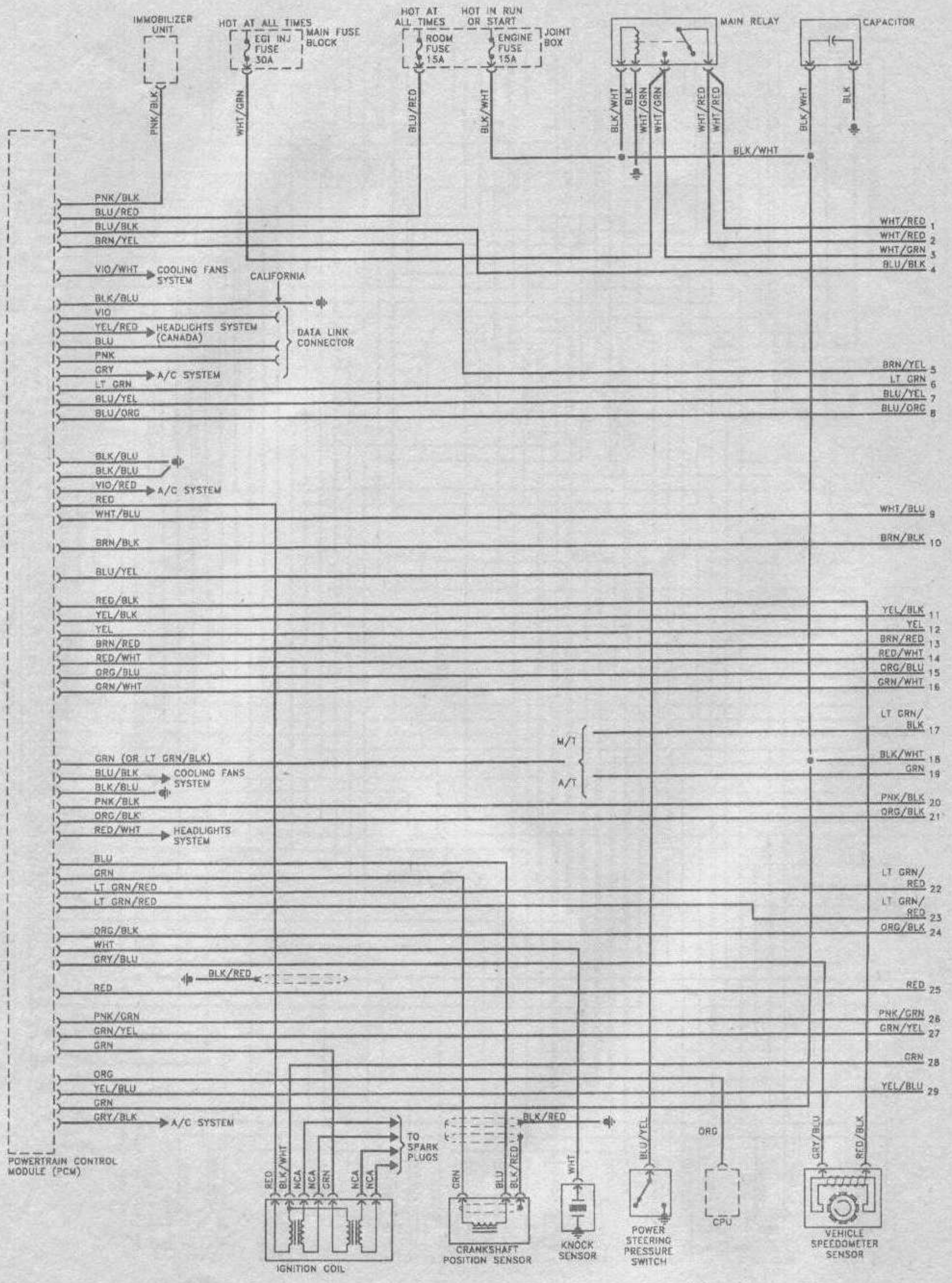
Engine control system - 1996 and 1997 four-cylinder models with manual transaxle (part 2 of 2)



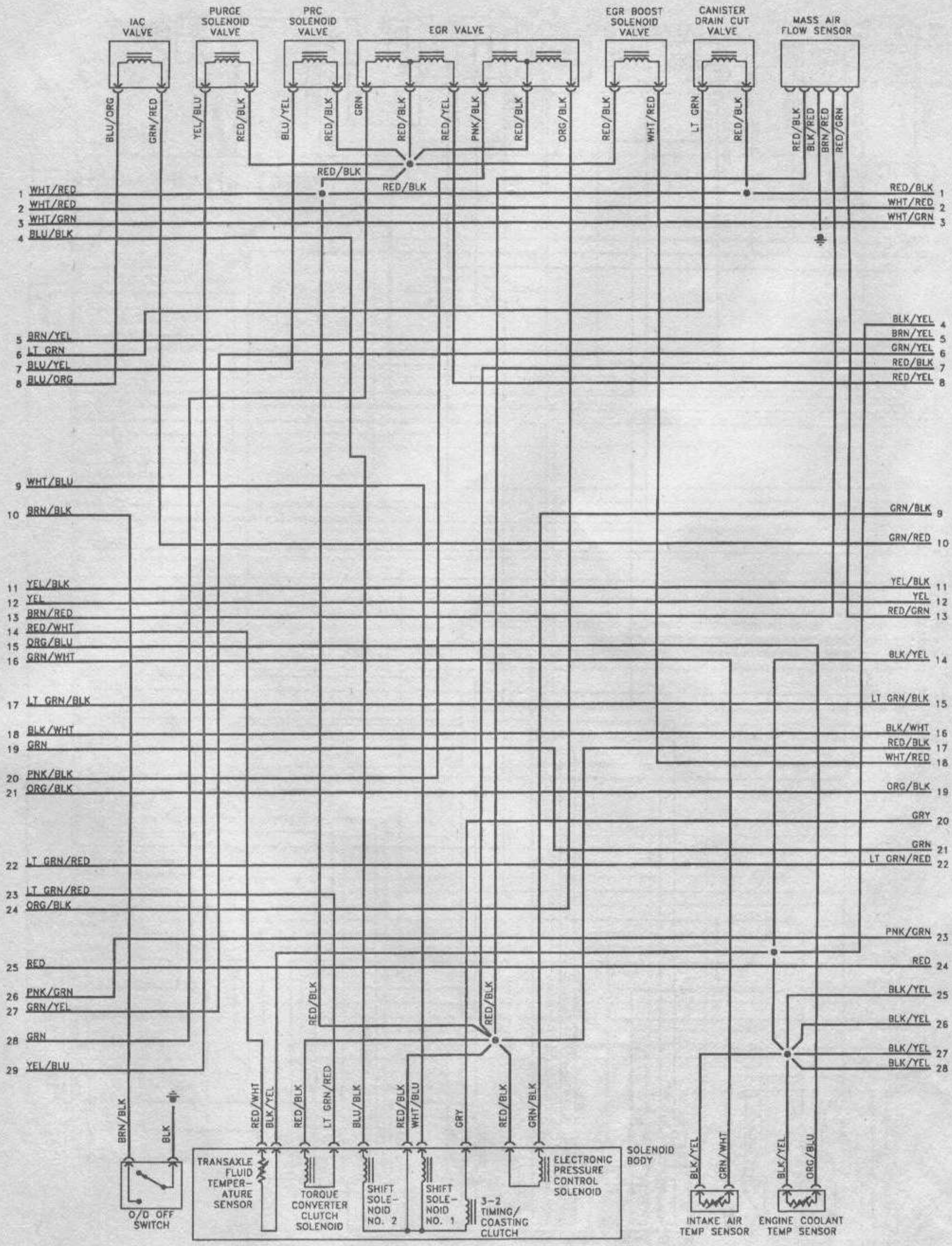
Engine control system - 1996 and 1997 V6 models (1 of 2)



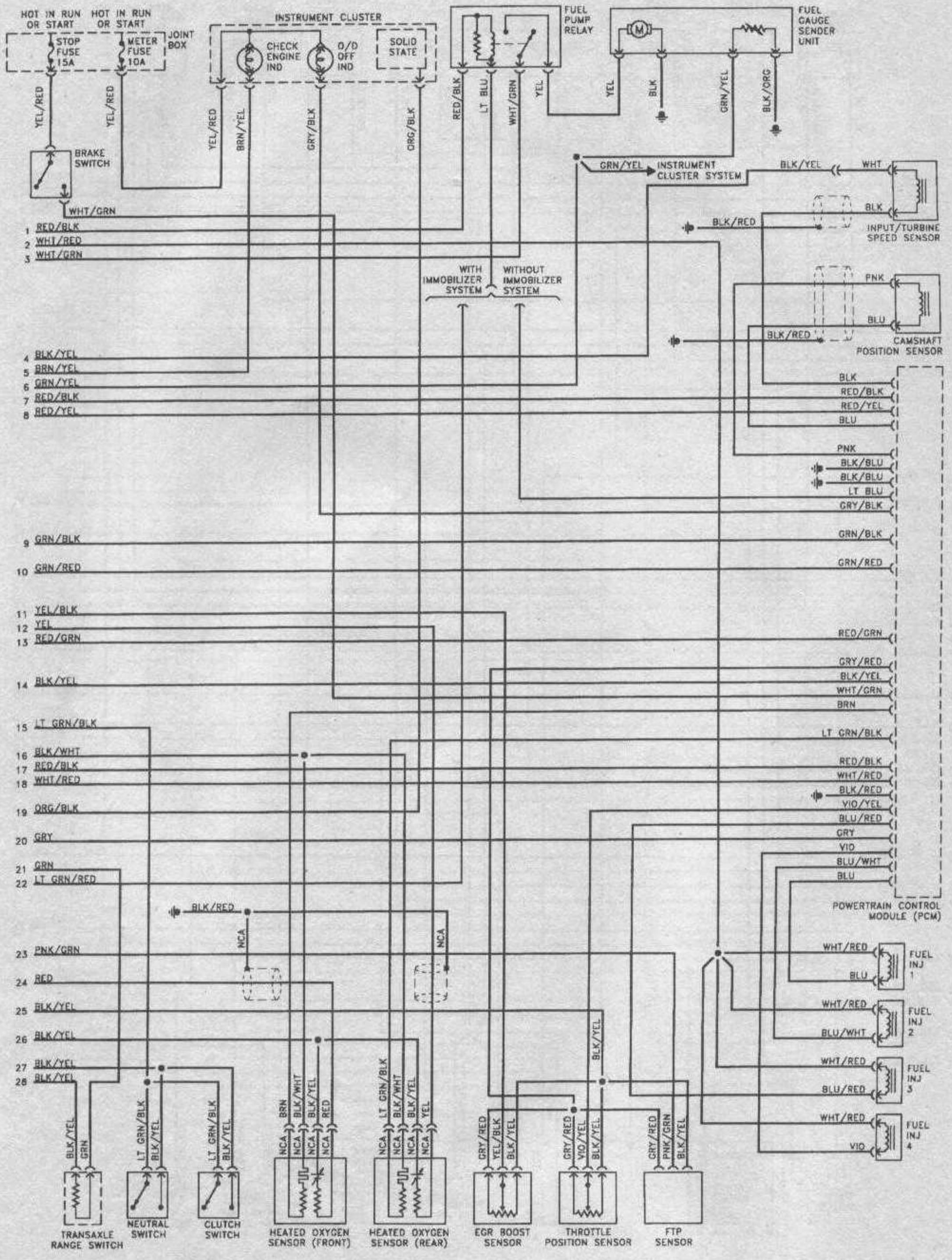
Engine control system - 1996 and 1997 V6 models (2 of 2)



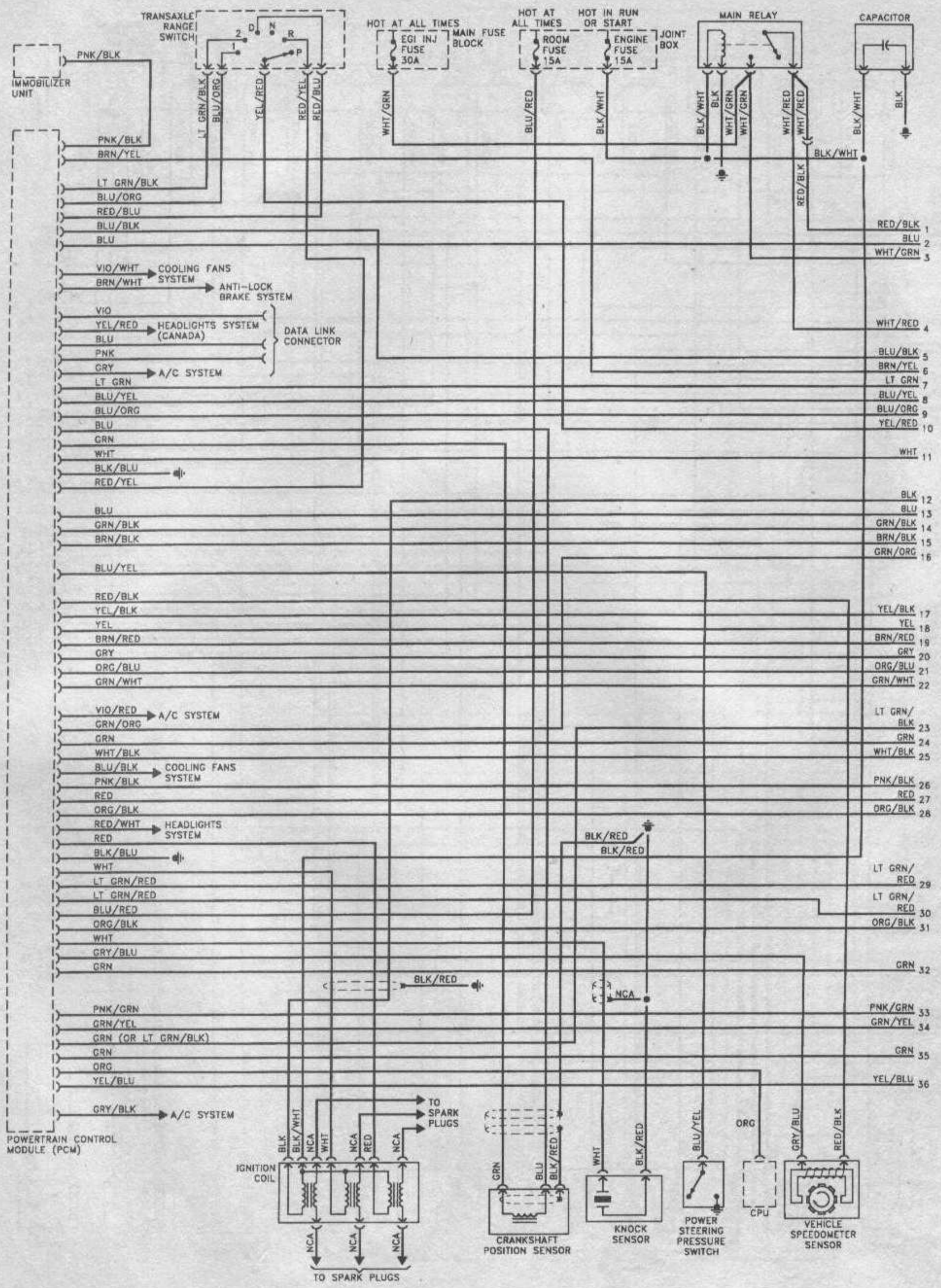
Engine control system - 1998 and later four-cylinder models (1 of 3)



Engine control system - 1998 and later four-cylinder models (2 of 3)

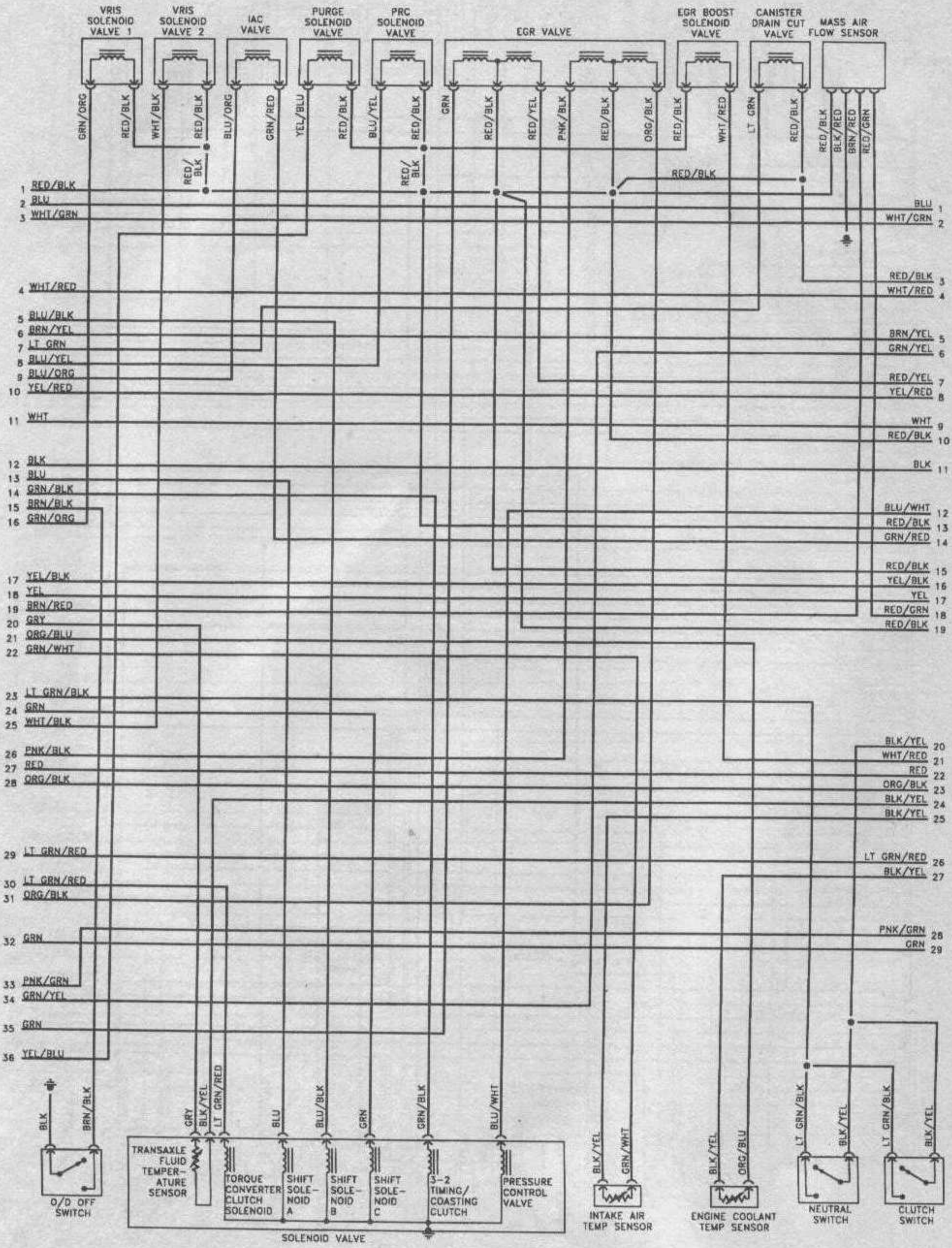


Engine control system - 1998 and later four-cylinder models (3 of 3)

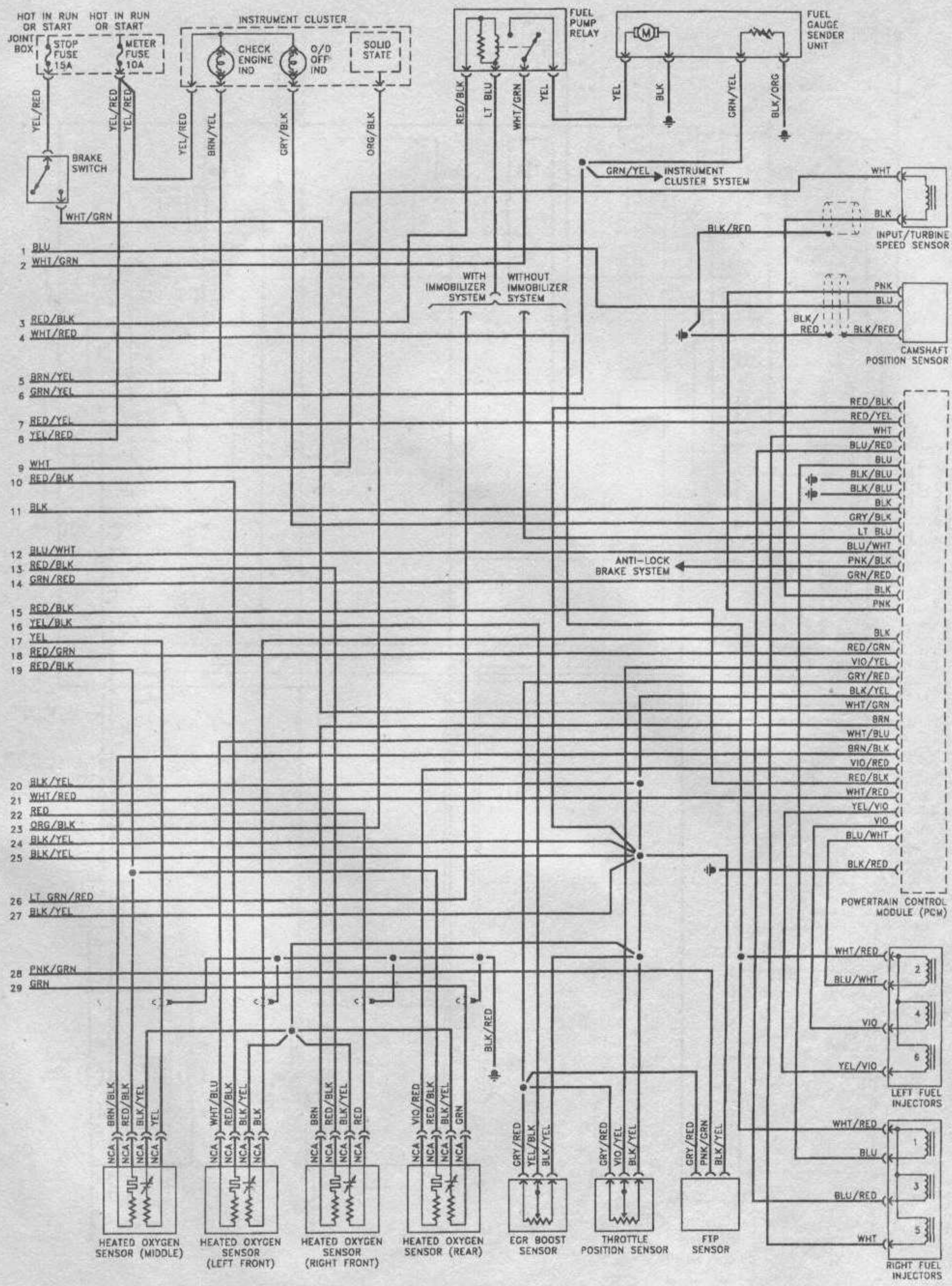


Engine control system - 1998 and later V6 models (1 of 3)

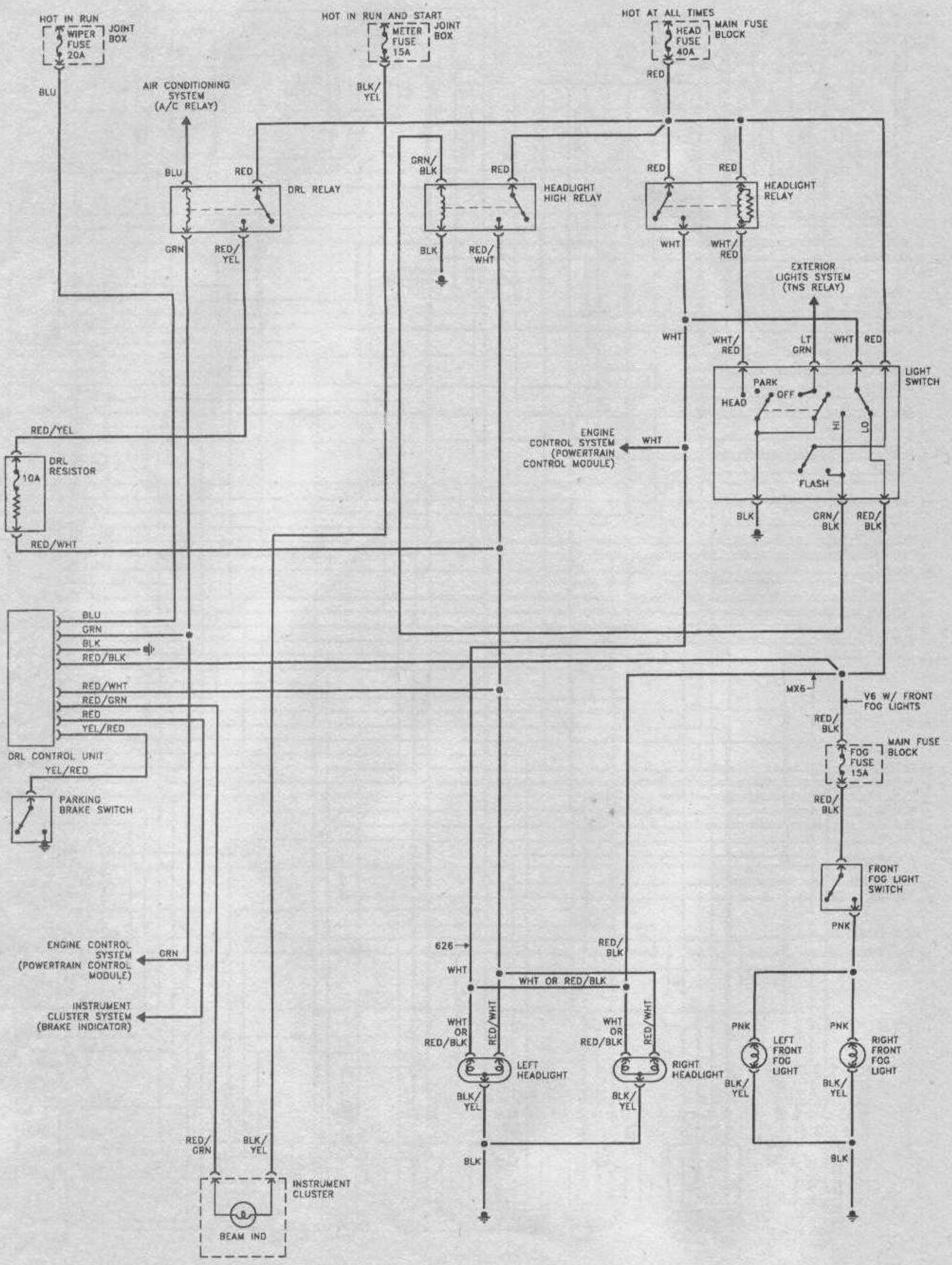
12



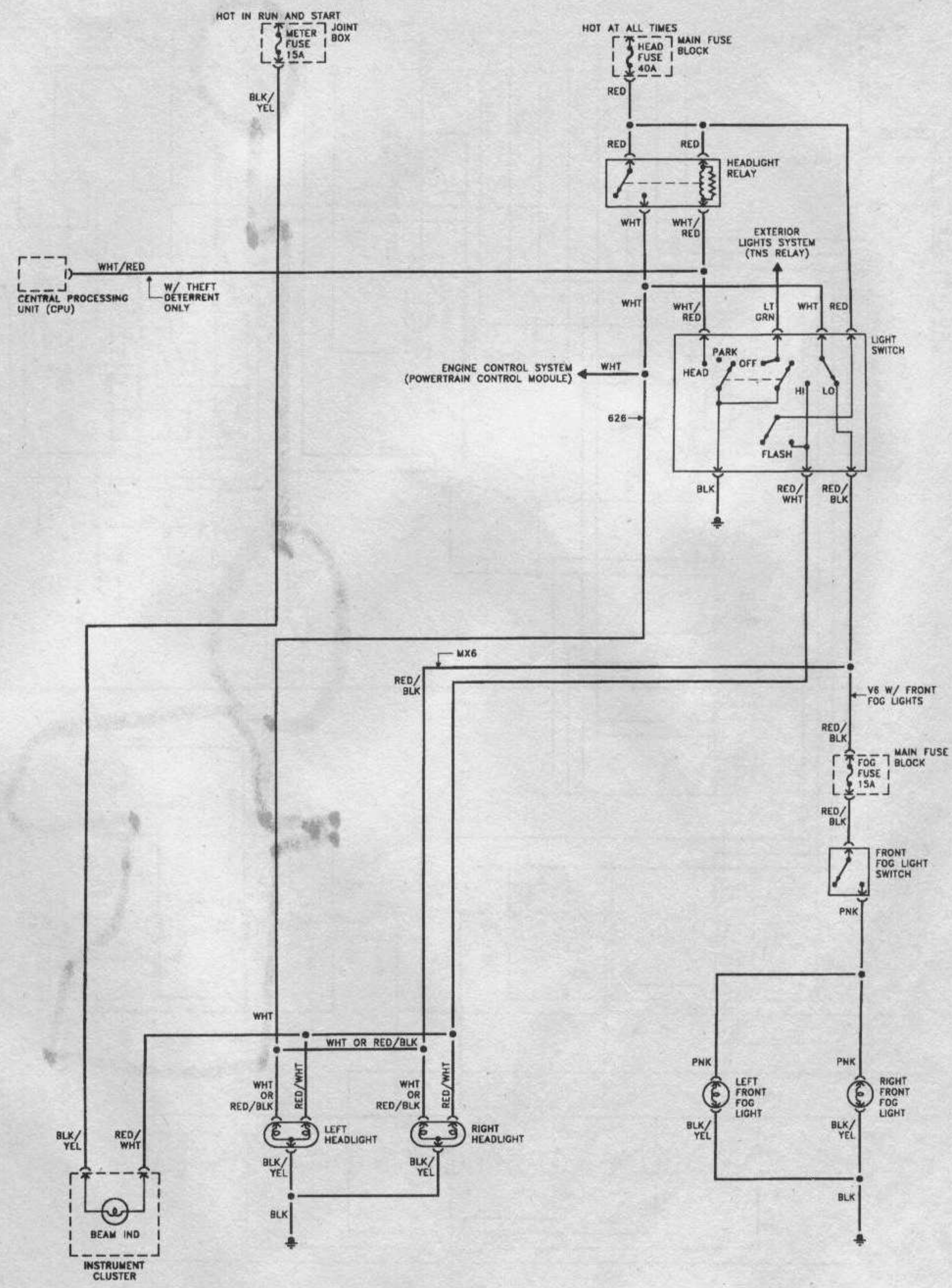
Engine control system - 1998 and later V6 models (2 of 3)



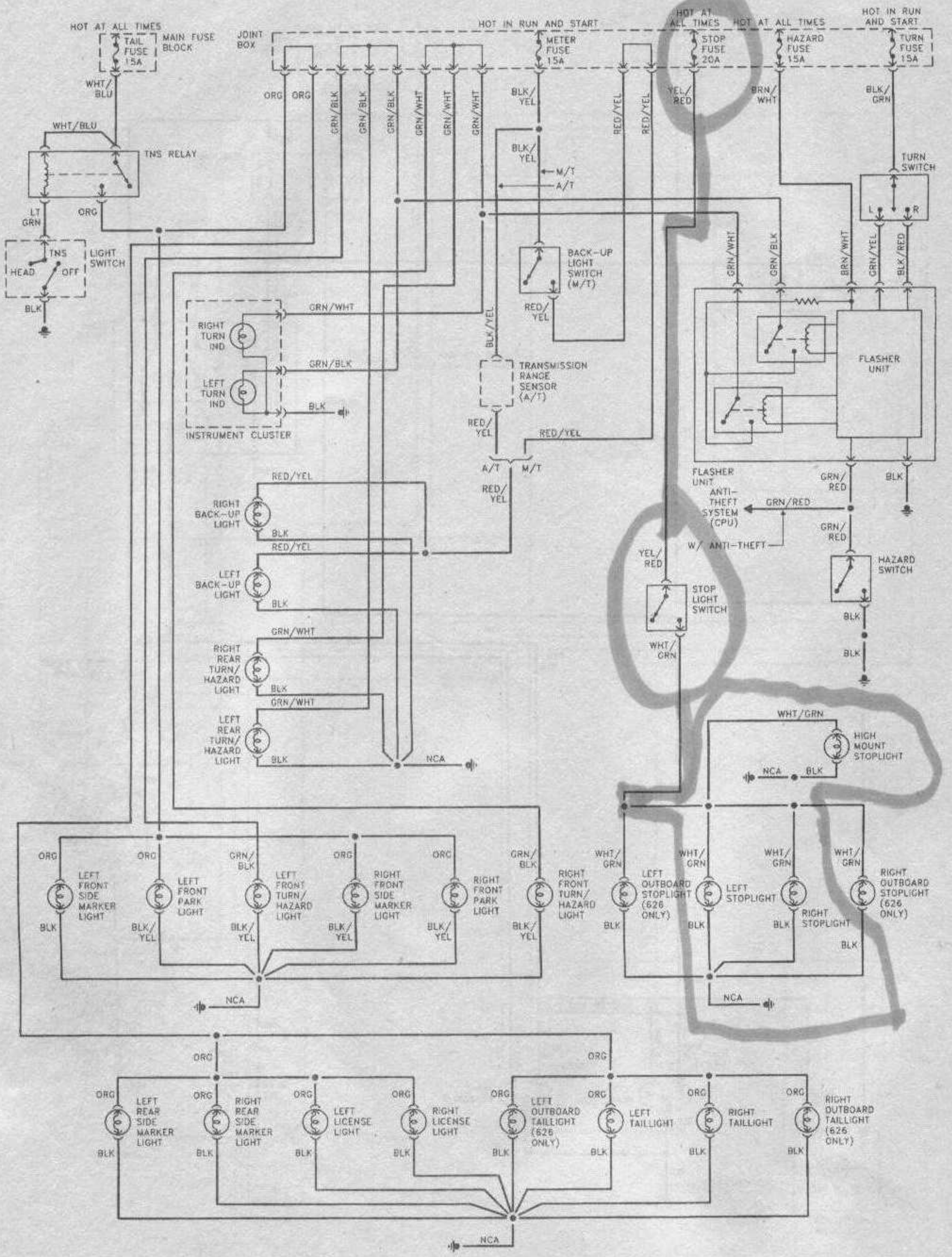
Engine control system - 1998 and later V6 models (3 of 3)



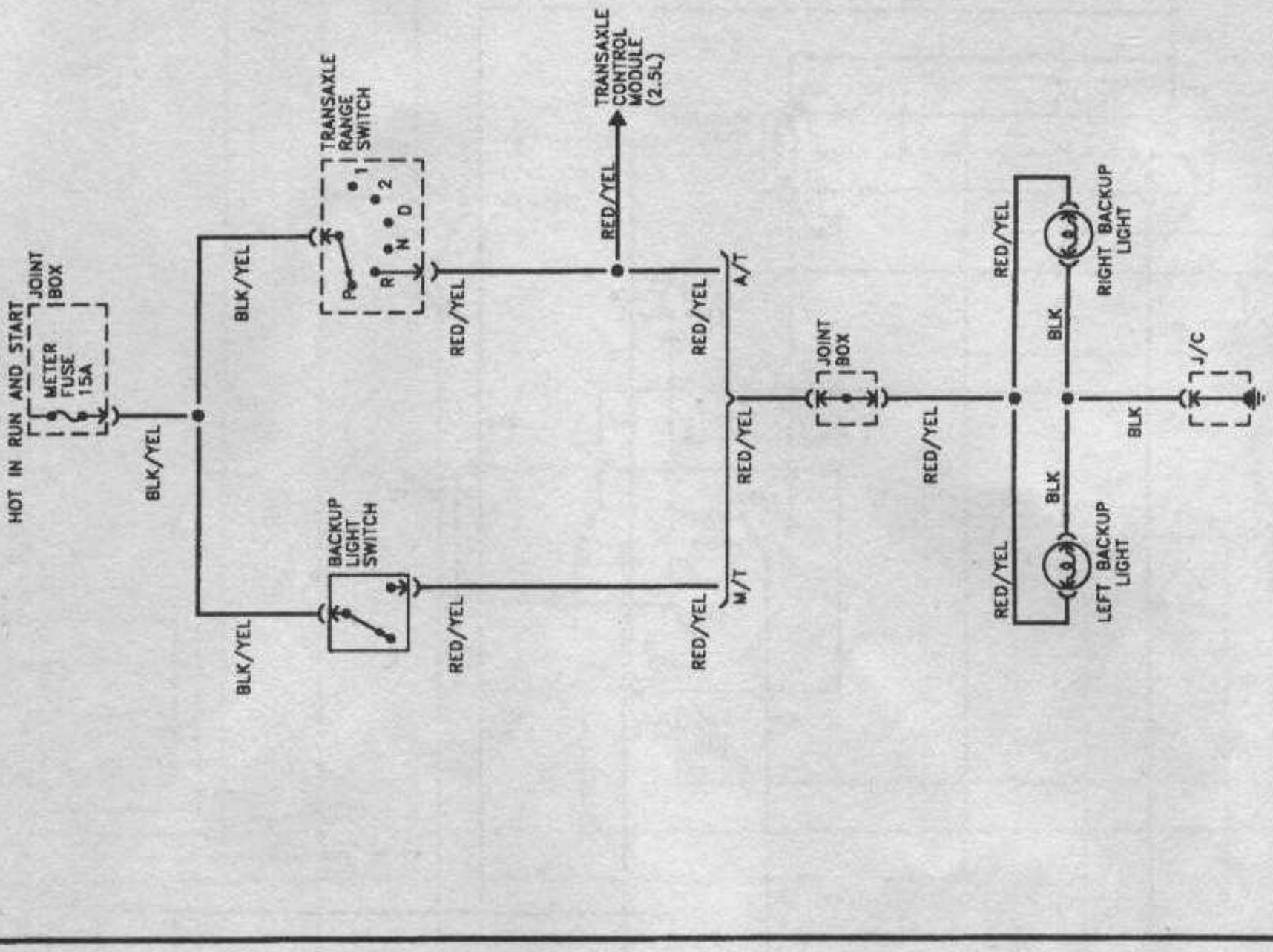
Headlight system - 1993 and 1994 models with Daytime Running Lights

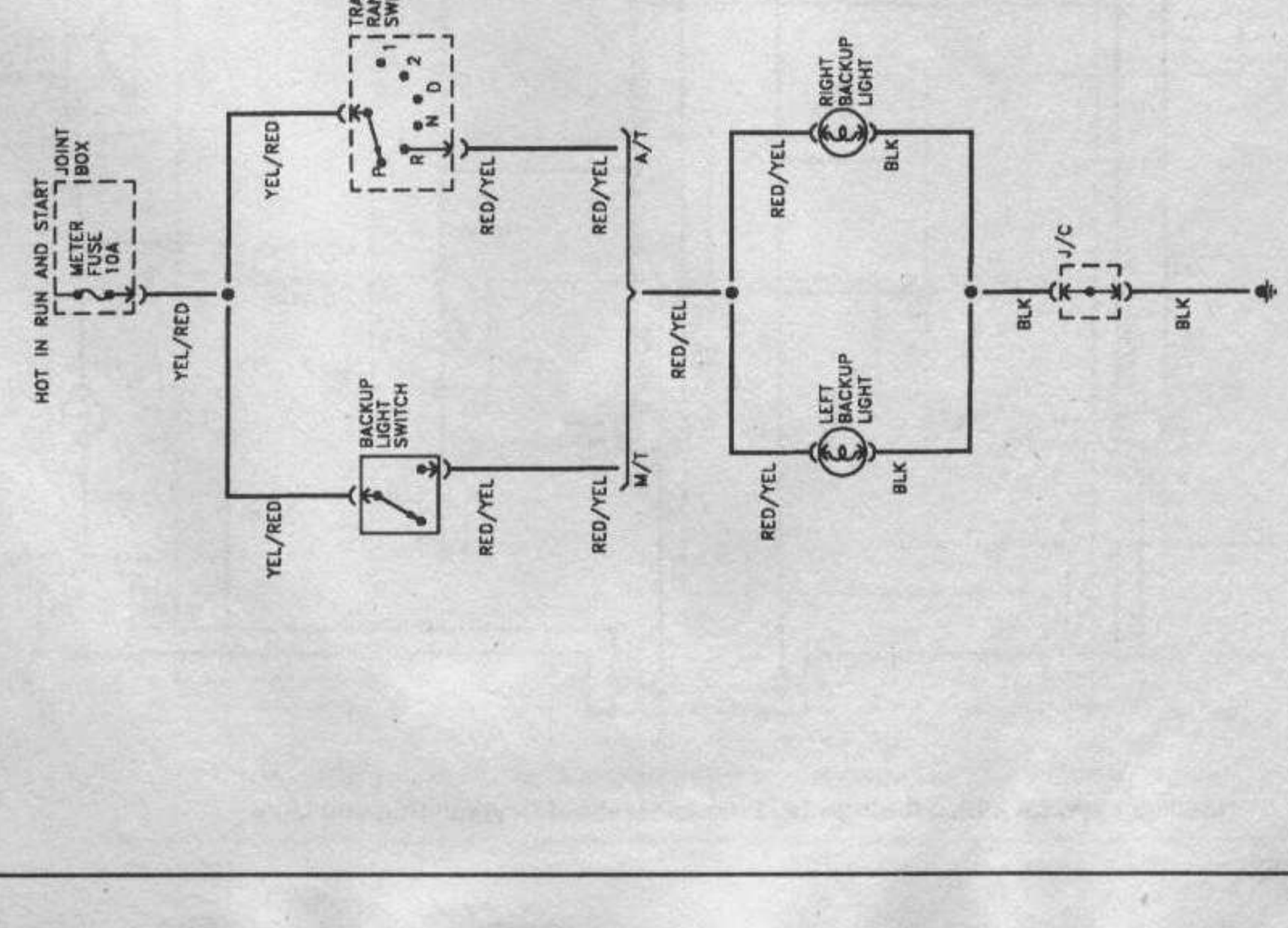


Headlight system - 1993 and 1994 models without Daytime Running Lights

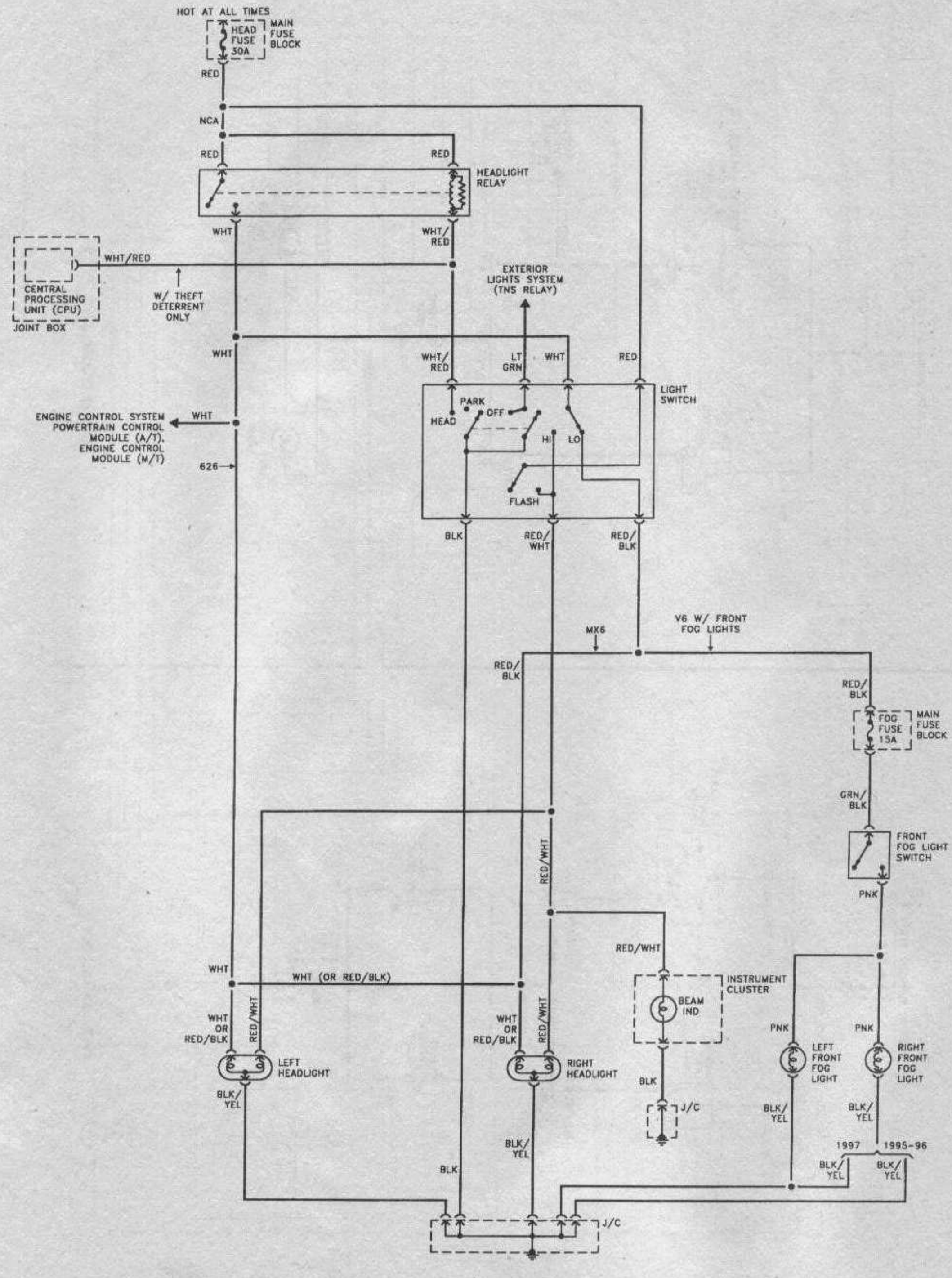


Exterior lighting system - 1993 and 1994 models

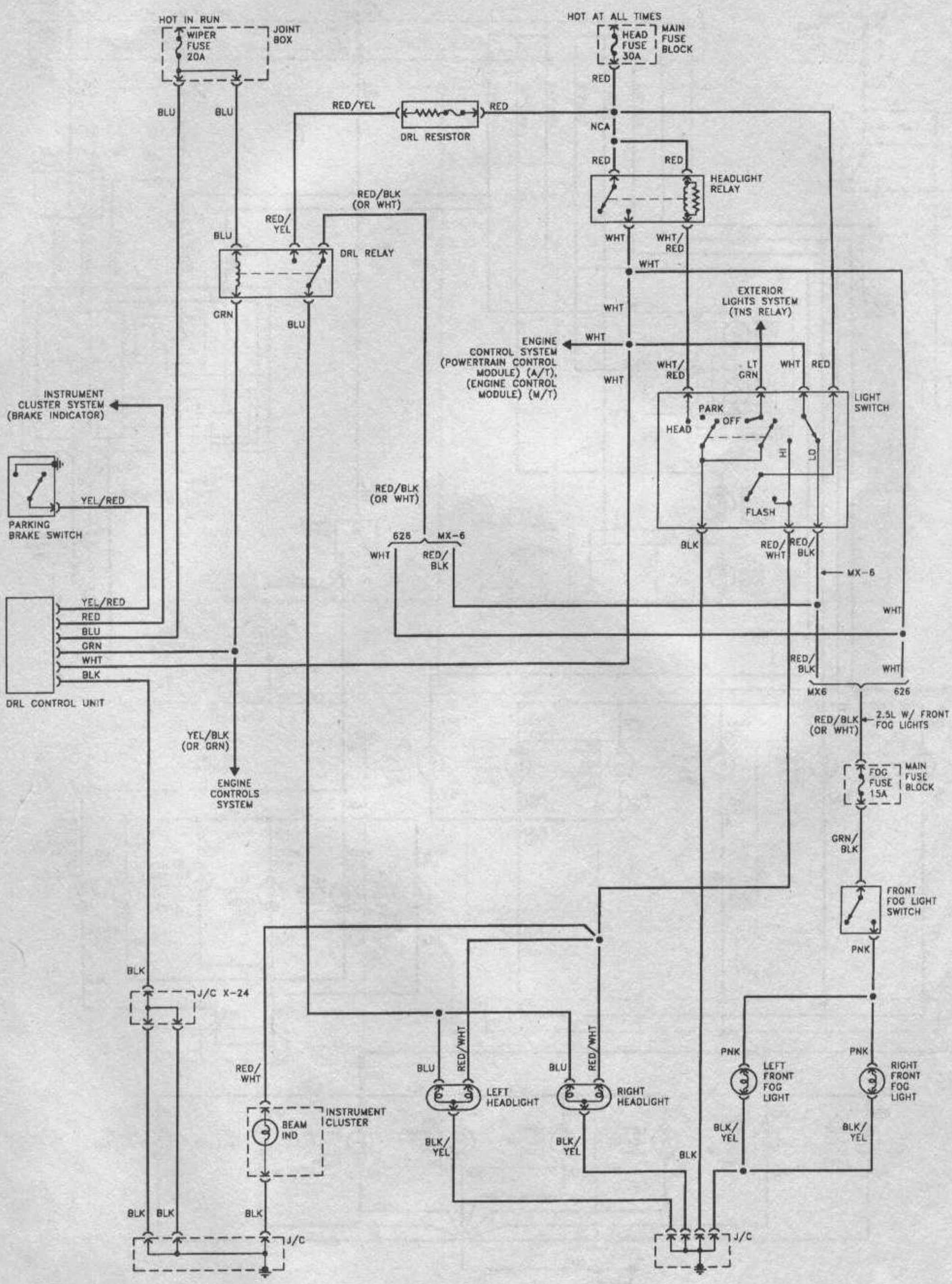




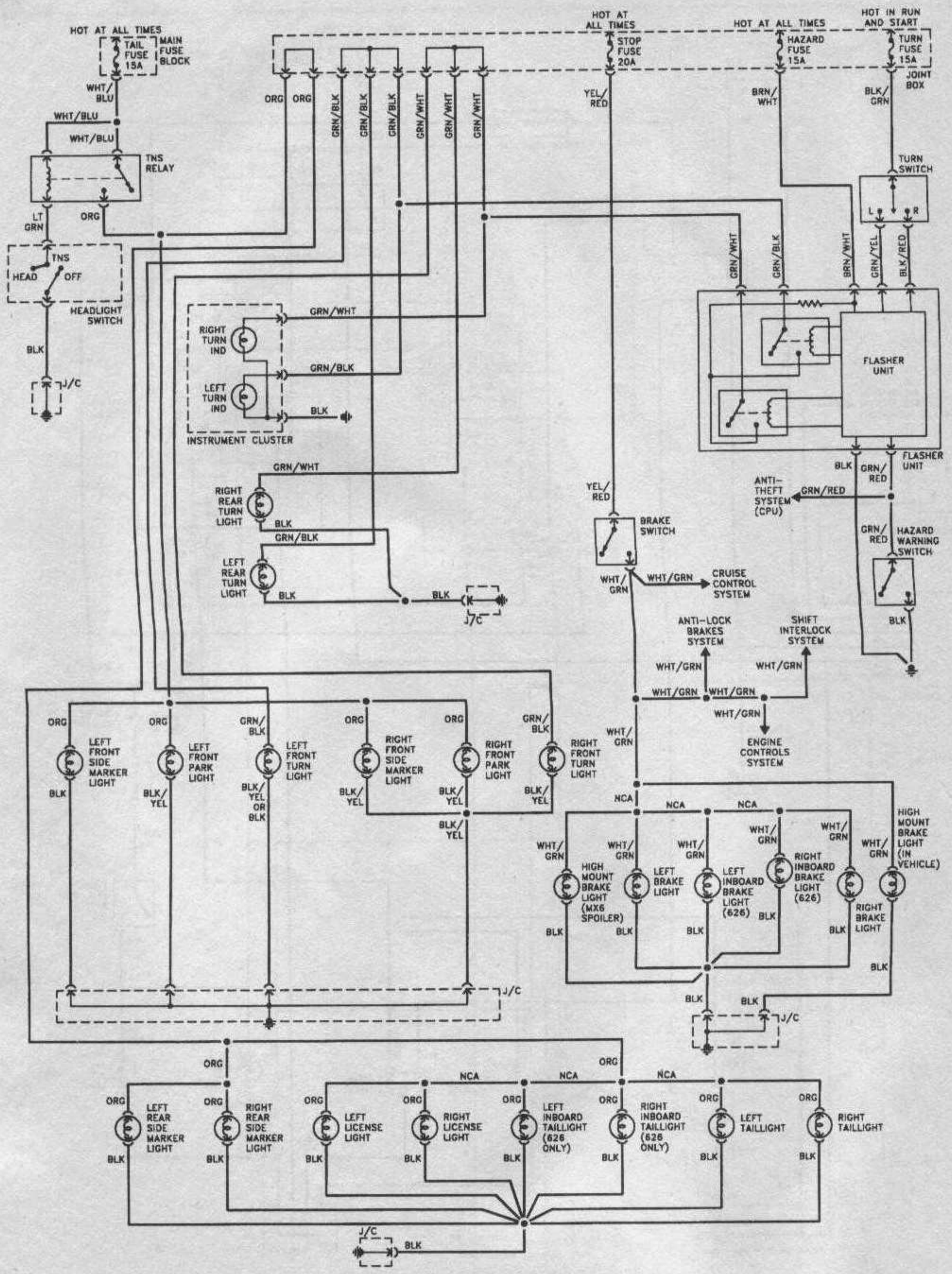
Backup light system - 1995 through 1998 and later models



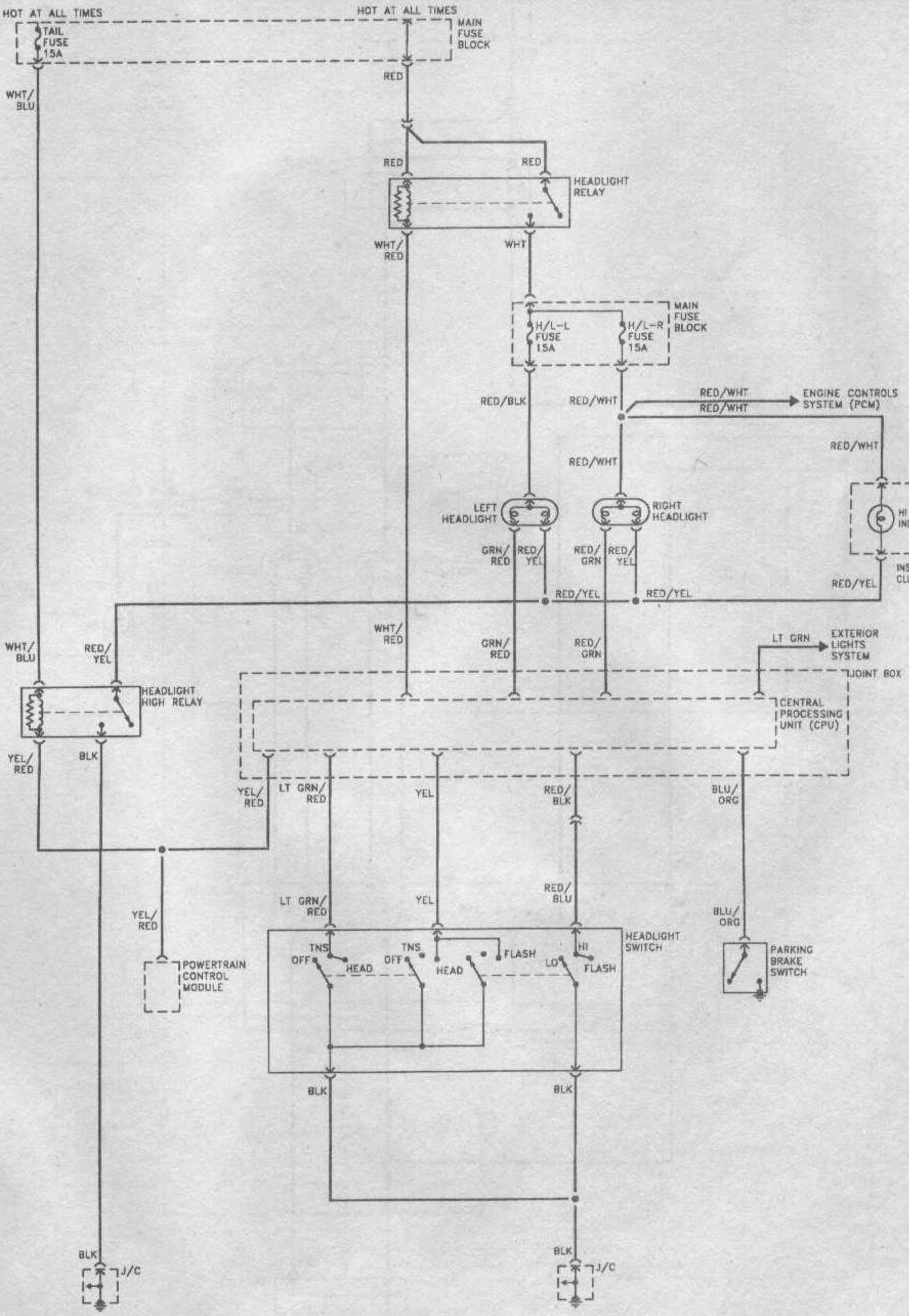
Headlight system - 1995 through 1997 models without Daytime Running Lights



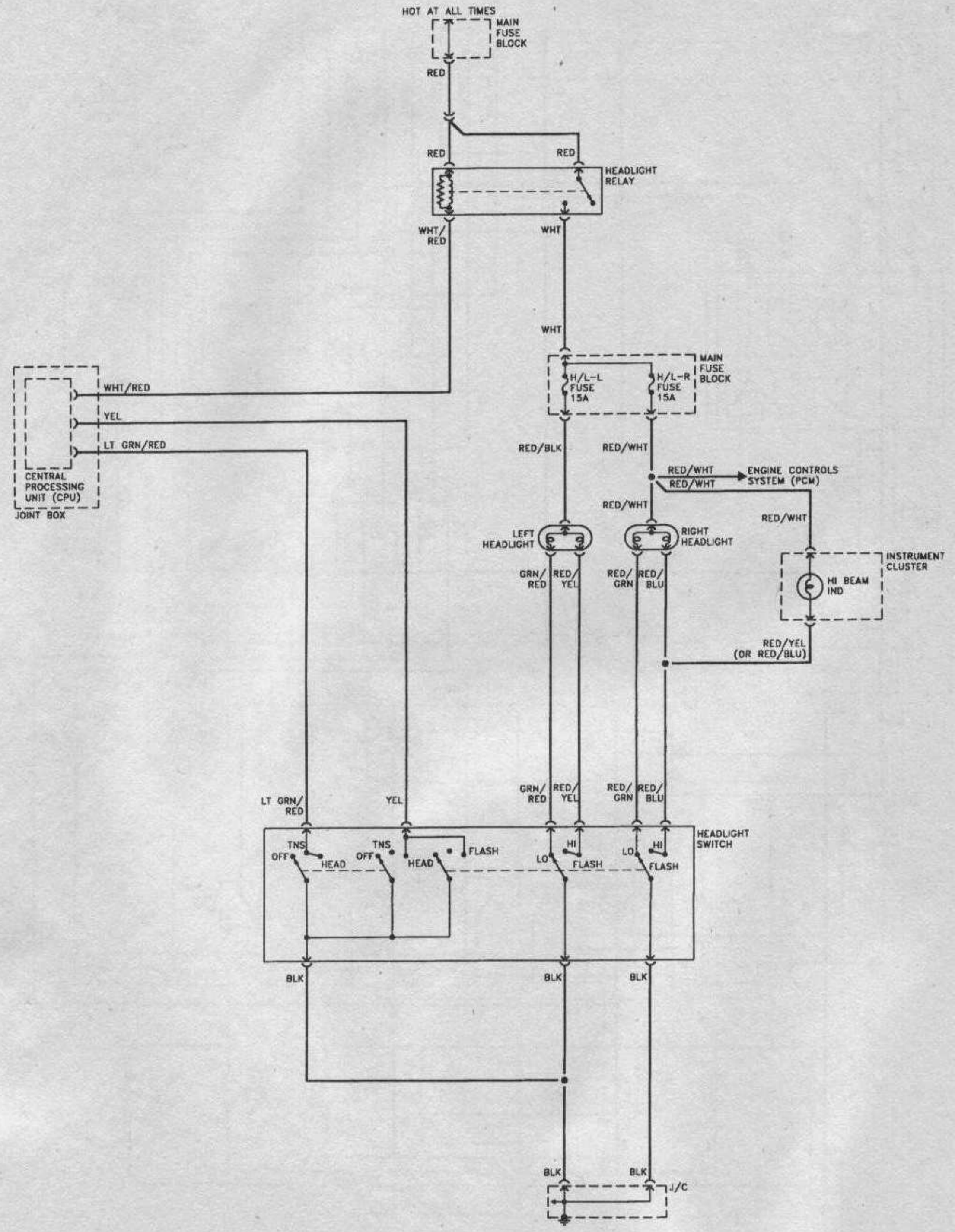
Headlight system - 1995 through 1997 models with Daytime Running Lights



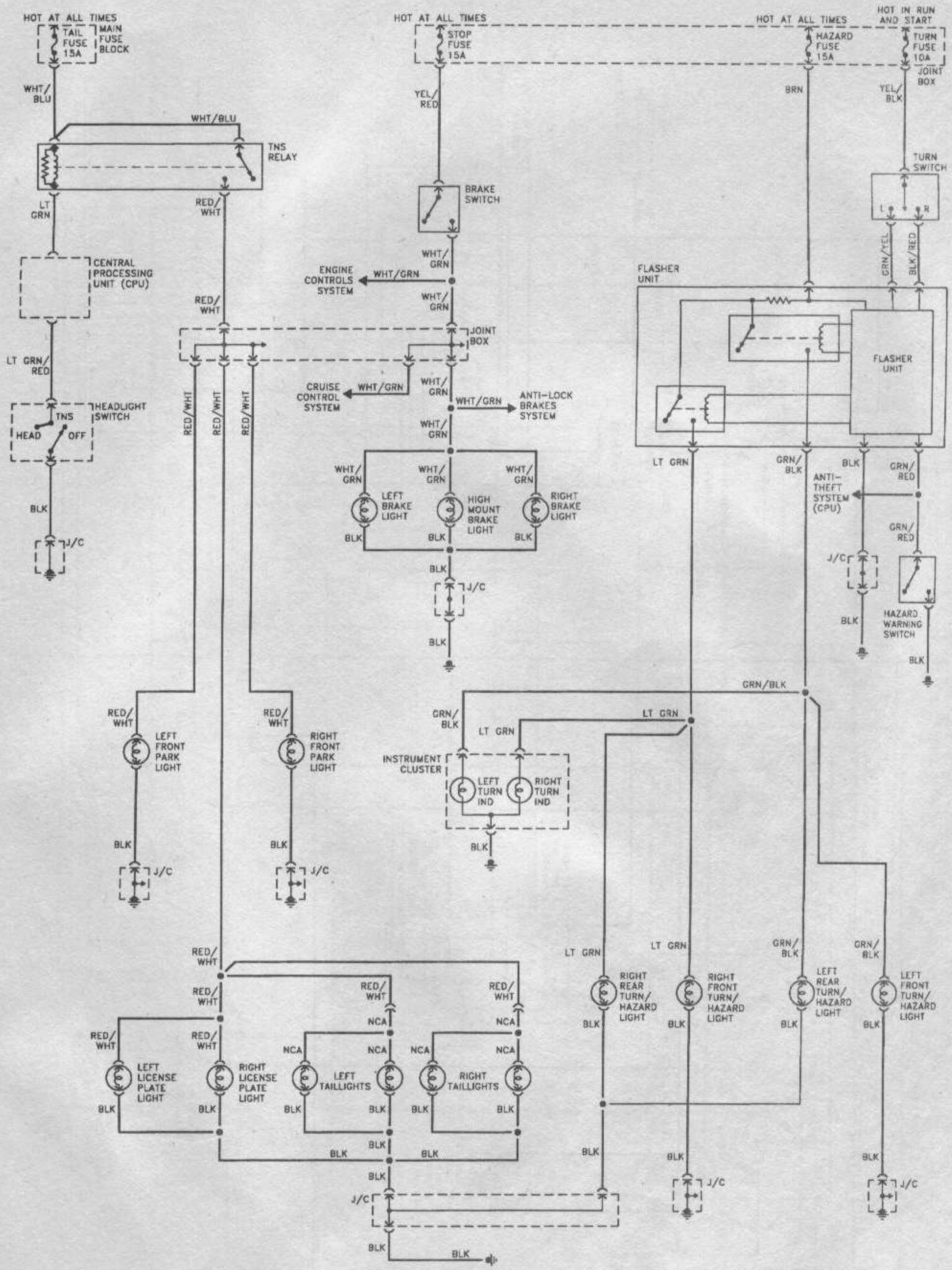
Exterior lighting system - 1995 through 1997 models



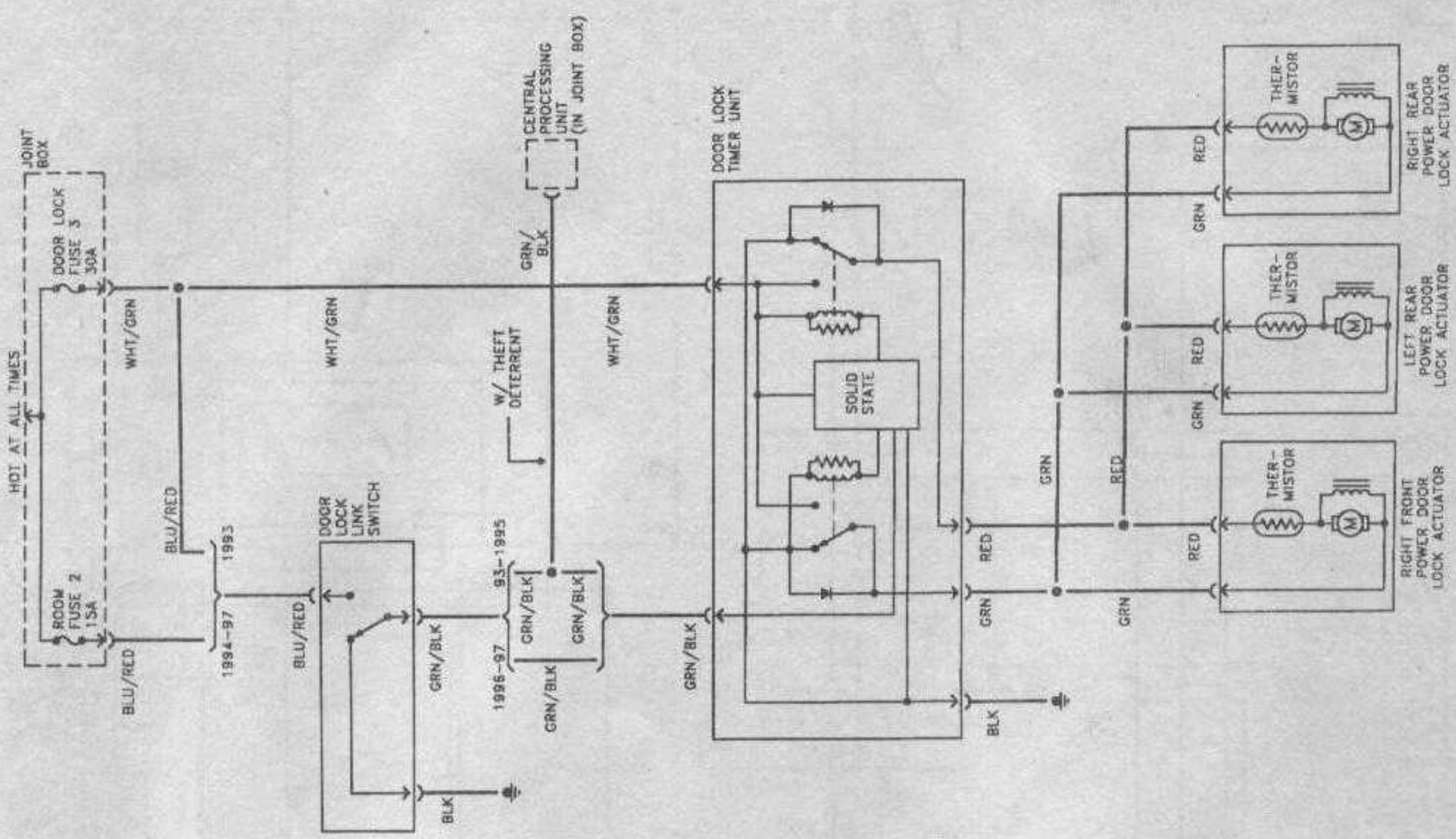
Headlight system - 1998 and later models with Daytime Running Lights



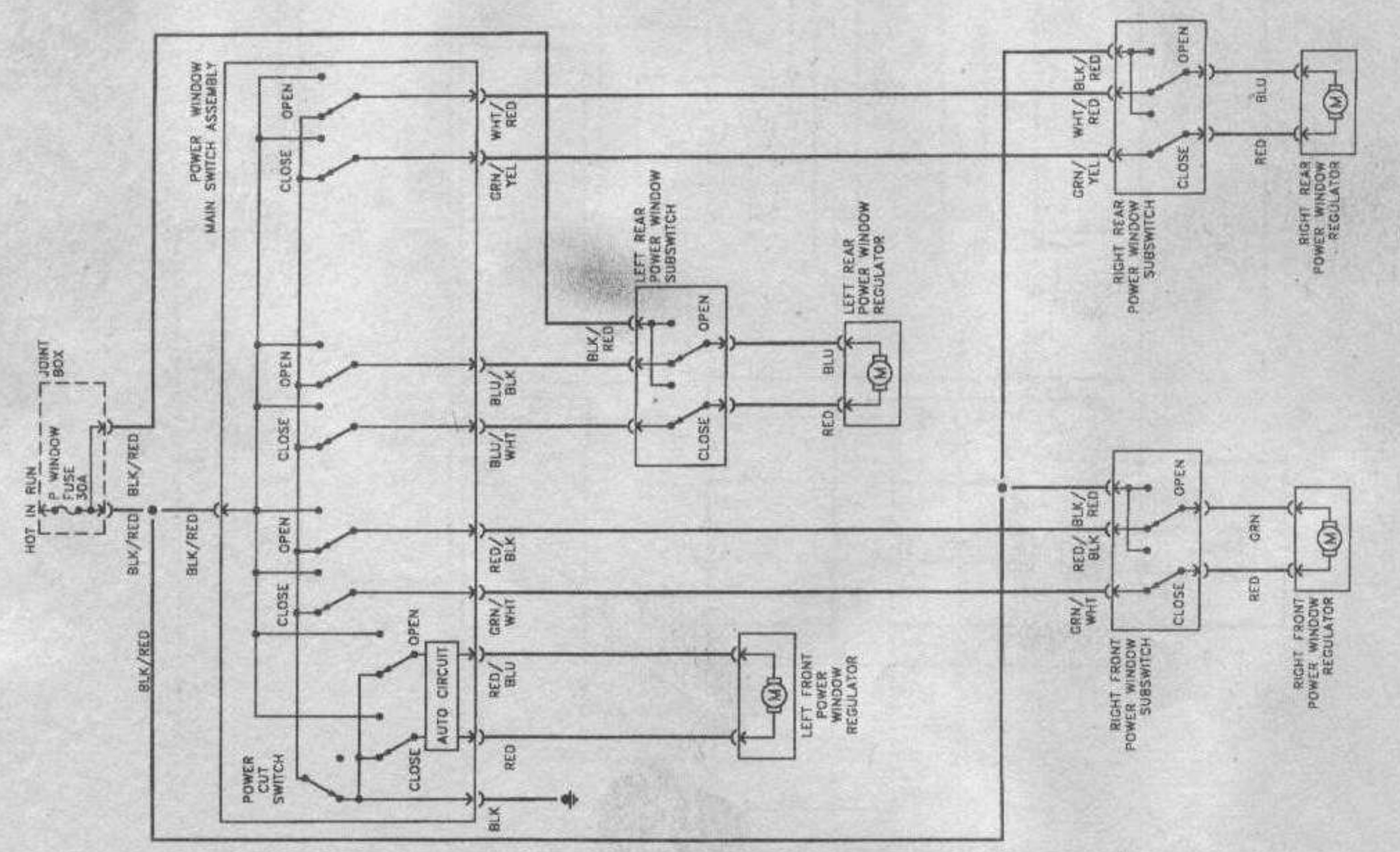
Headlight system - 1998 and later models without Daytime Running Lights



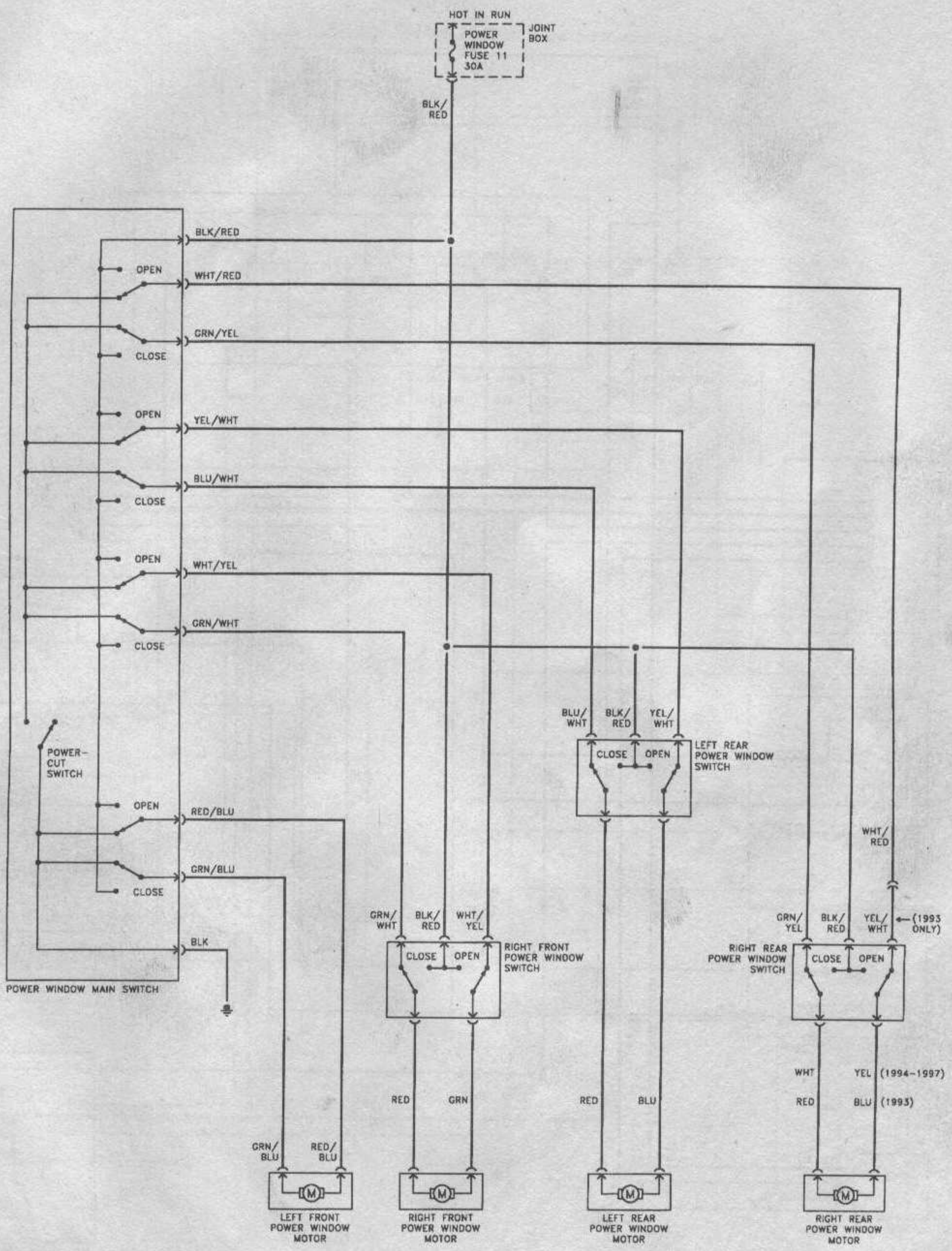
Exterior lighting system - 1998 and later models



Power door lock system - 1993 through 1997 models

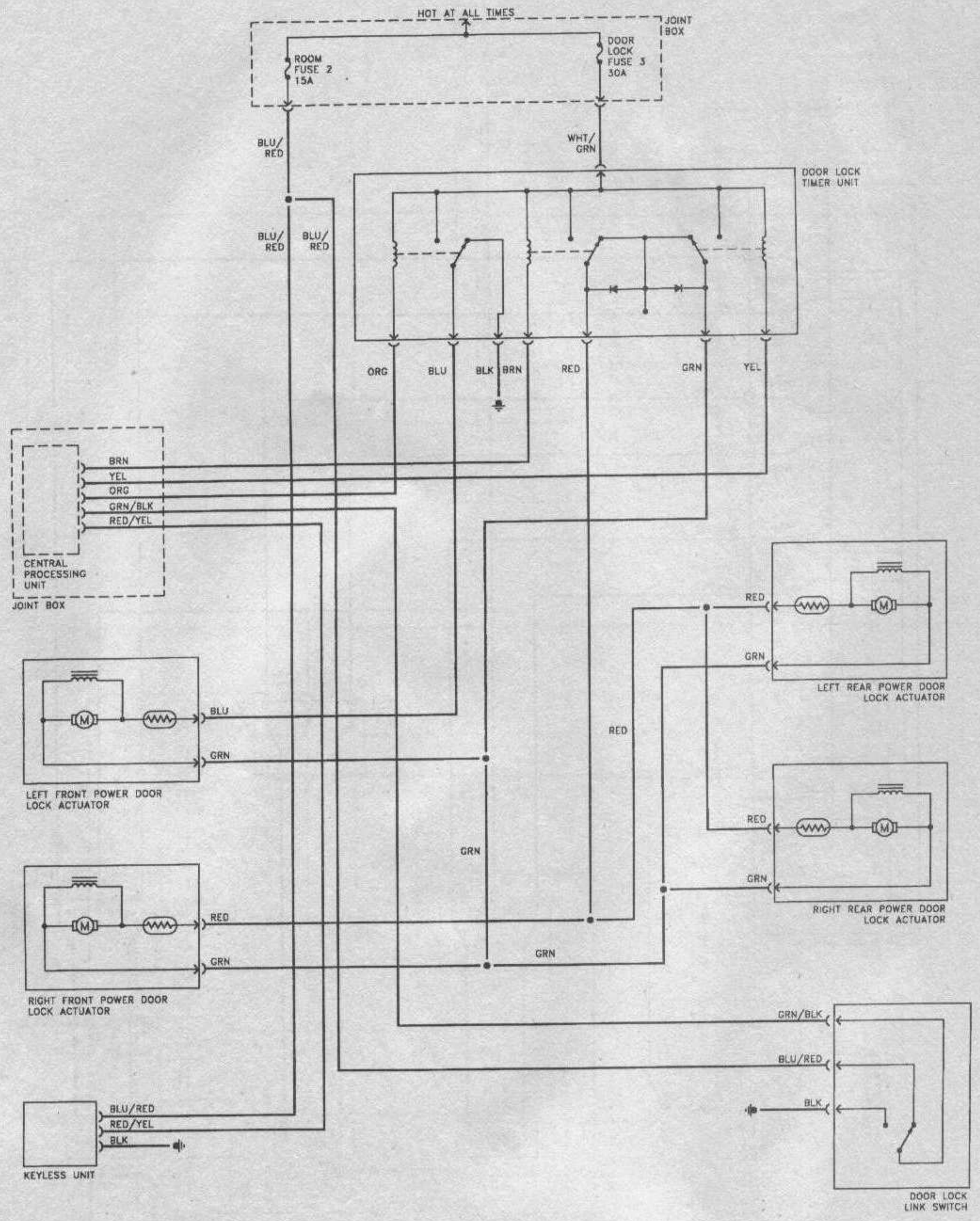


Power window system - 1998 and later models

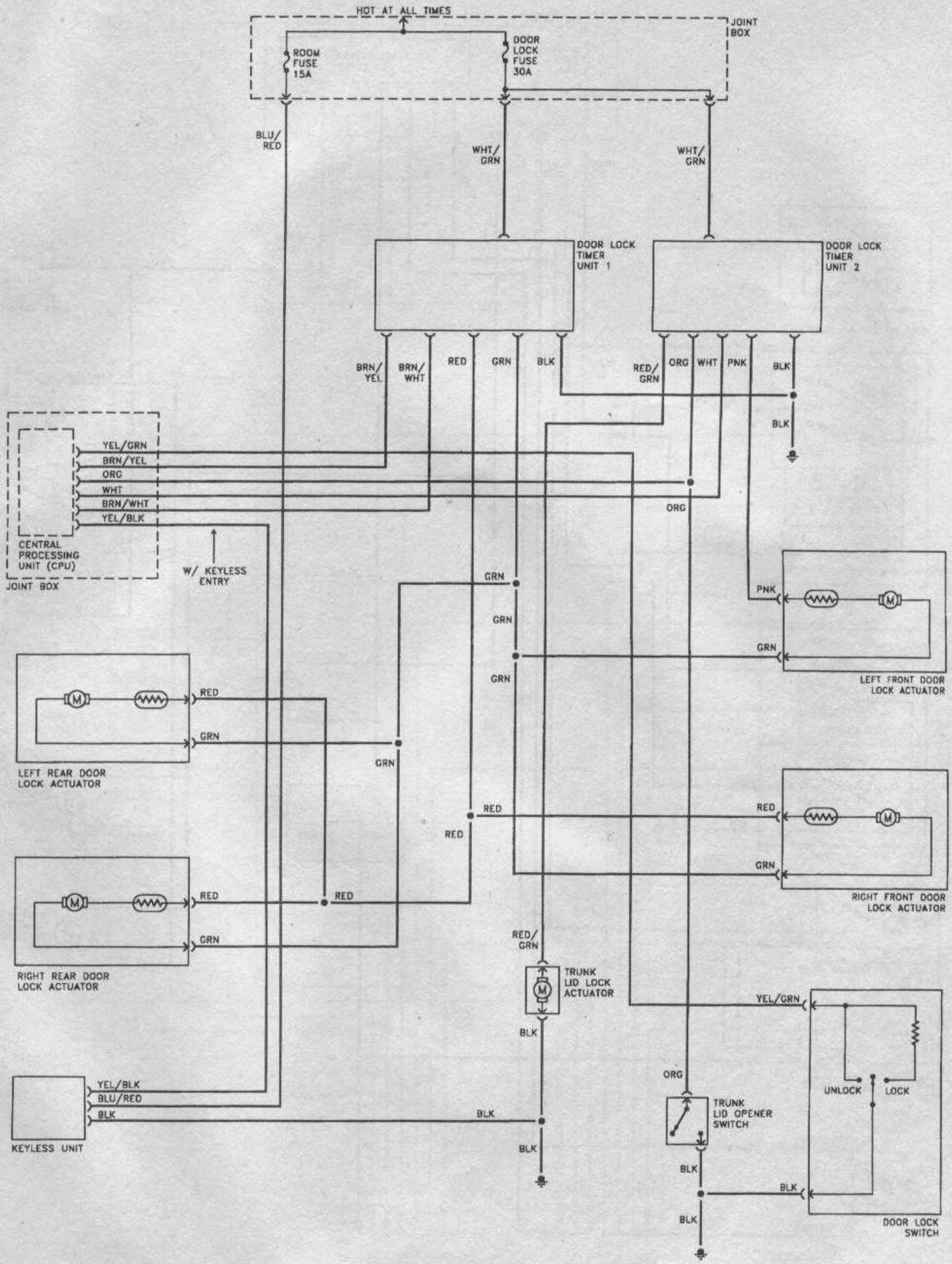


Power window system - 1993 through 1997 models

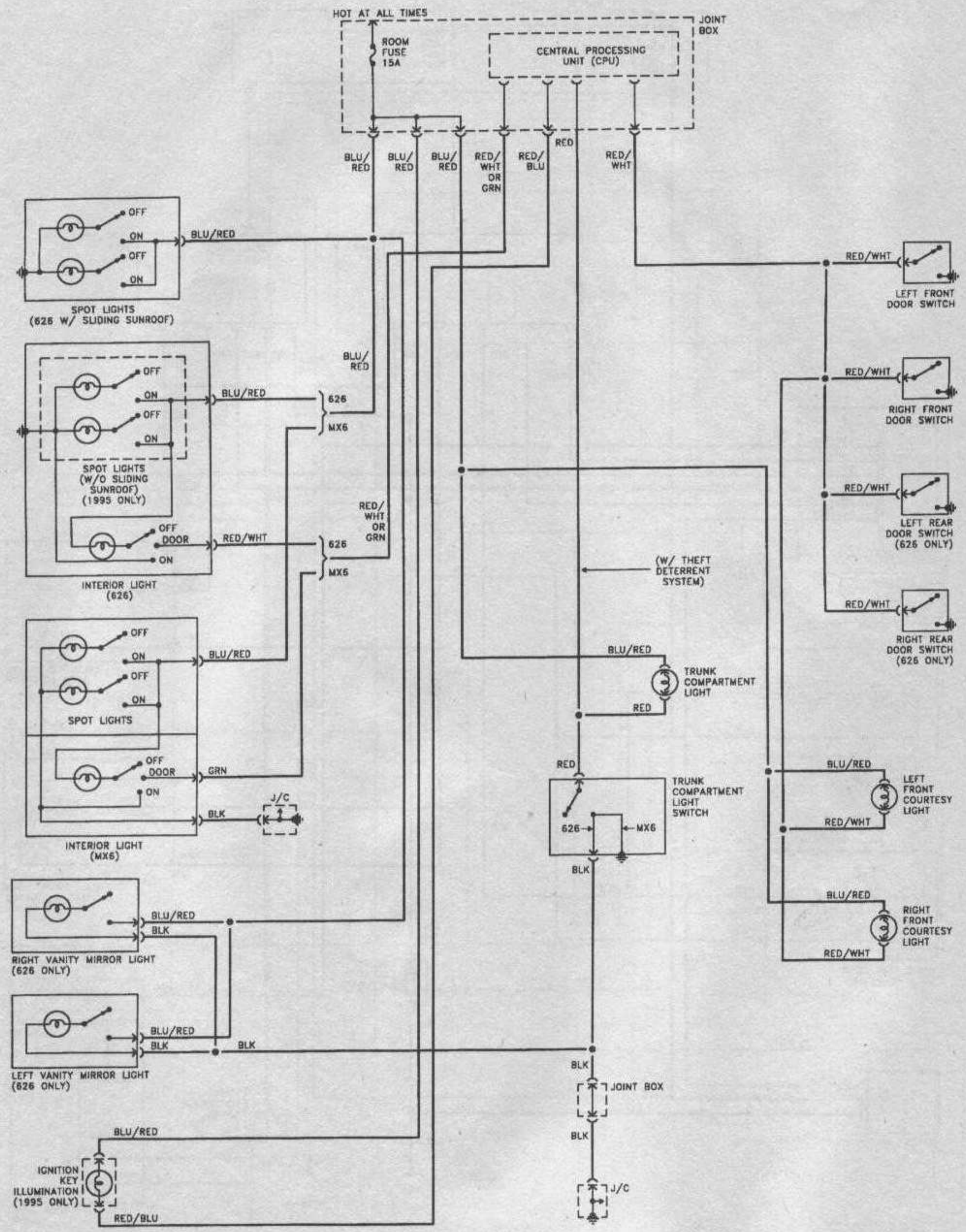
12



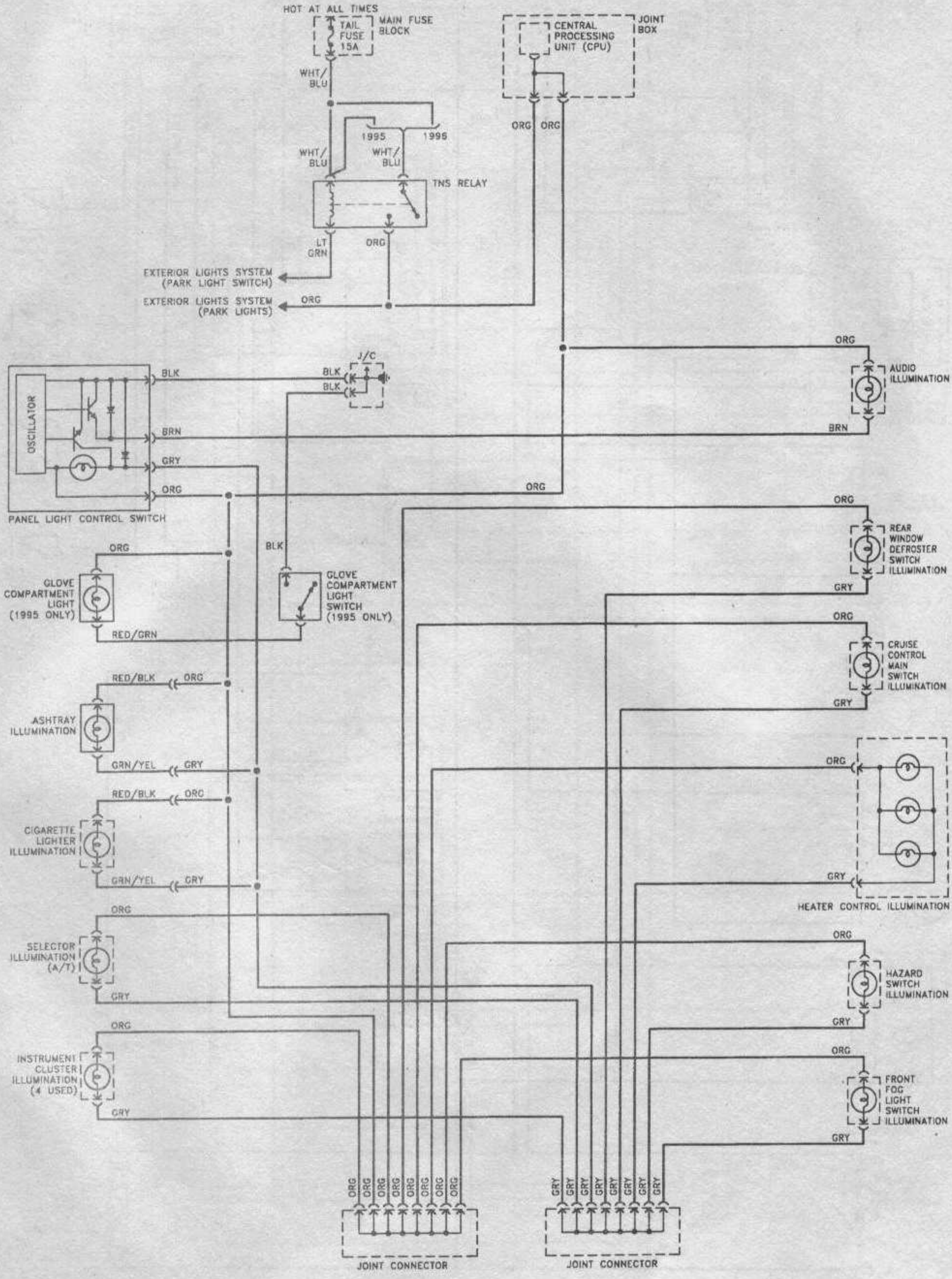
Keyless entry system - 1995 through 1997 models



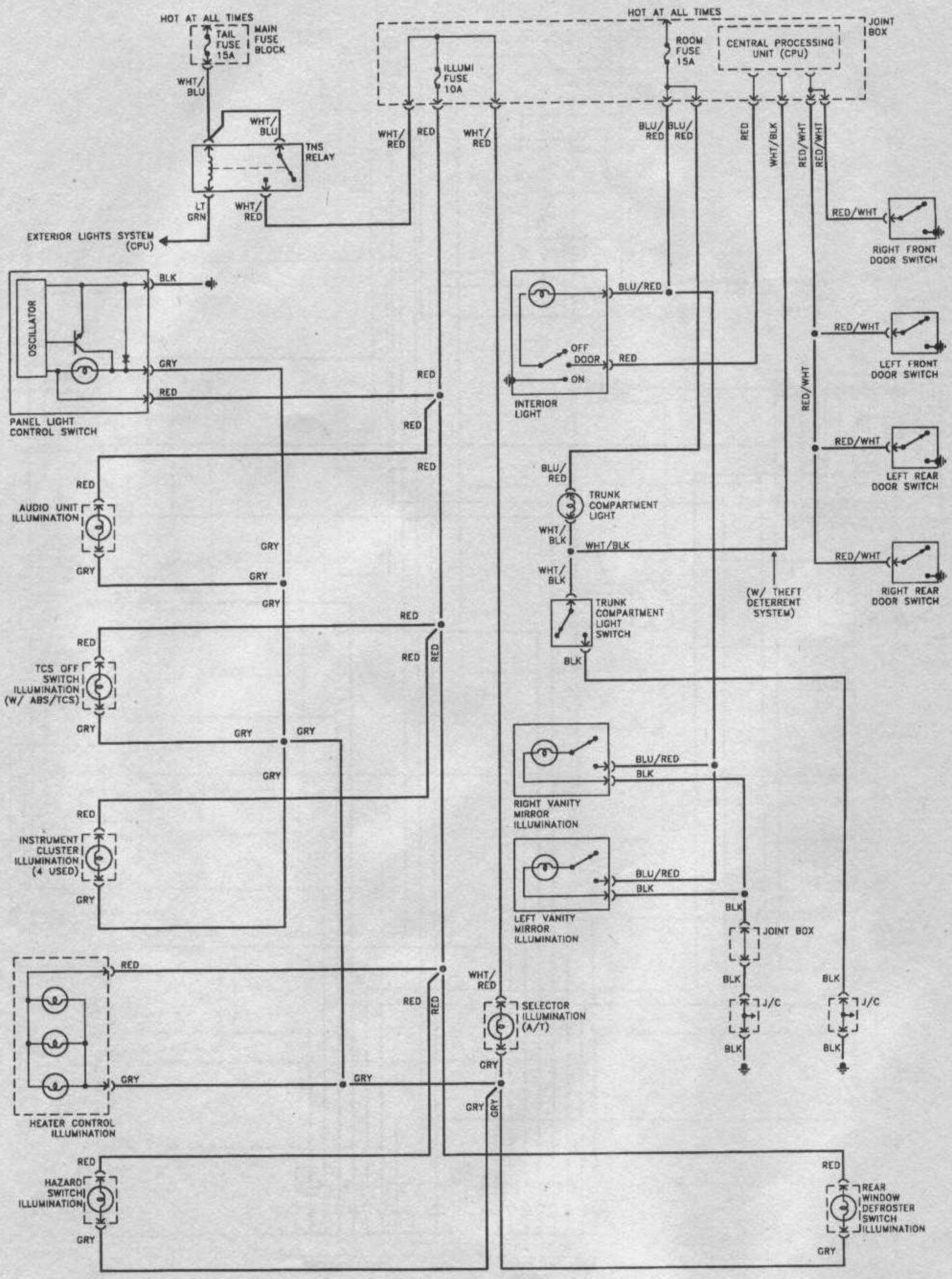
Power door lock system - 1998 and later models



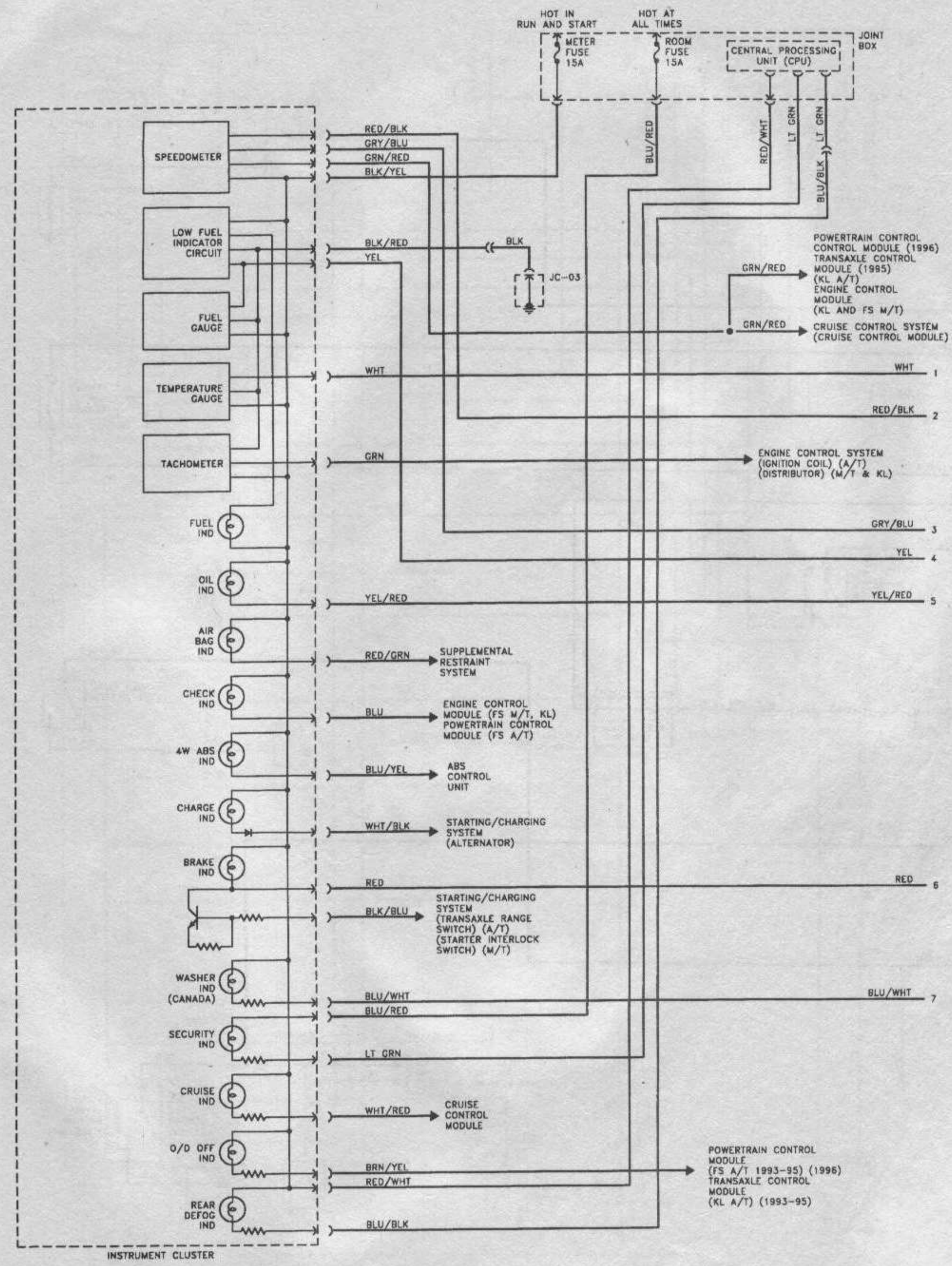
Courtesy light system - 1993 through 1997 models



Interior lighting system - 1993 through 1997 models

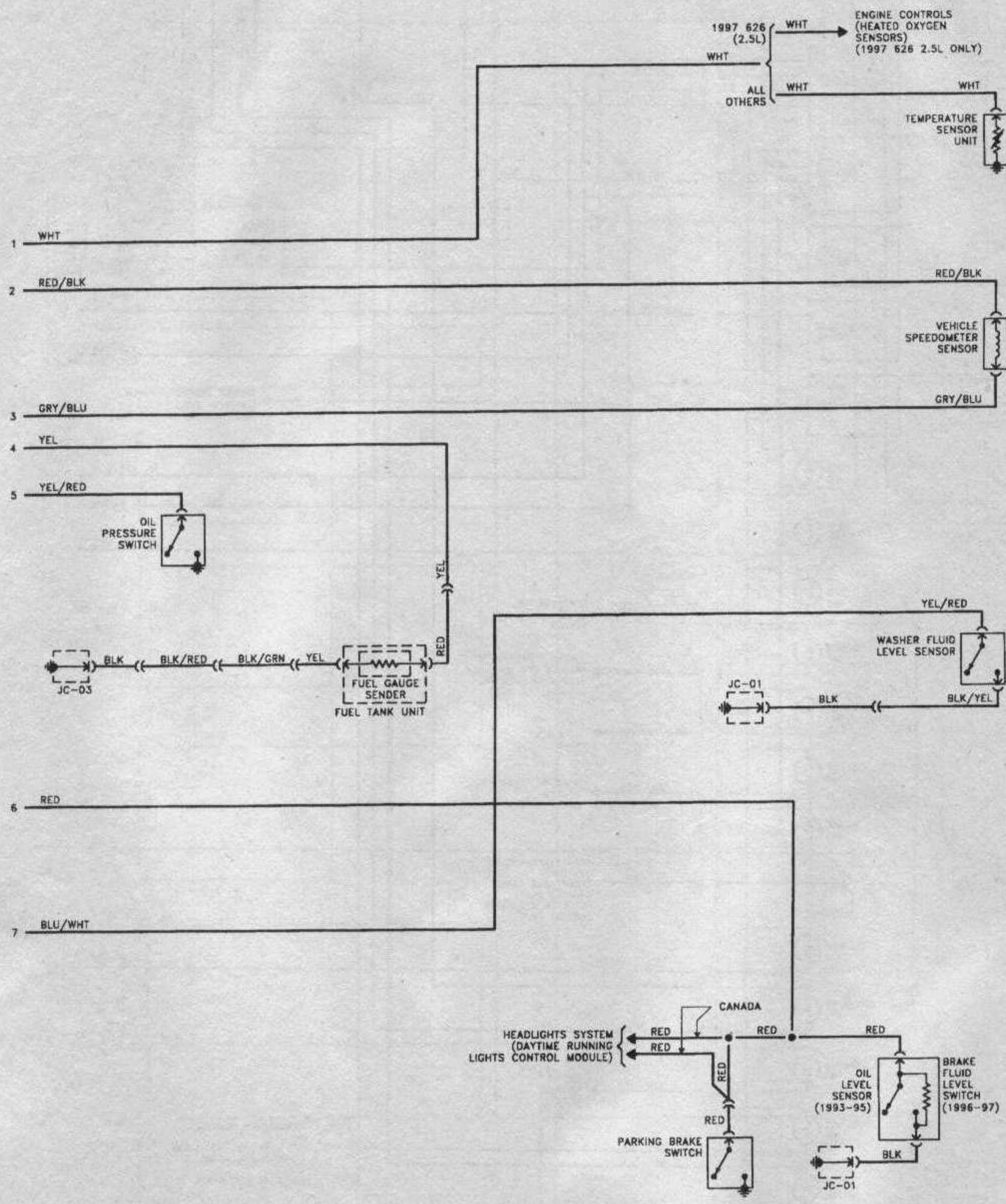


Interior lighting system - 1998 and later models

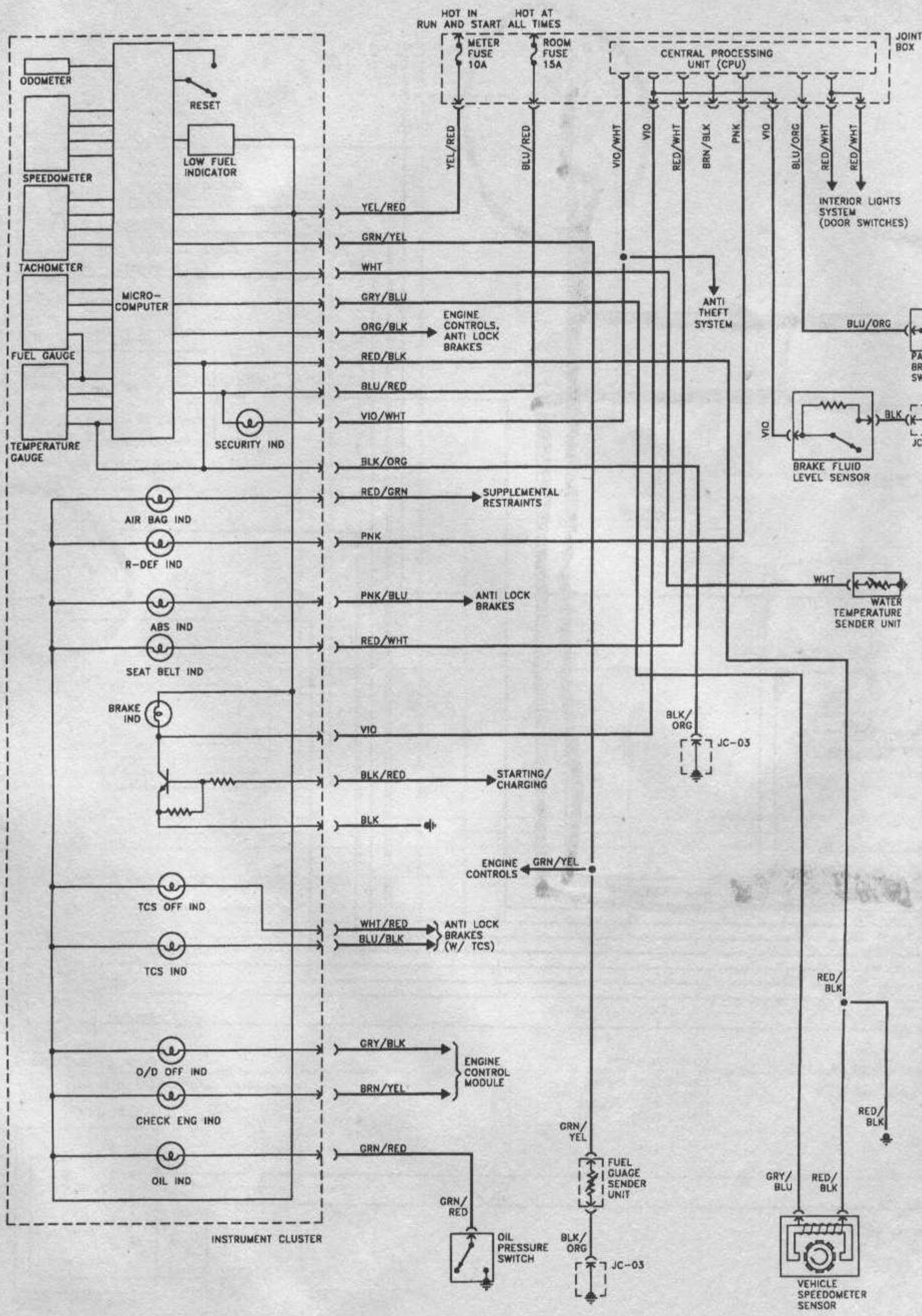


Instrument panel gauges and warning light system - 1993 through 1997 models (1 of 2)

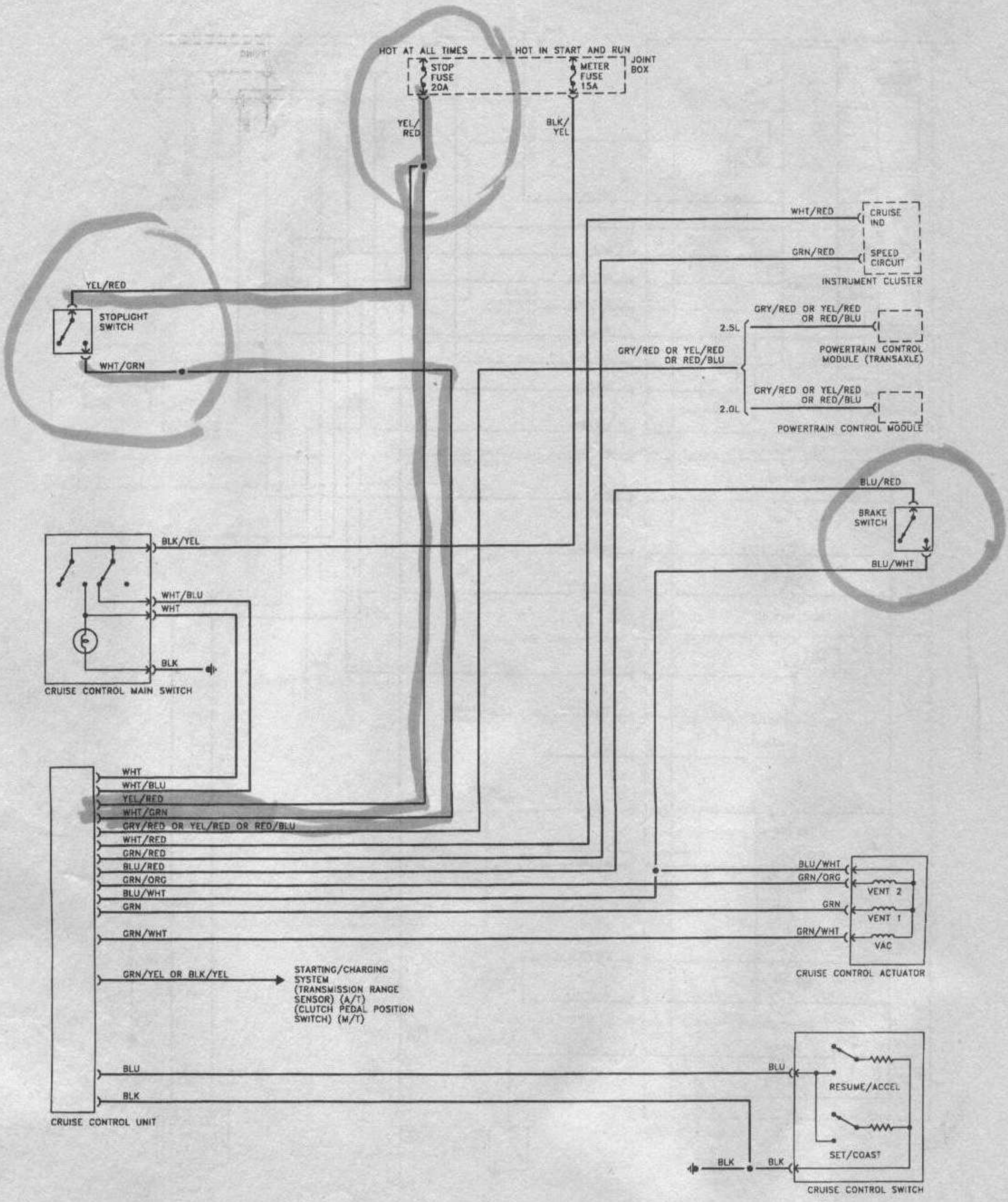
12



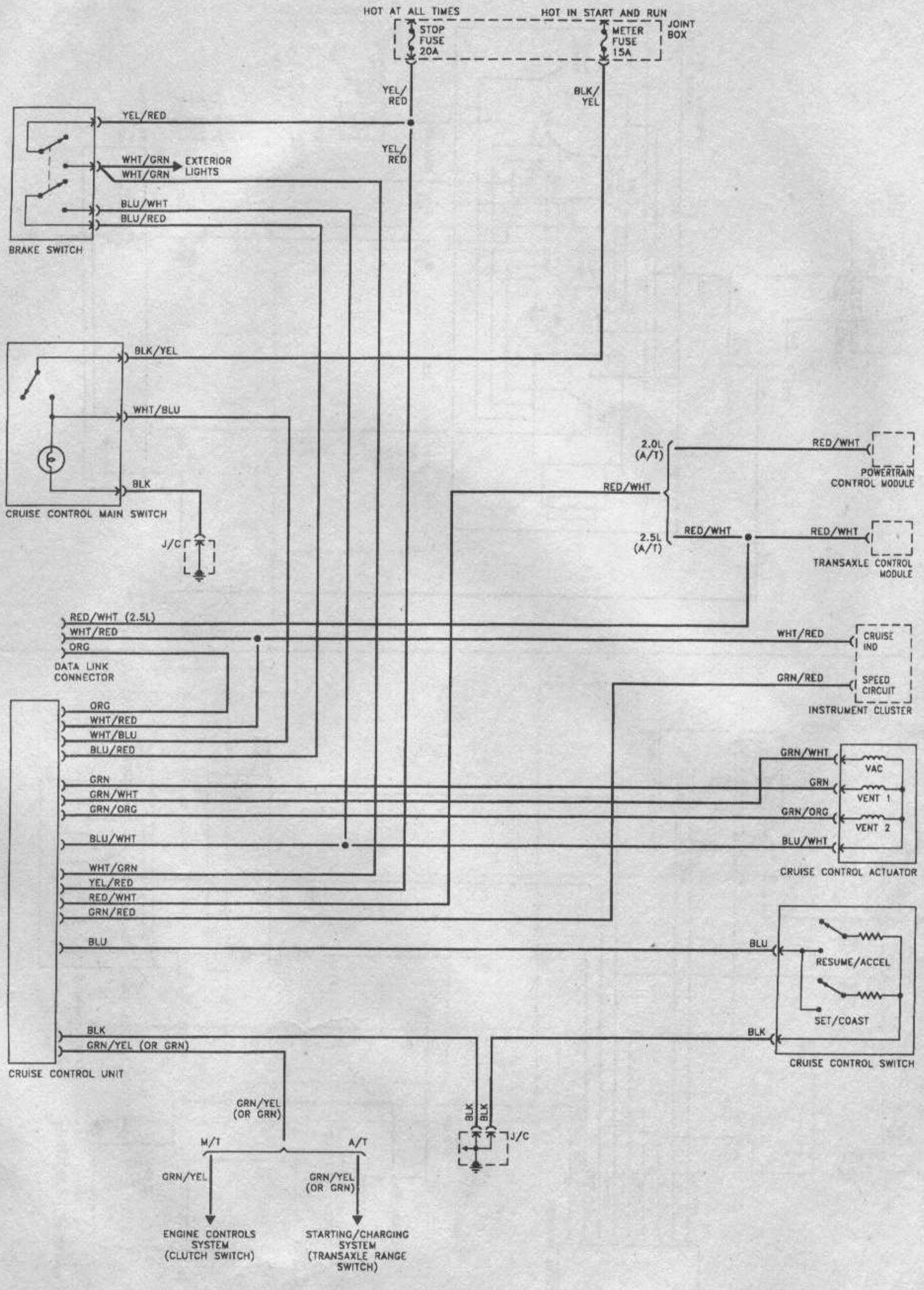
Instrument panel gauges and warning light system - 1993 through 1997 models (2 of 2)



Instrument panel gauges and warning light system - 1998 and later models



Cruise control system - 1993 and 1994 models



Cruise control system - 1995 through 1997 models

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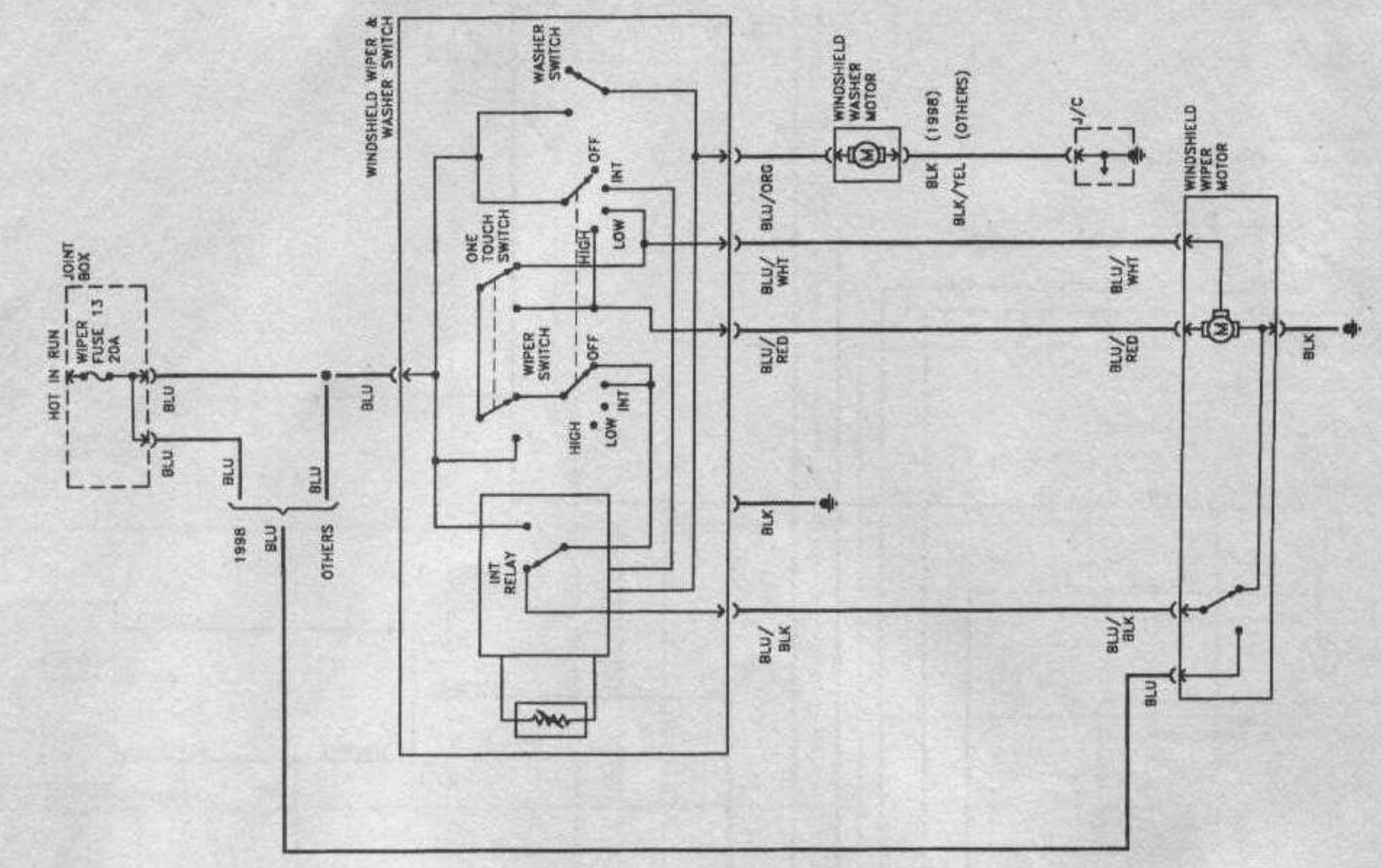
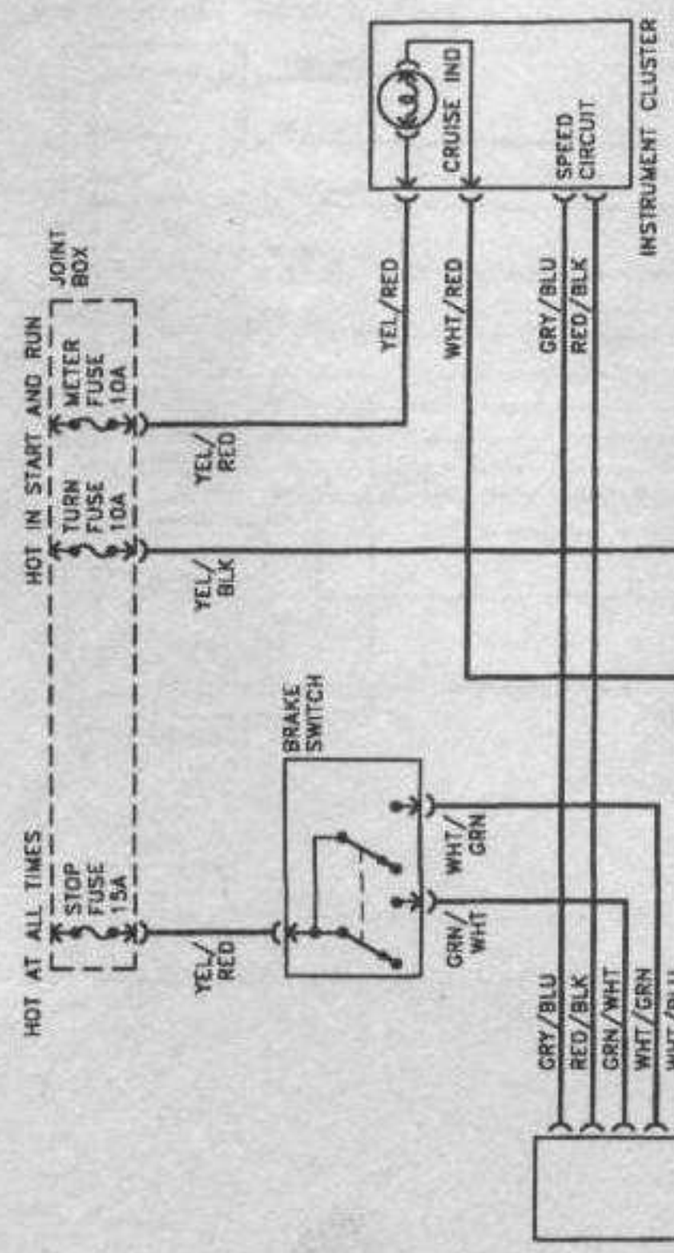
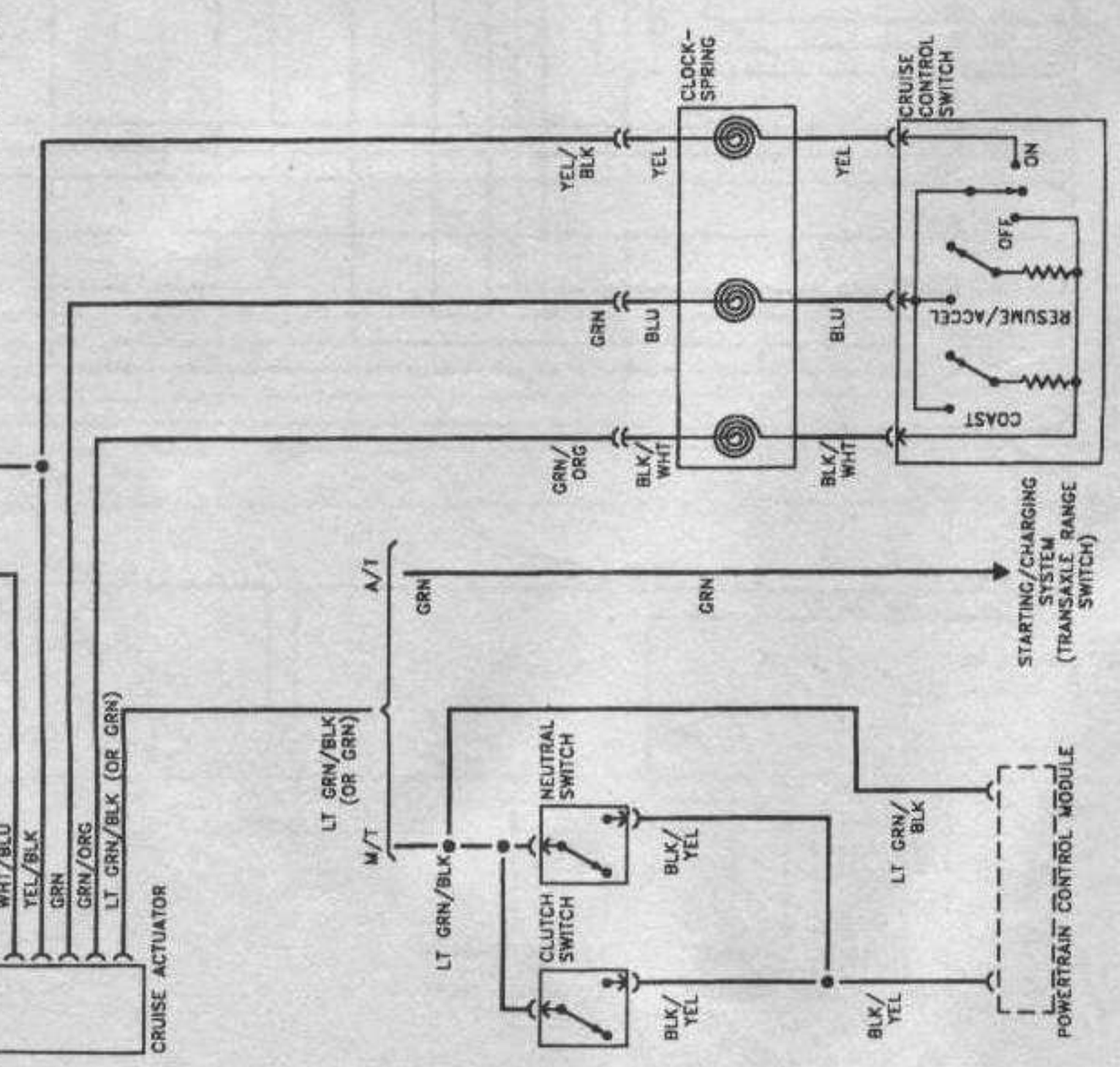
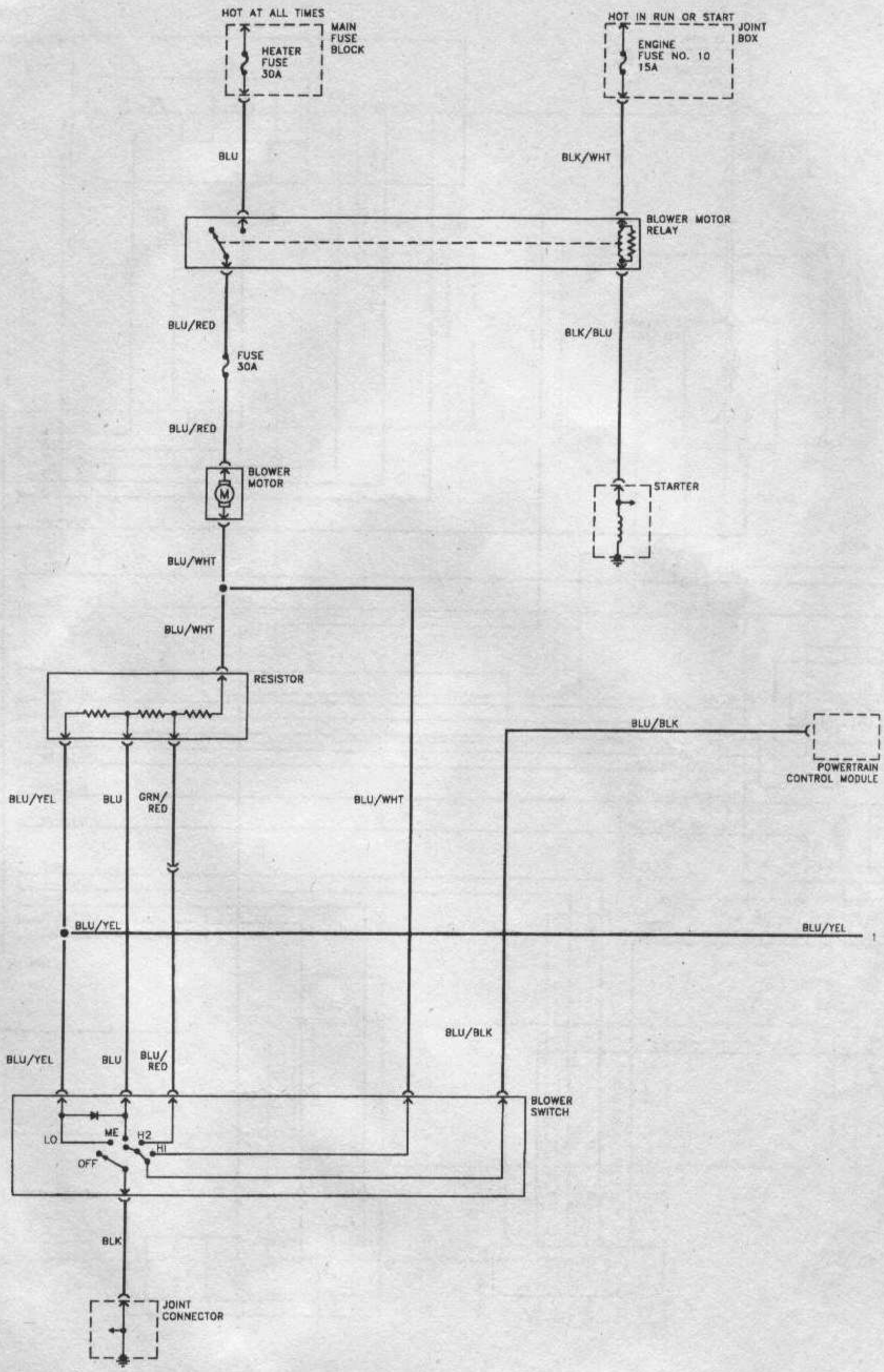


Windshield wiper and washer system - 1993 through 1998 and later models



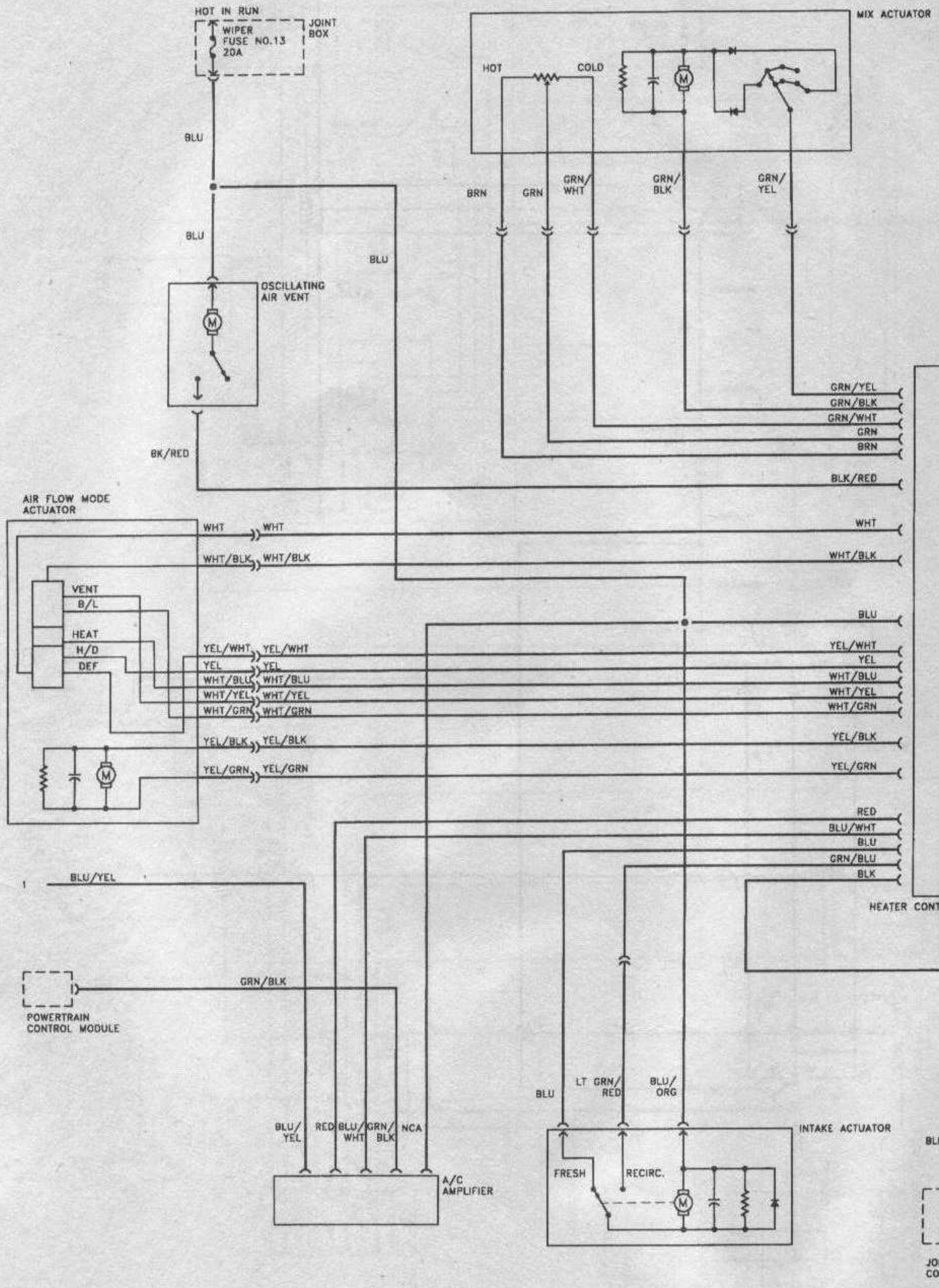


Cruise control system - 1998 and later models

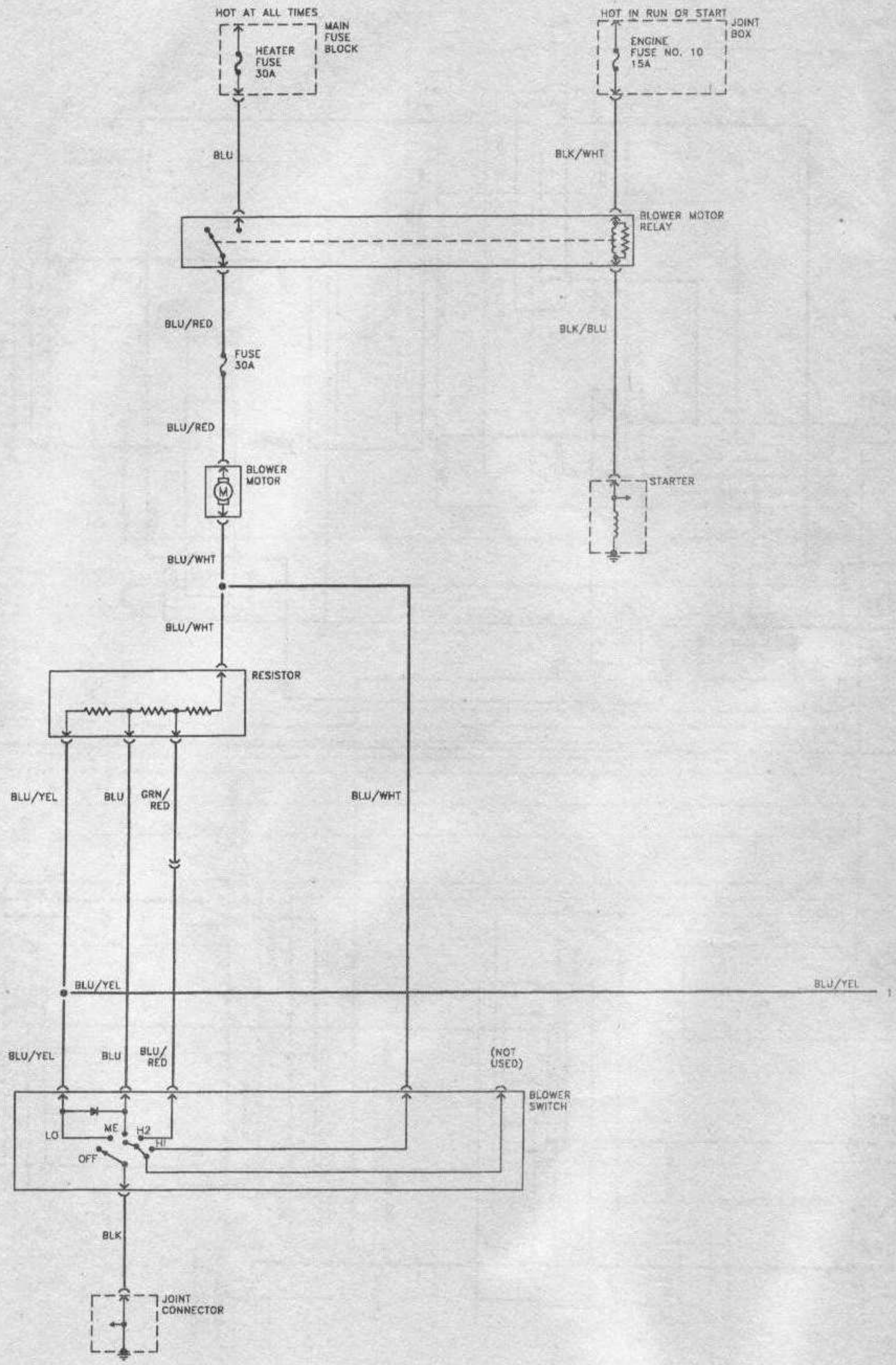


Heating and air conditioning system (including engine cooling fan) - 1993 four-cylinder models (1 of 3)

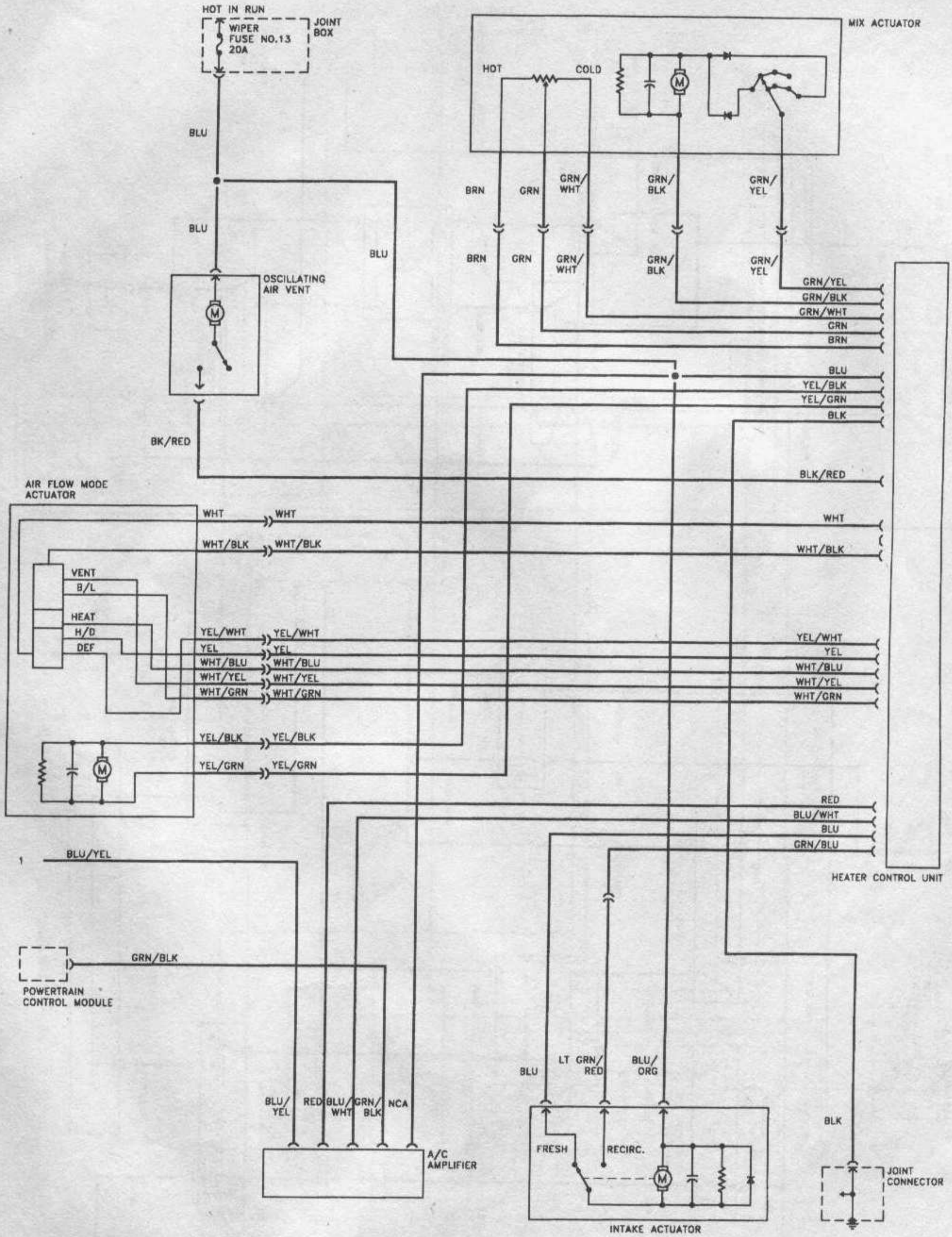
12



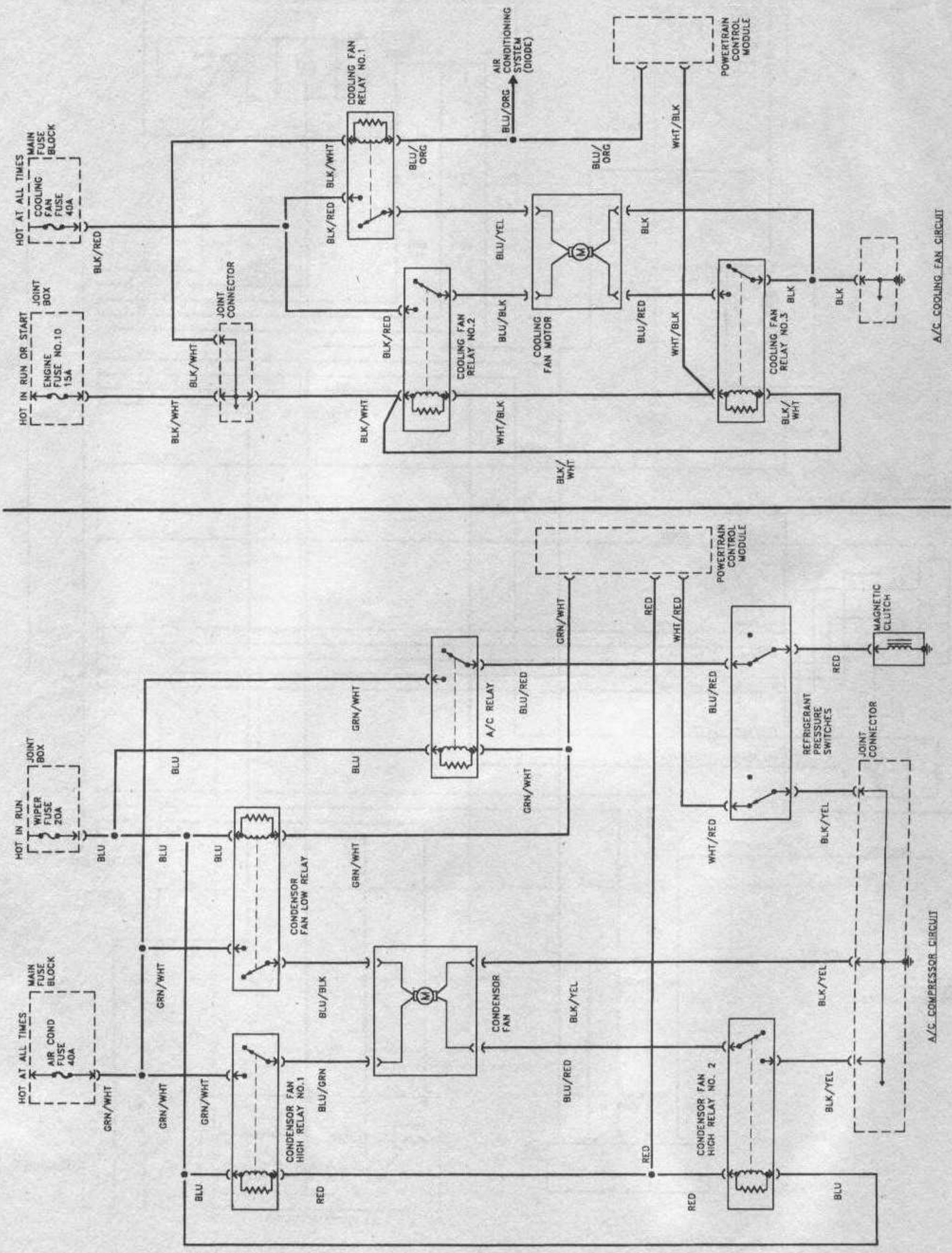
Heating and air conditioning system (including engine cooling fan) - 1993 four-cylinder models (2 of 3)



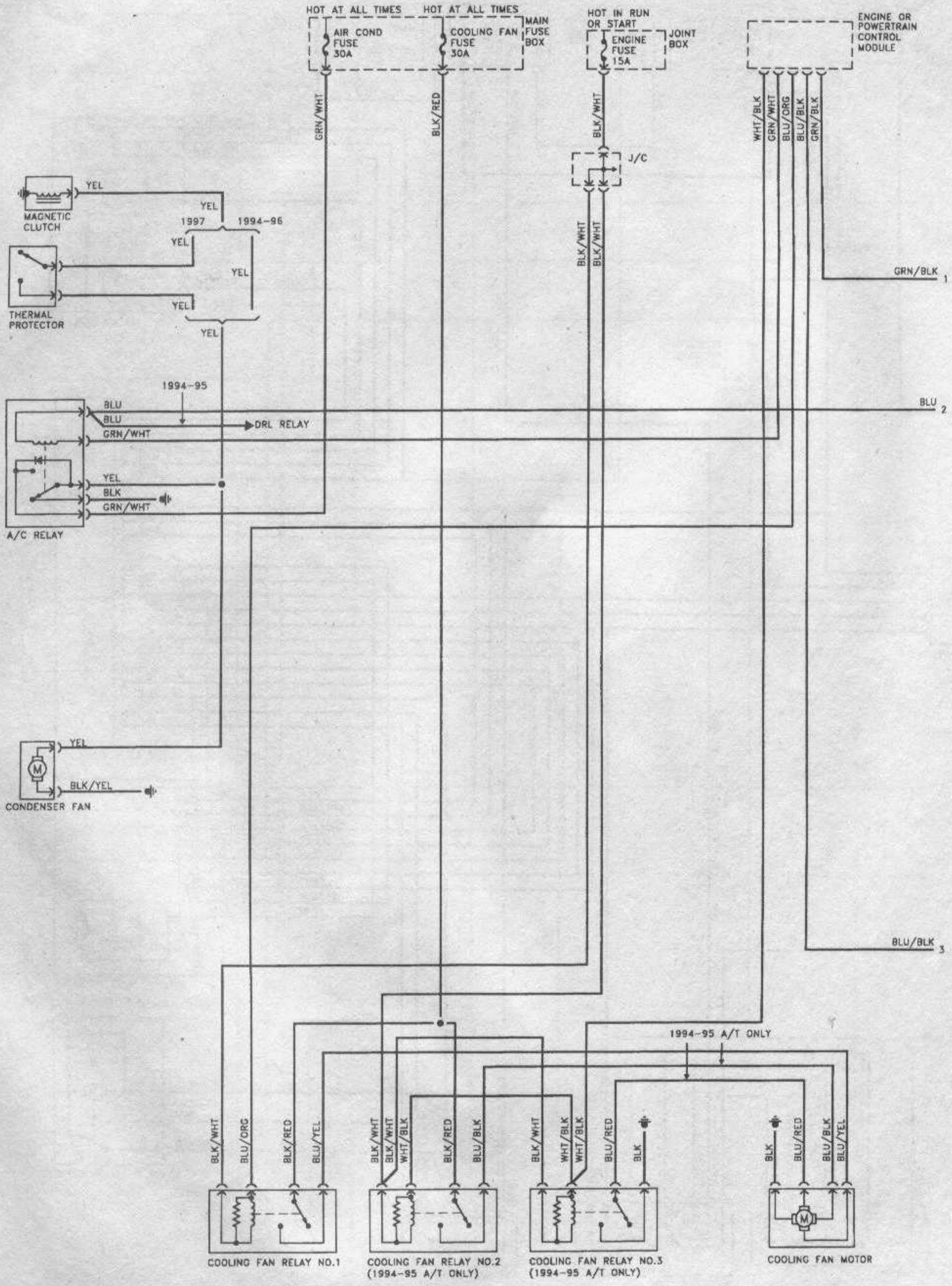
Heating and air conditioning system (including engine cooling fan) - 1993 V6 models (1 of 3)



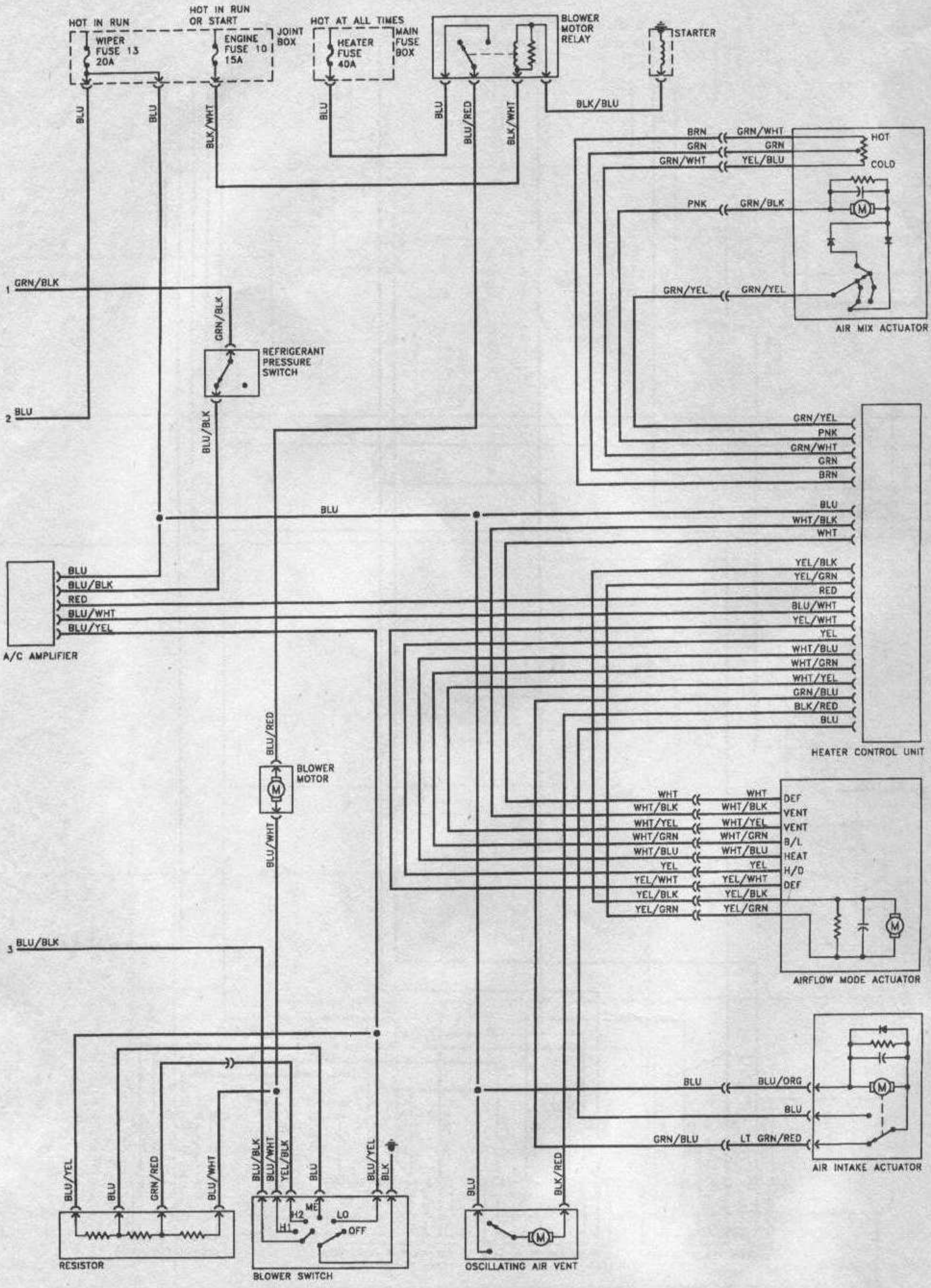
Heating and air conditioning system (including engine cooling fan) - 1993 V6 models (2 of 3)



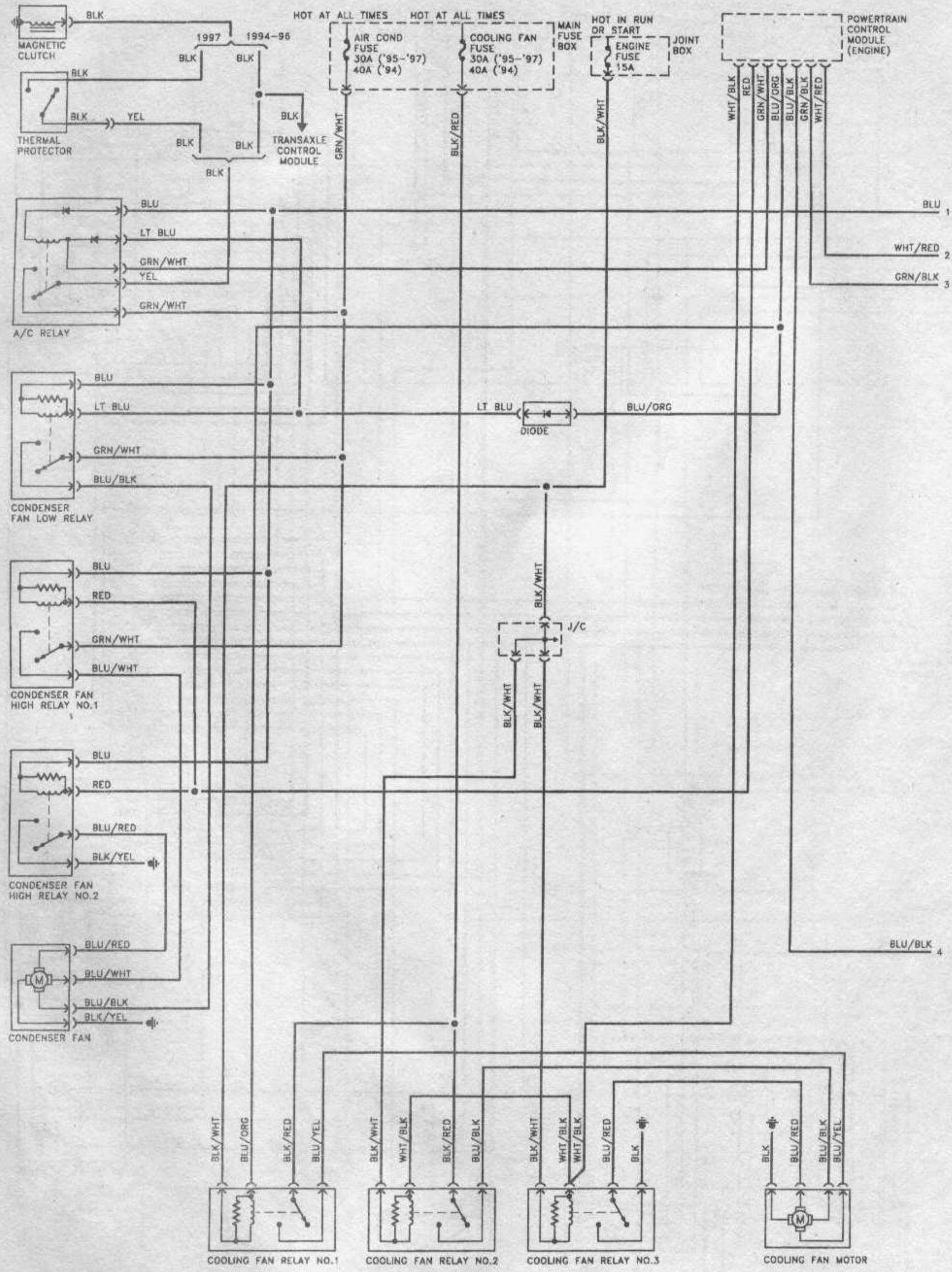
Heating and air conditioning system (including engine cooling fan) - 1993 V6 models (3 of 3)



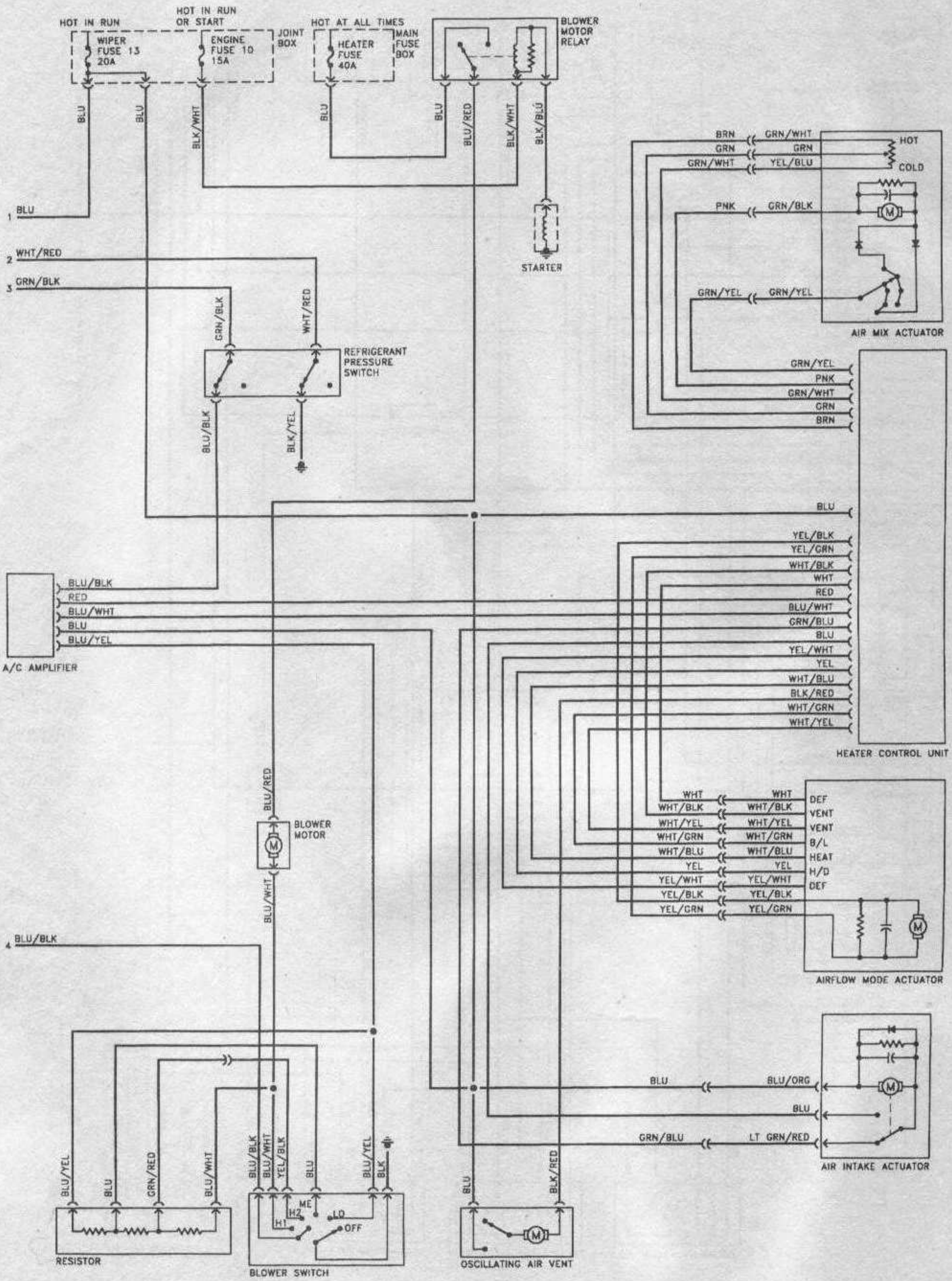
Heating and air conditioning system (including engine cooling fan) - 1994 through 1997 four-cylinder models (1 of 2)



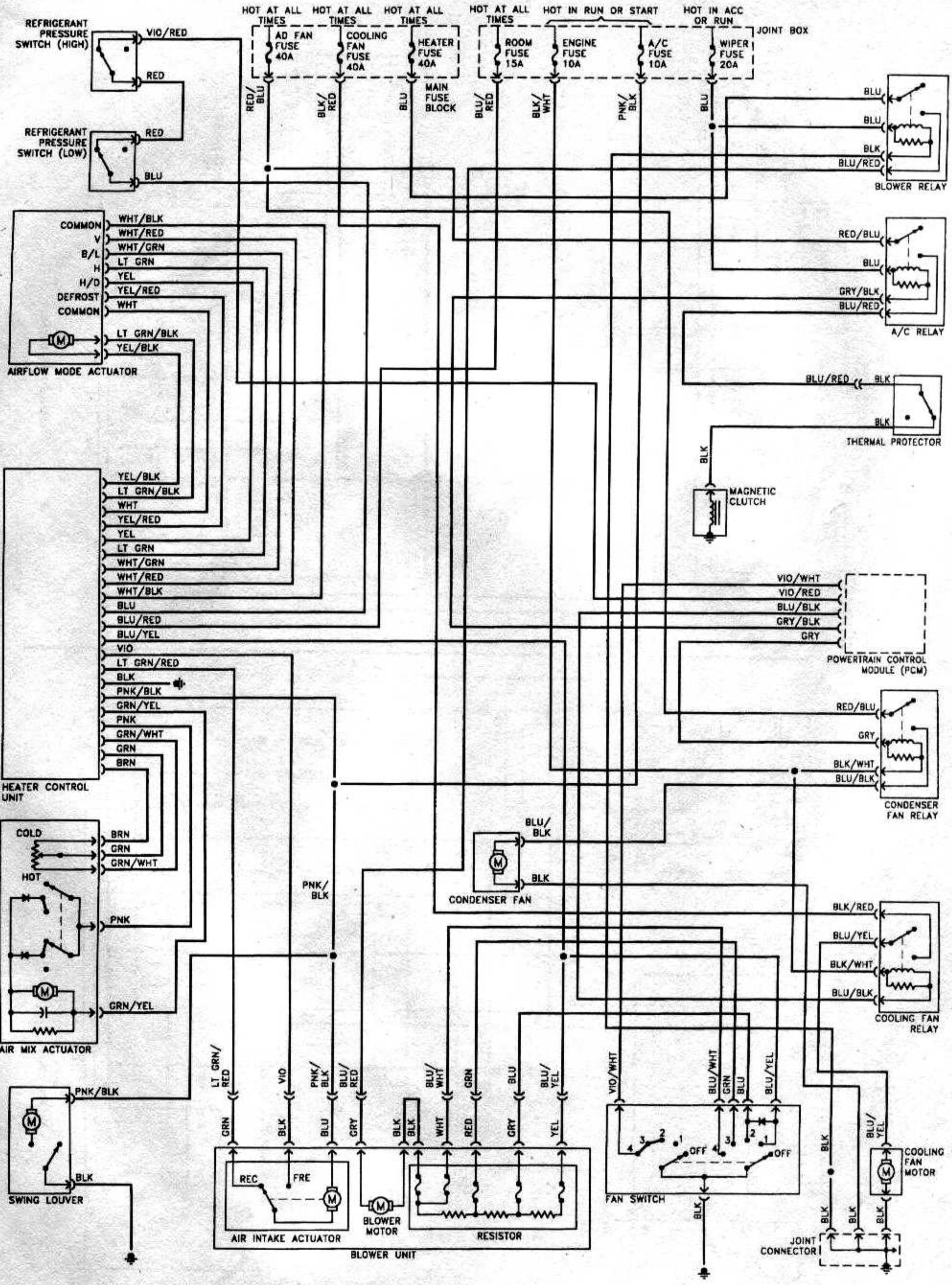
Heating and air conditioning system (including engine cooling fan) - 1994 through 1997 four-cylinder models (2 of 2)



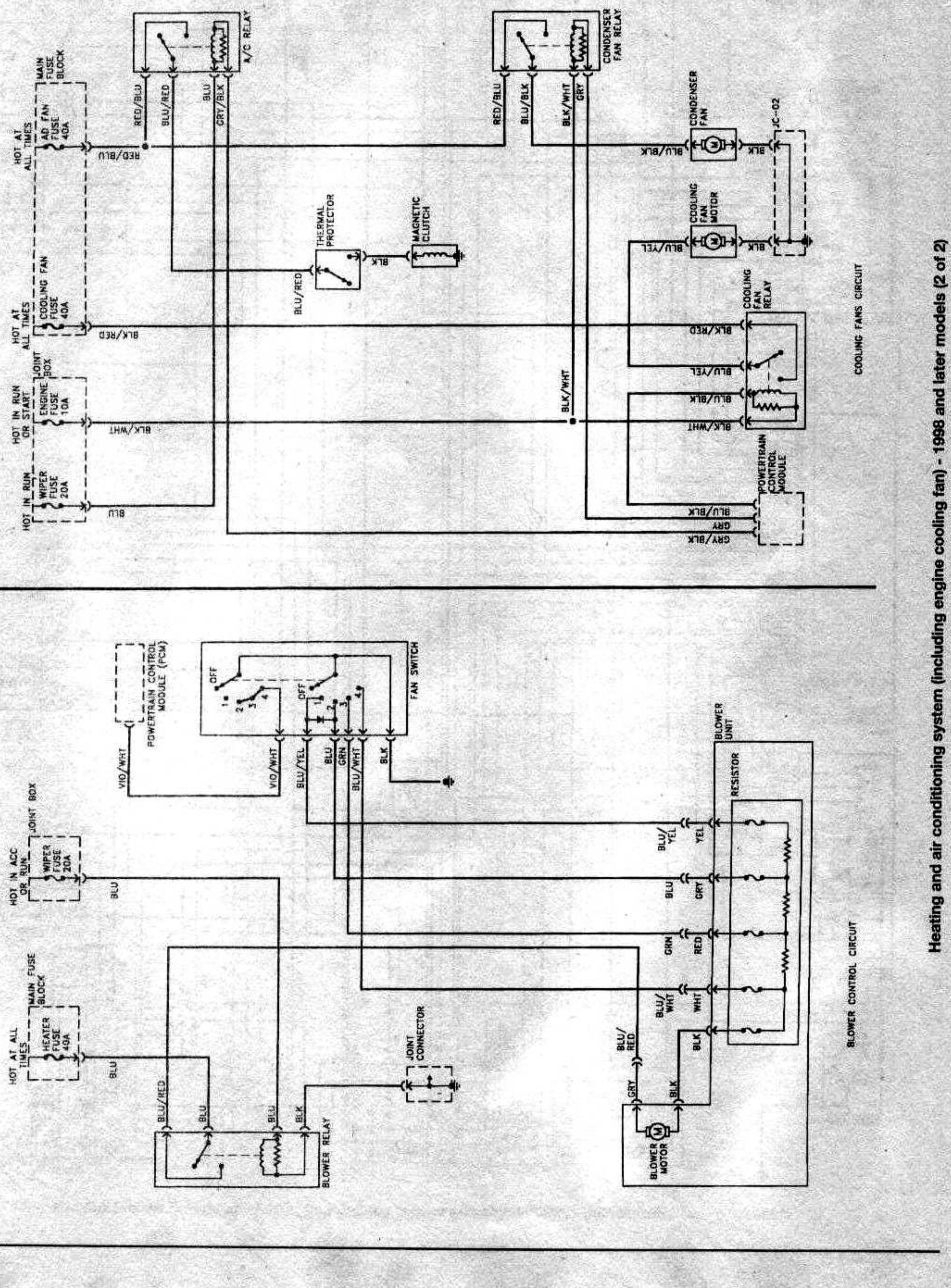
Heating and air conditioning system (including engine cooling fan) - 1994 through 1997 V6 models (1 of 2)



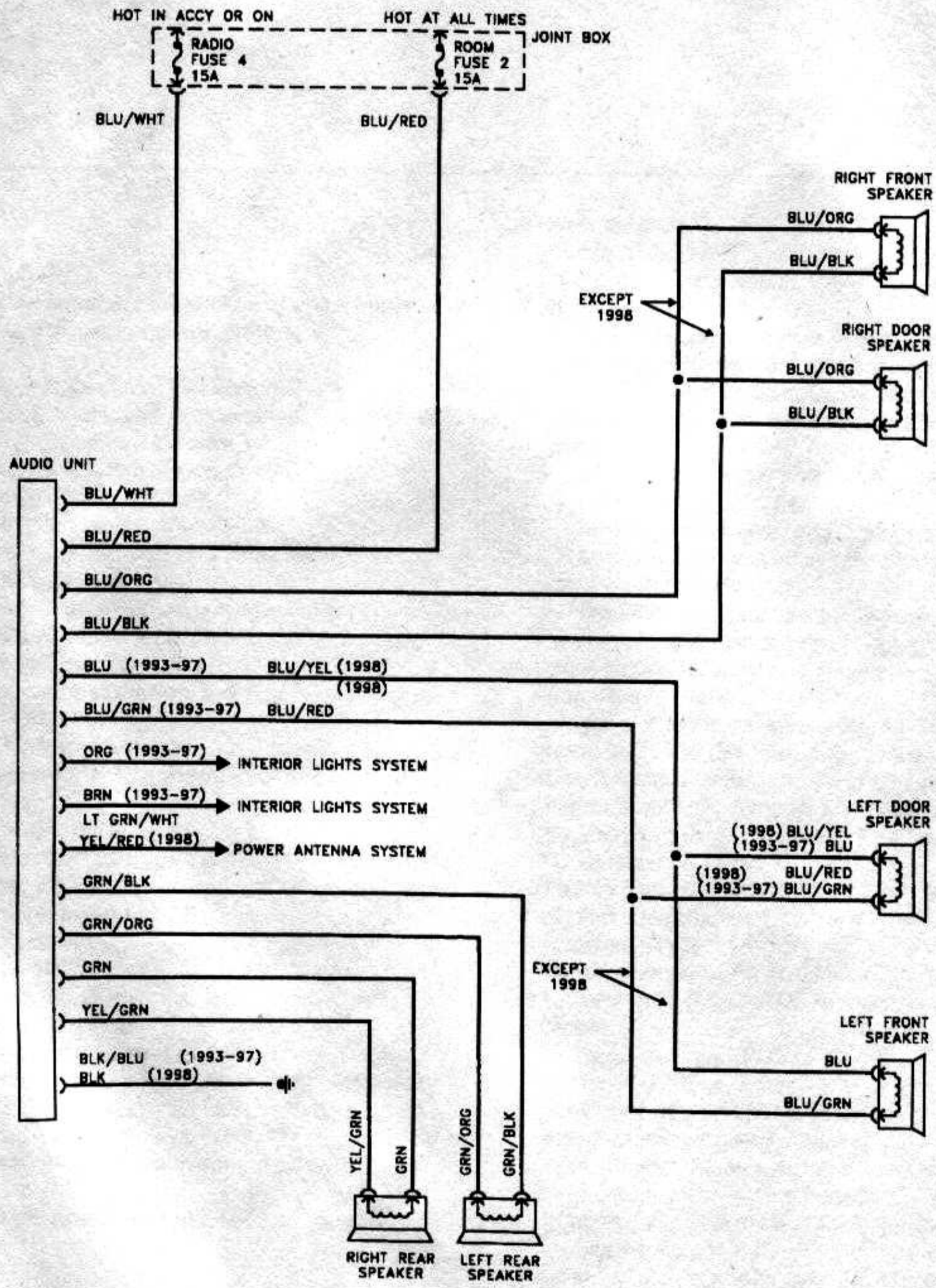
Heating and air conditioning system (including engine cooling fan) - 1994 through 1997 V6 models (2 of 2)



Heating and air conditioning system (including engine cooling fan) - 1998 and later models (1 of 2)



Heating and air conditioning system (including engine cooling fan) - 1998 and later models (2 of 2)



Typical stereo system